



US 20140109628A1

(19) **United States**(12) **Patent Application Publication**
Hwang(10) **Pub. No.: US 2014/0109628 A1**(43) **Pub. Date: Apr. 24, 2014**(54) **DRUM WASHING MACHINE****Publication Classification**(75) Inventor: **Ui Kun Hwang**, Bucheon-si (KR)(51) **Int. Cl.**
D06F 37/22 (2006.01)(73) Assignee: **Dongbu Daewoo Electronics Corporation**, Seoul (KR)(52) **U.S. Cl.**
CPC **D06F 37/22** (2013.01)
USPC **68/140**(21) Appl. No.: **14/008,440**(22) PCT Filed: **Mar. 27, 2012**(86) PCT No.: **PCT/KR12/02214**

§ 371 (c)(1),

(2), (4) Date: **Dec. 10, 2013**(30) **Foreign Application Priority Data**

Mar. 28, 2011 (KR) 10-2011-0027485

(57) **ABSTRACT**

Disclosed herein is a drum washing machine including: a cabinet; a tub fillable with wash water; a drum receiving laundry therein; a motor at the rear of a lower portion of the tub; a balancer coupled to a front surface of the tub; a plurality of springs having one end coupled to the cabinet and another end coupled to an upper surface of the tub to support the tub; and a plurality of dampers having one end coupled to the cabinet and another end coupled to a lower surface of the tub, wherein the springs include one spring coupled to one side of the cabinet and another spring coupled to an opposite side of the cabinet, the one spring having a spring constant different from that of the other spring.

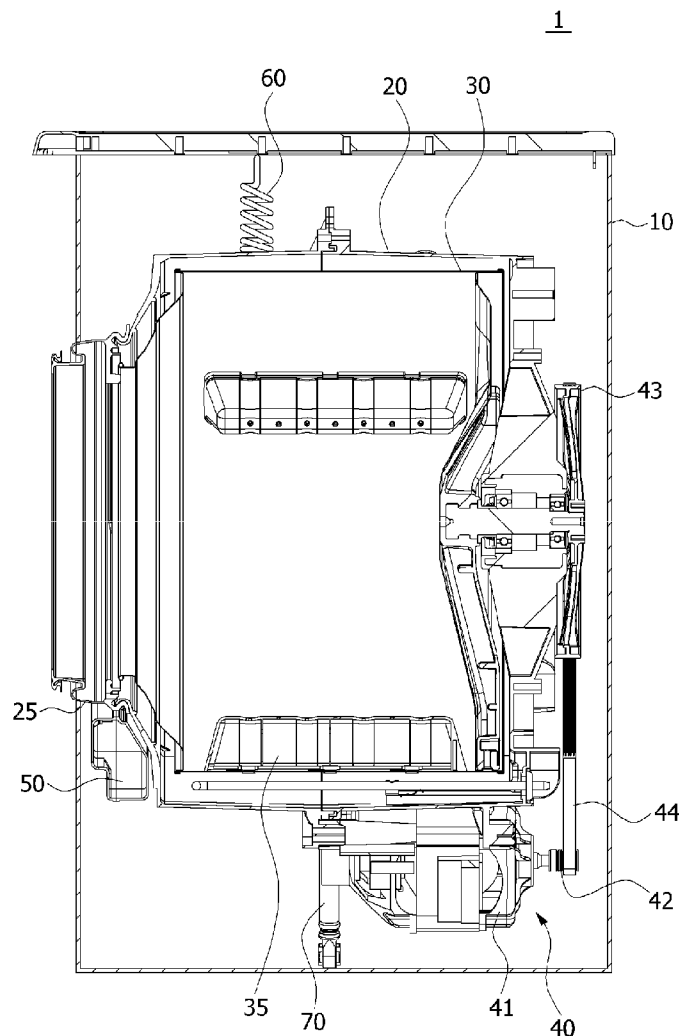


Fig. 1

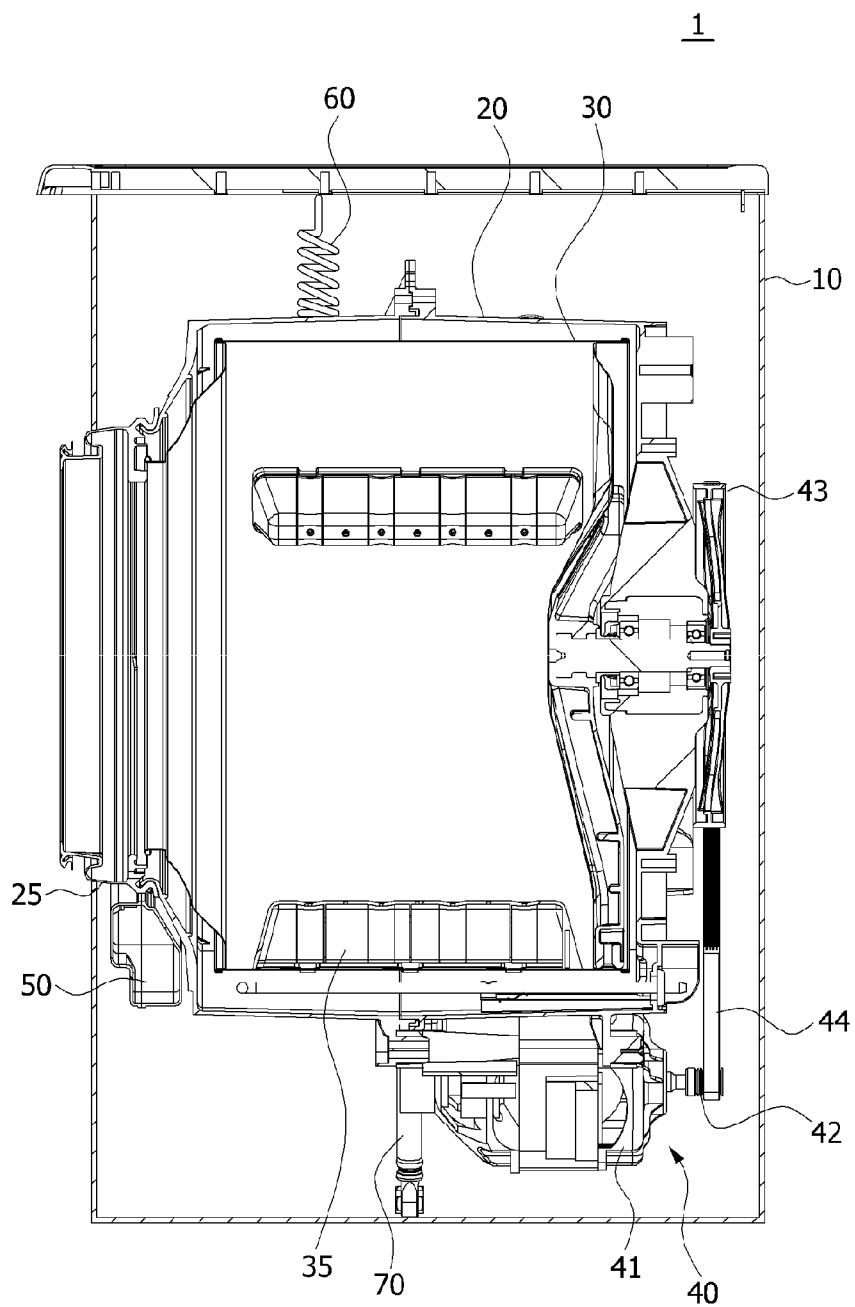


Fig. 2

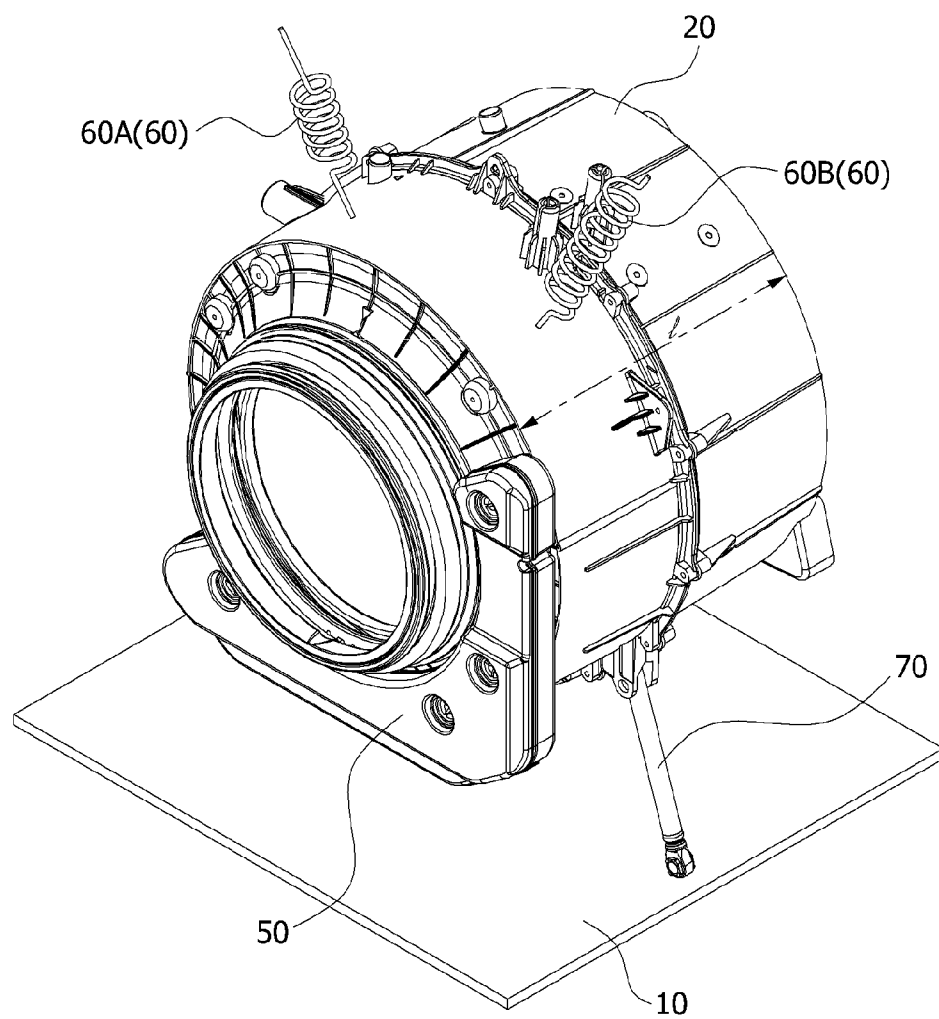


Fig. 3

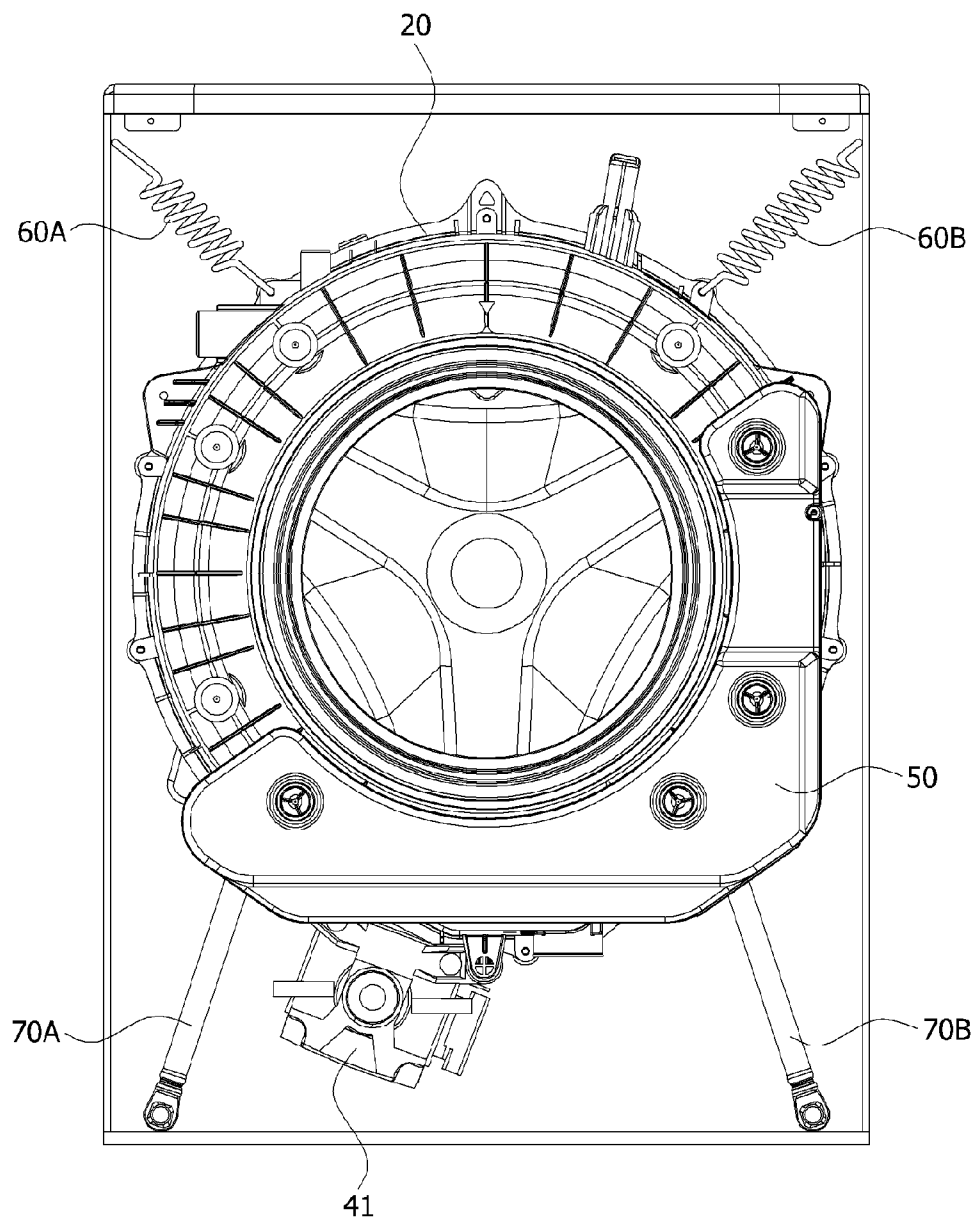


Fig. 4

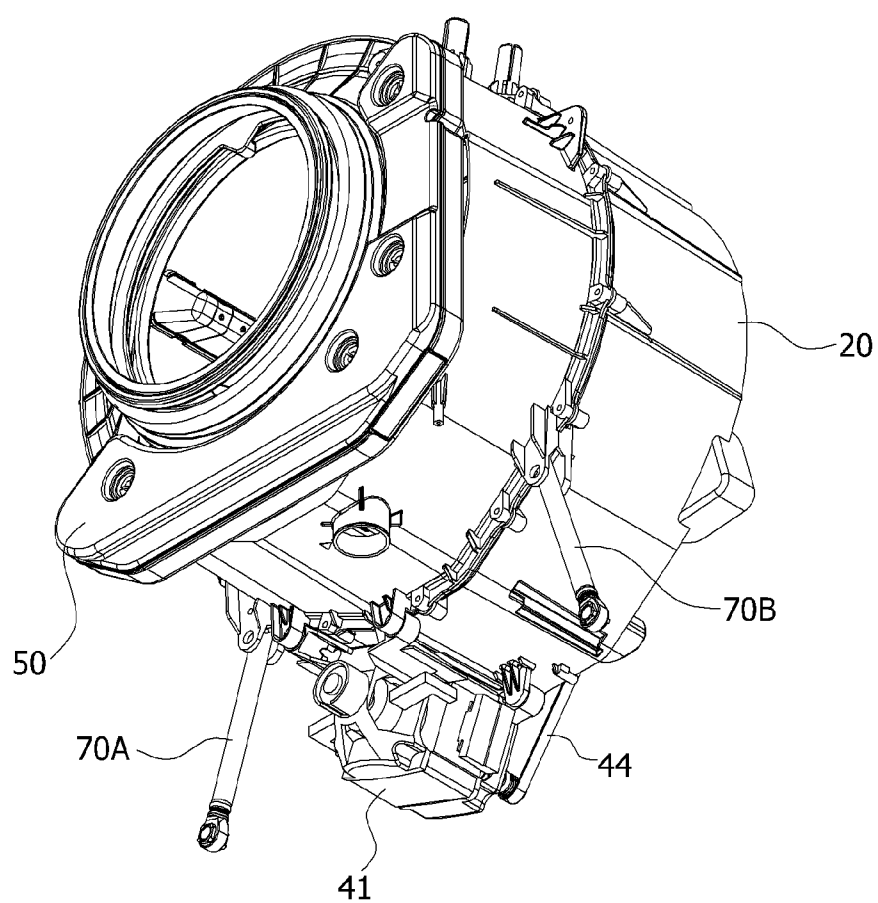
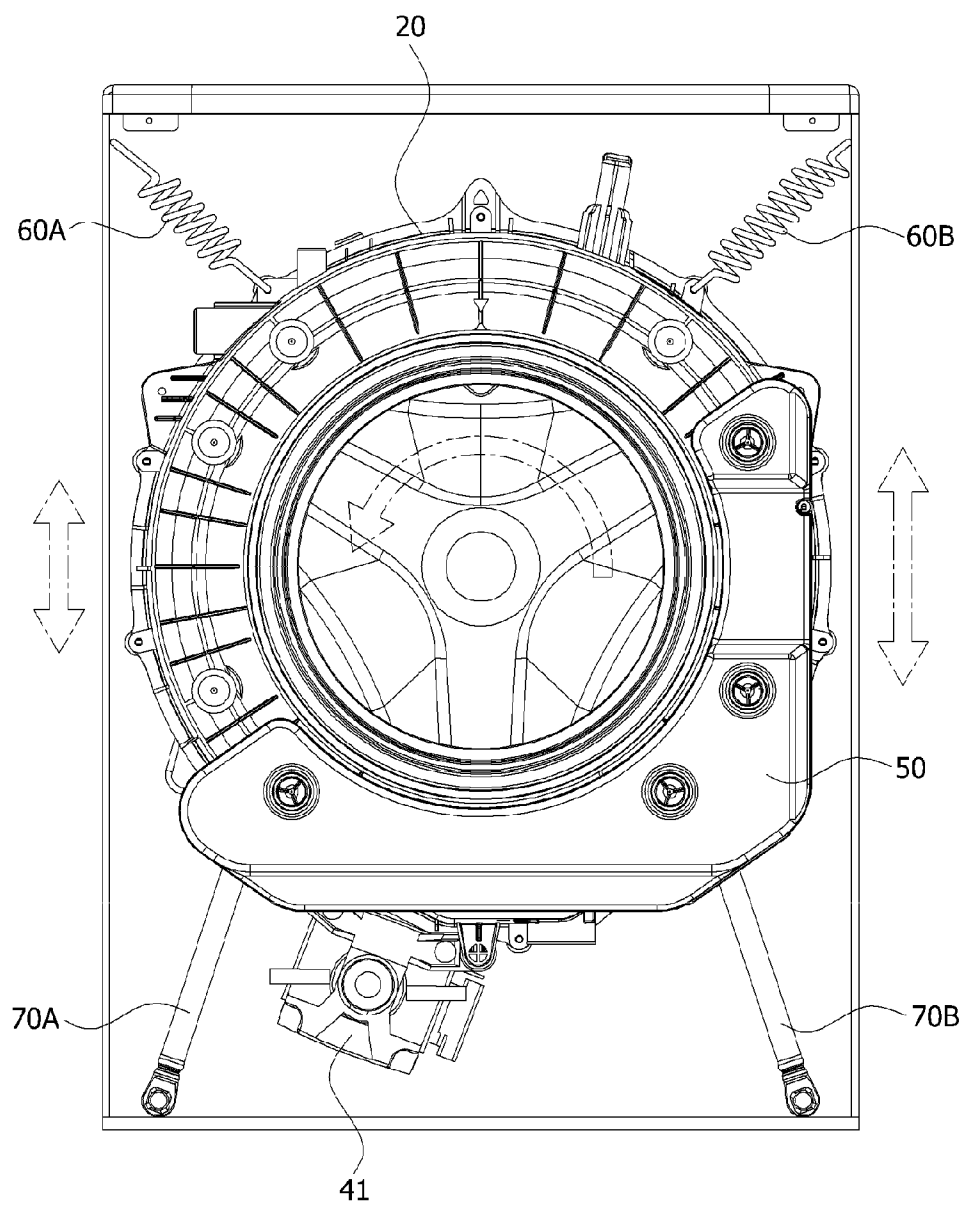


Fig. 5



DRUM WASHING MACHINE

TECHNICAL FIELD

[0001] The present invention relates to a drum washing machine, and more particularly, to a drum washing machine capable of decreasing vibrations by using a plurality of springs having different spring constants.

BACKGROUND ART

[0002] A washing machine uses power from an electric motor as main power and performs washing, rinsing, and dehydrating processes so as to remove stains on laundry. The washing machine includes an electric motor, which is a power apparatus, a mechanical part that transfers energy to the laundry, a controlling part controlling the washing process, a water supply apparatus, a water draining apparatus, and the like.

[0003] Washing machines are classified into agitator type washing machines, pulsator type washing machines, and drum type washing machines, depending on their washing scheme. The agitator type washing machine performs washing by horizontally rotating a spiral agitator at the center of a tub. The pulsator type washing machine performs washing using a water flow generated by rotating a disk shaped pulsator. The drum type washing machine performs washing using impact generated when the laundry is lifted by a lifter in the drum and then dropped into the wash water and detergent into the drum provided with several protrusion parts and then rotating the drum around a horizontal axis.

DISCLOSURE

Technical Problem

[0004] In accordance with the related art, since spring constants of springs absorbing vibrations during rotation of the drum are the same, it is difficult to effectively decrease the vibrations.

[0005] Therefore, there is a need to solve such a problem.

[0006] The present invention is conceived to solve such problems of the related art, and an aspect of the present invention is to provide a drum washing machine capable of decreasing vibrations by using a plurality of springs having different spring constants.

Technical Solution

[0007] In accordance with an aspect of the invention, a drum washing machine includes: a cabinet; a tub in the cabinet and fillable with wash water; a rotatable drum in the tub and receiving laundry therein; a motor at the rear of a lower portion of the tub and generating power; a motor pulley connected to the motor; a drum pulley connected to the drum; a belt having one side wound around the motor pulley and another side wound around the drum pulley so that the motor rotates the drum; a balancer coupled to a front surface of the tub; a plurality of springs having one end coupled to the cabinet and another end coupled to an upper surface of the tub to support the tub; and a plurality of dampers having one end coupled to the cabinet and another end coupled to a lower surface of the tub, wherein the springs include one spring coupled to one side of the cabinet and another spring coupled to an opposite side of the cabinet, the one spring having a spring constant different from that of the other spring.

[0008] The spring constant of the one spring may be larger than that of the other spring.

[0009] The one spring may have a length greater than that of the other spring.

[0010] When the drum is not rotated, the one spring and the other spring may have the same length to support the tub.

[0011] The dampers may include one damper coupled to one side of the cabinet and another damper coupled to an opposite side of the cabinet, wherein the one damper has a frictional force different from that of the other damper.

[0012] The frictional force of the one damper may be larger than that of the other damper.

Advantageous Effects

[0013] In accordance with an embodiment of the present invention, since vibrations may be decreased using one balancer, the assembling process and the manufacturing cost may be decreased.

[0014] In addition, in accordance with an embodiment of the present invention, since movement of the tub is changed to a vertical direction during the dehydration cycle by the plurality of springs having different spring constants, vibrations of the tub may be effectively absorbed by the springs.

[0015] Further, in accordance with an embodiment of the present invention, since the movement of the tub is changed to the vertical direction during the dehydration cycle by the plurality of dampers having different frictional forces, vibrations of the tub may be effectively damped by the dampers.

[0016] Furthermore, in accordance with an embodiment of the present invention, when positions at which one spring and one damper are mounted are the same as each other, and positions at which another spring and another damper are mounted are the same as each other, a vertical direction change of the movement of the tub due to a spring constant difference between the springs and a frictional force difference between the dampers may be maximized, such that a damping rate for the vibrations of the tub may be further improved.

DESCRIPTION OF DRAWINGS

[0017] The above and other aspects, features and advantages of the invention will become apparent from the following detailed description in conjunction with the accompanying drawings, in which:

[0018] FIG. 1 is a side cross-sectional view of a drum washing machine in accordance with an embodiment of the present invention;

[0019] FIG. 2 is a perspective view of the drum washing machine in accordance with one embodiment of the present invention;

[0020] FIG. 3 is a front view of the drum washing machine in accordance with an embodiment of the present invention;

[0021] FIG. 4 is a bottom perspective view of the drum washing machine in accordance with an embodiment of the present invention; and

[0022] FIG. 5 is a view illustrating an operation state of the drum washing machine in accordance with an embodiment of the present invention.

BEST MODE

[0023] Hereinafter, a drum washing machine in accordance with an embodiment of the present invention will be described with reference to the accompanying drawings. In

the present description, thicknesses of lines, sizes of components, or the like, illustrated in the accompanying drawings may be exaggerated for clarity and convenience of explanation.

[0024] Further, the following terminologies are defined in consideration of the functions in the present invention and may be construed in different ways by the intention of users and operators. Therefore, the definitions of terms used in the present description should be construed based on the contents throughout the specification.

[0025] FIG. 1 is a side cross-sectional view of a drum washing machine in accordance with an embodiment of the present invention; and FIG. 2 is a perspective view of the drum washing machine in accordance with an embodiment of the present invention. FIG. 3 is a front view of the drum washing machine in accordance with an embodiment of the present invention; FIG. 4 is a bottom perspective view of the drum washing machine in accordance with an embodiment of the present invention; and FIG. 5 is a view illustrating an operation state of the drum washing machine in accordance with an embodiment of the present invention.

[0026] As illustrated in FIGS. 1 to 5, the drum washing machine 1 includes a cabinet 10 that forms an appearance of the drum washing machine 1, a tub 20 positioned between front and rear plates (based on FIG. 1) of the cabinet 10 and fillable with wash water, a rotatable drum 30 positioned in the tub 20 and receiving laundry therein, a driving part 40 generating power to rotate the drum 30, a balancer 50 coupled to a front surface of the tub 20, springs 60 that absorb vibrations of the tub 20, and a damper 70 that dampens the vibrations of the tub 20.

[0027] The front plate of the cabinet 10 is provided with a laundry entrance hole (not illustrated) through which laundry is introduced and discharged and a door (not illustrated) opening or closing the laundry entrance hole.

[0028] The tub 20 is mounted in the cabinet 20 and has a hollow cylindrical shape that is laid laterally. The rear of the laundry entrance hole has an opening hole (not illustrated).

[0029] An upper portion of the tub 20 is provided with a water supplying apparatus (not illustrated) that supplies the wash water into the tub 20 and a detergent housing (not illustrated) that supplies a detergent. The tub 20 has the rotatable drum 30 disposed therein.

[0030] The drum 30 has a hollow cylindrical shape that is laterally laid, similar to the tub 20, and includes opening holes (not illustrated) at the rear of the laundry entrance hole. The drum 30 has holes (not illustrated) in the side thereof so that the wash water filled in the tub 20 may be introduced thereinto and discharged therefrom and has a lifter on an inner circumferential surface thereof so as to move the laundry.

[0031] The driving part 40 generates the power to rotate the drum 30. The driving part 40 includes a motor 41, a motor pulley 42, a drum pulley 43, and a belt 44.

[0032] The motor 41 is disposed at the rear of a lower portion of the tub 20 (see FIG. 1) and generates the power. The motor pulley 42 is connected to the motor 41, the drum pulley 43 is connected to the drum 30, and the belt 44 has one side wound around the motor pulley 42 and the other side wound around the drum pulley 43.

[0033] A rotational force generated by the motor 41 is transferred to the motor pulley 42. Then, the rotational force is transferred to the drum pulley 42 at the rear of the drum 30 through the belt 44, and the drum 30 is rotated. The motor

pulley 42 and the drum pulley 43 have grooves in central portions thereof to prevent the belt 44 from separating from the pulleys.

[0034] When an unbalanced mass occurs during rotation of the drum 30, vibrations inevitably occur. The balancer 50 includes a body having a predetermined mass and a housing having an internal space to guide movement of the body, in order to rapidly decrease these vibrations.

[0035] The balancer 50 is coupled to the front surface of the tub 20 (see FIG. 1). The reason why the balancer 50 is coupled to the front surface of the tub 20 as described above is to correspond to the motor 41 at the rear of the tub 20. That is, since the motor 41 having a weight is at the rear of the tub 20, the balancer 50 is positioned on the front surface of the tub 20 in order to eliminate a weight unbalance due to the weight of the motor 41.

[0036] The motor 41 is biased toward the left of the tub 40 (based on FIG. 4). The balancer 50 is positioned so that the center of gravity thereof is biased toward the right, opposite to the motor 41, to correspond to the biasing toward one side. Therefore, the tub 40 is horizontally balanced by biasing the motor 41 toward the left and biasing the center of gravity of the balancer 50 toward the right.

[0037] The balancer 50 has a $\perp$ shape that enables the center of gravity thereof to be biased toward the right. The balancer 50 may also have another shape in addition to the above-mentioned shape as long as the center of gravity thereof is biased toward the right.

[0038] The springs 60 have an upper end coupled to an upper end portion of a side plate of the cabinet 10 and a lower end coupled to an upper surface of the tub 20. Therefore, the springs 60 support the tub 20 and absorb the vibrations of the tub 20 that occur at the time of a dehydration cycle.

[0039] The number of springs 60 is plural. The same number of springs 60 are mounted on the left and right of the tub 20 to absorb the vibrations generated due to horizontal and vertical movement of the tub 20. Although one spring 60 is mounted on each of the left and right of the tub 20 in the present embodiment, the present invention is not limited thereto.

[0040] The springs 60 are coupled to the upper surface of the tub 20 at a center of gravity of the tub 20. Here, the center of gravity of the tub 20 means the center of gravity when the balancer 50 and the motor 41 are mounted on the tub 20, rather than the center of gravity of only the tub 20 itself.

[0041] The spring 60 is positioned at the center of gravity of the tub 20 so that the tub 20 is balanced in the front-to-rear direction. In accordance with the present embodiment, the lower end of the spring 60 is coupled to the tub 20 at the center of gravity of the tub 20 in the front-to-rear direction, and the upper end of the spring 60 is coupled to the cabinet 10 at the same position in the front-to-rear direction as that of the lower end of the springs 60 (see FIG. 1).

[0042] Hereinafter, a spring 60 coupled to the left (based on FIG. 3) of the tub 20 is referred to as one spring 60A, and a spring 60 coupled to the right of the tub 20 is referred to as the other spring 60B.

[0043] In the present embodiment, a spring constant of one spring 60A is different from that of the other spring 60B. Here, the spring constant is a constant indicating a proportional relationship between a force acting on the spring and a change of length of the spring. As the spring constant becomes larger, a larger force is required to extend the spring.

In the present embodiment, the spring constant is adjusted by the number of windings of the spring 60.

[0044] The spring constant of one spring 60A is larger than that of the other spring 60B. Therefore, when the same force acts on one spring 60A and the other spring 60B, the other spring 60B extends further, as compared with the one spring 60A.

[0045] That is, when vibrations having the same magnitude are applied to one spring 60A and the other spring 60B during the dehydration cycle, an extension length of the other spring 60B is larger than that of the one spring 60A.

[0046] In the present embodiment, one spring 60A has a length greater than that of the other spring 60B. As described above, since one spring 60A has a spring constant larger than that of the other spring 60B, when the drum 30 is not rotated, that is, when a washing cycle is not performed, the length of one spring 60A should be greater than that of the other spring 60B, based on the case in which force is not applied to one spring 60A and the other spring 60B in order to horizontally balance the tub 20.

[0047] In FIG. 3, the entire length of one spring 60A extended by a predetermined length by the weight of the tub 30 is the same as that of the other spring 60B. Therefore, the tub 20 is supported by the springs 60 in a state in which it is horizontally balanced.

[0048] A weight of the balancer 50 is greater than that of the motor 41. In accordance with the present embodiments, the weight of the motor 41 is about 5 kg, and the weight of the balancer 50 is about 9 kg.

[0049] Since the balancer 50 is heavier than the motor 41, the center of gravity of the tub 20 on which both of the motor 41 and the balancer 50 are mounted is in front of the center of a front and rear length l of the tub 20.

[0050] Therefore, in the present embodiment, the springs 60 are coupled to the upper surface of the tub 20 at a position ahead of the center of the front and rear length l of the tub 20.

[0051] The dampers 70 have an upper end coupled to the lower surface of the tub 20 and a lower end coupled to a lower surface plate of the cabinet 10. Therefore, the dampers 70 damp the vibrations of the tub 20 during the dehydration cycle.

[0052] The number of dampers 70 is plural. In the present embodiment, two dampers 70 are provided, in which one damper is coupled to the left and the right of the tub 20, respectively, to dampen the vibrations due to horizontal and vertical movement of the tub 20.

[0053] The dampers 70 are coupled to the lower surface of the tub 20 behind the springs 60 (see FIG. 1). In accordance with the present embodiment, the dampers 70 are coupled to the lower surface of the tub 20 at the center along the front-to-rear length l of the tub 20.

[0054] Since the spring 60 at which the center of gravity of the tub 20 is positioned is positioned ahead of the center of the front and rear length l of the tub 20 and a front end of the tub 20 is fixed to a gasket 25, when an unbalanced mass results from the rotation of the drum at the time of the dehydration cycle, larger vibrations are generated at the rear of the tub 20, as compared to the front of the tub 20.

[0055] Therefore, the dampers 70 are positioned behind the center of gravity of the tub 20 to dampen the relatively large vibrations at the rear of the tub 20, thereby making it possible to further improve a vibration damping effect.

[0056] When the dampers 70 are excessively close to the rear of the tub 20, the damping rate for vibrations at the front

of the tub 20 decreases. Thus, the dampers 70 are located at the center along the front-to-rear length l of the tub 20 so as to dampen the vibrations at both of the front and the rear of the tub 20.

[0057] Hereinafter, a damper 70 coupled to the left side (based on FIG. 3) of the tub 20 is referred to as one damper 70A, and a damper 70 coupled to the right side of the tub 20 is referred to as the other damper 70B. In the present embodiment, the frictional force of one damper 70A is different from that of the other damper 70B. Here, the frictional force is calculated by the product of normal force and the friction factor of an object. The larger the frictional force, the larger the force required to compress the damper 70. More specifically, the frictional force of one damper 70A is larger than that of the other damper 70B. Therefore, when the same force acts on one damper 70A and the other damper 70B, the other damper 70B is compressed further than the one damper 70A.

[0058] That is, when vibrations having the same magnitude are applied to one damper 70A and the other damper 70B during the dehydration cycle, a compression length of the other damper 70B is larger than that of one damper 70A.

[0059] The lifter 35 is on the inner circumferential surface of the drum 30 toward a central portion of the drum 30. The lifter 35 lifts the laundry in the drum 30 as the drum 30 rotates.

[0060] Hereinafter, an operation principle of the drum washing machine in accordance with an embodiment of the present invention will be described.

[0061] After the laundry is placed in the drum 30, an operating panel (not shown) is operated to operate the drum washing machine 1. As a washing cycle starts, the wash water is supplied to the tub 20 and is also introduced into the drum 30 through the holes.

[0062] The motor 40 is driven to rotate the drum 30, and the laundry in the drum 30 is lifted by the lifter 35 fixed to the inner circumferential surface of the drum 30 and then drops down.

[0063] In the drum washing machine 1, large vibrations are generated at the time of the dehydration cycle among several washing cycles. These vibrations are rapidly decreased by the balancer 50 located at a position corresponding to that of the motor 41.

[0064] The vibrations generated during rotation of the drum 30 are decreased by the springs 60 and the dampers 70, in addition to the balancer 50. The springs 60 are positioned ahead of the center of the front-to-rear length l of the tub 20 when there is a weight difference between the balancer 50 and the motor 41 to maintain of the balance of the tub 20 in the front-to-rear direction. The dampers 70 are coupled to the tub 20 behind the springs 60 to offset an increase in vibrations at the rear of the tub 20 caused by a forward movement of the center of gravity of the tub 20.

[0065] With the above-mentioned configuration, only one balancer 50 may sufficiently decrease the vibrations of the drum washing machine 1 during the dehydration cycle. Therefore, the process of assembling the balancer 50 and the manufacturing cost may be decreased as compared with the related art in which a plurality of balancers are provided.

[0066] The springs 60 are divided into one spring 60A and the other spring 60B to induce a movement of the tub 20 in a vertical direction during the dehydration cycle. Since the spring constant of the other spring 60B is smaller than that of one spring 60A, the right of the tub 20 to which the other spring 60B is mounted is further moved vertically as compared with the left of the tub 20 to which one spring 60A is

mounted during the dehydration cycle, in which the drum 30 is rotated in a counterclockwise direction.

[0067] In accordance with the related art in which the tub is supported by springs having the same spring constant, a rotation trajectory of the tub has substantially a circle shape. However, in accordance with the present embodiment in which the tub 20 is supported by springs 60 having different spring constants, a rotation trajectory of the tub 20 has substantially an oval shape in which the vertical length is greater than the horizontal length.

[0068] Since movement of the tub 20 is greater in the vertical direction due to the change of the rotation trajectory of the tub 20 into the oval shape by the springs 60 as described above, an absorption rate for the vibrations of the tub 20 using the springs 60 of which an absorption effect for vertical vibrations is higher than an absorption effect for horizontal vibrations is improved.

[0069] The dampers 70 are divided into one damper 70A and the other damper 70B to induce the movement of the tub 20 in the vertical direction at the time of the dehydration cycle. Since the frictional force of the other damper 70B is smaller than that of one damper 70A, the right of the tub 20 to which the other damper 70B is mounted is further moved vertically as compared with the left of the tub 20 to which one damper 70A is mounted during the dehydration cycle, in which the drum 30 is rotated in the counterclockwise direction.

[0070] In accordance with the related art in which the tub is supported by dampers having the same frictional force, a rotation trajectory of the tub has substantially a circle shape. However, in accordance with the present embodiment in which the tub 20 is supported by dampers 70 having different frictional forces, a rotation trajectory of the tub 20 has substantially an oval shape in which the vertical length is greater than the horizontal length.

[0071] Since movement of the tub 20 is greater in the vertical direction due to the change of the rotation trajectory of the tub 20 into an oval shape by the dampers 70 as described above, the damping rate for vibrations of the tub 20 using the dampers 70 of which a damping effect for vertical vibrations is higher than a damping effect for horizontal vibrations is improved.

[0072] Further, in the present embodiment, since positions at which one spring 60A and one damper 70A are mounted are the same as each other, and positions at which the other spring 60B and the other damper 70B are mounted are the same as each other, the change of the vibrational movement of the tub 20 in the vertical direction due to a spring constant difference between the springs 60 and a frictional force dif-

ference between the dampers 70 may be maximized, and the damping rate for vibrations of the tub 20 may be further improved.

[0073] Although the present invention has been described with reference to embodiments shown in the accompanying drawings, they are only examples. It will be appreciated by those skilled in the art that various modifications and equivalent other embodiments are possible from the present invention.

[0074] Therefore, the scope of the present invention is to be defined by the following claims.

1. A drum washing machine comprising:

- a cabinet;
- a tub in the cabinet and fillable with wash water;
- a rotatable drum in the tub and receiving laundry therein;
- a motor at a rear of a lower portion of the tub and generating power;
- a motor pulley connected to the motor;
- a drum pulley connected to the drum;
- a belt having one side wound around the motor pulley and the other side wound around the drum pulley so that the motor rotates the drum;
- a balancer coupled to a front surface of the tub;
- a plurality of springs having one end coupled to the cabinet and another end coupled to an upper surface of the tub to support the tub; and
- a plurality of dampers having one end coupled to the cabinet and another end coupled to a lower surface of the tub, wherein the springs include one spring coupled to one side of the cabinet and another spring coupled to an opposite side of the cabinet, the one spring having a spring constant different from that of the other spring.

2. The drum washing machine according to claim 1, wherein the spring constant of the one spring is larger than that of the other spring.

3. The drum washing machine according to claim 2, wherein the one spring has a length greater than that of the other spring.

4. The drum washing machine according to claim 3, wherein when the drum is not rotated, the one spring and the other spring have a same length.

5. The drum washing machine according to claim 2, wherein the dampers include one damper coupled to one side of the cabinet and another damper coupled to an opposite side of the cabinet, the one damper having a frictional force different from that of the other damper.

6. The drum washing machine according to claim 5, wherein the frictional force of the one damper is larger than that of the other damper.

* * * * *