US 20100281625A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2010/0281625 A1**

(43) **Pub. Date: Nov. 11, 2010**

Oh et al.

(54) **METHOD AND APPARATUS FOR TREATING LAUNDRY**

(75) Inventors: **Soo Young Oh**, Seoul (KR); **Myong Hun Im**, Seoul (KR); **Tae Young Park**, Seoul (KR); **Kyung Chul Woo**, Seoul (KR)

Correspondence Address:
MCKENNA LONG & ALDRIDGE LLP
1900 K STREET, NW
WASHINGTON, DC 20006 (US)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

(21) Appl. No.: **12/743,794**

(22) PCT Filed: **Nov. 20, 2008**

(86) PCT No.: **PCT/KR2008/006847**

§ 371 (c)(1),
(2), (4) Date: **Jun. 2, 2010**

(30) **Foreign Application Priority Data**

Nov. 20, 2007 (KR) 10-2007-0118725
Nov. 20, 2007 (KR) 10-2007-0118726
Nov. 20, 2007 (KR) 10-2007-0118728
Nov. 20, 2007 (KR) 10-2007-0118729
Nov. 21, 2007 (KR) 10-2007-0119203
Feb. 12, 2008 (KR) 10-2008-0012756

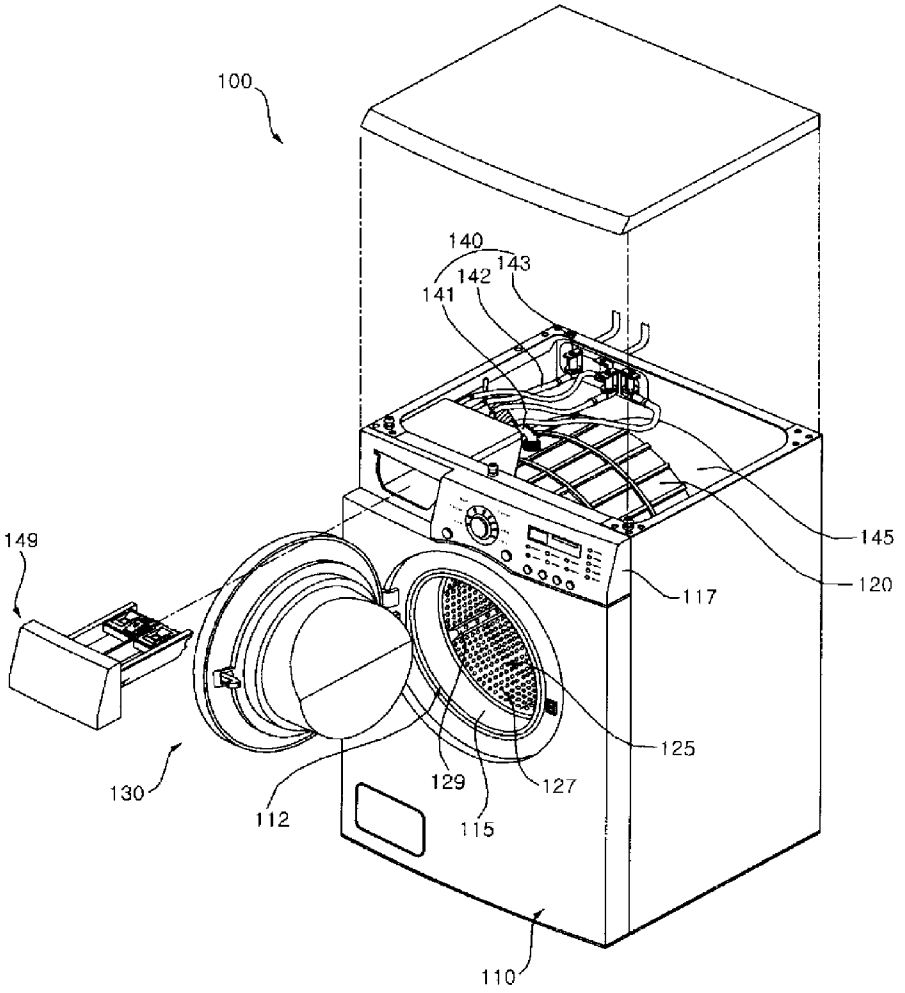
Publication Classification

(51) **Int. Cl.**
D06F 35/00 (2006.01)

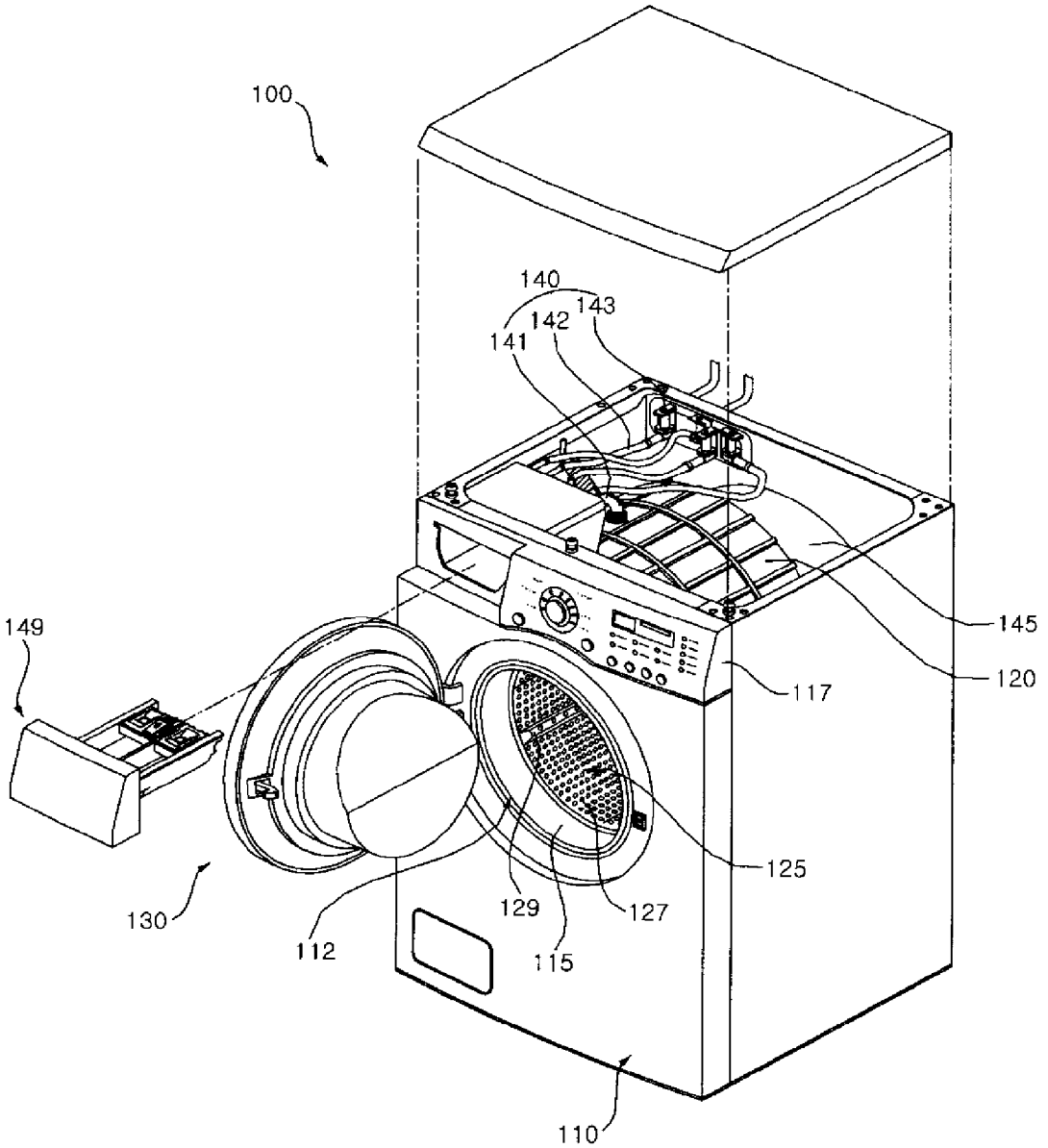
(52) **U.S. Cl.** ..... **8/137**; 68/13 R

(57) **ABSTRACT**

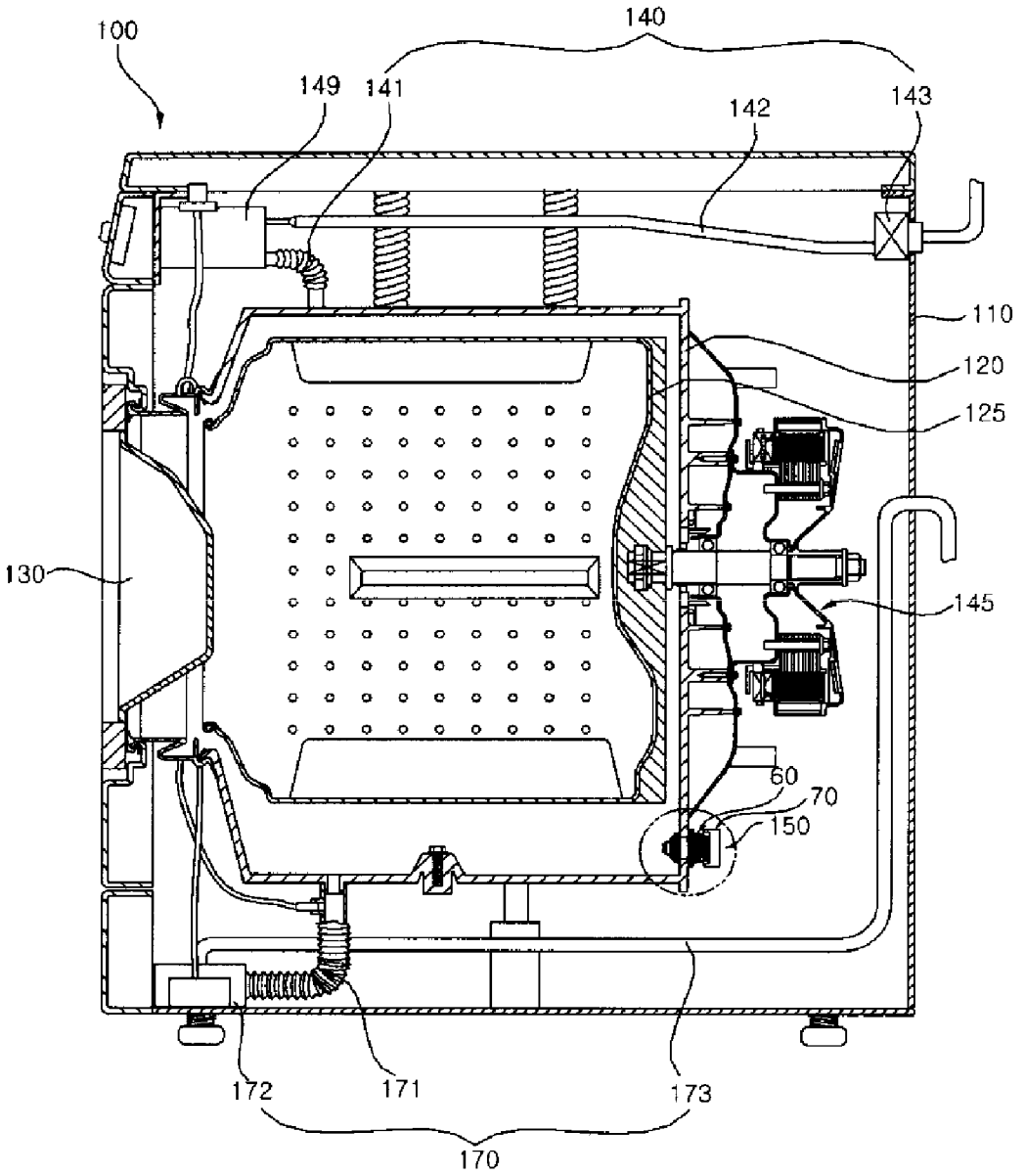
A laundry treatment method and apparatus are provided. The laundry treatment method includes (a) measuring the amount of detergent in wash water in a tub during a rinsing operation; and (b) automatically determining whether to continue performing the rinsing operation based on a plurality of operating variables including the amount of detergent in the wash water.



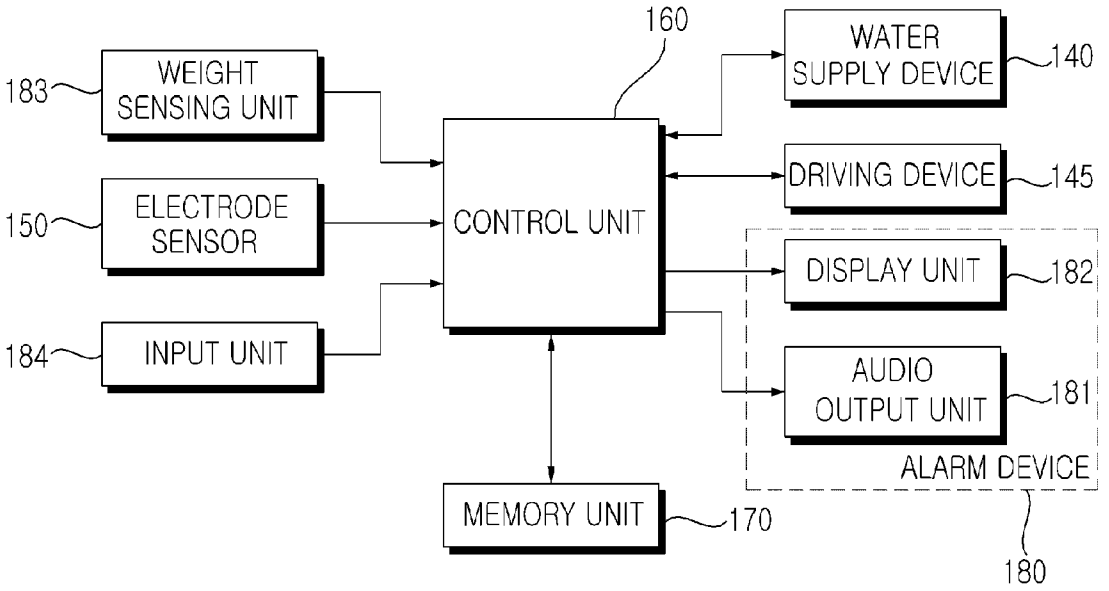
【Figure 1】



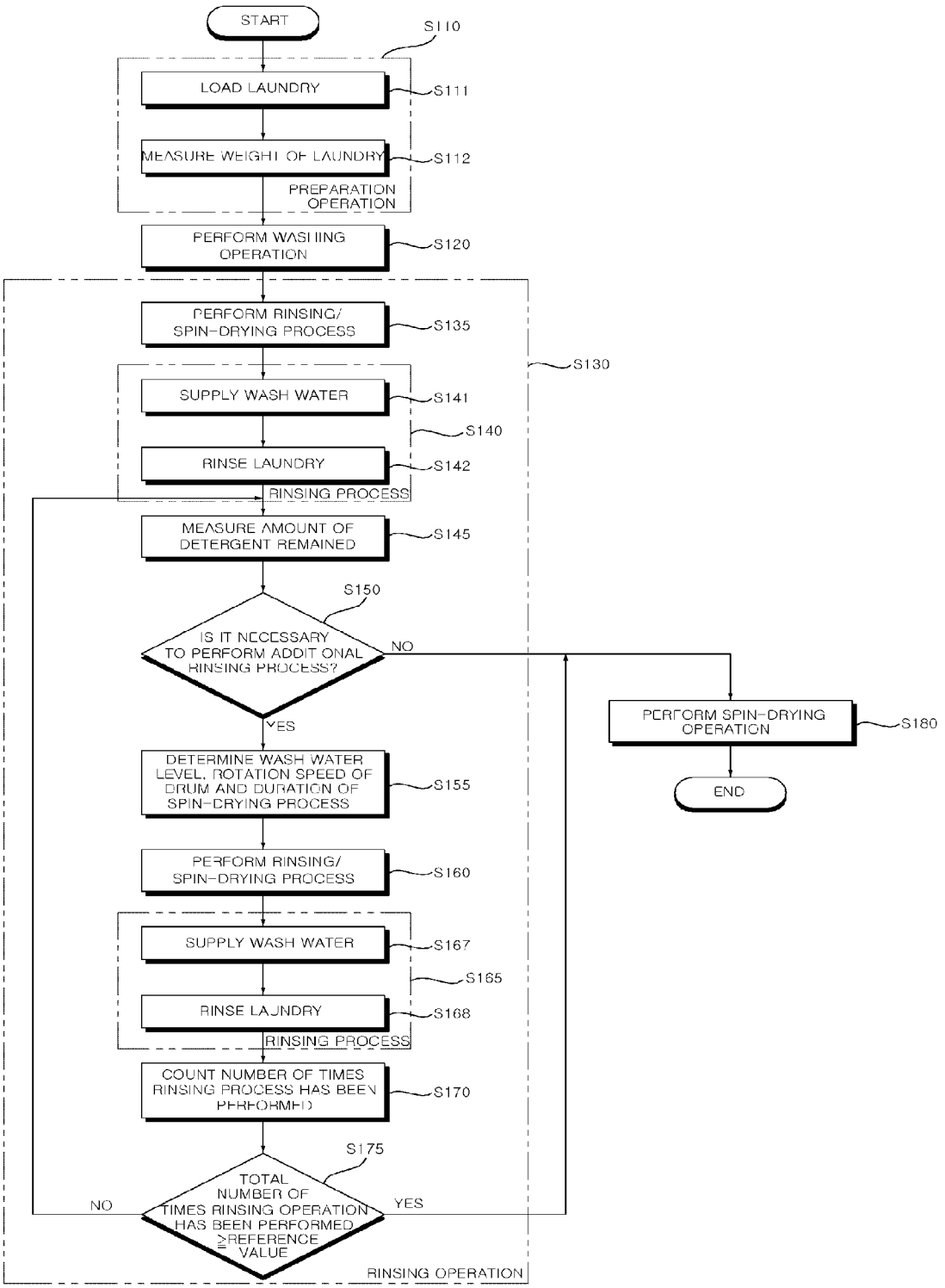
【Figure 2】


100
140
149
141
142
143
110
120
125
130
145
60
70
150
172
171
173
170

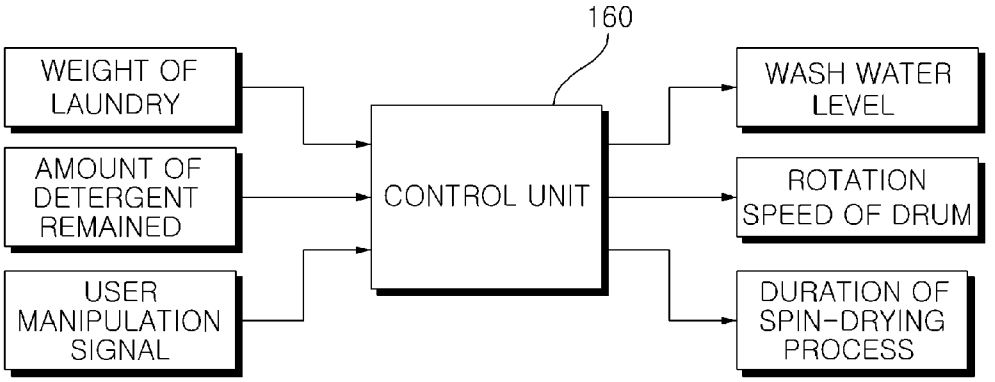
【Figure 3】


160
WEIGHT SENSING UNIT
183
ELECTRODE SENSOR
150
INPUT UNIT
184
CONTROL UNIT
WATER SUPPLY DEVICE
140
DRIVING DEVICE
145
DISPLAY UNIT
182
AUDIO OUTPUT UNIT
181
ALARM DEVICE
180
MEMORY UNIT
170

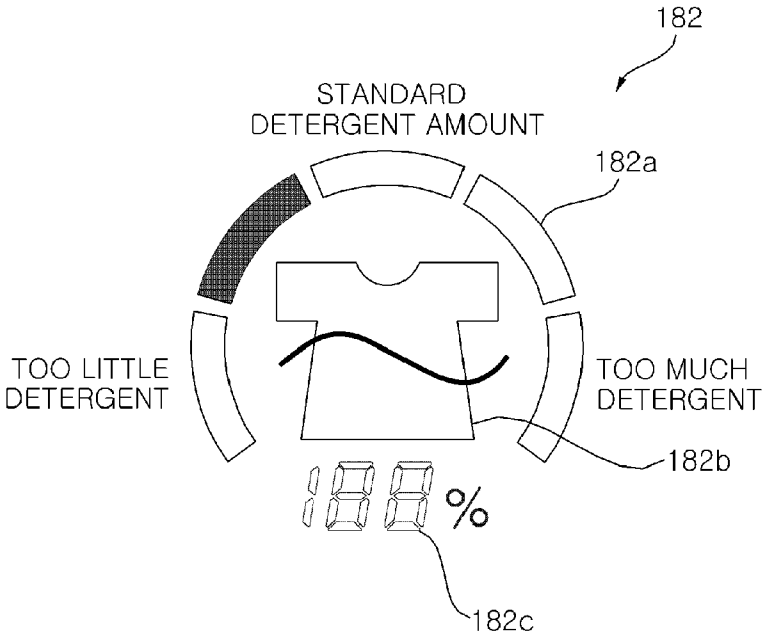
【Figure 4】


START
S110
LOAD LAUNDRY
S111
MEASURE WEIGHT OF LAUNDRY
S112
PREPARATION OPERATION
PERFORM WASHING OPERATION
S120
PERFORM RINSING/ SPIN-DRYING PROCESS
S135
S130
SUPPLY WASH WATER
S141
S140
RINSE LAUNDRY
S142
RINSING PROCESS
MEASURE AMOUNT OF DETERGENT REMAINED
S145
S150
IS IT NECESSARY TO PERFORM ADDITIONAL RINSING PROCESS?
NO
YES
PERFORM SPIN-DRYING OPERATION
S180
END
DETERMINE WASH WATER LEVEL, ROTATION SPEED OF DRUM AND DURATION OF SPIN-DRYING PROCESS
S155
PERFORM RINSING/ SPIN-DRYING PROCESS
S160
SUPPLY WASH WATER
S167
S165
RINSE LAUNDRY
S168
RINSING PROCESS
COUNT NUMBER OF TIMES RINSING PROCESS HAS BEEN PERFORMED
S170
S175
TOTAL NUMBER OF TIMES RINSING OPERATION HAS BEEN PERFORMED ≥ REFERENCE VALUE
NO
YES
RINSING OPERATION

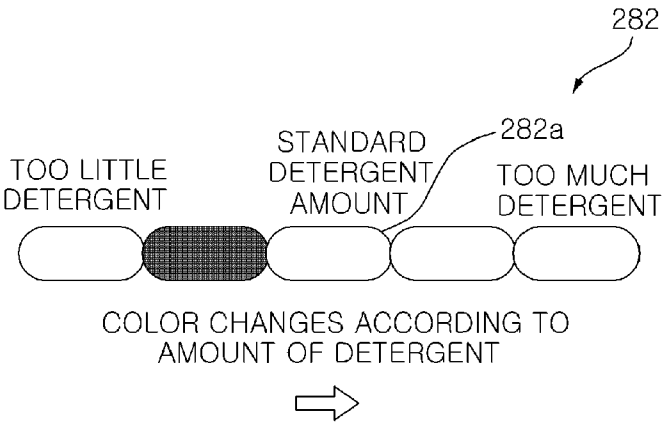
【Figure 5】



【Figure 6】

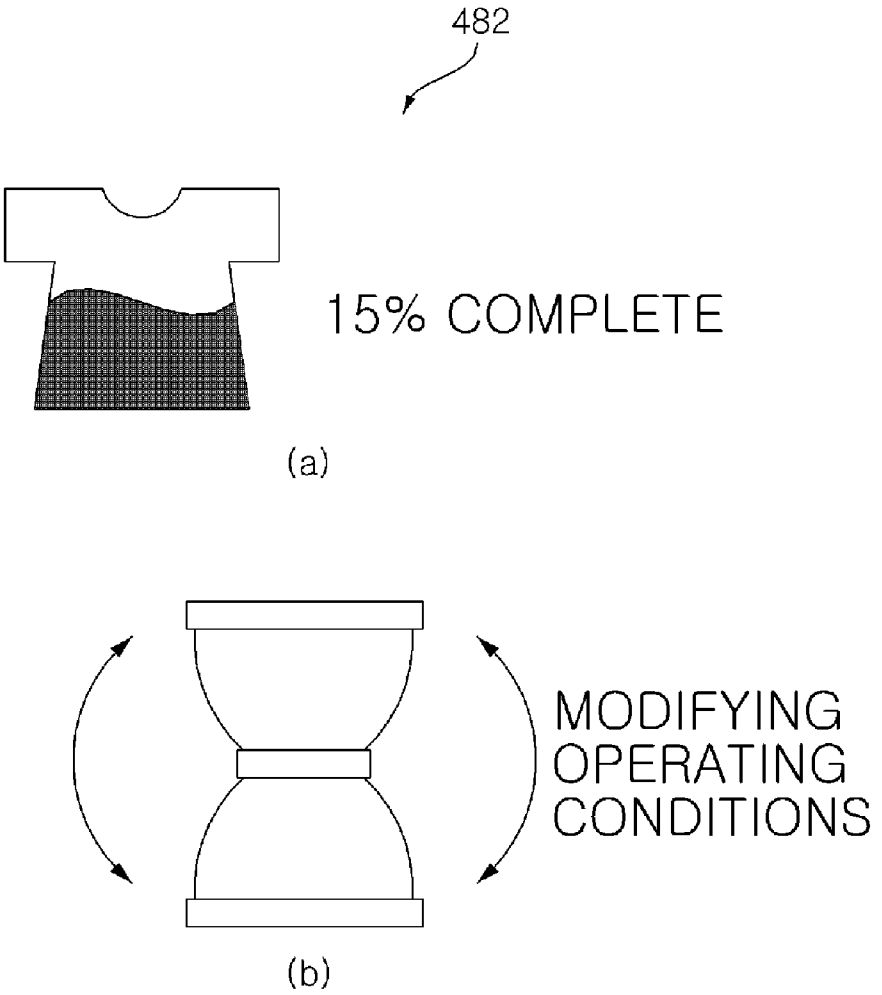


【Figure 7】

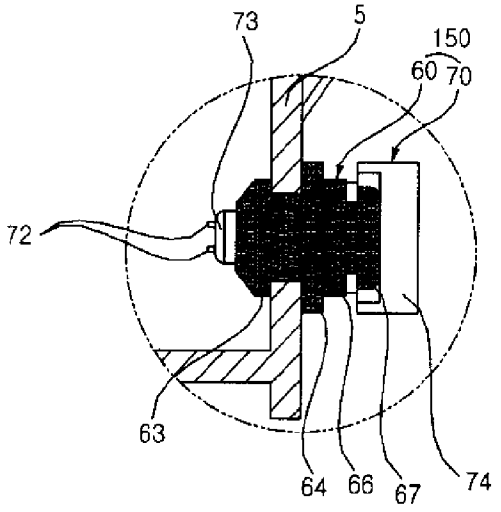


【Figure 8】

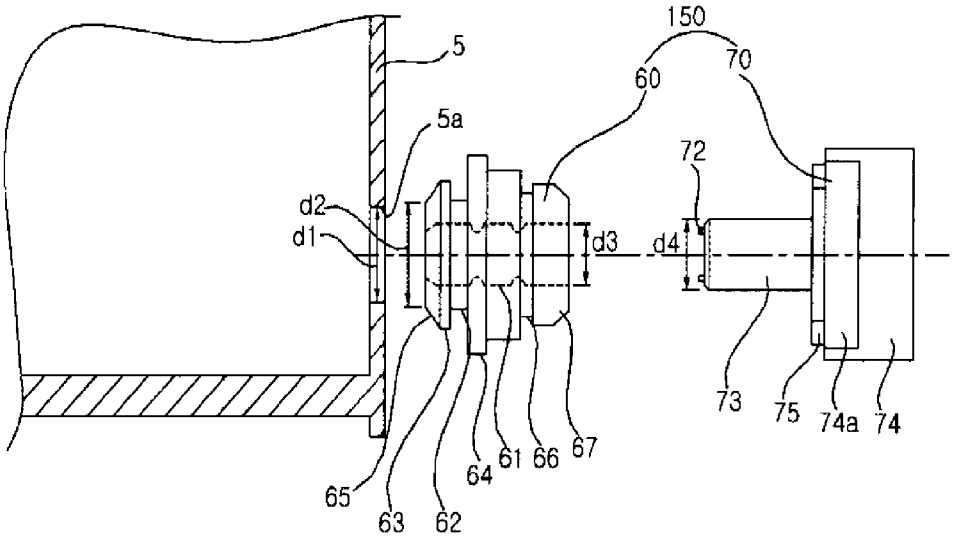
【Figure 9】



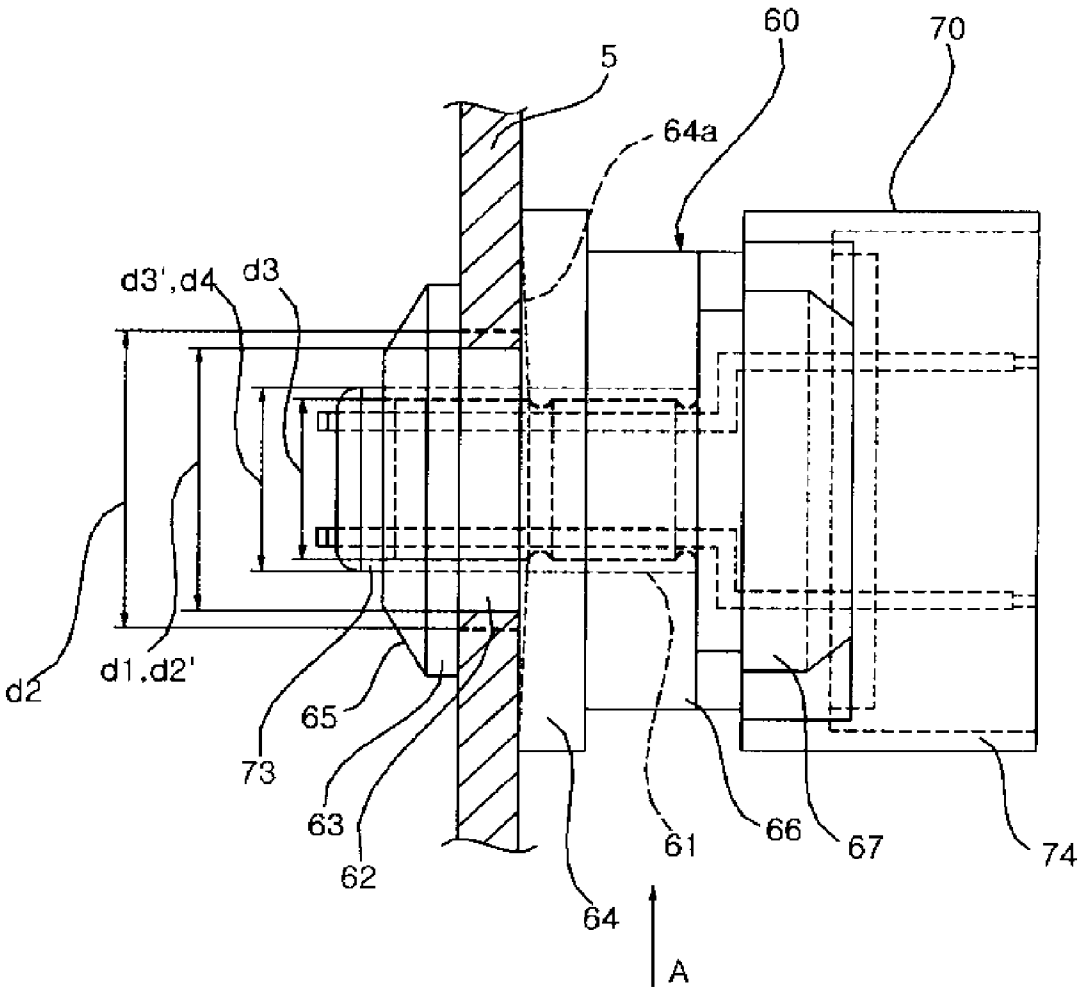
【Figure 10】



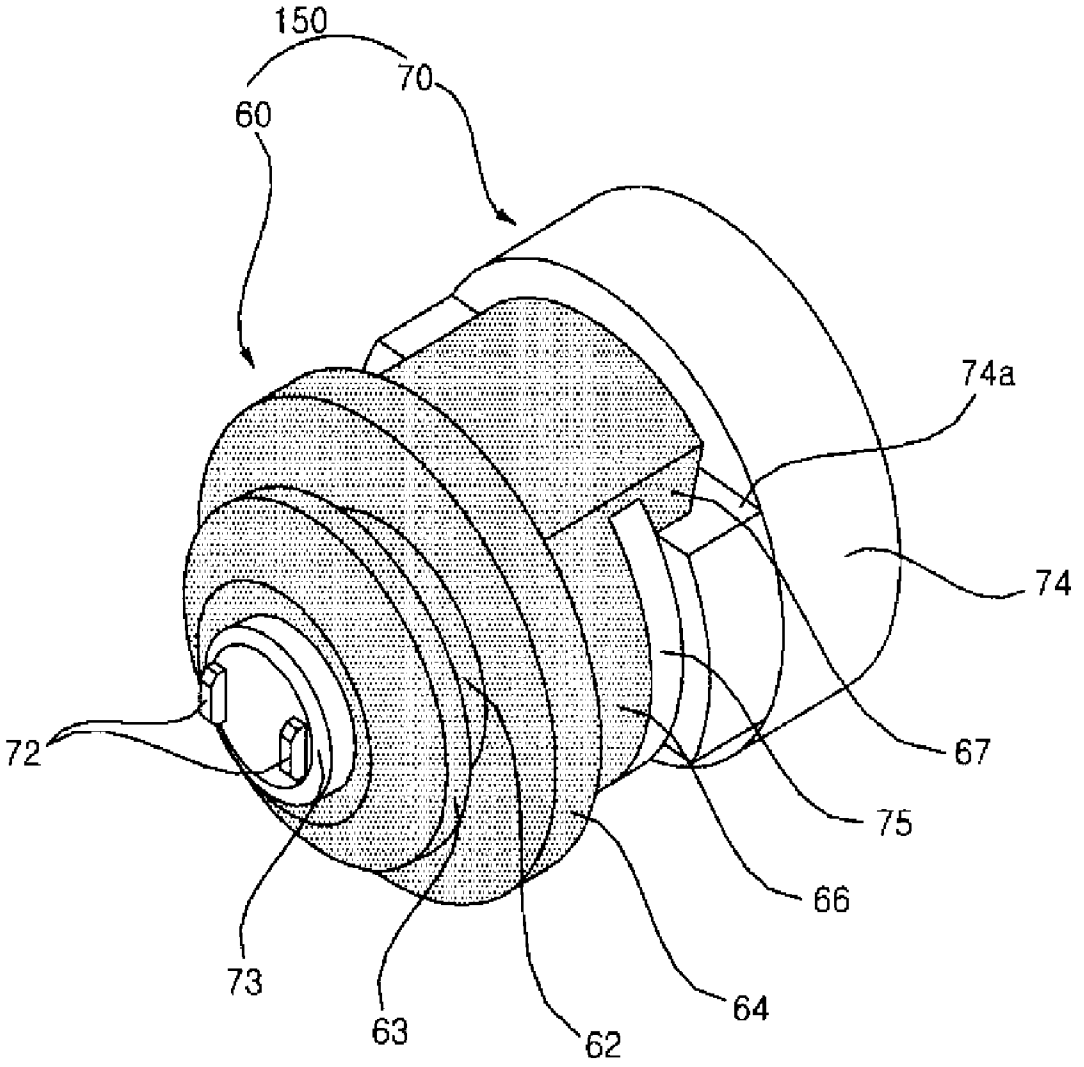
【Figure 11】



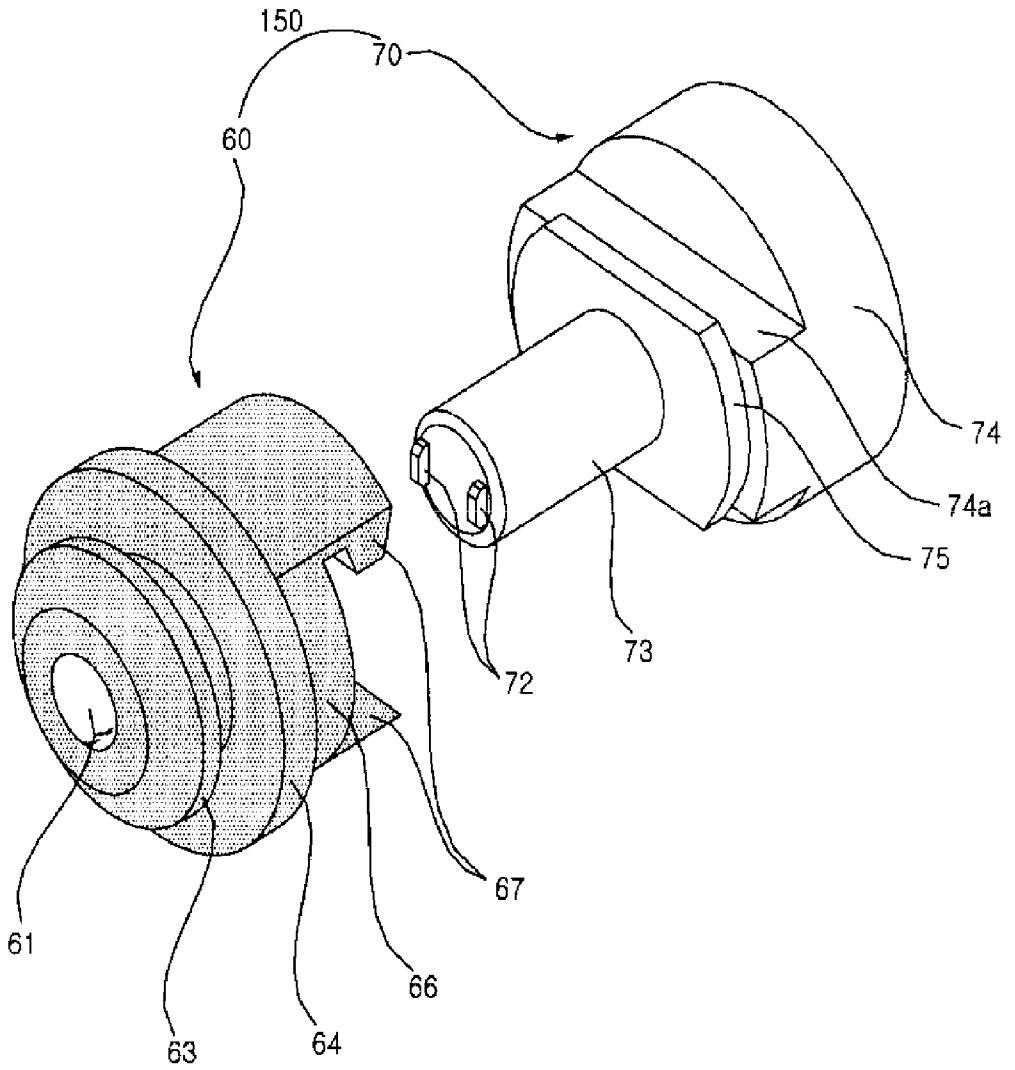
【Figure 12】



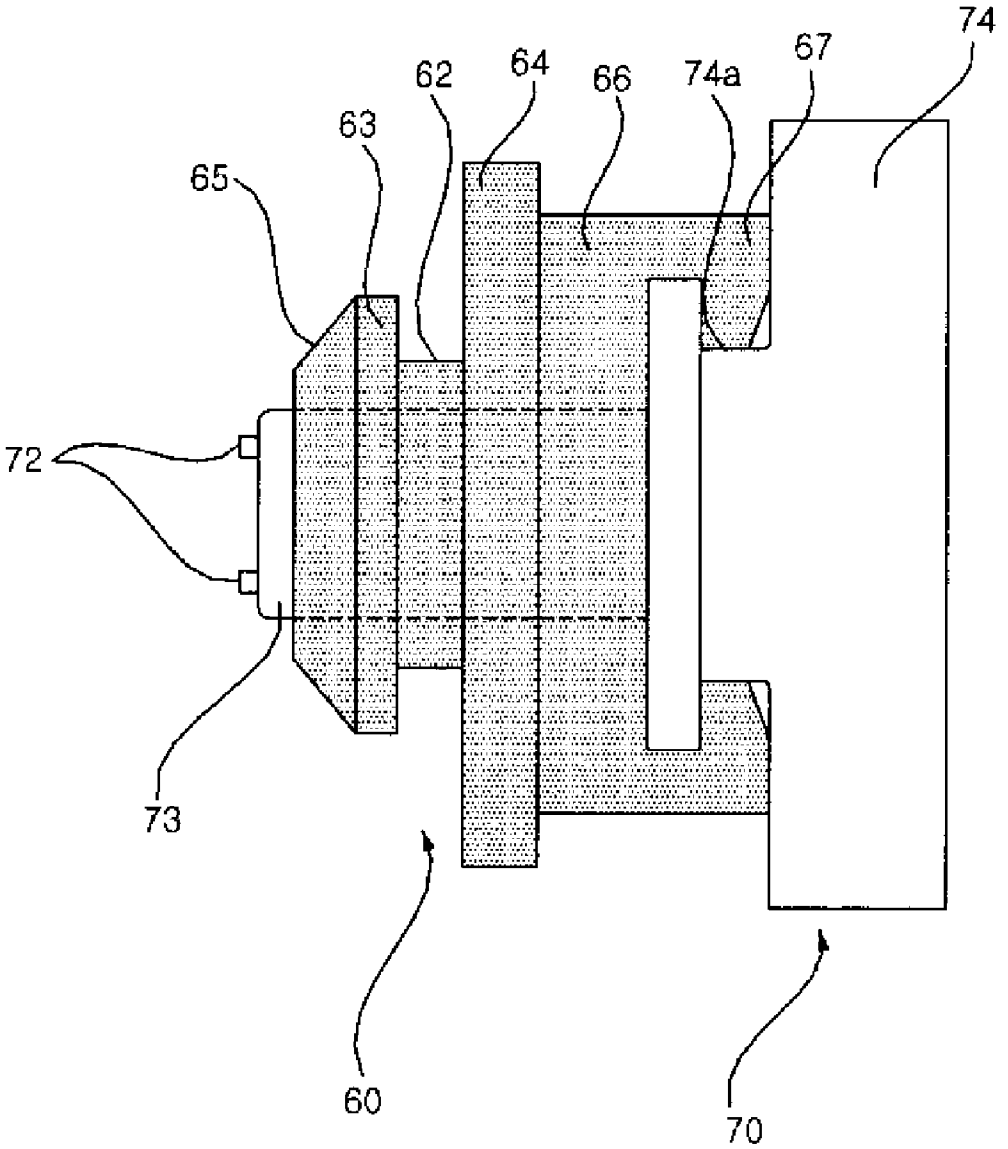
【Figure 13】



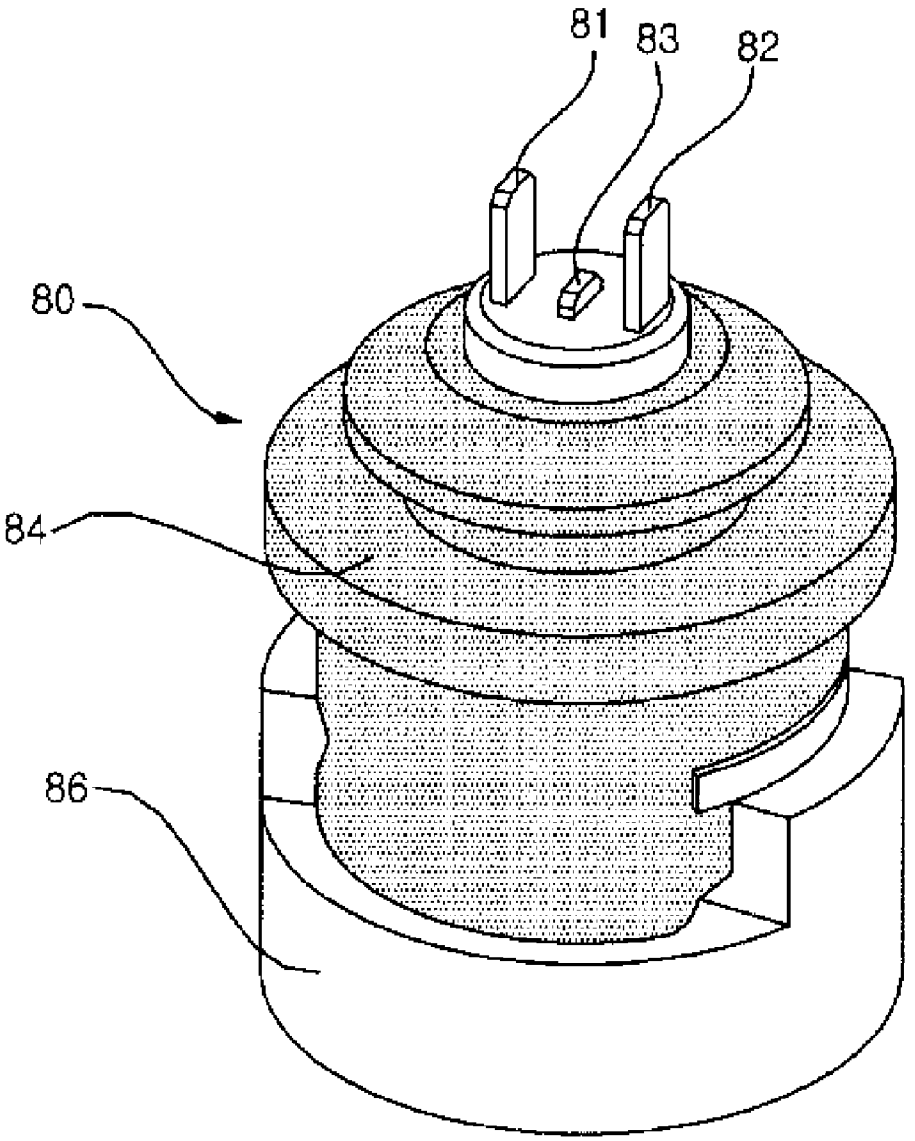
【Figure 14】



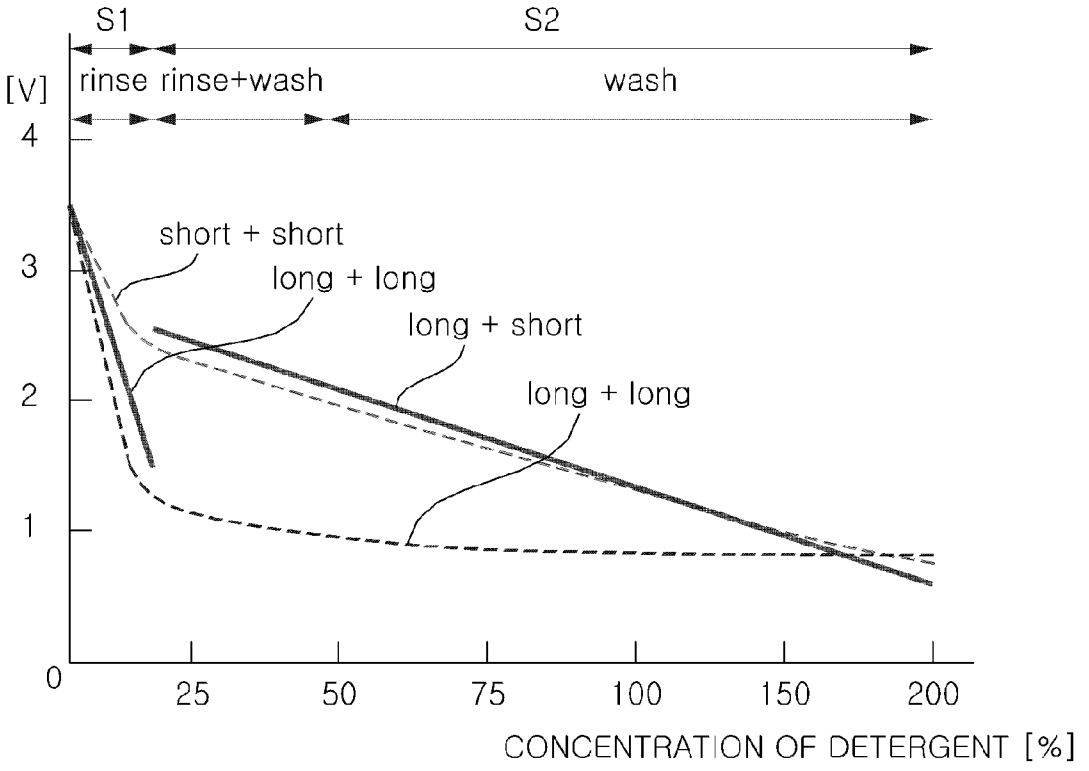
【Figure 15】



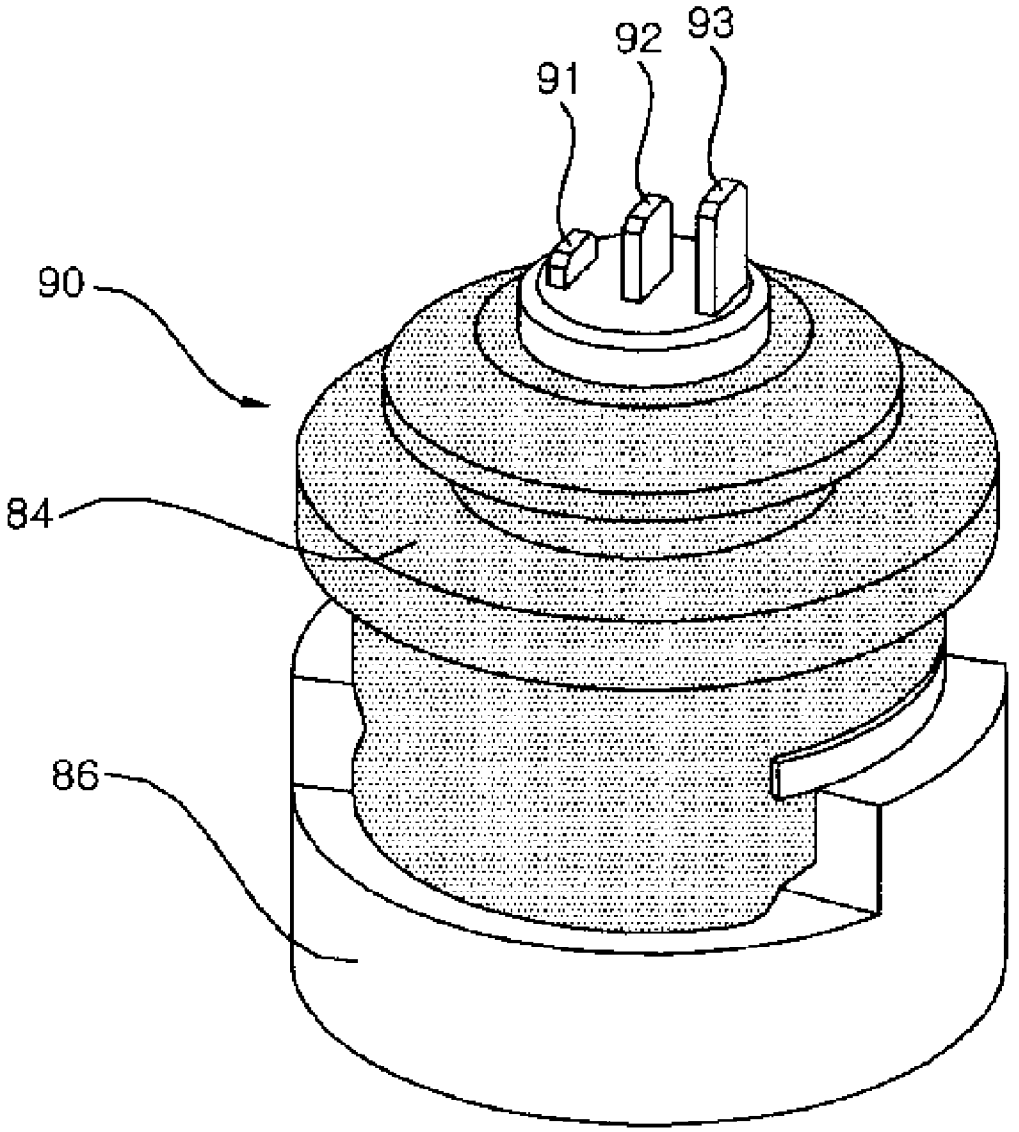
【Figure 16】



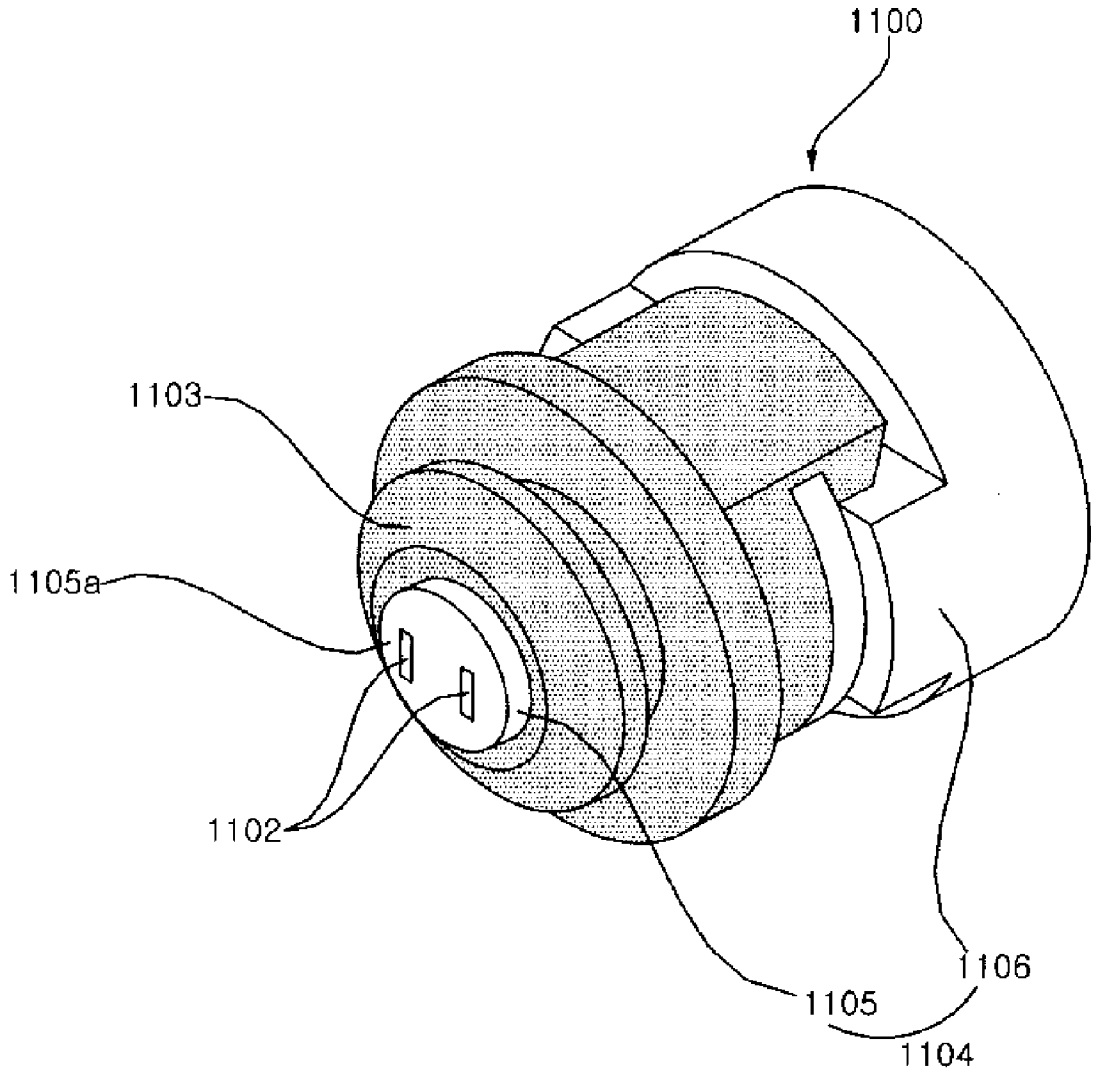
【Figure 17】


S1
S2
rinse
rinse+wash
wash
[V]
4
3
2
1
0
short + short
long + long
long + short
long + long
25
50
75
100
150
200
CONCENTRATION OF DETERGENT [%]

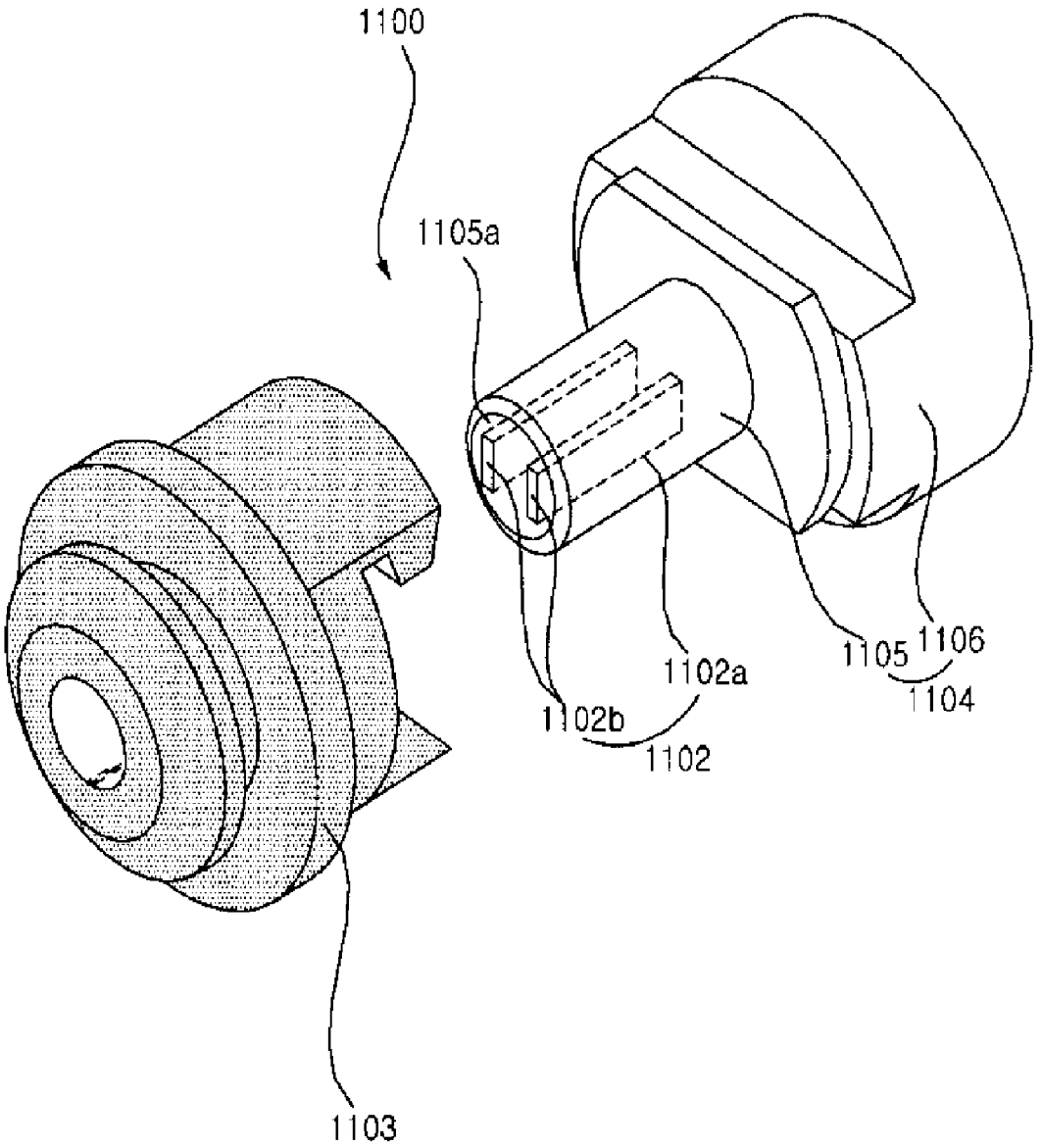
【Figure 18】



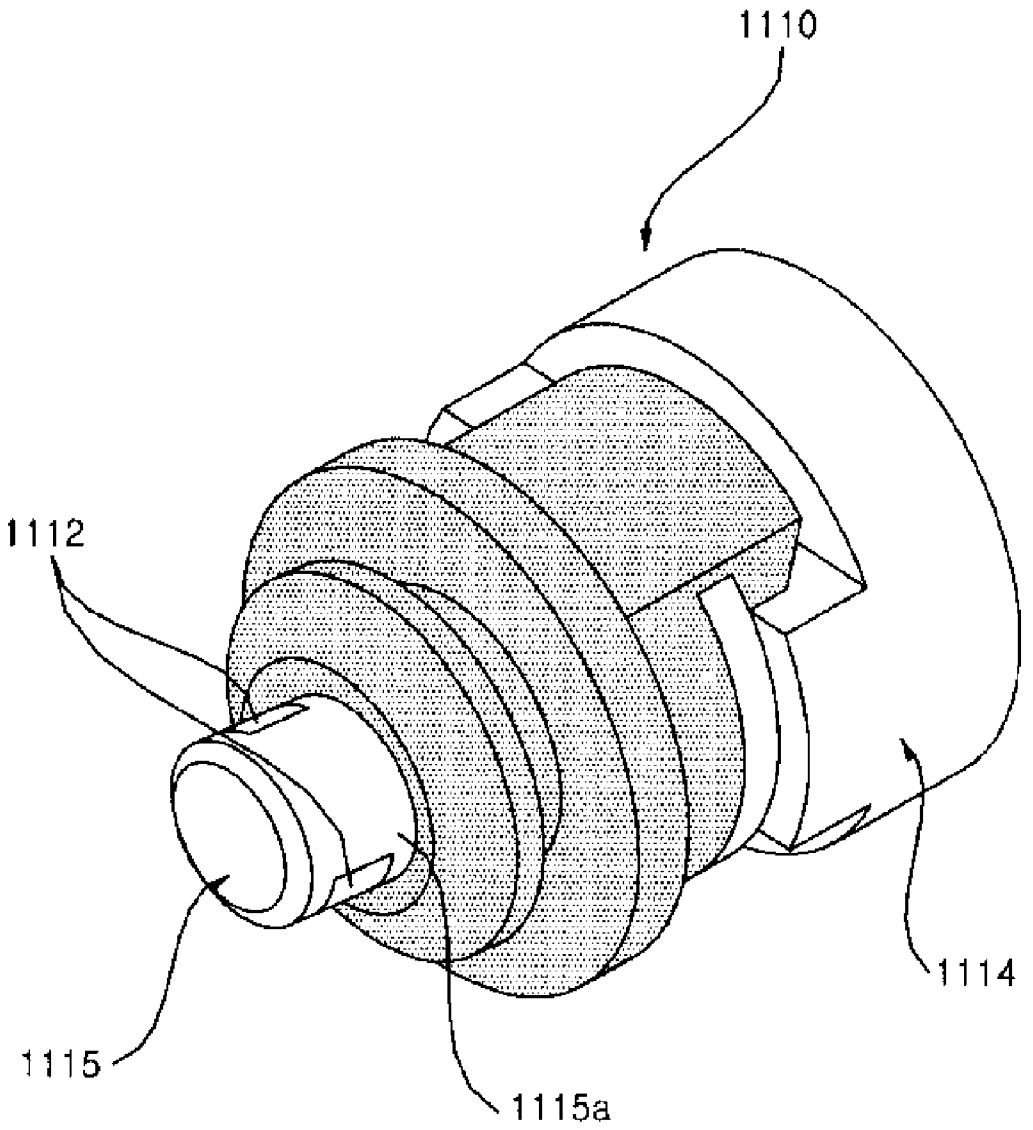
【Figure 19】



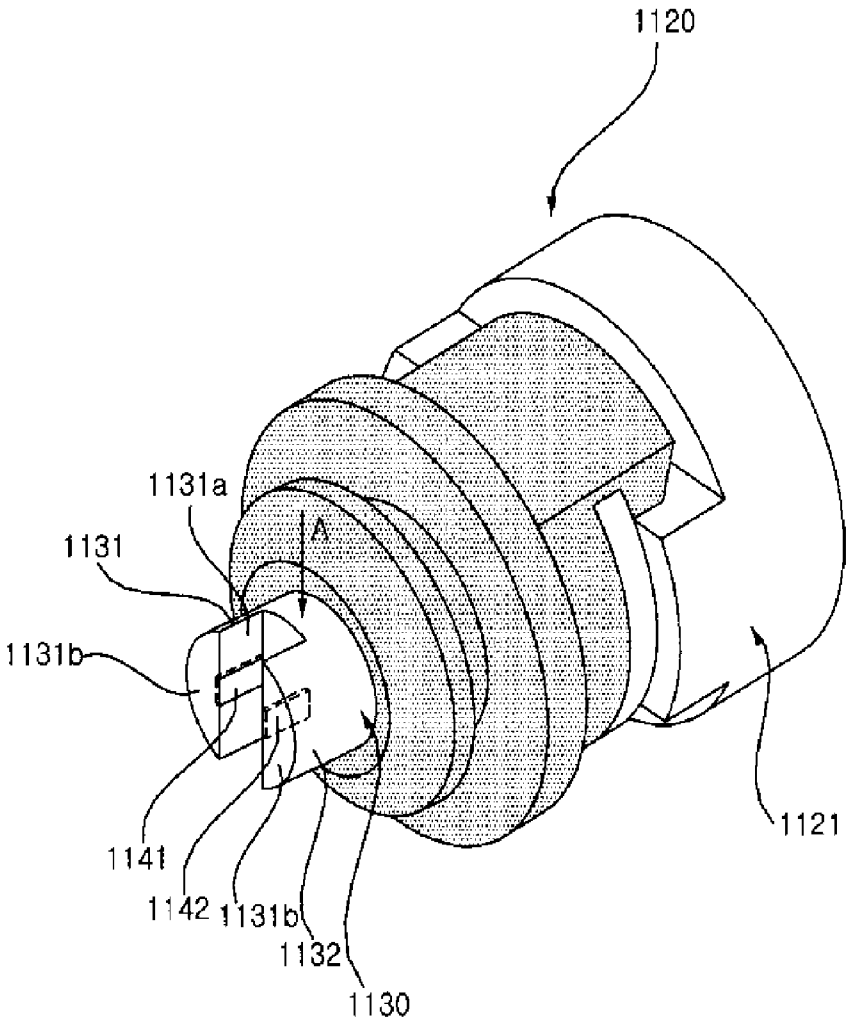
【Figure 20】



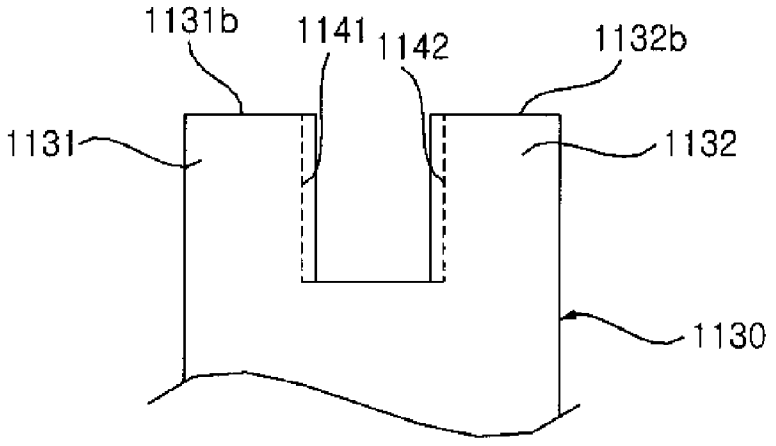
【Figure 21】



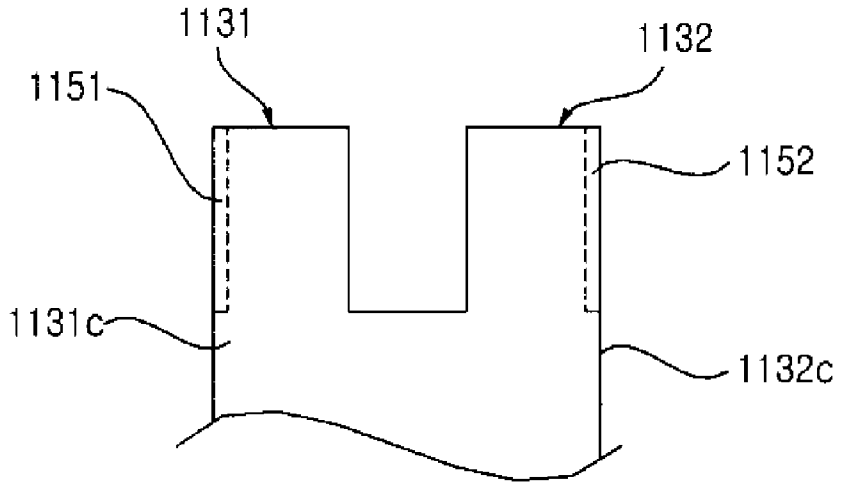
【Figure 22】



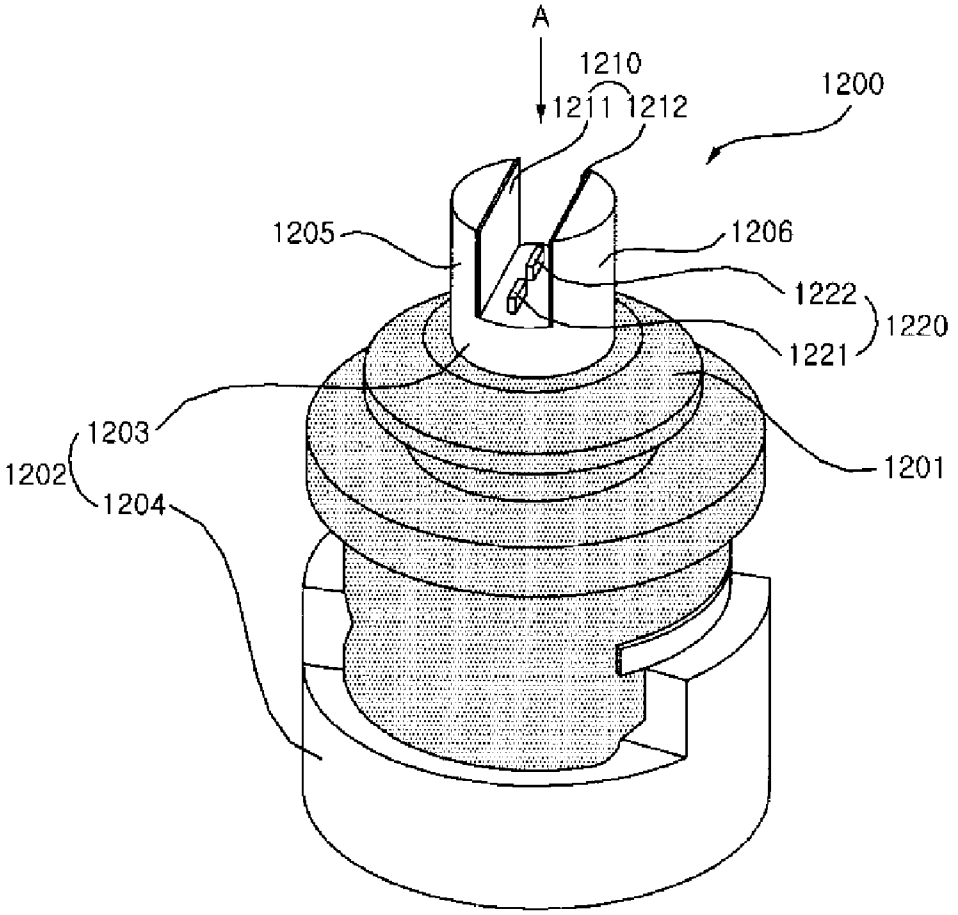
【Figure 23】



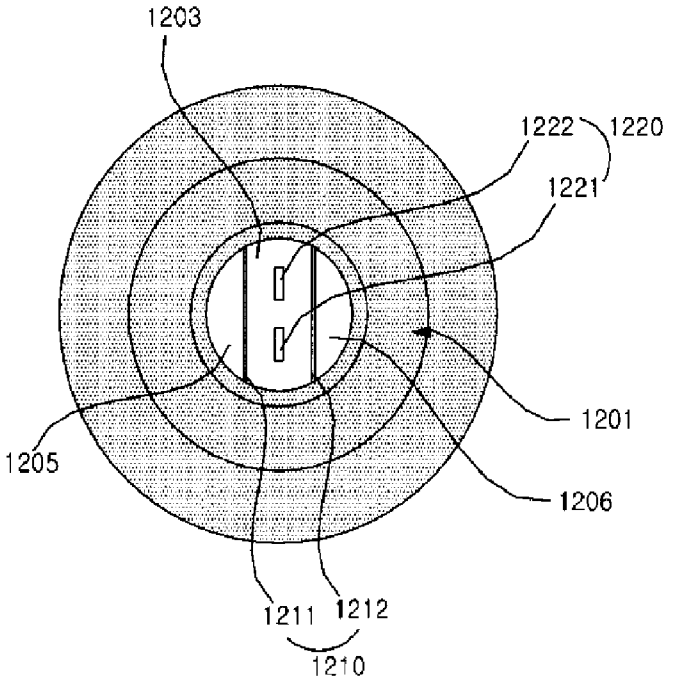
【Figure 24】



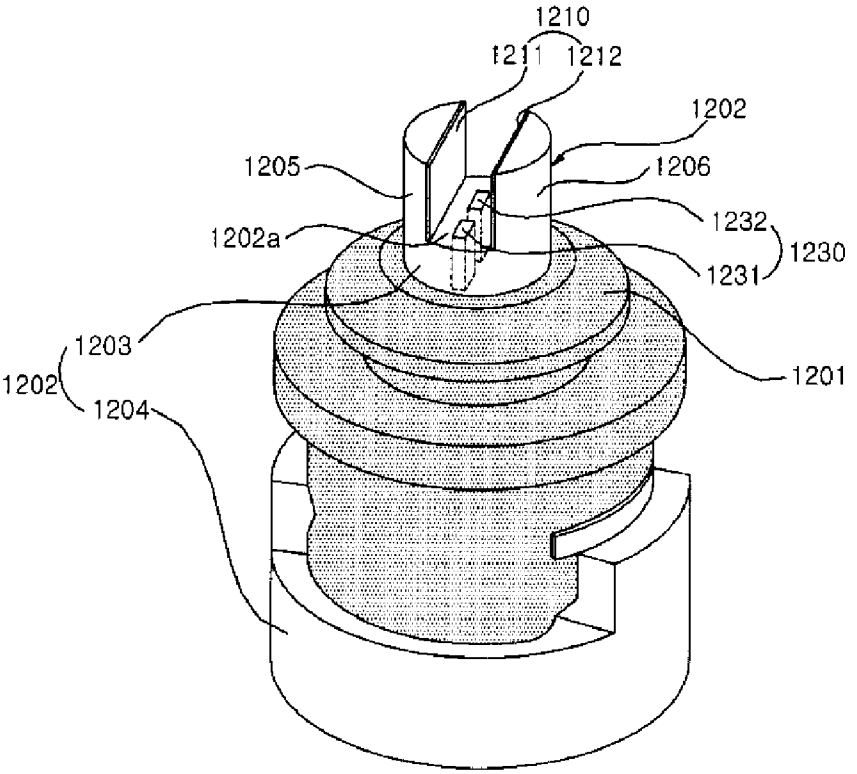
【Figure 25】



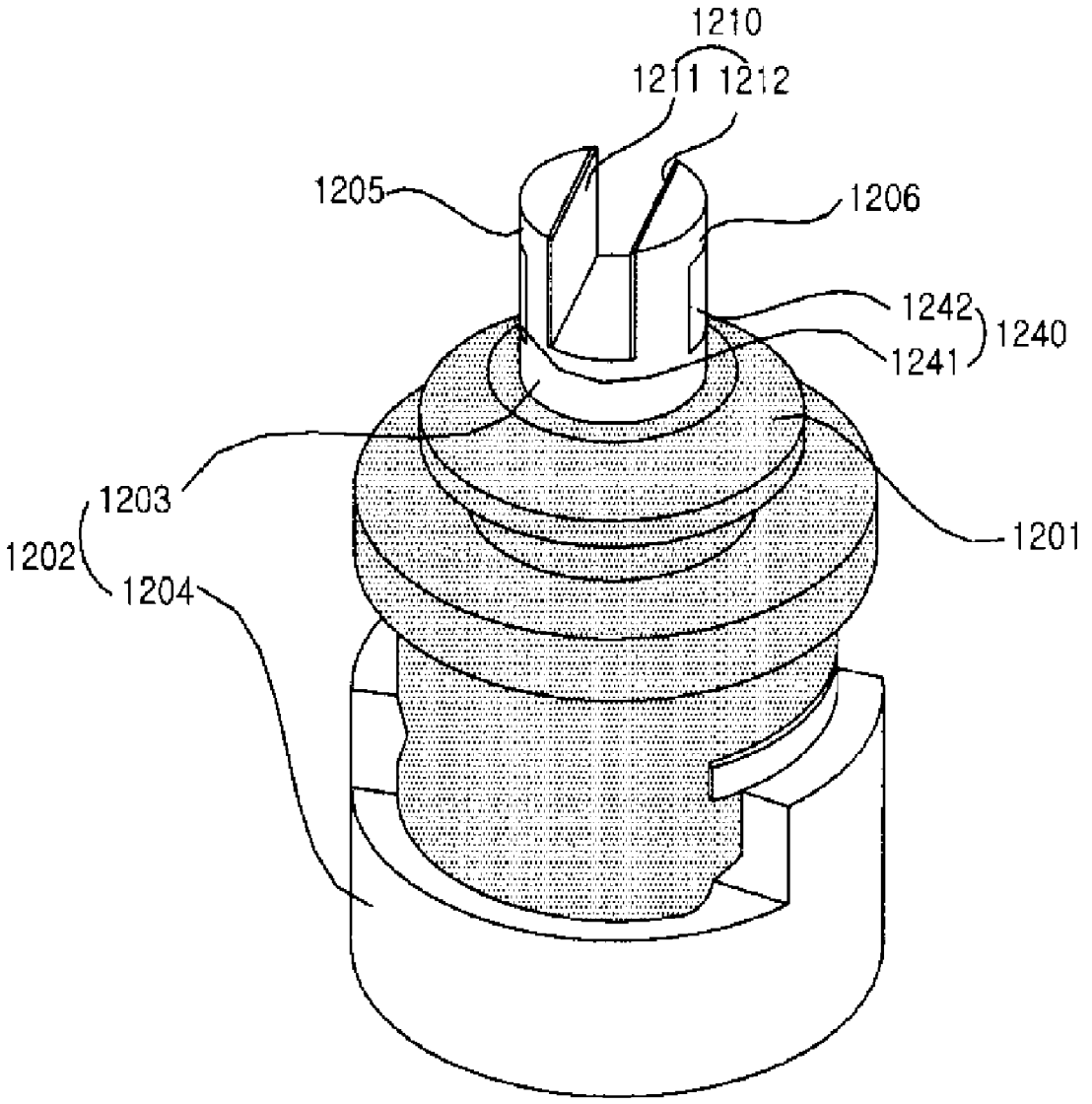
【Figure 26】



【Figure 27】



【Figure 28】



METHOD AND APPARATUS FOR TREATING LAUNDRY

TECHNICAL FIELD

[0001] The present invention relates to a laundry treatment method and apparatus, and more particularly, to a laundry treatment method and apparatus which can reduce the amount of detergent remained and can output information regarding the amount of detergent.

BACKGROUND ART

[0002] Conventionally, a rinsing operation is automatically terminated after the lapse of a preset time period, and thus, too much detergent may remain in laundry even after the washing of the laundry is complete. Detergent remained in laundry may result in user dissatisfaction and may cause various skin diseases.

[0003] In order to reduce the amount of detergent remained in laundry, the duration of a rinsing process may be increased. However, an increase in the duration of a rinsing process may result in a prolonged washing operation and an increase in the consumption of electricity.

[0004] In addition, conventionally, it is almost impossible for a user to determine whether the amount of detergent supplied into a washing machine is appropriate. More specifically, since it is impossible to determine how much the amount of detergent remained in wash water varies according to the progress of a rinsing operation, it is impossible to determine whether detergent still remains in laundry after the rinsing of the laundry.

DISCLOSURE

Technical Problem

[0005] The present invention provides a laundry treatment method and apparatus which can reduce the amount of detergent remained and can output information regarding the amount of detergent.

Technical Solution

[0006] According to an aspect of the present invention, there is provided a laundry treatment method including (a) measuring the amount of detergent in wash water in a tub during a rinsing operation; and (b) automatically determining whether to continue performing the rinsing operation based on a plurality of operating variables including the amount of detergent in the wash water.

[0007] According to another aspect of the present invention, there is provided a laundry treatment apparatus including a tub in which wash water for washing laundry is loaded; a wash water sensing apparatus which measures the amount of detergent remained in the wash water; and an alarm device which outputs information regarding the amount of detergent remained in the wash water.

ADVANTAGEOUS EFFECTS

[0008] According to the present invention, it is possible to reduce the amount of detergent remained in laundry and thus to reduce the number of times a rinsing process needs to be performed.

[0009] According to the present invention, it is possible for a user to easily determine whether too much detergent has been supplied or how a rinsing operation progresses based on information regarding the amount of detergent.

[0010] According to the present invention, it is possible to provide an electrode sensor, which has a simple structure and is thus easy to assemble.

DESCRIPTION OF DRAWINGS

[0011] FIG. **1** illustrates an exploded perspective view of a laundry treatment apparatus according to an exemplary embodiment of the present invention;

[0012] FIG. **2** illustrates a cross-sectional view of the laundry treatment apparatus shown in FIG. **1**;

[0013] FIG. **3** illustrates a block diagram of the laundry treatment machine shown in FIG. **1**;

[0014] FIG. **4** illustrates a flowchart of a laundry treatment method according to an exemplary embodiment of the present invention;

[0015] FIG. **5** illustrates a block diagram for explaining control logic for performing an additional rinsing process shown in FIG. **4**;

[0016] FIG. **6** illustrates a diagram of an example of a display unit shown in FIG. **3**;

[0017] FIG. **7** illustrates a diagram of another example of the display unit shown in FIG. **3**;

[0018] FIG. **8** illustrates a diagram of another example of the display unit shown in FIG. **3**;

[0019] FIG. **9** illustrates a diagram of another example of the display unit shown in FIG. **3**;

[0020] FIG. **10** illustrates a cross-sectional view showing how an electrode sensor according to an exemplary embodiment of the present invention is coupled to a tub shown in FIG. **1**;

[0021] FIG. **11** illustrates an exploded lateral view of the electrode sensor shown in FIG. **10**;

[0022] FIG. **12** illustrates a lateral view of the electrode sensor shown in FIG. **10**;

[0023] FIG. **13** illustrates a perspective view of the electrode sensor shown in FIG. **10**;

[0024] FIG. **14** illustrates an exploded perspective view of the electrode sensor shown in FIG. **10**;

[0025] FIG. **15** illustrates a lateral view of the electrode sensor shown in FIG. **12**, as seen from direction A of FIG. **12**;

[0026] FIG. **16** illustrates a perspective view of an electrode sensor according to another exemplary embodiment of the present invention;

[0027] FIG. **17** illustrates a graph showing the relationship between the concentration of detergent and the voltage of the electrode sensor shown in FIG. **16**;

[0028] FIG. **18** illustrates a perspective view of an electrode sensor according to another exemplary embodiment of the present invention;

[0029] FIG. **19** illustrates a perspective view of an electrode sensor according to another exemplary embodiment of the present invention;

[0030] FIG. **20** illustrates an exploded perspective view of the electrode sensor shown in FIG. **19**;

[0031] FIG. **21** illustrates a perspective view of an electrode sensor according to another exemplary embodiment of the present invention;

[0032] FIG. **22** illustrates a perspective view of an electrode sensor according to another exemplary embodiment of the present invention;

[0033] FIG. **23** illustrates a plan view of a sensor body shown in FIG. **22**, as seen from direction A of FIG. **22**;

[0034] FIG. **24** illustrates a plan view of a sensor body of an electrode sensor according to another exemplary embodiment of the present invention;

[0035] FIG. **25** illustrates a perspective view of a wash water sensing apparatus according to an exemplary embodiment of the present invention;

[0036] FIG. **26** illustrates a plan view of the wash water sensing apparatus shown in FIG. **25**, as seen from direction A of FIG. **25**;

[0037] FIG. **27** illustrates a perspective view of a wash water sensing apparatus according to another exemplary embodiment of the present invention; and

[0038] FIG. **28** illustrates a perspective view of a wash water sensing apparatus according to another exemplary embodiment of the present invention.

BEST MODE

[0039] The present invention will hereinafter be described more fully with reference to the accompanying drawings, in which exemplary embodiments of the invention are shown.

[0040] The term 'laundry treatment apparatus' as used herein, may indicate nearly all types of devices capable of handling laundry such as a washing machine, a dryer and a spin dryer.

[0041] A laundry treatment apparatus according to an exemplary embodiment of the present invention will hereinafter be described, taking a drum-type washing machine as an example.

[0042] FIG. **1** illustrates an exploded perspective view of a laundry treatment apparatus according to an exemplary embodiment of the present invention, i.e., a drum-type washing machine **100**, and FIG. **2** illustrates a cross-sectional view of the drum-type washing machine **100**.

[0043] Referring to FIGS. **1** and **2**, the drum-type washing machine **100** may include a cabinet **110** defining the interior of the drum-type washing machine **100**. A laundry inlet/outlet hole **112** may be formed at the front of the cabinet **110**, and thus, laundry may be injected into or ejected from a drum **125** through the laundry inlet/outlet hole **112**. A door assembly **130** may be disposed at the front of the cabinet **110** so as to be able to open or close the laundry inlet/outlet hole **112**.

[0044] The drum-type washing machine **100** may also include a tub **120** which is disposed in the cabinet **110** so as to be buffered by a spring and a damper and can be loaded with wash water; the drum **125** which is disposed in the tub **120** so as to be rotatable and can be loaded with laundry; and a driving device **145** which is disposed at the rear of the tub **120** and applies rotation force to the drum **125**. A plurality of through holes **127** may be formed on the drum **125** so that wash water can pass through the through holes **127**. A lifter **129** may be disposed on an inner side surface of the drum **125** and may lift and then drop laundry with the use of gravitational force during the rotation of the drum **125**.

[0045] The drum-type washing machine **100** may also include a control panel **117** which is disposed at an upper part of the cabinet **110**, displays various information regarding the operation of the drum-type washing machine **100**, and controls the operation of the drum-type washing machine **100**; a drain device **170** which is disposed at the bottom of the tub **120** and discharges wash water from the tub **120**; and a water supply device **140** which is disposed at the top of the tub **120** and supplies water into the tub **120**. The water supply device **140** may include a water supply bellows **141**, a water supply hose **142** and a water supply valve **143**. A detergent supply device **149** may be disposed on a water supply path of the water supply device **140** and may supply detergent with the use of wash water supplied into the tub **120**. The drain device **170** may include a drain bellows **171**, a drain pump **172** and a drain hose **173**.

[0046] The drum-type washing machine **100** may also include a gasket **115** disposed between the opening of the drum **125** and the laundry inlet/outlet hole **112** of the cabinet **110**. The gasket **115** may alleviate shock to the door assembly **130** during the rotation of the drum **125** and may prevent a water leak from the tub **120**.

[0047] The drum-type washing machine **100** may also include an electrode sensor **150** which measures the conductivity of wash water in the tub **120**. The term 'wash water', as used herein, may indicate not only water alone but also the mixture of water and detergent. The term 'detergent', as used herein, may indicate not only a solid detergent but also a liquid detergent. The electrode sensor **150** may measure the conductivity of wash water and may thus determine the amount of detergent remained in the wash water. However, the present invention is not restricted to this. That is, a wash water sensing apparatus measuring the hardness or turbidity of wash water may be provided in the drum-type washing machine **100**, instead of the electrode sensor **150**. That is, the electrode sensor **150** is an example of such wash water sensing apparatus.

[0048] The electrode sensor **150** may be attached to the rear of a lower part of the tub **120**. More specifically, the electrode sensor **150** may be coupled to the rear of the tub **120** through a hole **5***a* formed on a rear surface **5** of the tub **120**, but the present invention is not restricted to this. That is, the electrode sensor **150** may be disposed at various locations, other than that set forth herein.

[0049] The electrode sensor **150** will be described later in further detail with reference to FIGS. **10** through **28**.

[0050] FIG. **3** illustrates a block diagram of the drum-type washing machine **100**. Referring to FIG. **3**, a control unit **160** may receive various information from a weight sensing unit **183**, the electrode sensor **150** and an input unit **184** and may control the operations of the water supply device **140**, the driving device **145**, and an alarm device **180**. The control unit **160** may also control the operations of, for example, the driving device **145**, the water supply device **140** and the drain device **170**.

[0051] The weight sensing unit **183** may sense the weight of laundry loaded in the drum **125**. The input unit **184** may receive a user manipulation signal from a user. The input unit **184** may be included in the control panel **117**. Examples of the user manipulation signal include a signal for turning on or off the drum-type washing machine **100**, a signal for choosing a washing course, a signal for performing an additional rinsing process, and a signal for performing an additional spin-drying operation.

[0052] An alarm device **180** may include the audio output unit **181** and the display unit **182**. The audio output unit **181** may output audio data regarding the amount of detergent. The display unit **182** may output video data regarding the amount of detergent.

[0053] The drum-type washing machine **100** may also include a memory unit **170** in which various audio data and display information is stored. The control unit **160** may control the alarm device **180** to notify the user of the amount of detergent either auditorily or visually using the information present in the memory unit **170**.

[0054] The audio output unit **181** may output information regarding the amount of detergent as an audio message. The audio output unit **181** may be implemented as a speaker.

[0055] The display unit **182** may output text data or graphic data regarding the amount of detergent. The display unit **182** may account for part of the control panel **117** for setting a washing course. For example, the display unit **182** may be implemented as a liquid crystal display (LCD) or a light-emitting diode (LED) and may be disposed on one side of the control panel **117**. The display unit **182** may display not only information regarding the amount of detergent but also various other information indicating how a washing operation progresses such as information indicating the beginning and/or the end of a washing operation.

[0056] FIG. **4** illustrates a flowchart of a laundry treatment method according to an exemplary embodiment of the present invention. Referring to FIG. **4**, the laundry treatment method may largely include performing a preparation operation (S**110**), performing a washing operation (S**120**), performing a rinsing operation (S**130**) and performing a spin-drying operation (S**180**). More specifically, operation S**110** may involve loading laundry in the drum **125** (S**111**) and measuring the weight of the laundry (S**112**). In operation S**120**, wash water may be supplied to the laundry, and the laundry may be washed with the wash water while rotating the drum **125**. Once operation S**120** is complete, the laundry may be rinsed (S**130**).

[0057] In operation S**120**, the electrode sensor **150** may measure the conductivity of wash water and may output the result of the measurement to the control unit **160**. The control unit **160** may determine the amount of detergent in wash water based on data present in the memory unit **170** and measurement data provided by the electrode sensor **150** regarding the conductivity of wash water. The control unit **160** may also determine whether too little detergent has been supplied into the tub **120** by comparing the determined detergent amount with a standard detergent amount stored in the memory unit **170**.

[0058] The drum-type washing machine **100** may provide the user with video data regarding the amount of detergent supplied into the tub **120**. More specifically, the display unit **182** may display a text message, "Too much detergent has been input," "An appropriate amount of detergent has been input," or "Too little detergent has been input."

[0059] Alternatively, the display unit **182** may display graphic data such as geometrical figures, images, or colors, instead of a text message, in order to provide information regarding the amount of detergent supplied into the tub **120**. The display unit **182** will be described later in further detail with reference to FIG. **6**.

[0060] Still alternatively, the control unit **160** may control the audio output unit **181** to output information regarding the amount of detergent supplied into the tub **120** using audio data present in the memory unit **170**. For example, the audio output unit **181** may output a voice message, "Too much detergent has been input," "An appropriate amount of detergent has been input," or "Too little detergent has been input." As a result, the user may easily recognize whether too much or too little detergent has been supplied into the tub **120** based on the voice message and may thus be able to supply an appropriate amount of detergent into the tub **120**.

[0061] Operation S**130** will hereinafter be described in further detail.

[0062] A rinsing/spin-drying operation may be performed while rotating the drum **125** (S**135**). Thereafter, a rinsing process may be performed (S**140**). More specifically, wash water may be supplied into the tub **120** (S**141**), and the laundry may be rinsed with the wash water while rotating the drum **125** (S**142**). Alternatively, the rinsing process may be performed by supplying wash water into the tub **120** while rotating the drum **125**.

[0063] The electrode sensor **150** may measure the conductivity of the wash water in the tub **120**, and the control unit **160** may determine the amount of detergent remained by comparing measurement data provided by the electrode sensor regarding the conductivity of the wash water in the tub **120** with data present in the memory unit **170** (S**145**). Thereafter, the control unit **160** may determine whether a user manipulation signal related to a rinsing operation has been received from the user. Thereafter, the control unit **160** may determine whether an additional rinsing process needs to be performed (S**150**). Alternatively, the control unit **160** may determine whether an additional rinsing process needs to be performed during the rinsing process performed in operation S**140**.

[0064] The control unit **160** may output information regarding the amount of detergent remained with the use of the display unit **182** or the audio output unit **181**, and this will be described later in further detail with reference to FIG. **6**.

[0065] If it is determined in operation S**150** that an additional rinsing process needs to be performed, the control unit **160** may determine a set of operating conditions for performing an additional rinsing process (S**155**). The operating conditions for performing an additional rinsing process may include the water level in the tub **120**, the rotation speed of the drum **125**, which is the measure of spin-drying speed, and the duration of a spin-drying process.

[0066] FIG. **5** illustrates a block diagram for explaining control logic for performing an additional rinsing process. Referring to FIG. **7**, the control unit **160** may use a variety of logic to determine the necessity of an additional rinsing process (S**165** of FIG. **4**) and the operating conditions for performing an additional rinsing process. In the exemplary embodiment of FIG. **4**, the control unit **160** may use fuzzy logic. In the fuzzy logic, the weight of laundry and a user manipulation signal may be condition variables, and the water level in the tub **120**, the rotation speed of the drum **125** and the duration of a spin-drying process may be conclusion variables. The control unit **160** may determine the conclusion variables using a membership function between the condition variables and the conclusion variables. The fuzzy logic may also use various operating variables, other than those set forth herein, as condition variables. However, since the amount of detergent remained in laundry is one of the most important factors for determining whether to perform an additional rinsing process, operating variables associated with the amount of detergent remained in laundry may be used as condition variables. That is, the conductivity of wash water measured by the electrode sensor **150** and the weight of laundry are important factors for determining the amount of detergent remained in laundry, and a user manipulation signal is also an important factor because it indicates whether to perform an additional rinsing process or whether to terminate a rinsing operation. In short, since only the amount of detergent remained, the weight of laundry and a user manipulation

signal are used as condition variables, it is possible to simplify fuzzy control and thus to facilitate the use of a membership function.

[0067] In short, if it is determined in operation S**150** that an additional rinsing process needs to be performed, the operating conditions for performing an additional rinsing process may be determined (S**155**). Thereafter, a rinsing/spin-drying operation may be performed (S**160**). The control unit **160** may provide the user with information regarding an additional rinsing process to be performed in operation S**165** with the use of the display unit **182** or the audio output unit **181**.

[0068] Thereafter, an additional rinsing process may be performed (S**165**). More specifically, wash water may be supplied into the tub **120** (S**167**), and the laundry loaded in the drum **125** may be rinsed with the wash water while rotating the drum **125** (S**168**). Alternatively, the laundry in the drum **125** may be rinsed by supplying wash water into the tub **120** while rotating the drum **125**. When the additional rinsing process performed in operation S**165** is complete, the total number of times a rinsing process has been performed may be counted (S**170**). If the total number of times a rinsing process has been performed is less than a predefined reference value (S**175**), the laundry treatment method returns to operation S**150**. The more rinsing operations, the better the laundry can be rinsed out. However, the more rinsing operations the drum-type washing machine **100** performs, the longer it takes for the drum-type washing machine **100** to wash laundry, and the more wash water and electricity the drum-type washing machine **100** consumes. In addition, the more rinsing operations the drum-type washing machine **100** performs, the more likely the drum-type washing machine **100** is to damage laundry. In order to address these problems, the control unit **160** may control a total number of times a rinsing process is performed not to exceed the predefined reference value.

[0069] If it is determined in operation S**150** that an additional rinsing process does not need to be performed any longer or if the total number of times a rinsing process has been performed exceeds the predefined reference value, a spin-drying operation may be performed (S**180**). A drying operation may be performed after the spin-drying operation performed in operation S**180**.

[0070] FIG. **6** illustrates a schematic diagram of an example of the display unit **182**. Referring to FIG. **6**, the display unit **182** may include a plurality of first segments **182***a* which are selectively turned on or off according to the amount of detergent supplied and represent different colors and a second segment **182***b* whose color changes according to the amount of detergent supplied. More specifically, one of the first segments **182***a* may be turned on according to the amount of detergent supplied, and the color of the second segment **182***b* may be determined by the amount of detergent supplied. If the color of the second segment **182***b* is the same as the color of whichever of the first segments **182***a* is turned on according to the amount of detergent supplied, the user may be able to easily recognize the amount of detergent supplied.

[0071] The display unit **182** may also include a third segment **182***c* displaying information regarding the amount of detergent remained. If a reference remaining detergent amount is "100%", the third segment **182***c* may display the information regarding the amount of detergent remained as, for example, "99%" or "98%". If there is no detergent remained, the third segment **182***c* may display the information regarding the amount of detergent remained as "0%". Therefore, the user may easily determine how well laundry in the drum **125** has been rinsed out based on the information regarding the amount of detergent remained. Thus, it is possible to improve user satisfaction.

[0072] Alternatively, the information regarding the amount of detergent remained may be displayed using the first segments **182***a*, instead of using the third segment **182***c*. That is, the first segment **182***a* labeled as "Too much detergent" may be turned on at the beginning of a rinsing operation. Thereafter, the first segments **182***a* except the first segment **182***a* labeled as "Too much detergent" and the first segment **182***a* labeled as "Too little detergent" may be sequentially turned on in accordance as the amount of detergent remained decreases. If the amount of detergent remained is less than a predefined level, the first segment **182***a* labeled as "Too little detergent" may be turned on.

[0073] FIG. **7** illustrates a schematic diagram of another example of the display unit **182**, i.e., a display unit **282**. Referring to FIG. **7**, the display unit **282** may include a plurality of first segments **282***a* arranged side by side in a horizontal direction. One of the first segments **282***a* may be turned on according to the amount of detergent.

[0074] FIG. **8** illustrates a schematic diagram of another example of the display unit **182**, i.e., a display unit **382**. Referring to FIG. **8**, the display unit **382** may display information regarding the amount of detergent remained using a progress bar. When a rinsing operation begins, the progress bar may be increasingly filled up according to the amount of detergent remained. If the amount of detergent remained is reduced to a predefined value or below, the progress bar may be completely filled up. The display unit **382** may be implemented as an LCD.

[0075] FIG. **9** illustrates a schematic diagram of another example of the display unit **182**, i.e., a display unit **482**. Referring to FIG. **9**(*a*), the display unit **483** may display a progress bar having a certain shape, other than a bar shape. The progress bar may be increasingly filled up according to the amount of detergent remained.

[0076] Referring to FIG. **9**(*b*), the display unit **482** may display, for example, a spinning hourglass, in order to indicate whether the determination of the amount of detergent remained in wash water based on the conductivity of wash water measured by the electrode sensor **150** (S**145**) is under way.

[0077] The alarm device **180** is illustrated in FIG. **3** as including both the audio output unit **181** and the display unit **182**, but the present invention is not restricted to this. That is, the alarm device **180** may include only one of the audio output unit **181** and the display unit **182**. Even if the alarm device **180** includes both the audio output unit **181** and the display unit **182**, the control unit **160** may control the audio output unit **181** and the display unit **182** not to operate at the same time, i.e., the control unit **160** may control only one of the audio output unit **181** and the display unit **182** to operate at a time.

[0078] FIG. **10** illustrates a cross-sectional view showing how an electrode sensor **150** according to a first exemplary embodiment of the present invention is coupled to the tub **120** shown in FIG. **1**, FIG. **11** illustrates an exploded lateral view of the electrode sensor **150** shown in FIG. **10**, FIG. **12** illustrates a lateral view of the electrode sensor **150** shown in FIG. **10**, FIG. **13** illustrates a perspective view of the electrode sensor **150** shown in FIG. **10**, FIG. **14** illustrates an exploded perspective view of the electrode sensor **150** shown in FIG. **10**, and FIG. **15** illustrates a lateral view of the electrode sensor **150**, as seen from direction A of FIG. **12**.

[0079] Referring to FIGS. **10** through **14**, the electrode sensor **150** may include a sealing cover **60** and a sensor body **70**. The sealing cover **60** may be coupled to the tub **120** by being inserted into the hole **5***a*. The sensor body **70** may include a plurality of electrodes **72** and may be coupled to the sealing cover by being inserted into a through hole **61** formed through the sealing cover **60**.

[0080] The sealing cover **60** may be coupled to the tub **120** by pressing the sensor body **70** into the tub **120**. Thus, the sealing cover **60** may be more elastic than the sensor body **70**. The sealing cover **60** may be formed of rubber.

[0081] The sealing cover **60** may include a cover insertion portion **62** which can be inserted into the hole **5***a*. Referring to FIG. **11**, when the cover insertion portion **62** is yet to be inserted into the hole **5***a*, the cover insertion portion **62** may have an outer diameter d**2**, which is greater than a diameter d**1** of the hole **5***a*. For example, the outer diameter d**2** may be about 5 mm greater than the diameter d**1**. On the other hand, referring to FIG. **12**, when the cover insertion portion **62** is inserted in the hole **5***a*, the cover insertion portion **62** may be pressed by the inner circumferential surface of the hole **5***a*, and thus, the outer diameter of the cover insertion portion **62** may be reduced to an outer diameter d**2'** which is the same diameter as the diameter d**1**.

[0082] Referring to FIG. **10**, the sealing cover **60** may also include first and second ribs **63** and **64**. The first and second ribs **63** and **64** may protrude beyond the outer circumferential surface of the cover insertion portion **62**. When the sealing cover **60** is coupled to the tub **120**, the first and second ribs **63** and **64** may be disposed at the front and the rear, respectively, of the hole **5***a* on a rear surface **5** of the tub **120** and may thus firmly fix the sealing cover **60** in the hole **5***a*. More specifically, the first and second ribs **63** and **64** may protrude radially from the cover insertion portion **62**. The first and second ribs **63** and **64** may be a predetermined distance apart from each other. Due to the first and second ribs **63** and **64**, the cover insertion portion **62** of the sealing cover **60** may be fit in the hole **5***a* when the sealing cover **60** is inserted in the hole **5***a*.

[0083] Referring to FIG. **12**, a surface **64***a* of the second rib **64** may be placed in contact with the rear surface **5** of the tub **120** when the sealing cover **60** is inserted into the hole **5***a*. The surface **64***a* of the second rib **64** may be recessed toward the centre of the through hole **61**.

[0084] A hem portion **65** of the sealing cover **60** may be tapered so that the sealing cover **60** can be easily inserted into the hole **5***a*.

[0085] Referring to FIGS. **13** through **15**, the sealing cover **60** may also include a cover cylinder portion **66** which extend backwards from the second rib **64** and a number of hook portions **67** which protrude from the cover cylinder portion **66** so as to be able to be coupled to the sensor body **70**. At least one hook portion **67** may be formed on the cover cylinder portion **66**. Referring to FIGS. **14** and **15**, two hook portions **67** may be formed on opposite sides of the cover cylinder portion **66**.

[0086] The sensor body **70** may be formed through injection molding, and the electrodes **72** may be inserted into the sensor body **70** during the formation of the sensor body **70**. For example, two electrodes **72** may be inserted into the sensor body **70** so that the ends of the two electrodes **72** can be exposed.

[0087] The sensor body **70** may include a body insertion portion **73** which can be inserted into the through hole **61** and a body cylinder portion **74** which extends backwards from the body insertion portion **73**.

[0088] Referring to FIG. **11**, when the body insertion portion **73** is yet to be inserted into the through hole **61**, the body insertion portion **73** may have an outer diameter d**4** which is greater than a diameter d**3** of the through hole **61**. For example, the outer diameter d**4** may be about 2 mm greater than the diameter d**3**. On the other hand, referring to FIG. **12**, when the body insertion portion **73** is inserted into the through hole **61**, the inner circumferential surface of the through hole **61** may be pressed by the body insertion portion **73**, and thus, the diameter of the through hole **61** may be reduced to a diameter d**3'** which is the same as the outer diameter d**4**.

[0089] Referring to FIGS. **13** through **15**, the sensor body **70** may also include an engaging protrusion **75** which engages with the hook portion **67** when the body insertion portion **73** is inserted into the through hole **61**. The engaging protrusion **75** may protrude radially from a portion of the body insertion portion **74** corresponding to the hook portions **67**. The body cylinder portion **74** may include a plurality of recessed portions **74***a* into which the hook portions **67** can be inserted.

[0090] How to assemble the electrode sensor **150** will hereinafter be described in detail.

[0091] The sealing cover **60** may be pressed into the hole **5***a* of the tub **120**. Since the sealing cover **60** is formed of rubber and the outer diameter of the cover insertion portion **61** is greater than the diameter of the insertion hole **5***a* when the cover insertion portion **61** is yet to be inserted into the hole **5***a*, the cover insertion portion **61** may be pressed by and thus firmly attached onto the inner circumferential surface of the hole **5***a* when the sealing cover **60** is inserted into the hole **5***a*.

[0092] Therefore, it is possible to easily install the sealing cover **60** simply by inserting the sealing cover **60** into the hole **5***a* of the tub **120**. In addition, since the cover insertion portion **62** is pressed by and thus firmly attached onto the inner circumferential surface of the hole **5***a* when the sealing cover **60** is inserted into the hole **5***a*, there is no need to additionally seal the connection between the sealing cover **60** and the hole **5***a*.

[0093] Once the installation of the sealing cover **60** is complete, the sensor body **70** may be inserted into the through hole **61** of the sealing cover **60**. Since the outer diameter of the body insertion portion **73** is greater than the diameter of the through hole **61** when the sensor body **70** is yet to be inserted into the through hole **61**, the body insertion portion **73** may be pressed by and thus firmly attached onto the inner circumferential surface of the through hole **61** when the sensor body **70** is inserted into the through hole **61**.

[0094] Therefore, it is possible to easily assemble the electrode sensor **150** simply by inserting the sensor body **70** into the through hole **61** of the sealing cover **60**. In addition, since the body insertion portion **73** of the sensor body **70** is pressed by and thus firmly attached onto the inner circumferential surface of the hole **5***a* when the sensor body **70** is inserted into the through hole **61** of the sealing cover **60**, there is no need to additionally seal the connection between the sealing cover **60** and the hole **5***a*.

[0095] The operation of the electrode sensor **150** will hereinafter be described in detail.

[0096] When laundry is loaded into the drum **125** and wash water is supplied into the tub **120**, the electrode sensor **150** measures the conductivity of the wash water in the tub **120**.

[0097] More specifically, if a voltage is applied to the electrodes **72** of the electrode sensor **150**, the electrodes **72** may be electrically connected, and thus, the electrode sensor **150** may thus be able to measure the conductivity of the wash water in the tub **120**.

[0098] FIG. **16** illustrates a perspective view of an electrode sensor **80** according to a second exemplary embodiment of the present invention. Referring to FIG. **16**, the electrode sensor **80** may include a sealing cover **84**, which is coupled to the tub **120** by being inserted into the hole **5***a* of the tub **120**, and a sensor body **86**, which is coupled to the sealing cover **84** by being inserted into a through hole of the sealing cover **84** and includes first through third electrode sensors **81** through **83**. The second exemplary embodiment is almost the same as the first exemplary embodiment except that the electrode sensor **80** includes at least three electrodes and that at least one of the three electrodes has a different length from the other electrodes. Thus, the second exemplary embodiment will hereinafter be described, focusing mainly on differences with the first exemplary embodiment.

[0099] The first and second electrodes **81** and **82** may have the same length, and the third electrode **83** may be shorter than the first and second electrodes **81** and **82**.

[0100] The operation of the electrode sensor **80** will hereinafter be described in detail.

[0101] FIG. **17** illustrates a graph showing the relationship between the concentration of detergent and the voltage of the electrode sensor **80**. Referring to FIG. **17**, when a current is applied to the electrode sensor **80**, the concentration of detergent may serve as a resistor. That is, the higher the concentration of detergent, the lower the voltage of each of the first through third electrodes **81**, **82** and **83** becomes. The more the voltage of an electrode varies according to the concentration of detergent (i.e., the greater the slope of a voltage-detergent concentration curve of an electrode), the better the electrode is able to precisely determine the amount of detergent.

[0102] Any two of the first through third electrodes **81** through **83** producing a greatest voltage variation for a given detergent concentration variation may be selectively used. The amount by which the voltage of each of the first through third electrodes **81** through **83** varies according to the concentration of detergent may differ from a first concentration section S**1** to a second concentration section S**2**.

[0103] The first concentration section S**1** may correspond to a period of time during which there is little, if any, detergent detected, i.e., a period of time during which a rinsing operation is performed. The second concentration section S**2** may correspond to a period of time during which a wash operation is performed alone or together with a rinsing operation.

[0104] During the first concentration section S**1**, the first and second electrodes **81** and **82** may produce a greatest voltage variation for any given detergent concentration variation. More specifically, there is little, if any, detergent detected during the first concentration section S**1**. In addition, since the first and second electrodes **81** and **82** are longer than the third electrode **83**, the contact area between each of the first and second electrodes **81** and **82** and wash water is larger than the contact area between the third electrode **83** and the wash water. Thus, during the first concentration section S**1**, the first and second electrodes **81** and **82** may be selectively used to detect the amount of detergent.

[0105] On the other hand, during the second concentration section S**2**, the third electrode **83** and one of the first and second electrodes **81** and **82** may produce first a greatest voltage variation for any given detergent concentration variation. More specifically, the amount of detergent is greater during the second concentration section S**2** than during the first concentration section S**1**. Thus, during the second concentration section S**1**, the third electrode **83** and one of the first and second electrodes **81** and **82** (particularly, the first electrode **81**) may be selectively used to detect the amount of detergent.

[0106] Therefore, during the first concentration section S**1**, a current may be applied to the first and second electrodes **81** and **82**, and thus, the amount of detergent may be determined based on voltage measurements obtained from the first and second electrodes **81** and **82**. On the other hand, during the second concentration section S**2**, a current may be applied to the first and third electrodes **81** and **83**, and thus, the amount of detergent may be determined based on voltage measurements obtained from the first and third electrodes **81** and **83**. In this manner, it is possible to precisely determine the amount of detergent by selectively using the first through third electrodes **81** through **83** according to the concentration of detergent.

[0107] FIG. **18** illustrates a perspective view of an electrode sensor **90** according to another exemplary embodiment of the present invention. The third exemplary embodiment is almost the same as the second exemplary embodiment except that the electrode sensor **90** includes three electrodes having different lengths. Thus, the third exemplary embodiment will hereinafter be described, focusing mainly on differences with the second exemplary embodiment.

[0108] Referring to FIG. **18**, the electrode sensor **90** may include fourth through sixth electrodes **91** through **93**. The fourth electrode **91** may be shorter than the fifth electrode **92**, and the fifth electrode **92** may be shorter than the sixth electrode **93**. The fourth through sixth electrodes **91** through **93** may be sequentially arranged in order of length.

[0109] The electrode sensor **90** may be able to precisely measure the amount of detergent by selectively using the fourth through sixth electrodes **91** through **93**. In addition, the electrode sensor **90** may be able to prevent foreign materials from being stuck between the fourth through sixth electrodes **91** through **93**.

[0110] FIG. **19** illustrates a perspective view of an electrode sensor **1100** according to a fourth exemplary embodiment of the present invention, and FIG. **20** illustrates an exploded perspective view of the electrode sensor **1100**. Referring to FIGS. **19** and **20**, the electrode sensor **1100** may include a sealing cover **1103** coupled to the tub **120** and a sensor body **1104** coupled to the sealing cover **1103** and including a plurality of electrodes **1102**. At least one of the contact surfaces of wash water in the tub **120** and each of the electrodes **1102** may be disposed on a level with a surface of the sensor body **1104**.

[0111] More specifically, the electrodes **1102** may be inserted into a body insertion portion **1105** of the sensor body **1104**, and at least one surface of each of the electrodes **1102** may be exposed on a front surface **1105***a* of the body insertion portion **1105**, facing the tub **120**.

[0112] Each of the electrodes **1102** may include a first portion **1102***a* inserted into the body insertion portion **1105** and a second portion **1102***b* exposed on the front surface **1105** of the body insertion portion **1105** and contacting wash water in the tub **120**.

[0113] The area of the second portions **1102***b* of the electrodes **1102** may be determined by the thickness of the elec-

trodes **1102**. The area of the second portions of the electrodes **1102** may be appropriately adjusted in order to control the performance of the electrode sensor **1100**.

[0114] The operation of the electrode sensor **1100** will hereinafter be described in detail.

[0115] When laundry is loaded into the drum **125** and wash water is supplied into the tub **120**, the electrode sensor **1100** measures the conductivity of the wash water in the tub **120**.

[0116] More specifically, if a voltage is applied to the electrodes **72** of the electrode sensor **150**, the voltage of the electrodes **1102** may vary according to the concentration of detergent in the wash water in the tub **120**. The electrode sensor **1100** may determine the amount of detergent by measuring the voltage of the electrodes **1102**.

[0117] Since the electrodes **1102** do not protrude beyond the sensor body **1104**, it is possible to prevent foreign materials from being stuck between the electrodes **1102**. Therefore, it is possible to prevent deterioration the performance of the electrode sensor **1100** and thus to increase the lifetime of the electrode sensor **1100**.

[0118] FIG. **21** illustrates a perspective view of an electrode sensor **1110** according to a fifth exemplary embodiment of the present invention. The fifth exemplary embodiment is almost the same as the fourth exemplary embodiment except that an electrode **1112** is attached onto the surface of a sensor body **1114**. Thus, the fifth exemplary embodiment will hereinafter be described, focusing mainly on differences with the fourth exemplary embodiment.

[0119] Referring to FIG. **21**, the electrode **1112** may be attached onto an outer circumferential surface **1115***a* of a body insertion portion **1115** of the sensor body **1114**. The electrode **1112** may be formed as a plate, but the present invention is not restricted to this. That is, the electrode **1112** may be formed as a stick.

[0120] The electrode **1112** may be bonded onto the outer circumferential surface **1115***a* of the body insertion portion **1115** by an adhesive. A groove (not shown) for accommodating the electrode **1112** may be formed on the outer circumferential surface **1115***a*.

[0121] According to the fifth exemplary embodiment, it is possible to increase the contact area between the electrode **1112** and wash water.

[0122] FIG. **22** illustrates a perspective view of an electrode sensor **1120** according to a sixth exemplary embodiment of the present invention, and FIG. **23** illustrates a plan view of a sensor body **1121** of the electrode sensor **1120**, as seen from direction A of FIG. **22**. The sixth exemplary embodiment is almost the same as the fourth exemplary embodiment except that a body insertion portion **1130** of a sensor body **1121** includes first and second protrusions **1131** and **1132**, and that first and second electrodes **1141** and **1142** are disposed on the first and second protrusions **1131** and **1132**, respectively. Thus, the sixth exemplary embodiment will hereinafter be described, focusing mainly on differences with the fourth exemplary embodiment.

[0123] Referring to FIGS. **22** and **23**, the first and second protrusions **1131** and **1132** may protrude toward the tub **120**. The first and second protrusions **1131** and **1132** may face each other.

[0124] A surface **1131***a* of the first protrusion **1131** on which the first electrode **1141** is disposed and a surface **1131***a* of the second protrusion **1132** on which the second electrode **1142** is disposed may face each other. Thus, the first and second electrodes **1141** and **1142** may face each other. The first and second electrodes **1131** and **1132** may be attached onto or inserted into the first and second protrusions **1131** and **1132**, respectively.

[0125] The first and second electrodes **1141** and **1142** may be exposed on the surfaces **1131***a* of the first and second protrusions **1131** and **1132** and on top surfaces **1131***b* and **1132***b* of the first and second protrusions **1131** and **1132** and may thus be able to contact wash water.

[0126] FIG. **24** illustrates a plan view of a sensor body of an electrode sensor according to a seventh exemplary embodiment of the present invention. The seventh exemplary embodiment is almost the same as the sixth exemplary embodiment except that first and second electrodes **1151** and **1152** are disposed on opposite sides of a sensor body. Thus, the seventh exemplary embodiment will hereinafter be described, focusing mainly on differences with the sixth exemplary embodiment.

[0127] More specifically, the first electrode **1151** may be disposed on a surface **1131***c* of a first protrusion **1131**, and the second electrode **1152** may be disposed on a surface **1132***c* of a second protrusion **1132**. The surfaces **1131***c* and **1132***c* may be on opposite sides of the sensor body.

[0128] FIG. **25** illustrates a perspective view of a wash water sensing apparatus **1200** according to an eighth exemplary embodiment of the present invention, and FIG. **26** illustrates a plan view of the wash water sensing apparatus **1200**, as seen from direction A of FIG. **25**. Referring to FIGS. **25** and **26**, the wash water sensing apparatus **1200** may include a sealing cover **1201** which is coupled to the tub **120** by being inserted into the hole **5***a* of the tub **120**; a sensor body **1202** which is coupled to the sealing cover **1201** by being inserted into a through hole of the sealing cover **1201**; an optical sensor **1210** which is disposed on one side of the sensor body **1202** and measures the pollution level of wash water; and an electrode sensor **1220** which is disposed on the other side of the sensor body **1202** and measures the conductivity of wash water.

[0129] The sealing cover **1201** may be pressed into the tub **120**, and the sensor body **1202** may be pressed into the sealing cover **1201**. The sealing cover **1201** may be more elastic than the tub **120** or the sensor body **1202**. The sealing cover **1201** may be formed of rubber.

[0130] The sensor body **1202** may include a body insertion portion **1203** which is formed as a protrusion and can thus be inserted into the sealing cover **1201** and a body connector portion **1204** which extends backwards from the body insertion portion **1203** and to which wires connected to the optical sensor **1220** and the electrode sensor **1210** are coupled.

[0131] The body insertion portion **1203** may be cylindrical. The body insertion portion **1203** may include first and second protrusions **1205** and **1206** which protrude toward the tub **120**. The first and second protrusions **1205** and **1206** may face each other.

[0132] The optical sensor **1210** may include a light emitter **1211** disposed on the first protrusion **1205** and emitting light and a light receptor **1212** disposed on the second protrusion **1206** and receiving the light emitted by the light emitter **1211**. A surface of the first protrusion **1205** on which the light emitter **1211** is disposed and a surface of the second protrusion **1206** on which the light receptor **1212** is disposed may face each other.

[0133] The electrode sensor **1220** may include first and second electrodes **1221** and **1222**. The first and second electrodes **1221** and **1222** may be disposed between the first and

second protrusions **1205** and **1206**. The sensor body **1202** may be formed through injection molding, and the first and second electrodes **1221** and **1222** may be inserted into the sensor body **1202** during the formation of the sensor body **1202**. The first and second electrodes **1221** and **1222** may be a predetermined distance apart from each other.

[0134] The operation of the wash water sensing apparatus **1200** will hereinafter be described in detail.

[0135] Laundry may be loaded into the drum **125**, and wash water mixed with detergent may be supplied into the tub **120**. The wash water in the tub **120** may be polluted by dust and dirt from the laundry.

[0136] The wash water sensing apparatus **1200** may measure the quality of the wash water in the tub **120**.

[0137] If the light emitter **1211** of the optical sensor **1210** emits light, the light receptor **1212** of the optical sensor **1210** may receive the light through the wash water in the tub **120**. The more polluted the wash water is, the less the amount of light received by the light receptor **121**. Therefore, the wash water sensing apparatus **1200** may determine the pollution level of the wash water in the tub **120** based on the amount of light received by the light receptor **1212**. Thus, the wash water sensing apparatus **1200** may determine for how long a washing operation is to be performed and how much detergent is to be used in the washing operation based on the pollution level of the wash water in the tub **120**.

[0138] If a current is applied to the first and second electrodes **1221** and **1222** of the electrode sensor **1220**, the voltage of the first and second electrodes **1221** and **1222** may vary according to the concentration of detergent in the wash water in the tub **120**. Thus, the wash water sensing apparatus **1200** may determine the amount of detergent in the wash water in the tub **120** based on the voltage of the first and second electrodes **1221** and **1222**.

[0139] Therefore, it is possible to appropriately adjust the duration of a washing process and the temperature of the wash water in the tub based on measurement data provided by the optical sensor **1210** and the electrode sensor **1220**.

[0140] That is, if the measurement data provided by the optical sensor **1210** and the electrode sensor **1210** indicates that the pollution level of the wash water in the tub **120** is lower than a reference pollution level, and that the amount of detergent in the wash water in the tub **120** is greater than a reference detergent amount level, the duration of a washing process or the temperature of the wash water in the tub **120** may be reduced. In the latter case, it is possible to reduce the heating energy of a heater and thus to reduce the time and cost required for performing a washing operation.

[0141] On the other hand, if the measurement data provided by the optical sensor **1210** and the electrode sensor **1210** indicates that the pollution level of the wash water in the tub **120** is higher than the reference pollution level, and that the amount of detergent in the wash water in the tub **120** is less than the reference detergent amount level, the duration of a washing process or the temperature of the wash water in the tub **120** may be increased.

[0142] In this manner, it is possible to improve the performance of a washing operation by appropriately adjusting the duration of a washing process and the temperature of wash water based on the pollution level and conductivity of the wash water.

[0143] FIG. **27** illustrates a perspective view of a wash water sensing apparatus **1230** according to a ninth exemplary embodiment of the present invention. The ninth exemplary embodiment is almost the same as the eighth exemplary embodiment except that first and second electrodes **1231** and **1232** of an electrode sensor **1230** are disposed on a level with a surface **1202***a* of a sensor body **1202**. Thus, the ninth exemplary embodiment will hereinafter be described, focusing mainly on differences with the eighth exemplary embodiment.

[0144] Referring to FIG. **27**, the electrode sensor **1230** may include the first and second electrodes **1231** and **1232**. The first and second electrodes **1231** and **1232** may be disposed between first and second protrusions **1205** and **1206**. The first and second electrodes **1231** and **1232** may be inserted in the sensor body **1202** so that at least one surface of each of the first and second electrodes **1231** and **1232** can be exposed on the surface **1202***a* of the sensor body **1202**. The contact area between wash water and each of the first and second electrodes **1231** and **1232** may be determined by the thickness of the first and second electrodes **1231** and **1232**. The thickness of the first and second electrodes **1231** and **1232** may be appropriately adjusted in order to control the performance of the electrode sensor **1230**.

[0145] Since the first and second electrodes **1231** and **1232** do not protrude beyond the sensor body **1202**, it is possible to prevent foreign materials from being stuck between the electrodes **1231** and **1232**. Therefore, it is possible to prevent deterioration the performance of the electrode sensor **1230** and the performance of an optical sensor **1210**.

[0146] FIG. **28** illustrates a perspective view of a wash water sensing apparatus **1240** according to a tenth exemplary embodiment of the present invention. The tenth exemplary embodiment is almost the same as the eighth exemplary embodiment except that first and second electrodes **1241** and **1242** of an electrode sensor **1240** are attached onto a sensor body **1202**. Thus, the tenth exemplary embodiment will hereinafter be described, focusing mainly on differences with the eighth exemplary embodiment.

[0147] Referring to FIG. **28**, the first and second electrodes **1241** and **1242** may be attached onto first and second protrusions **1205** and **1206**, respectively. More specifically, the first and second electrodes **1241** and **1242** may be disposed on opposite sides of the sensor body **1202**. The first and second electrodes **1241** and **1242** may be formed as plates. A pair of grooves for accommodating the first and second electrodes **1241** and **1242** may be respectively formed on the first and second protrusions **1205** and **1206**.

[0148] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

1. A laundry treatment method comprising:

(a) measuring the amount of detergent in wash water in a tub during a rinsing operation; and

(b) automatically determining whether to continue performing the rinsing operation based on a plurality of operating variables including the amount of detergent in the wash water.

2. The laundry treatment method of claim **1**, wherein the operating variables also include the weight of laundry and a user manipulation signal.

3. The laundry treatment method of claim **1**, further comprising, if it is determined to continue performing the rinsing

operation, (d) discharging the wash water from the tub, supplying wash water into the tub, and rinsing the laundry again.

4. The laundry treatment method of claim **1**, further comprising, if it is determined to continue performing the rinsing operation, (c) determining at least one of the water level in the tub, the rotation speed of a drum and the duration of a spin-drying process.

5. The laundry treatment method of claim **1**, further comprising, if is determined to continue performing the rinsing operation, (e) counting the total number of times a rinsing process has been performed and comparing the result of the counting with a predefined value.

6. The laundry treatment method of claim **1**, further comprising (f) outputting information regarding the amount of detergent remained in the wash water.

7. A laundry treatment apparatus comprising:

a tub in which wash water for washing laundry is loaded;

a wash water sensing apparatus which measures the amount of detergent remained in the wash water; and

an alarm device which outputs information regarding the amount of detergent remained in the wash water.

8. The laundry treatment apparatus of claim **7**, wherein the wash water sensing apparatus comprises a sealing cover, which is coupled to a tub by being inserted into a hole of the tub and includes a through hole, and a sensor body, which includes a plurality of electrodes for measuring the conductivity of wash water and is coupled to the sealing cover by being inserted into the through hole.

9. The laundry treatment apparatus of claim **7**, wherein the alarm device comprises an audio output unit which outputs audio data regarding the amount of detergent remained in the wash water.

10. The laundry treatment apparatus of claim **7**, wherein the alarm device comprises a display unit which displays the information regarding the amount of detergent remained in the wash water.

11. The laundry treatment apparatus of claim **7**, further comprising a control unit which automatically determines whether to continue performing a rinsing operation based on measurement data provided by the wash water sensing apparatus regarding the amount of detergent in the wash water.

* * * * *