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(54) **CLOTHES TREATING APPARATUS**

(71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)

(72) Inventors: **Bosung SEO**, Seoul (KR); **Sunku KWON**, Seoul (KR)

(73) Assignee: **LG Electronics Inc.**, Seoul (KR)

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(57) **ABSTRACT**

The present invention relates to a clothes treating apparatus that comprise: a cabinet that forms the external appearance and includes a door on the top thereof for extracting or introducing laundry; a tub provided within the cabinet so as to store washing water; a drum rotatably provided within the tub so as to receive the laundry; a balancer provided to rotate together with the drum and to maintain dynamic equilibrium of the drum using water supplied thereinto; and a water supply unit that supplies water to the balancer. The balancer includes a drain unit that drains the water received in the balancer when the rotating speed of the drum is lower than or equal to a specified speed.

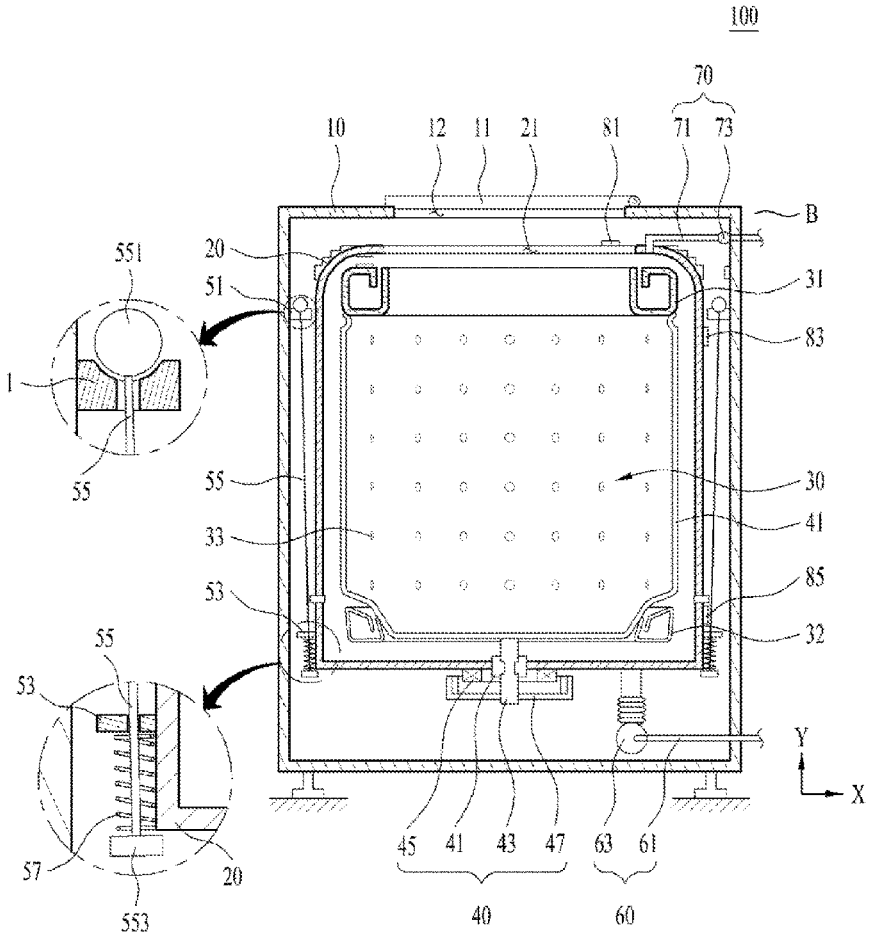
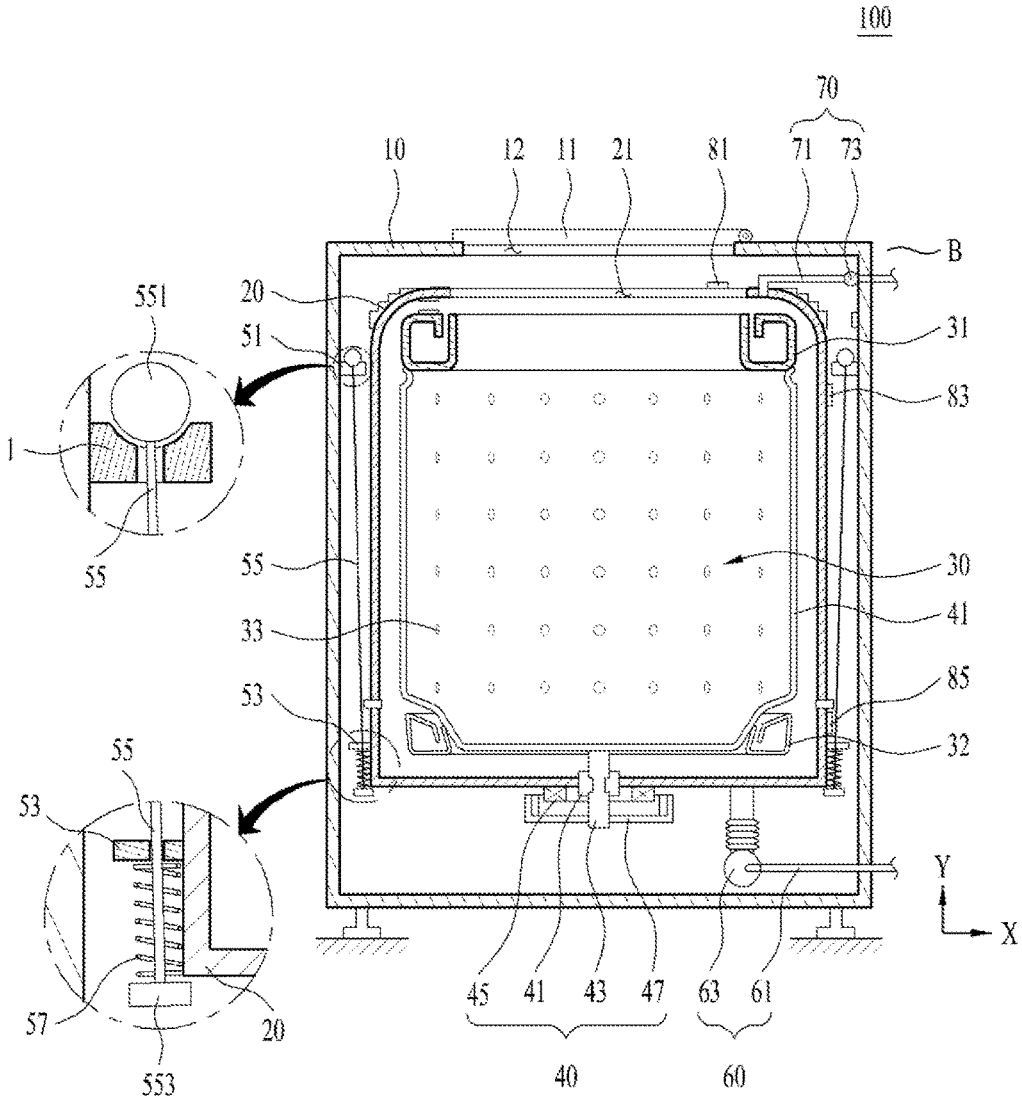


FIG. 1


100
70
10
12
11
21
81
71
73
B
551
20
51
31
83
1
55
55
30
33
41
53
85
55
32
53
Y
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57
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553
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41
43
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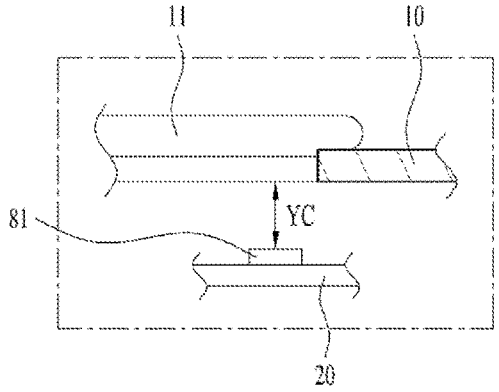
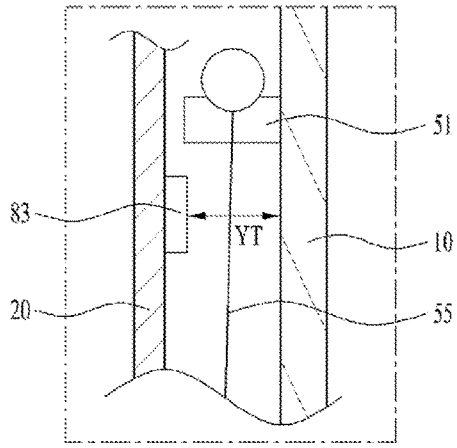
61
40
60

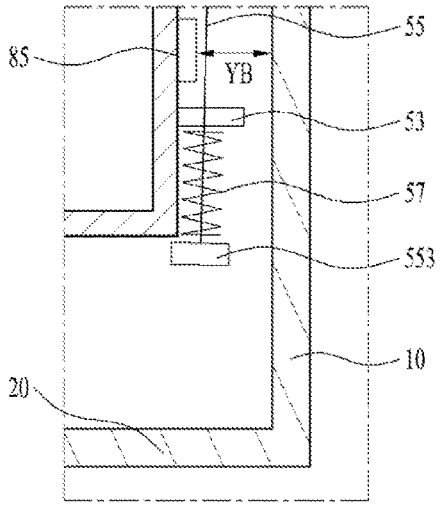
FIG. 2




(a)




(b)




(c)

FIG. 3

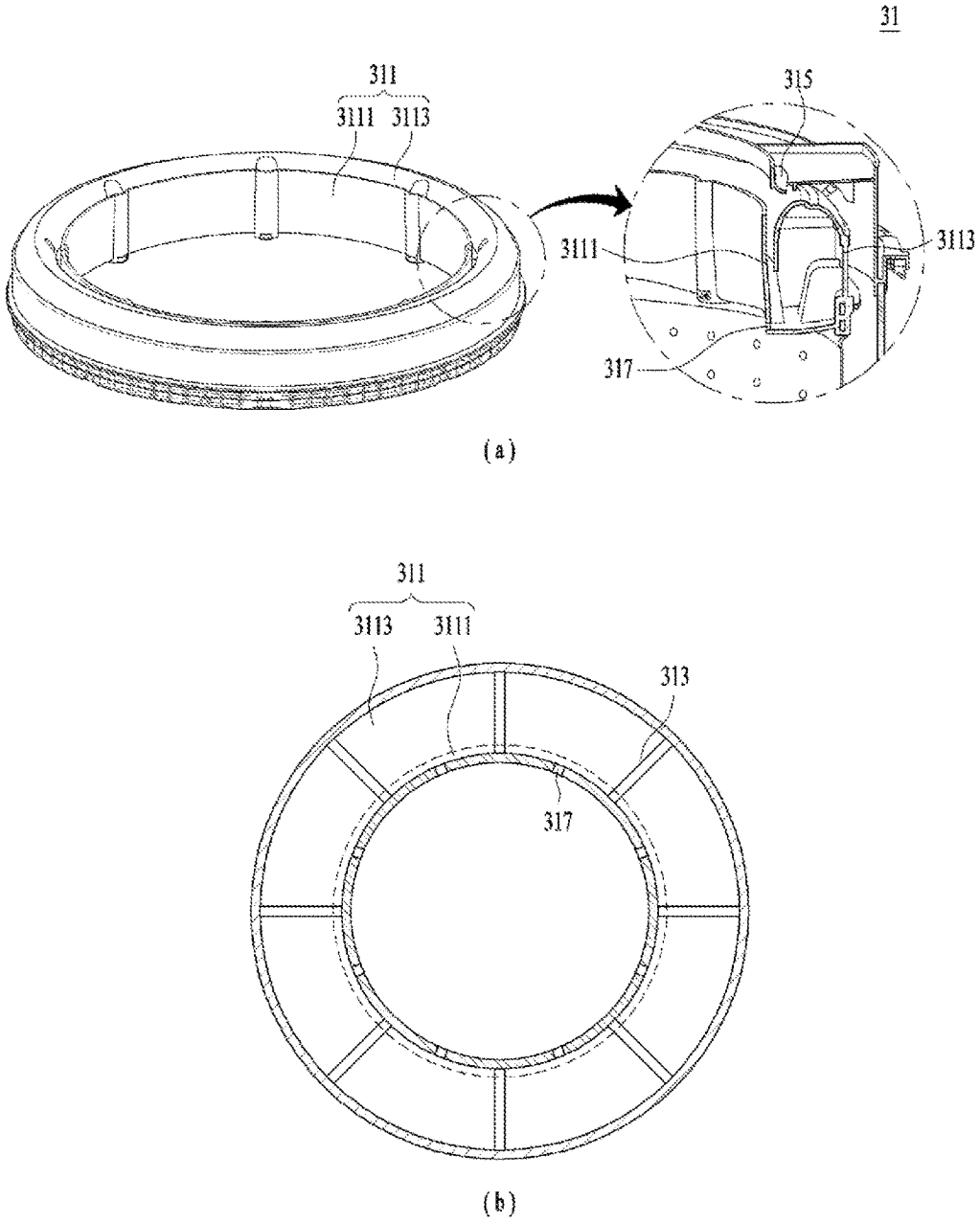


FIG. 4

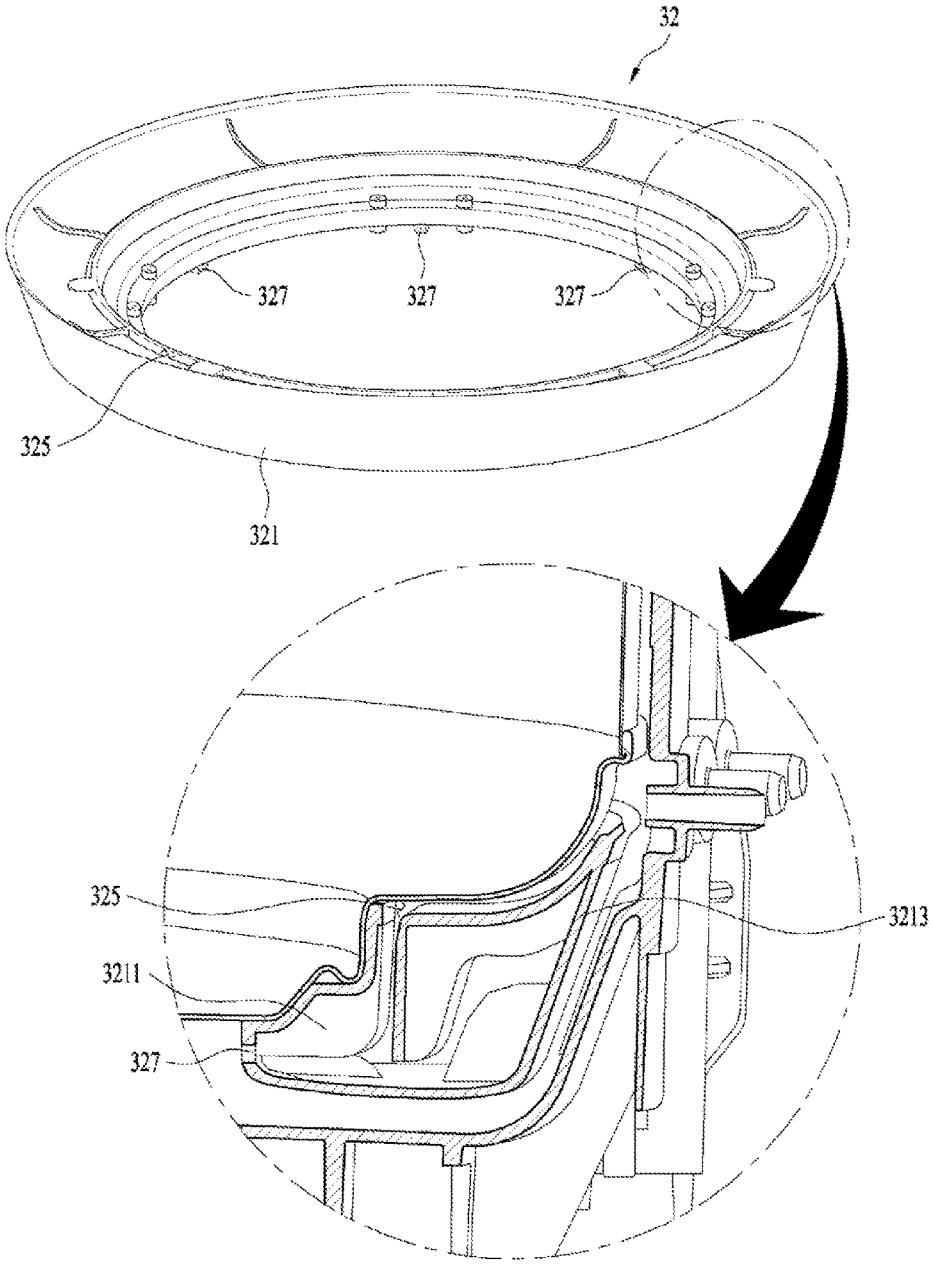


FIG. 5

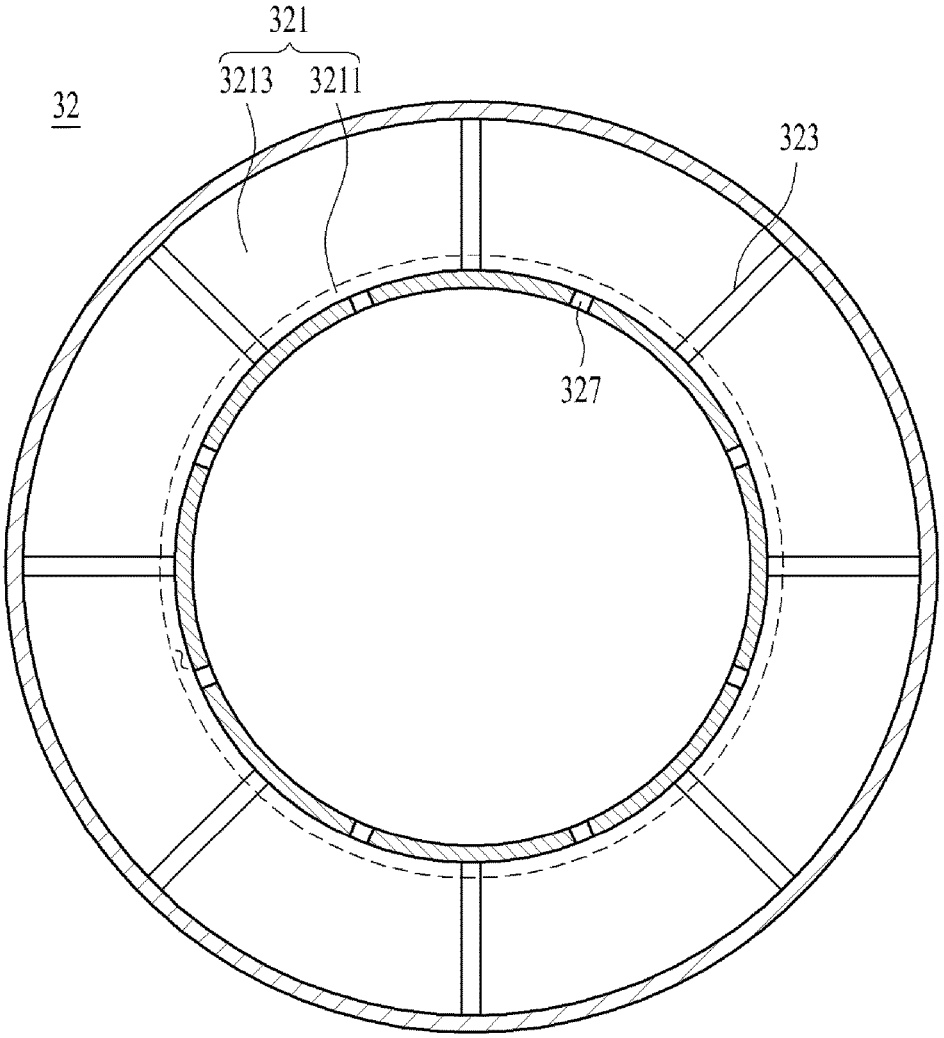


FIG. 6

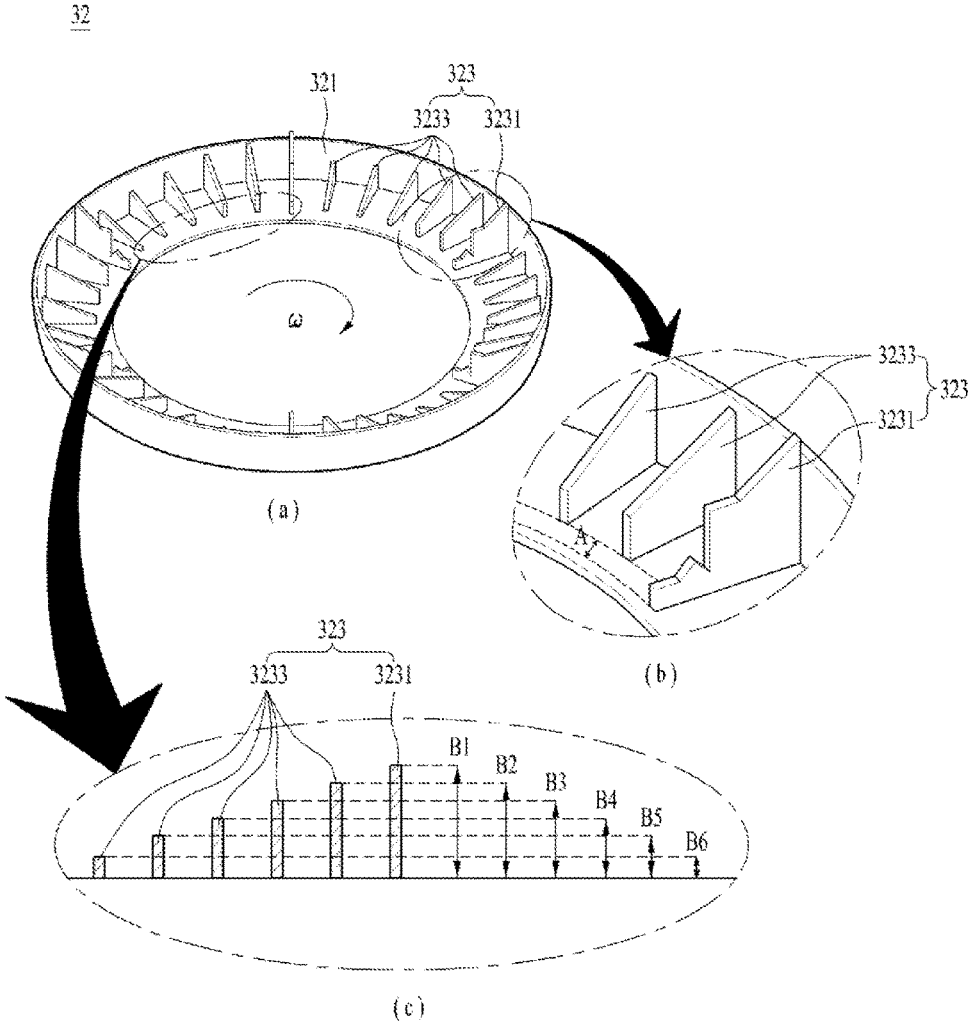
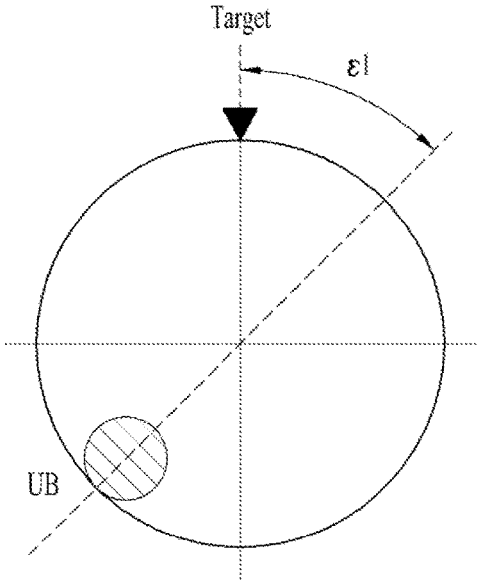
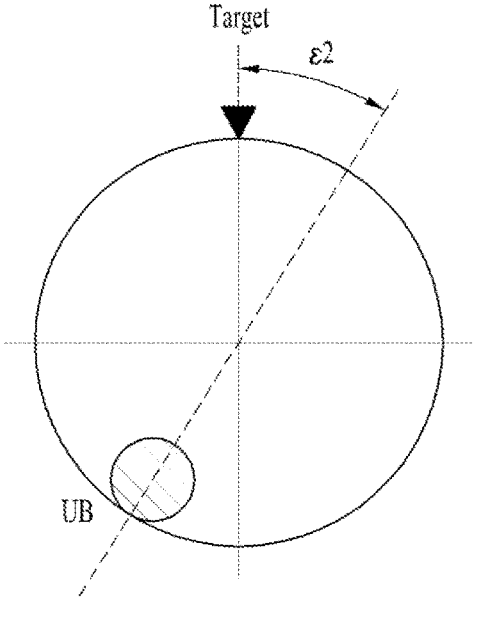

32
321
323
3233
3231
ω
(a)
3233
323
3231
A1
(b)
323
3233
3231
B1
B2
B3
B4
B5
B6
(c)

FIG. 7




(a)



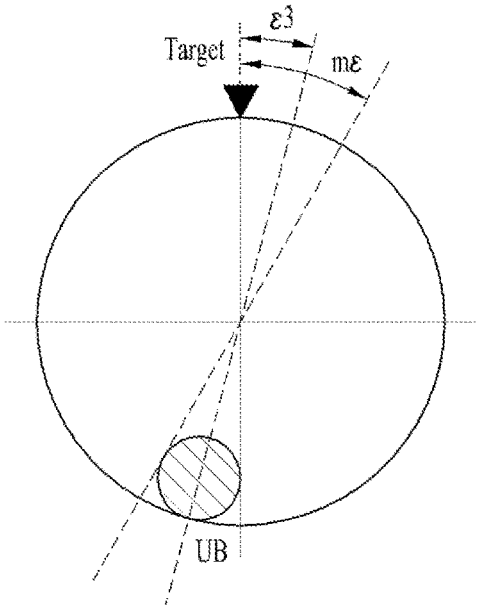



FIG. 8

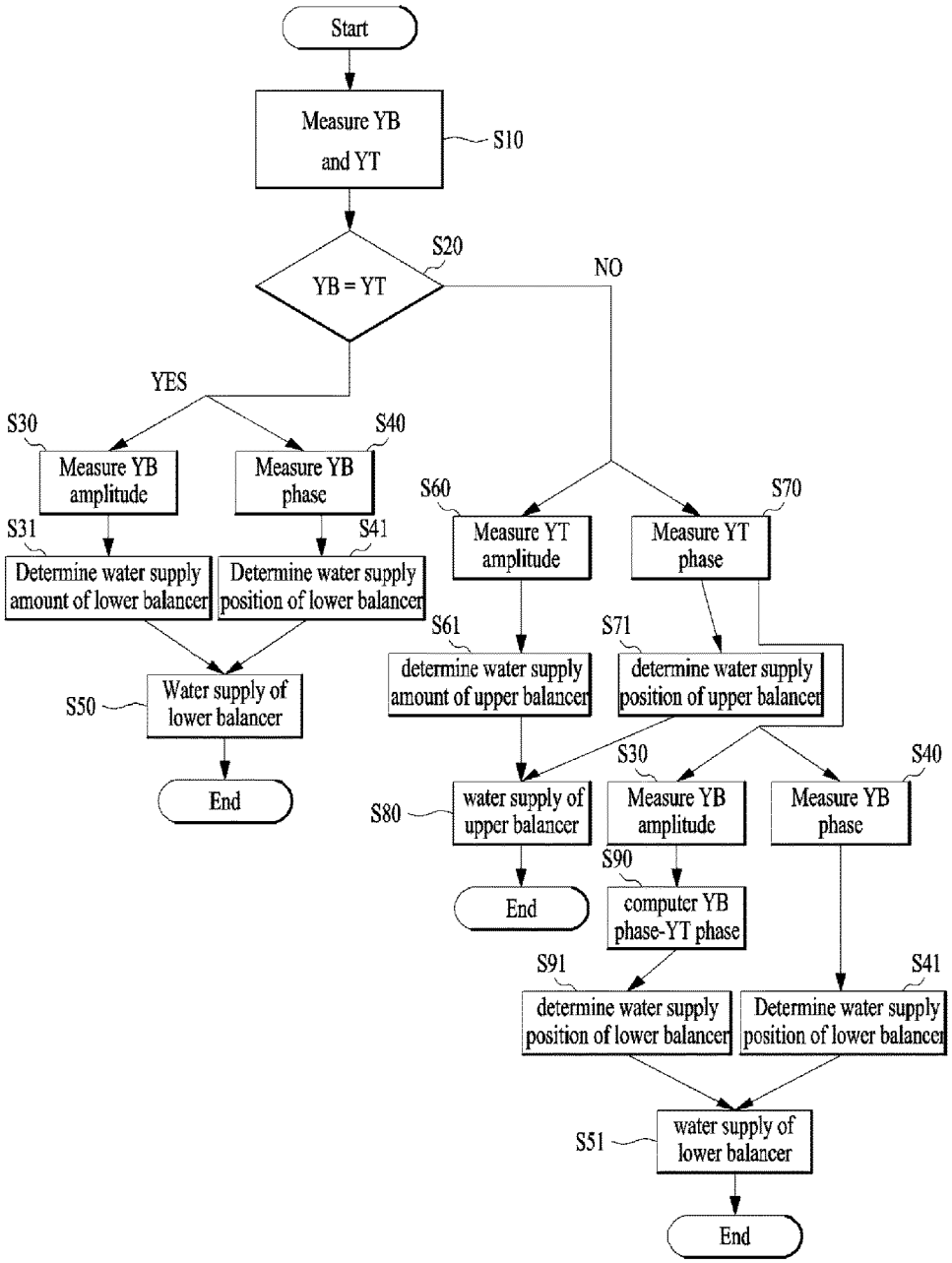

Start
Measure YB and YT
S10
YB = YT
S20
NO
YES
S30
Measure YB amplitude
S40
Measure YB phase
S31
Determine water supply amount of lower balancer
S41
Determine water supply position of lower balancer
S50
Water supply of lower balancer
End
S60
Measure YT amplitude
S70
Measure YT phase
S61
determine water supply amount of upper balancer
S71
determine water supply position of upper balancer
S80
water supply of upper balancer
End
S30
Measure YB amplitude
S40
Measure YB phase
S90
computer YB phase-YT phase
S91
determine water supply position of lower balancer
S41
Determine water supply position of lower balancer
S51
water supply of lower balancer
End

FIG. 9

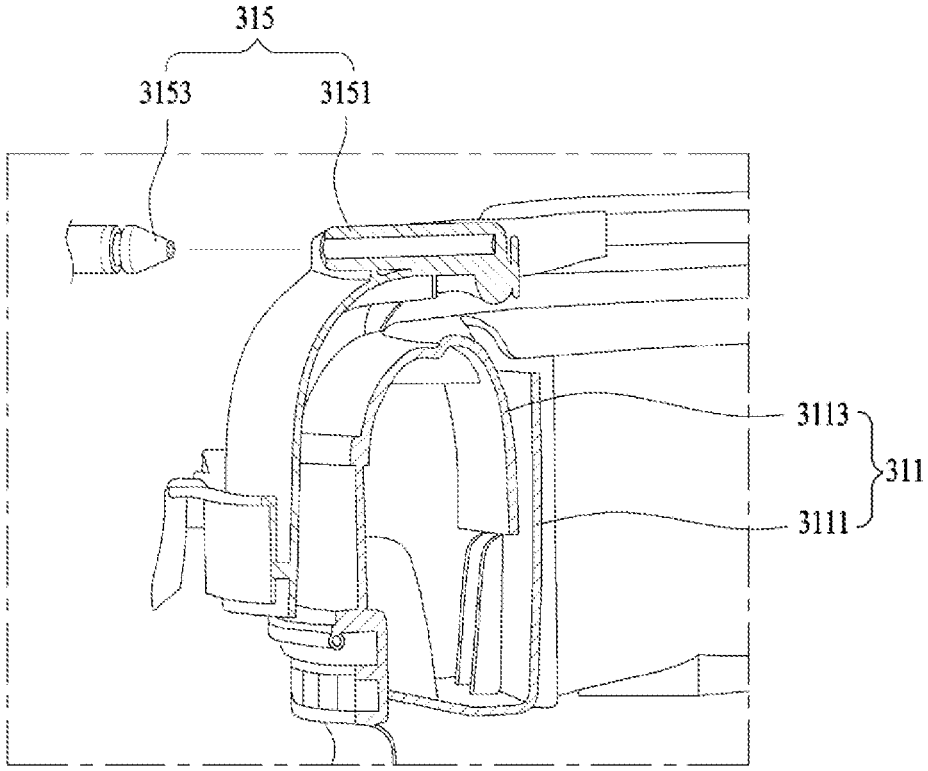
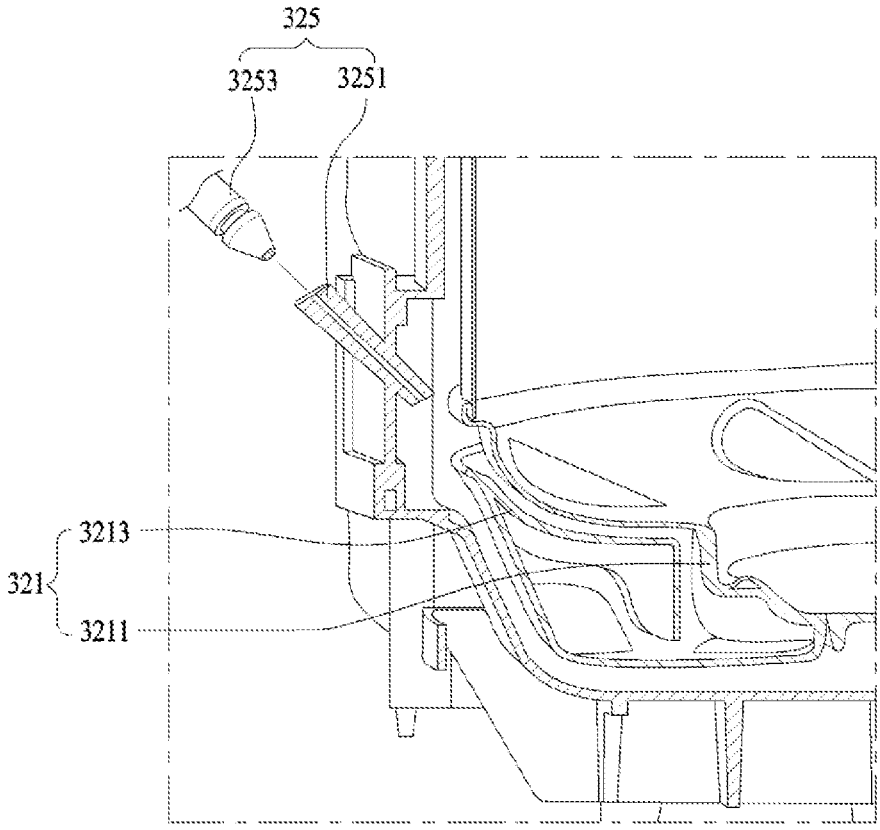


FIG. 10



# CLOTHES TREATING APPARATUS

## TECHNICAL FIELD

**[0001]** The present invention relates to a laundry treating apparatus and a method of controlling the same.

## BACKGROUND ART

**[0002]** A conventional laundry treating apparatus includes a cabinet forming an external appearance, a tub provided inside the cabinet, a drum rotatably provided inside the tub to wash laundry, and a motor of which rotary shaft is fixed to the drum by passing through the tub to rotate the drum.

**[0003]** The drum may be rotated without maintaining dynamic equilibrium depending on a position of laundry stored therein.

**[0004]** Dynamic equilibrium means 'the state that a centrifugal force or a moment made by the centrifugal force is 0 with respect to a rotary shaft when a rotor is rotated'. In case of a rigid body, if mass distribution of the rigid body is uniformly maintained around the rotary shaft, dynamic equilibrium is maintained.

**[0005]** Therefore, dynamic equilibrium in the laundry treating apparatus may be understood that mass distribution of laundry is within an allowable range around the rotary shaft of the drum when the drum is rotated in a state that laundry is stored in the drum (the case that the drum is rotated while being vibrated within the allowable range).

**[0006]** In contrast, the state that dynamic equilibrium has been broken (i.e., unbalance) in the laundry treating apparatus means that mass distribution is not maintained uniformly around the rotary shaft of the drum when the drum is rotated. This unbalance is generated when laundry is not distributed uniformly inside the drum.

**[0007]** If the drum of the unbalance state is rotated, the drum is vibrated, and the vibration of the drum is delivered to the tub or the cabinet, whereby noise may be caused.

**[0008]** The conventional laundry treating apparatus includes balancing units to solve unbalance of the drum. The balancing units provided in the conventional laundry treating apparatus are ball balancers or fluid balancers having a ball or a fluid received in a housing fixed to the drum.

**[0009]** The ball balancer or the fluid balancer included in the conventional laundry treating apparatus functions to control unbalance by moving the ball or the fluid to an opposite side of a direction where laundry causing unbalance is located when a rotation track of the drum wobbles by means of the laundry causing unbalance.

**[0010]** However, the aforementioned unbalance control is useful for a steady state that vibration of the drum is within a certain range, whereas a problem occurs in that the unbalance control is not effective at a transient vibration state of the drum. Also, the conventional balancing unit has a structure that it is difficult to immediately solve unbalance (actively solve unbalance) when unbalance is generated.

## DISCLOSURE

### Technical Problem

**[0011]** An object of the present invention is to provide a laundry treating apparatus that may solve unbalance by supplying water to balancers while a drum is being rotated without stopping its rotation in an unbalance state that laundry is not distributed uniformly.

**[0012]** Another object of the present invention is to provide a laundry treating apparatus that includes a structure for discharging water supplied to balancers of a drum after solving unbalance.

**[0013]** Still another object of the present invention is to provide a laundry treating apparatus that includes balancers for actively solving unbalance by supplying water thereto at upper and lower portions of a drum while the drum is being rotated.

**[0014]** Further still another object of the present invention is to provide a laundry treating apparatus that includes at least one balancer provided at an upper portion or a lower portion of a drum to actively solve unbalance by supplying water thereto while the drum is being rotated.

### Technical Solution

**[0015]** To achieve these objects and other advantages and in accordance with the purpose of the invention, the present invention provides a laundry treating apparatus comprising a cabinet forming an external appearance and including a door provided on a top surface to take or put laundry out of or into the top surface; a tub provided inside the cabinet to store washing water therein; a drum rotatably provided inside the tub to receive the laundry therein; a balancer provided in a single body to be rotated together with the drum and provided to maintain dynamic equilibrium of the drum by supplying water thereinto; and a water supply unit supplying water to the balancer, wherein the balancer includes a drainage unit provided to drain the water received in the balancer when a rotating speed of the drum reaches a predetermined speed or less.

**[0016]** Also, the balancer is provided on at least one of an upper portion and a lower portion of the drum.

**[0017]** Also, the balancer includes a housing in which water is stored, at least one or more barriers partitioning the inside of the housing, and an inlet provided in the housing to allow the water to enter the inside of the housing.

**[0018]** Also, the drainage unit is provided at a circumferential inner side of the housing to drain the water inside the housing when the rotating speed of the drum reaches a predetermined speed or less.

**[0019]** Also, the barriers include a main barrier provided to partition the inside of the housing, and at least one or more sub barriers provided in a space partitioned by the main barrier to prevent the water received in the housing from being concentrated on one side.

**[0020]** Also, the sub barriers are provided to have their respective heights which gradually become higher along a rotating direction of the drum.

**[0021]** Also, the water supply unit includes a water supply nozzle provided to spray water to a desired position in a state that the balancer is rotated, and a water supply guider guiding the water sprayed by the water supply nozzle to enter the inside of the balancer.

**[0022]** Also, the water supply nozzle is provided to be communicated with a washing water supply unit for supplying washing water to the tub.

**[0023]** Also, the laundry treating apparatus further comprises a fluid balancer or a ball balancer provided at an upper portion or lower portion of the drum, having a fluid or a ball therein to maintain dynamic equilibrium of the drum.

**[0024]** Also, the drum is provided such that its rotary shaft is vertical to a lower surface of the cabinet.

**[0025]** Also, each of the drum and the tub includes an opening on an upper surface to put or take laundry into or out of the upper surface.

**[0026]** Also, the drainage unit is provided to drain the water received in the balancer in a direction vertical to a gravity direction.

**[0027]** Also, the barrier is extended in a direction vertical to a gravity direction to partition the inside of the housing.

**[0028]** Also, the laundry treating apparatus may further comprise a driving unit for rotating the drum. The driving unit includes a motor providing a rotating force, a shaft having one end communicated with the motor and the other end communicated with the drum, wherein the shaft is provided in parallel with a gravity direction.

## Advantageous Effects

**[0029]** According to the present invention, it is possible to solve unbalance by supplying water to balancers while a drum is being rotated without stopping its rotation in an unbalance state that laundry is not distributed uniformly.

**[0030]** Also, according to the present invention, since a laundry treating apparatus includes a structure for discharging water supplied to balancers of a drum after solving unbalance, the water supplied to the balancers may be discharged efficiently.

**[0031]** Also, according to the present invention, it is possible to actively solve unbalance by supplying water balancers at upper and lower portions of a drum while the drum is being rotated.

**[0032]** Also, according to the present invention, since a laundry treating apparatus includes at least one balancer provided at an upper portion or a lower portion of a drum to supply water thereto while the drum is being rotated, unbalance may be solved more efficiently.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0033]** FIG. **1** illustrates an example of a laundry treating apparatus according to the present invention.

**[0034]** FIG. **2** illustrates an example of a sensor unit provided in the present invention.

**[0035]** FIG. **3** illustrates an example of an upper balancer provided in the present invention.

**[0036]** FIGS. **4**, **5** and **6** illustrate an example of a lower balancer provided in the present invention.

**[0037]** FIG. **7** illustrates an example of a method for controlling unbalance generated in a laundry treating apparatus of the present invention.

**[0038]** FIG. **8** is a flow chart illustrating an example of a control method for determining a water supply amount and a water supply position of water supplied to an upper balancer and a lower balancer provided in a laundry treating apparatus of the present invention.

**[0039]** FIGS. **9** and **10** illustrate an example of water supply units provided in an upper balancer and a lower balancer to supply water.

## BEST MODE FOR CARRYING OUT THE INVENTION

**[0040]** Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Meanwhile, elements or control method of apparatuses which will be described below are only intended to describe the embodiments of the present invention and are not intended to restrict the scope of the present invention. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

**[0041]** FIG. **1** illustrates an example of a laundry treating apparatus according to the present invention.

**[0042]** Referring to FIG. **1**, the laundry treating apparatus according to the present invention includes a cabinet **10** for forming an external appearance, a tub **20** provided inside the cabinet **10**, storing washing water therein, and a drum **30** rotatably provided inside the tub **20**, for receiving laundry therein.

**[0043]** Since the laundry treating apparatus of the present invention is a top loading type for putting or taking laundry into or out of a top surface, a rotary shaft of the drum **30** may be provided to be vertical to a lower surface of the cabinet **10**.

**[0044]** The cabinet **10** may include a cabinet opening **12** and a door **111** on the top surface of the cabinet **10**, wherein the cabinet opening **12** is provided to put or take laundry into or out of the top surface of the cabinet, and the door **11** is rotatably provided to open or close the cabinet opening **12**.

**[0045]** The tub **20** may include a tub opening **11** on a top surface thereof to put or take laundry into or out of the top surface.

**[0046]** Although not shown, the drum **30** may include a drum opening (not shown) for allowing laundry to be put into or taken out of the cabinet opening **12** and the tub opening **21**.

**[0047]** That is, a user may put laundry into the drum **30** sequentially through the cabinet opening **12**, the tub opening **21** and the drum opening (not shown) by opening the door **11** rotatably provided on the top surface of the cabinet **10**.

**[0048]** Also, the laundry treating apparatus of the present invention may include a water supply unit **70** for supplying water to the tub **20** and a drainage unit **60** for draining washing water from the tub **20**.

**[0049]** The water supply unit **70** may include a water supply hose **71** and a water supply valve **73**. One end of the water supply hose **71** may be protruded toward the outside of the cabinet **10** such that water may externally be supplied thereto, and the other end of the water supply hose **71** may be communicated with one side of the tub **20** such that the externally supplied water may be supplied to the tub **20**. The water supply valve **73** may be provided in the water supply hose **71** to control the amount of water supplied to the tub **20** through the water supply hose **71**.

**[0050]** The drainage unit **60** may include a drainage hose **61** and a drainage valve **63**. The drainage hose **61** has one end communicated with the tub **20** and the other end protruded to the outside of the cabinet **10**, whereby the washing water drained from the tub **20** may be discharged to the outside of the laundry treating apparatus. The drainage valve **63** may be provided in the drainage hose **61** to control the amount of the washing water discharged to the outside of the laundry treating apparatus through the drainage hose **61**.

**[0051]** The drum **30** is rotatably provided, and the laundry treating apparatus of the present invention may include a power unit **40** for rotating the drum **30**.

**[0052]** The power unit **40** may include a shaft **41** provided to be communicated with the drum **30** to deliver a rotational force generated in the power unit **40** to the drum **30**, a stator **45** for generating a rotating magnetic force for rotating the

shaft **41**, a rotor **47** rotatably provided inside the stator **45** in a single body with the shaft **41**, and a bearing housing **43** provided to support gravity of the shaft **41** which is rotated.

**[0053]** The shaft **41** may be provided to be vertical to a lower surface of the cabinet **10**.

**[0054]** In other words, the shaft **41** may be provided in parallel with a gravity direction.

**[0055]** A BLDC motor typically used in the related art of the laundry treating apparatus may be used as the power unit **40** used in the laundry treating apparatus of the present invention. Since the BLDC motor is already known, its detailed description will be omitted.

**[0056]** Since the drum **30** is rotatably provided, vibration generated in the drum **30** may be delivered to the tub **20**, and the vibration delivered to the tub **20** may again delivered to the cabinet **10**.

**[0057]** If the tub **20** is vibrated, horizontal displacement or vertical displacement is generated. For this reason, interference between the tub **20** and the cabinet **10** is generated, whereby noise or damage may occur.

**[0058]** To avoid noise or damage, the laundry treating apparatus of the present invention may include a vibration unit for preventing vibration of the tub **20** from being delivered to the cabinet **10**.

**[0059]** The vibration unit may include a first holder **51** provided on one surface of the cabinet **10**, a second holder **53** provided on one surface of the tub **20**, a connector **55** connecting the first holder **51** with the second holder **53**, and an elastic member **57** provided at one end of the connector **55**, providing an elastic force to the second holder **53** and the connector **55**.

**[0060]** Also, the connector **55** may include a first clamp portion **551** provided at one end to prevent the connector **55** from being detached from the first holder **51**, and a second clamp portion **553** provided at the other end to prevent the connector **55** from being detached from the second holder **53**.

**[0061]** The drum **30** of the laundry treating apparatus according to the present invention may include balancers **31** and **32** on at least one of an upper portion or a lower portion of the drum **30** to prevent unbalance from being generated in the laundry stored in the drum **30** while the drum **30** is being rotated as described above.

**[0062]** As shown in FIG. **1**, the upper balancer **31** may be provided on the upper portion of the drum **30**, and the lower balancer **32** may be provided on the lower portion of the drum **30**.

**[0063]** As described above, the conventional ball balancer or fluid balancer is provided to solve unbalance in such a manner that a ball or fluid moves passively in an opposite direction of a wobble direction of laundry stored in the drum **30** when the laundry wobbles.

**[0064]** However, the balancers **31** and **32** of the laundry treating apparatus according to the present invention may effectively solve unbalance even in a transient state as well as a steady state.

**[0065]** In more detail, the balancers **31** and **32** may be active balancers that identify a position where unbalance is generated by sensing a vibration state of the drum **30** or the tub **20** and then actively solve unbalance by supplying water in an opposite direction of the position where unbalance is generated.

**[0066]** However, if the active balancers **31** and **32** are provided on the upper and lower portions of the drum **30**, it may act as load in view of the material cost and efficiency of production. Therefore, the active balancer **31** or **32** may be provided on at least one of the upper and lower portions of the drum **30**, and the conventional ball balancer or fluid balancer may be provided on the other portion.

**[0067]** Preferably, since it is more effective to solve unbalance that the aforementioned active balancers **31** and **32** are provided on the upper and lower portions of the drum **30**, the laundry treating apparatus of the present invention will be described on the assumption that the active balancers **31** and **32** are provided on the upper and lower portions of the drum **30**.

**[0068]** To solve unbalance in the laundry treating apparatus of the present invention, the vibration state of the tub **20** or the drum **30** should be sensed. To this end, the laundry treating apparatus may further include a sensor unit.

**[0069]** The sensor unit may include a top sensor **81** provided on the upper surface of the tub **20** to sense vertical vibration on the upper surface of the tub **20**, an upper sensor **83** provided on an upper portion of a side of the tub **20** to sense horizontal vibration at the upper portion of the side of the tub **20**, and a lower sensor **85** provided on a lower portion of the side of the tub **20** to sense horizontal vibration at the lower portion of the side of the tub **20**.

**[0070]** In more detail, the sensors used in the sensor unit may be provided as optical sensors. The top sensor **81**, the upper sensor **83** and the lower sensor **85** may respectively derive sinusoidal shaped profiles by sensing a vertical distance between the upper surface of the tub **20** and the upper surface of the cabinet **10**, a horizontal distance between the upper portion of the side of the tub **20** and the upper portion of the side of the cabinet **10**, and a horizontal distance between the lower portion of the side of the tub **20** and the lower portion of the side of the cabinet **10** in real time.

**[0071]** The controller (not shown) determines a portion of the drum **30** where laundry causing unbalance is concentrated on by modeling the profiles sensed by the respective sensors of the sensor unit, and sprays water to the positions of the upper balancer **31** and the lower balancer **32** to solve unbalance.

**[0072]** FIG. **2** illustrates an example of a sensor unit **80** provided in the present invention.

**[0073]** Referring to FIG. **2**(*a*), the laundry treating apparatus of the present invention may include a top sensor **81** provided on the upper surface of the tub **20** to measure a distance YC from the upper surface of the tub **20** to the upper surface of the cabinet **10**.

**[0074]** Referring to FIG. **2**(*b*), the laundry treating apparatus of the present invention may include an upper sensor **83** provided on the upper portion of the side of the tub **20** to measure a distance YT from the upper portion of the side of the tub **20** to the upper portion of the side of the cabinet **10**.

**[0075]** Referring to FIG. **2**(*c*), the laundry treating apparatus of the present invention may include a lower sensor **85** provided on the lower portion of the side of the tub **20** to measure a distance YB from the lower portion of the side of the tub **20** to the lower portion of the side of the cabinet **10**.

**[0076]** More preferably, the top sensor **81**, the upper sensor **83** and the lower sensor **85** are provided as optical sensors.

**[0077]** The top sensor **81** serves to sense vertical vibration of the tub **20**, and the upper sensor **83** and the lower sensor **85** serve to sense horizontal vibration of the tub **20**.

**[0078]** Basically, since the upper sensor **83** and the lower sensor **85** serve to sense horizontal vibration, there is no big problem in sensing the position of the laundry causing unbalance even though one of the two sensors is only provided.

**[0079]** However, if the laundry is located in the drum **30** in a diagonal direction to cause unbalance, for example, if the laundry is located at the upper portion of the right side of the drum **30** and at the same time is located at the lower portion of the left side of the drum **30**, unbalance is generated, whereby noise of the laundry treating apparatus may be generated.

**[0080]** Therefore, to solve unbalance through more precise control, it is preferable that the upper sensor **83** and the lower sensor **85** are respectively provided at the upper portion of the side of the tub **20** and the lower portion of the side of the tub **20**.

**[0081]** FIG. **3** illustrates an example of an upper balancer provided in the present invention.

**[0082]** Referring to FIG. **3**(*a*), the laundry treating apparatus of the present invention may include an upper balancer **31** provided in a hollow shape to solve unbalance at the upper portion of the drum **30**.

**[0083]** Since the upper balancer **31** is provided to surround the drum **30** and the laundry should be put into or taken out of the drum **30**, it is preferable that the upper balancer **31** is provided in a hollow shape provided with an opening at the center.

**[0084]** The upper balancer **31** may include an upper housing **311** providing a space for receiving water for solving unbalance, a first barrier portion **313** provided inside the upper housing **311**, a first water supply unit **315** provided to solve unbalance by supplying water to the inside of the upper housing **311**, and a first drainage unit **317** for discharging the water received in the upper housing **311** after solving unbalance.

**[0085]** The upper housing **311** may include a first upper housing **3111** forming an inner circumference surface of the upper balancer **31**, and a second upper housing **3113** for forming an outer circumference surface of the upper balancer **31**.

**[0086]** In more detail, a section of the first upper housing **3111** may be provided in a vertical direction to form the inner circumference surface of the upper balancer **31**, and a section of the second upper housing **3113** may be provided to form the lower surface, the outer circumference surface and the upper surface of the upper balancer **31**.

**[0087]** An upper surface of the second upper housing **3113** may be provided to be spaced apart from the first upper housing **3111** at a predetermined interval.

**[0088]** This is to provide a path for supplying water to the upper balancer **31** to solve unbalance. In other words, the upper surface of the first upper housing **3111** and the upper surface of the second upper housing **3113** may be formed to be spaced apart from each other to form the path that can supply water.

**[0089]** That is, the shapes of the first upper housing **3111** and the second upper housing **3113** have only to be provided to form the path for supplying water to the upper balancer **31** as described above without limitation to the shapes shown in FIG. **3**.

**[0090]** The shape of the first water supply unit **315** is not limited to the shape shown in FIG. **3**. That is, the shape of the first water supply unit **315** has only to be provided to supply water to the upper housing **311** without stopping rotation of the drum **30** in a state that the drum **30** is rotated.

**[0091]** The first drainage unit **317** may be provided at the lower end of the first upper housing **3111**.

**[0092]** The laundry treating apparatus of the present invention may solve unbalance generated in the drum **30** by supplying water in an opposite direction of the laundry in a state that the drum **30** is rotated.

**[0093]** After unbalance is solved, if the water supplied into the upper housing **311** is not drained, another unbalance may be generated.

**[0094]** Therefore, after unbalance is solved in a state that the drum **30** is rotated, rotation of the drum **30** should be stopped, and the water received in the upper housing **311** should be drained in a state that rotation of the drum **30** is stopped. Therefore, it is preferable that the first drainage unit **317** is provided at the lower portion of the inner side of the upper housing **311**, that is, the lower portion of the first upper housing **3111**.

**[0095]** That is, the first drainage unit **317** may be provided to drain the water received in the upper housing **311** in a direction vertical to a gravity direction.

**[0096]** While the drum **30** is being rotated, the upper balancer **31**, the upper housing **311** and the water supplied into the upper housing **311** perform circular motion, whereby a centrifugal force acts on an outer direction of a radius direction based on the rotation center of the drum **30**.

**[0097]** Therefore, the water supplied into the upper housing **311** is not drained due to the centrifugal force while the drum **30** is being rotated, whereby unbalance may be solved. After unbalance is solved, rotation of the drum **30** is stopped, whereby the water received in the upper housing **311** may be drained into the drum through the first drainage unit **317**.

**[0098]** The first barrier portion **313** may include a plurality of first barriers provided inside the upper housing **311** to partition the inside of the upper housing **311**.

**[0099]** Although the first barrier portion **313** is provided to partition the inside of the upper housing **311** into 8 spaces in FIG. **3**(*b*), the number of the inner spaces of the upper housing **311**, which are partitioned by the first barrier portion **313**, is not limited to the example of FIG. **3**(*b*). That is, the number of the first barriers **313** has only to be provided to solve unbalance, and may be provided differently if necessary.

**[0100]** FIGS. **4**, **5** and **6** illustrate an example of a lower balancer provided in the present invention.

**[0101]** Referring to FIG. **4**, the laundry treating apparatus of the present invention may include a lower balancer **32** provided in a hollow shape to solve balance at the lower portion of the drum **30**.

**[0102]** The laundry treating apparatus of the present invention may further include a power unit **40** for rotating the drum **30**. The power unit **40** may be provided on the lower surface of the drum **30**. Therefore, it is preferable that the lower balancer **32** is provided in a hollow shape to prevent interference with the power unit **40** from occurring.

**[0103]** The lower balancer **32** may include a lower housing **321** providing a space for receiving water for solving unbalance, a second barrier portion **323** provided inside the lower housing **321**, a second water supply unit **325** provided to solve unbalance by supplying water to the inside of the lower housing **321**, and a second drainage unit **327** for discharging the water received in the lower housing **321** after solving unbalance.

**[0104]** The lower housing **321** may include a first lower housing **3211** forming an inner circumference surface of the lower balancer **32**, and a second lower housing **3213** for forming an outer circumference surface of the lower balancer **32**.

**[0105]** In more detail, a section of the first lower housing **3211** may be provided in a vertical direction to form the inner circumference surface of the lower balancer **32**, and a section of the second lower housing **3213** may be provided to form the lower surface, the outer circumference surface and the upper surface of the lower balancer **32**.

**[0106]** An upper surface of the second lower housing **3213** may be provided to be spaced apart from the first lower housing **3211** at a predetermined interval.

**[0107]** This is to provide a path for supplying water to the lower balancer **32** to solve unbalance. In other words, the upper surface of the first lower housing **3211** and the upper surface of the second lower housing **3213** may be formed to be spaced apart from each other to form the path that can supply water.

**[0108]** That is, the shapes of the first lower housing **3211** and the second lower housing **3213** have only to be provided to form the path for supplying water to the lower balancer **32** as described above without limitation to the shapes shown in FIG. **4**.

**[0109]** The shape of the second water supply unit **325** is not limited to the shape shown in FIG. **4**. That is, the shape of the second water supply unit **325** has only to be provided to supply water to the lower housing **321** without stopping rotation of the drum **30** in a state that the drum **30** is rotated.

**[0110]** The second drainage unit **327** may be provided at the lower end of the first lower housing **3211**.

**[0111]** The laundry treating apparatus of the present invention may solve unbalance generated in the drum **30** by supplying water in an opposite direction of the laundry in a state that the drum **30** is rotated.

**[0112]** After unbalance is solved, if the water supplied into the lower housing **321** is not drained, another unbalance may be generated.

**[0113]** Therefore, after unbalance is solved in a state that the drum **30** is rotated, rotation of the drum **30** should be stopped, and the water received in the lower housing **321** should be drained in a state that rotation of the drum **30** is stopped. Therefore, it is preferable that the second drainage unit **327** is provided at the lower portion of the inner side of the lower housing **321**, that is, the lower portion of the first lower housing **3211**.

**[0114]** While the drum **30** is being rotated, the lower balancer **32**, the lower housing **321** and the water supplied into the lower housing **321** perform circular motion, whereby a centrifugal force acts on an outer direction of a radius direction based on the rotation center of the drum **30**.

**[0115]** Therefore, the water supplied into the lower housing **321** is not drained due to the centrifugal force while the drum **30** is being rotated, whereby unbalance may be solved. After unbalance is solved, rotation of the drum **30** is stopped, whereby the water received in the lower housing **321** may be drained into the drum through the second drainage unit **327**.

**[0116]** The second barrier portion **323** may include a plurality of second barriers provided inside the lower housing **321** to partition the inside of the lower housing **321**.

**[0117]** Although the second barrier portion **323** is provided to partition the inside of the lower housing **321** into 8 spaces in FIG. **5**, the number of the inner spaces of the lower housing **321**, which are partitioned by the second barrier portion **323**, is not limited to the example of FIG. **5**. That is, the number of the second barriers **323** has only to be provided to solve unbalance, and may be provided differently if necessary.

**[0118]** The second barrier portion **323** provided in the lower balancer **32** will be described with reference to FIG. **6**. Although the structure of the second barrier portion **323** of the lower balancer **32** is only shown in FIG. **6**, this structure may equally be applied to the upper balancer **31**.

**[0119]** The second barrier portion **323** may be provided to be extended in a direction vertical to a gravity direction so as to partition the inside of the lower housing **321**.

**[0120]** The second barrier portion **323** may include second main barriers **3231** partitioning the inside of the lower housing **321** into a plurality of spaces, and at least one or more second sub barriers **3233** provided in the partitioned spaces.

**[0121]** Unbalance generated in the laundry treating apparatus of the present invention may be solved even in the case that the second barrier portion **323** includes the second main barriers **3231** only.

**[0122]** However, since the drum **30** is rotated, the water received in the lower housing **321** is concentrated on an opposite direction of a rotational direction by its inertia, whereby unbalance cannot be solved efficiently.

**[0123]** To solve this, the upper balancer **31** and the lower balancer **32** of the laundry treating apparatus according to the present invention may include at least one or more second sub barriers **3233** provided between the main barriers **3231** to have their respective heights different from each other.

**[0124]** In more detail, the second sub barriers **3233** may be provided to have their heights which become gradually higher along the rotational direction of the drum **30**.

**[0125]** In this case, concentration of the water received in the upper housing **311** or the lower housing **321** due to inertia may be prevented from occurring, whereby unbalance may be solved more efficiently.

**[0126]** For example, in FIG. **6**, one second main barrier **3231** is provided and five second sub barriers **3233** are provided.

**[0127]** The five second sub barriers **3233** may be provided as B6, B5, B4, B3 and B2 of which heights become higher in due order, and the second main barrier **3231** may be provided as the highest B1.

**[0128]** However, the number of second sub barriers **3233** is not limited to this embodiment, and may be provided differently depending on the need of a user.

**[0129]** The second main barrier **3231** should be provided to partition the lower housing **321**. However, since the second sub barriers **3233** are intended to prevent concentration of the water received in the lower housing **321** from occurring as described above, the second sub barriers **3233** should be provided so as not to partition the lower housing **321**.

**[0130]** That is, the water received in the lower housing **321** should be provided to freely move among the plurality of second sub barriers **3233**.

**[0131]** Therefore, as shown in FIG. **6**, it is preferable that a length of the lower surface of the second sub barriers **3233** is shorter than a length of the lower surface of the second main barrier **3231** as much as A in a diameter direction.

**[0132]** However, the length difference between the lower surface of the second main barrier **3231** and the lower surface of the second sub barrier **3233** may be provided differently if necessary, and is not limited to the ratio shown in FIG. **6**.

**[0133]** FIG. **7** illustrates an example of a method for controlling unbalance generated in a laundry treating apparatus of the present invention.

**[0134]** In more detail, the method of FIG. **7** relates to a control method for determining a position of water supplied to the upper balancer **31** or the lower balancer **32** to solve unbalance generated in the laundry treating apparatus of the present invention more efficiently.

**[0135]** As described above, unbalance means that mass distribution is not maintained uniformly around the rotary shaft of the drum **30** when the drum **30** is rotated. This may mean that the drum **30** is rotated in a state that the laundry in the drum **30** is concentrated on one side.

**[0136]** The laundry treating apparatus of the present invention solves unbalance by identifying the concentrated position of the laundry and spraying water in an opposite direction of the concentrated position of the laundry based on the rotary shaft of the drum **30**. Since the laundry has its mass and rotated together with the drum **30**, in case of a primary control, an inertia error $\epsilon$**1** is generated by inertia as shown in FIG. **7**(*a*).

**[0137]** Therefore, to overcome the inertia error $\epsilon$**1** according to the primary control, a secondary control is performed considering the primary control value.

**[0138]** Meanwhile, even though the secondary control is performed considering the inertia error $\epsilon$**1** generated in the primary control as shown in FIG. **7**(*b*), a counter electromotive force error $\epsilon$**2** may be generated.

**[0139]** The counter electromotive force means an electromotive force generated in an opposite direction of an electromotive force of a power source in either an armature coil of an electric motor or a primary coil of a transformer.

**[0140]** That is, although the secondary control is performed in an opposite direction to compensate for the inertia error $\epsilon$**1**, the counter electromotive force error $\epsilon$**2** is generated by the counter electromotive force.

**[0141]** Therefore, the laundry treating apparatus of the present invention may include a third control for more precise control as shown in FIG. **7**(*c*).

**[0142]** The third control may control the balancers **31** and **32** by considering the counter electromotive force error $\epsilon$**2** generated in the secondary control.

**[0143]** A residual error $\epsilon$**3** may be generated through the aforementioned control. If this residual error $\epsilon$**3** is within a preset allowable error m$\epsilon$, it is possible to efficiently solve unbalance.

**[0144]** FIG. **8** is a flow chart illustrating an example of a control method for determining a water supply amount and a water supply position of water supplied to an upper balancer and a lower balancer provided in a laundry treating apparatus of the present invention.

**[0145]** Referring to FIG. **8**, the control method of the laundry treating apparatus according to the present invention may include a distance measuring step S**10** of measuring an upper distance YT and a lower distance YB through the upper sensor **83** and the lower sensor **85**, and a measurement comparing step S**20** of determining whether the upper distance YT and the lower distance YB measured in the distance measuring step are the same as each other.

**[0146]** If profiles of the upper distance YT and the lower distance YB are the same as each other in the measurement comparing step S**20**, the laundry in the drum **30** is concentrated on the upper portion of the drum **30** or the lower portion of the drum **30**. Since the laundry is not concentrated in a diagonal direction when viewed from a front end of the drum **30**, it is possible to solve unbalance by supplying water to only one of the upper balancer **31** and the lower balancer **32**.

**[0147]** Although the control method for supplying water to the lower balancer **32** only is shown in this embodiment, the control method is not limited to this embodiment and water may be supplied to only the upper balancer **31** if necessary.

**[0148]** Therefore, if the profiles of the upper distance YT and the lower distance YB are the same as each other in the measurement comparing step S**20**, the control method of the laundry treating apparatus according to the present invention may include a lower amplitude measuring step S**30** of measuring an amplitude of the lower distance YB from the profile of the lower distance YB, and a lower phase measuring step S**40** of measuring a phase of the lower distance YB.

**[0149]** The control method may further include a lower water supply amount determining step S**31** of determining a water supply amount of the lower balancer **32** through the amplitude of the lower distance YB measured in the lower amplitude measuring step S**30**, and a first lower water supply position determining step S**41** of determining a water supply position of the lower balancer through the phase of the lower distance YB.

**[0150]** Afterwards, the laundry treating apparatus of the present invention may solve unbalance through a first lower balancer water supply step S**50** of supplying water to the lower balancer **32** based on the water supply amount and the water supply position, which are determined by the lower water supply amount determining step S**31** and the first lower water supply position determining step S**41**.

**[0151]** If the profiles of the upper distance YT and the lower distance YB are not the same as each other in the measurement comparing step S**20**, since the laundry is concentrated in a diagonal direction when viewed from a front end of the drum **30**, water should be supplied to both the upper balancer **31** and the lower balancer **32** to solve unbalance.

**[0152]** In this case, the water should be supplied to the upper balancer **31** and the lower balancer **32** unlike the first lower balancer water supply step S**50**. Since the upper balancer **31** and the lower balancer **32** are provided on the upper and lower portions of the drum **30** in a single body with the drum **30** to be rotated together with the drum **30**, the upper balancer **31** and the lower balancer **32** are coupled to each other. Unbalance cannot be solved by simple water supply depending on the amplitude and the phase of the profiles of the upper distance YT and the lower distance YB.

**[0153]** In other words, the phase of the profile of the upper distance YT used for control of the upper balancer **31** should again be applied to the control of the lower balancer **32**.

**[0154]** Therefore, if the profiles of the upper distance YT and the lower distance YB are not the same as each other in the measurement comparing step S**20**, the control method of the laundry treating apparatus may include an upper amplitude measuring step S**60** of measuring an amplitude of the upper distance YT, an upper water supply amount determining step S**61** of determining a water supply amount of the

upper balancer **31** through the determined amplitude of the upper distance YT, an upper phase measuring step S**70** of measuring a phase of the upper distance YT, an upper water supply position determining step S**71** of determining a water supply position of the upper balancer **31** through the measured phase of the upper distance, and an upper balancer water supply step S**80** of supplying water to the upper balancer **31** based on the water supply amount and the water supply position, which are determined by the upper water supply amount determining step S**61** and the upper water supply position determining step S**71**.

**[0155]** The control method may further include a lower balancer water supply amount determining step S**31** of determining a water supply amount of the lower balancer through the lower amplitude measured in the lower amplitude measuring step of **30** of measuring the lower amplitude, a phase difference computing step S**90** of computing a phase difference between the lower phase measured in the lower phase measuring step S**40** of measuring a lower phase and the upper phase measured in the upper phase measuring step S**70** of measuring the upper phase, a second lower water supply position determining step S**91** of determining a water supply position of the lower balancer by using the phase difference between the upper phase and the lower phase, which is computed by the phase difference computing step S**90**, and a second lower balancer water supply step S**51** of supplying water to the lower balancer based on the water supply amount and the water supply position, which are determined by the lower water supply amount determining step S**31** and the second lower water supply position determining step S**91**.

**[0156]** FIGS. **9** and **10** illustrate an example of water supply units provided in an upper balancer and a lower balancer to supply water.

**[0157]** Referring to FIG. **9**, since the laundry treating apparatus of the present invention should supply water to the upper balancer **31** in a state that the drum **30** is rotated, the laundry treating apparatus may further include a first water supply unit **315**.

**[0158]** The first water supply unit **315** may include a first water supply nozzle **3153** which is a means for supplying water into the upper balancer **31** by using a predetermined pressure, and a first water supply guider **3151** provided to guide the water sprayed from the first water supply nozzle **3153** into the upper housing **311**.

**[0159]** The water supplied from the first water supply unit **315** moves into the upper housing **311**. In more detail, the water may be supplied into the upper housing **311** through a path formed by the first and second upper housings **3111** and **3113** spaced apart from each other at a predetermined distance.

**[0160]** Referring to FIG. **10**, since the laundry treating apparatus of the present invention should supply water to the lower balancer **32** in a state that the drum **30** is rotated, the laundry treating apparatus may further include a second water supply unit **325**.

**[0161]** The second water supply unit **325** may include a second water supply nozzle **3253** which is a means for supplying water into the lower balancer **32** by using a predetermined pressure, and a second water supply guider **3251** provided to guide the water sprayed from the second water supply nozzle **3253** into the lower housing **321**.

**[0162]** The water supplied from the second water supply unit **325** moves into the lower housing **321**. In more detail, the water may be supplied into the lower housing **321** through a path formed by the first and second lower housings **3211** and **3213** spaced apart from each other at a predetermined distance.

**[0163]** It will be apparent to those skilled in the art that the present invention may be embodied in other specific forms without departing from the spirit and essential characteristics of the invention. Thus, the above embodiments are to be considered in all respects as illustrative and not restrictive. The scope of the invention should be determined by reasonable interpretation of the appended claims and all change which comes within the equivalent scope of the invention are included in the scope of the invention.

**1**. A laundry treating apparatus comprising

a cabinet forming an external appearance and including a door provided on a top surface to take or put laundry out of or into the top surface;

a tub provided inside the cabinet to store washing water therein;

a drum rotatably provided inside the tub to receive the laundry therein;

a balancer provided in a single body to be rotated together with the drum and provided to maintain dynamic equilibrium of the drum by supplying water thereinto; and

a water supply unit supplying water to the balancer,

wherein the balancer includes a drainage unit provided to drain the water received in the balancer when a rotating speed of the drum reaches a predetermined speed or less.

**2**. The laundry treating apparatus according to claim **1**, wherein the balancer is provided on at least one of an upper portion and a lower portion of the drum.

**3**. The laundry treating apparatus according to claim **1**, wherein the balancer includes:

a housing in which water is stored;

at least one or more barriers partitioning the inside of the housing; and

an inlet provided in the housing to allow the water to enter the inside of the housing.

**4**. The laundry treating apparatus according to claim **3**, wherein the drainage unit is provided at a circumferential inner side of the housing to drain the water inside the housing when the rotating speed of the drum reaches a predetermined speed or less.

**5**. The laundry treating apparatus according to claim **3**, wherein the barriers include:

a main barrier provided to partition the inside of the housing; and

at least one or more sub barriers provided in a space partitioned by the main barrier to prevent the water received in the housing from being concentrated on one side.

**6**. The laundry treating apparatus according to claim **5**, wherein the sub barriers are provided to have their respective heights which gradually become higher along a rotating direction of the drum.

**7**. The laundry treating apparatus according to claim **1**, wherein the water supply unit includes:

a water supply nozzle provided to spray water to a desired position in a state that the balancer is rotated; and

a water supply guider guiding the water sprayed by the water supply nozzle to enter the inside of the balancer.

**8**. The laundry treating apparatus according to claim **7**, wherein the water supply nozzle is provided to be communicated with a washing water supply unit for supplying washing water to the tub.

**9**. The laundry treating apparatus according to claim **1**, further comprising a fluid balancer or a ball balancer provided at an upper portion or lower portion of the drum, having a fluid or a ball therein to maintain dynamic equilibrium of the drum.

**10**. The laundry treating apparatus according to claim **1**, wherein the drum is provided such that its rotary shaft is vertical to a lower surface of the cabinet.

**11**. The laundry treating apparatus according to claim **1**, wherein each of the drum and the tub includes an opening on an upper surface to put or take laundry into or out of the upper surface.

**12**. The laundry treating apparatus according to claim **1**, wherein the drainage unit is provided to drain the water received in the balancer in a direction vertical to a gravity direction.

**13**. The laundry treating apparatus according to claim **3**, wherein the barrier is extended in a direction vertical to a gravity direction to partition the inside of the housing.

**14**. The laundry treating apparatus according to claim **1**, further comprising a driving unit for rotating the drum, wherein the driving unit includes:

a motor providing a rotating force;

a shaft having one end communicated with the motor and the other end communicated with the drum, the shaft being provided in parallel with a gravity direction.

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