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(54) **DRUM TYPE WASHING MACHINE**
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(57) **ABSTRACT**

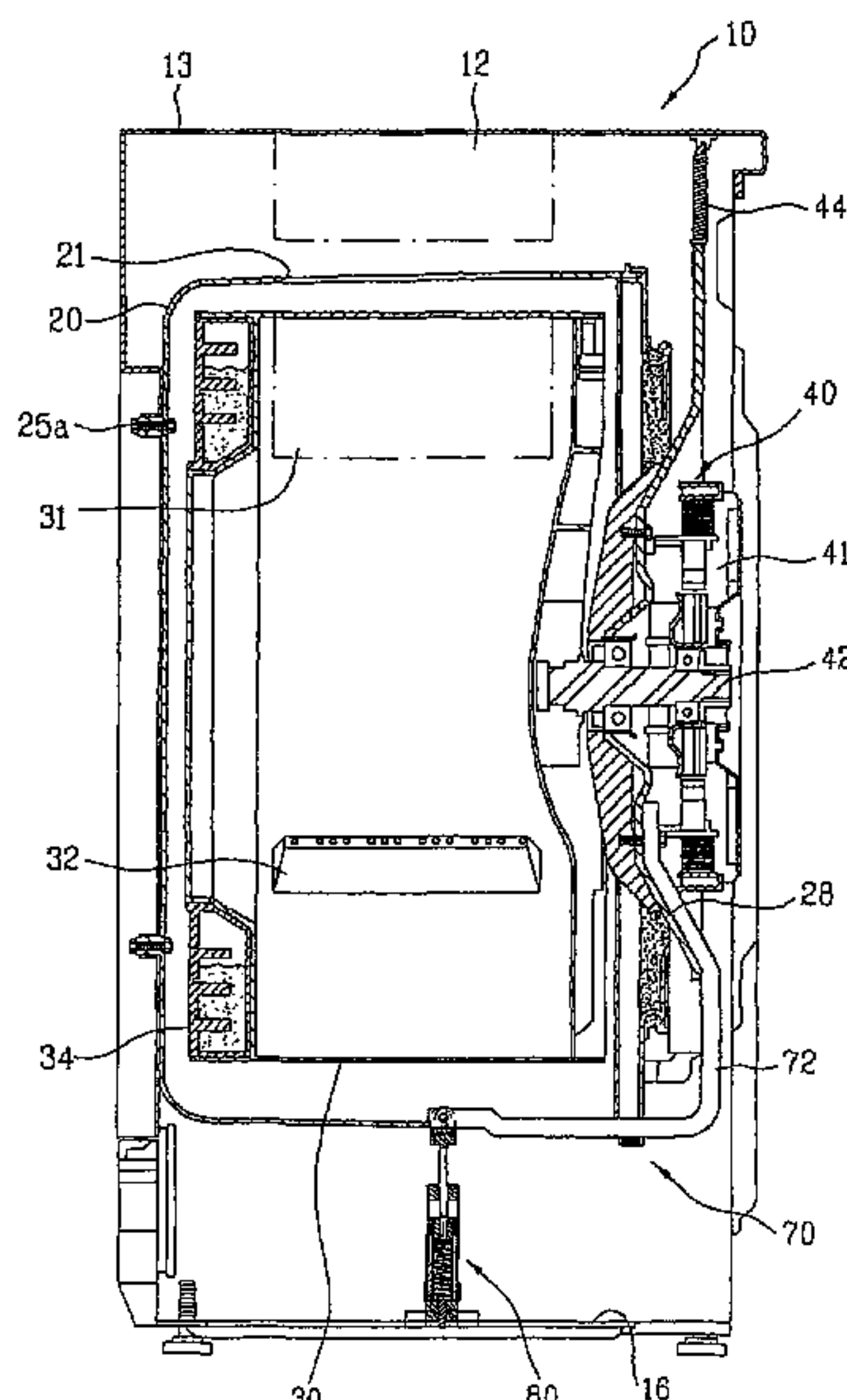
A drum type washing machine is provided, in which vibration is efficiently attenuated, by a maximum capacity within a size-fixed cabinet is provided, and by which a user does not bend over or sit down to load laundry into the washing machine. The drum type washing machine includes a cabinet forming an exterior of the drum type washing machine, a tub fixed within the cabinet, the tub having a laundry loading entrance at an outer circumference of the tub, a drum rotatably provided within the tub, the drum having an opening on a lateral side of the drum to communicate with the laundry loading entrance of the tub, a motor assembly provided next to one side of the drum to rotate the drum, and a suspension assembly provided to support a weight of the drum and attenuate vibration of the drum.

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24 Claims, 10 Drawing Sheets



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European Patent Office 0 132 805 Feb. 1985.*

* cited by examiner

FIG. 1
Related Art

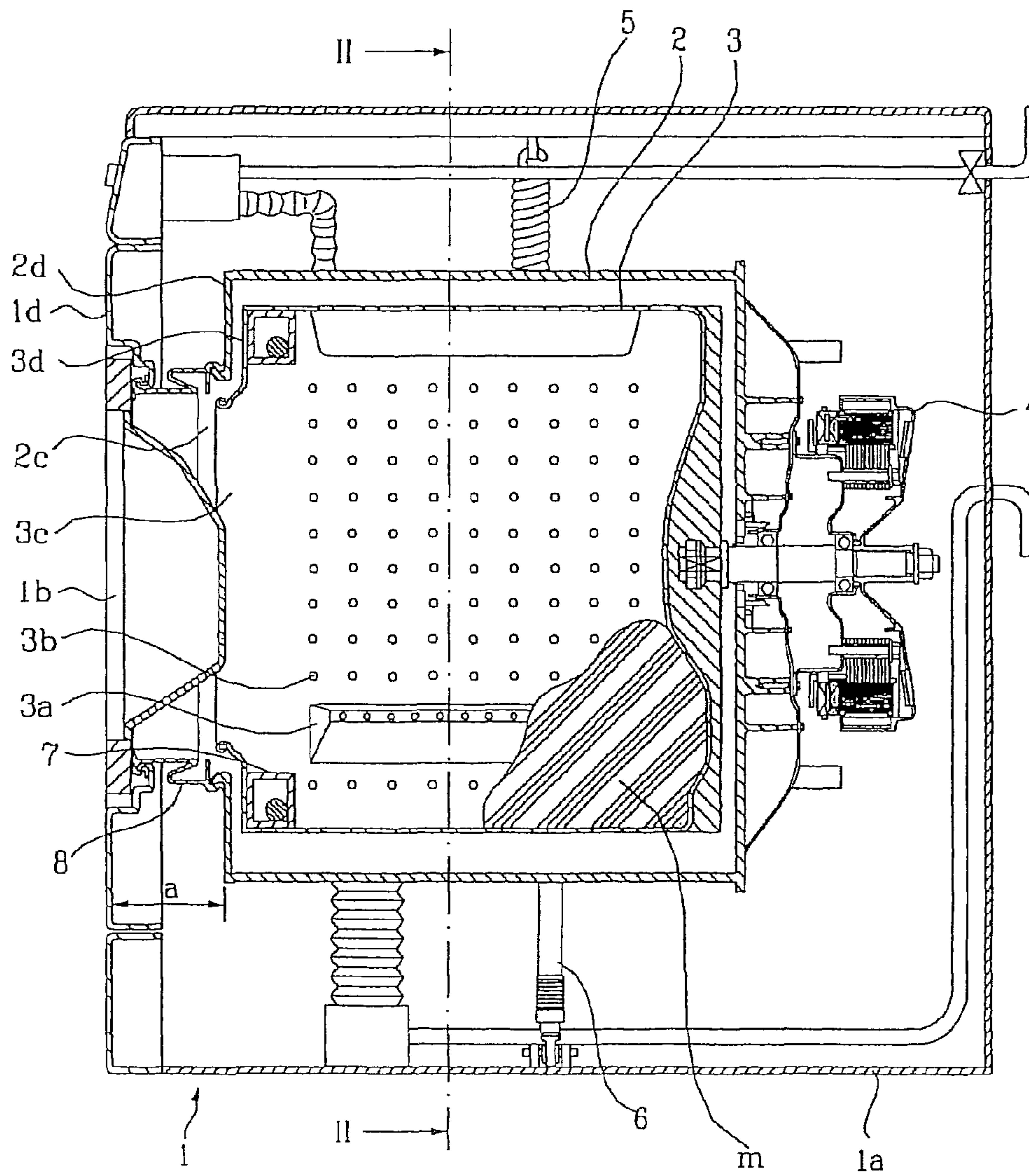


FIG. 2
Related Art

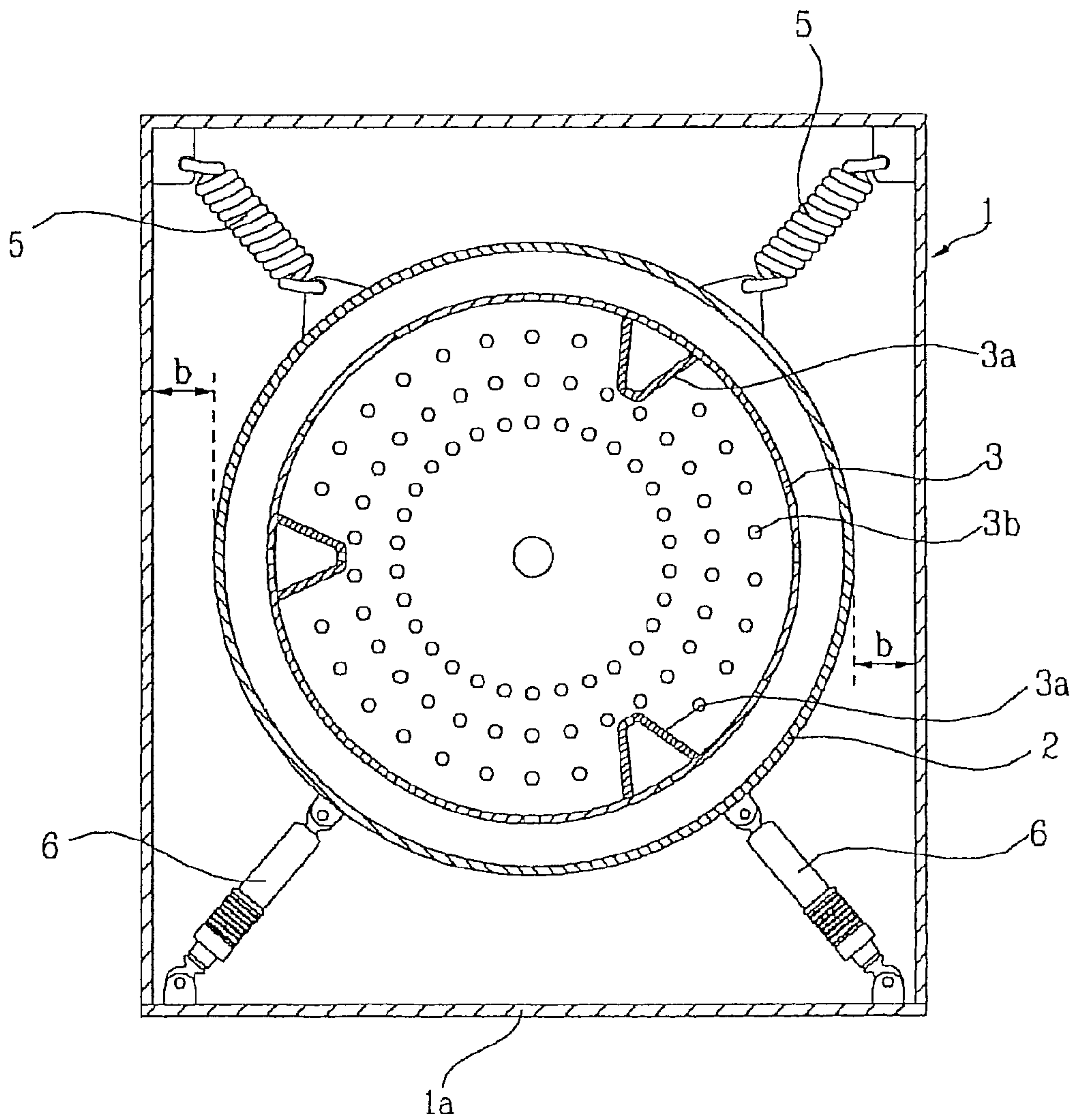


FIG. 3

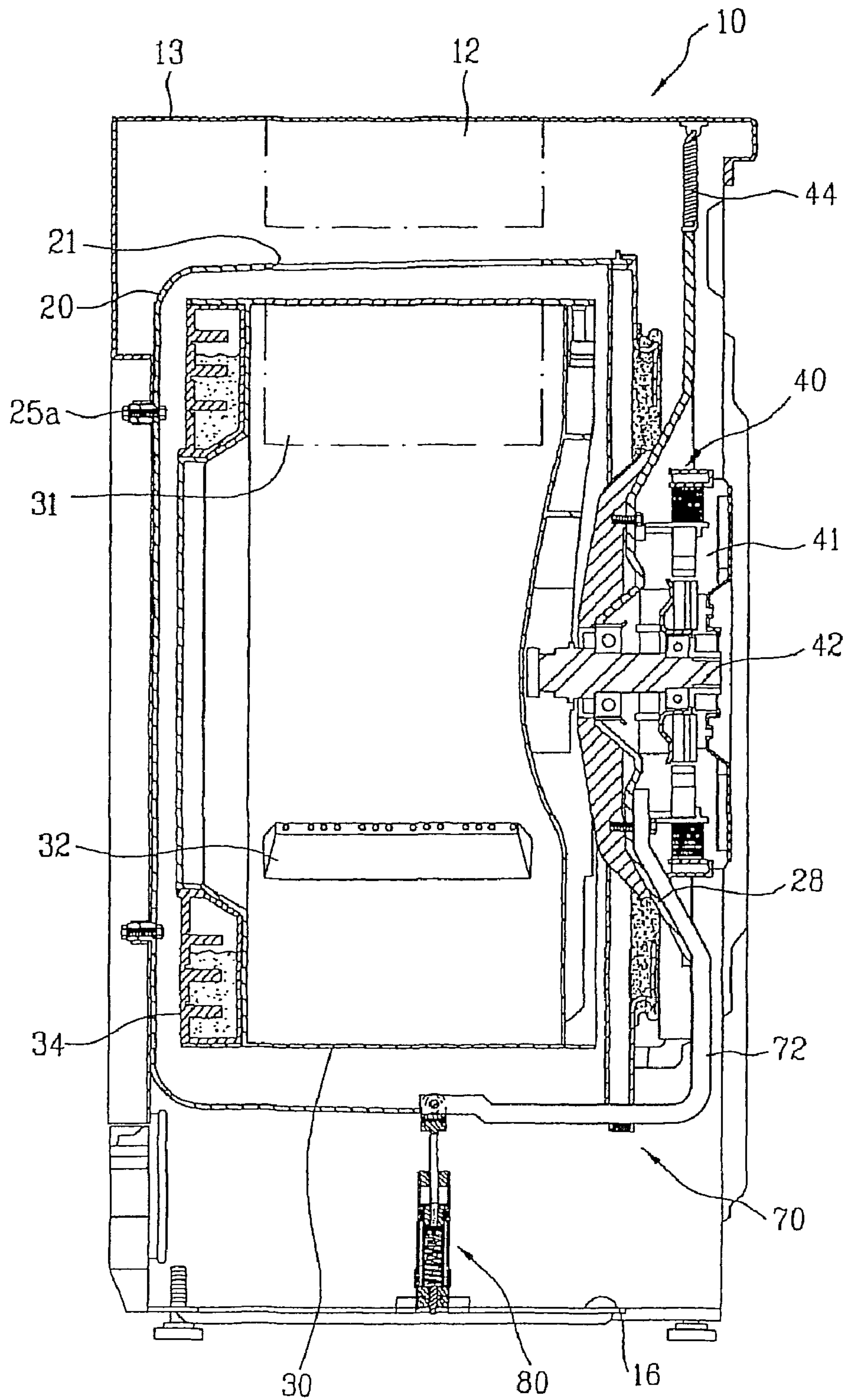


FIG. 4

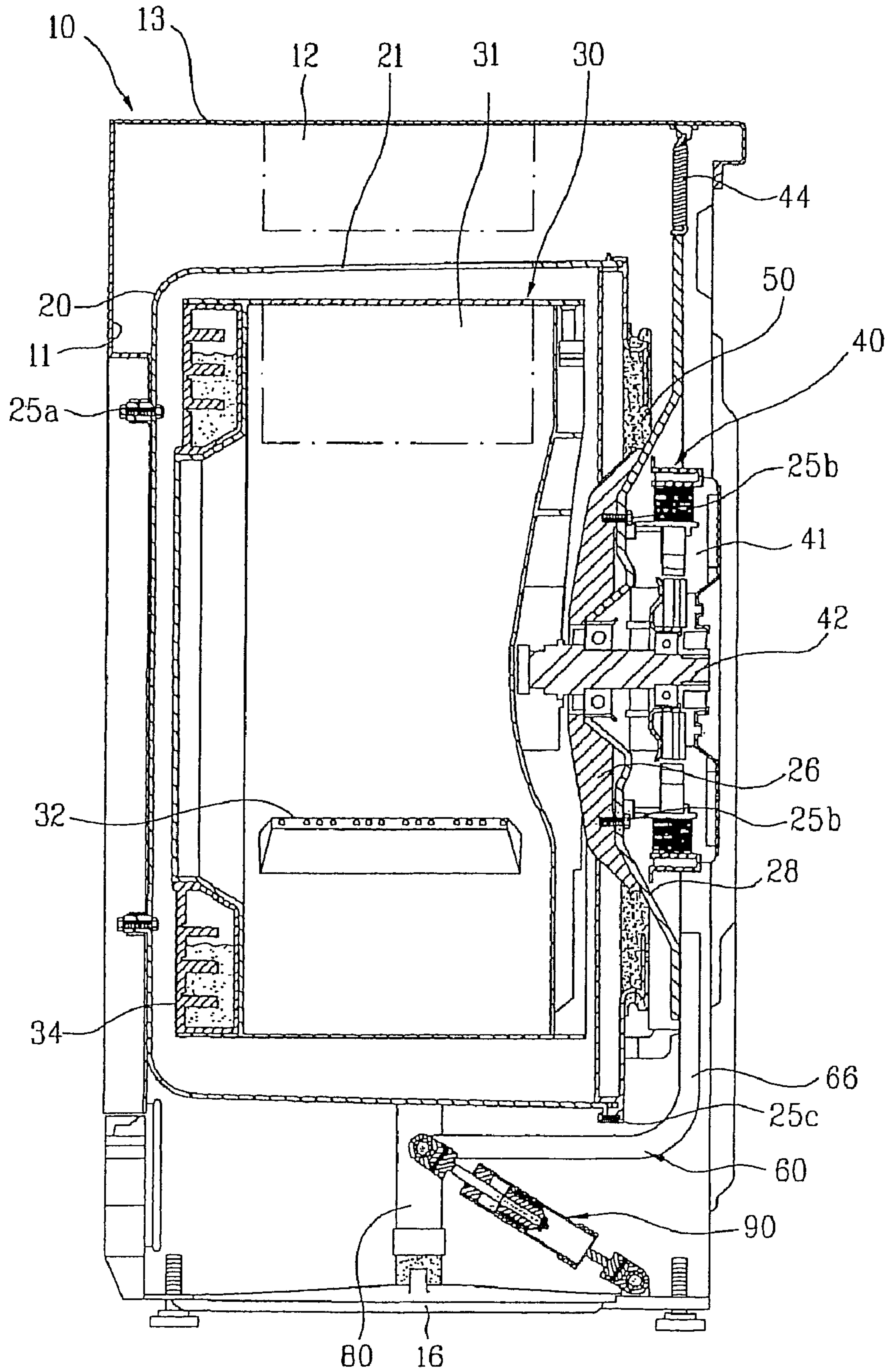


FIG. 5

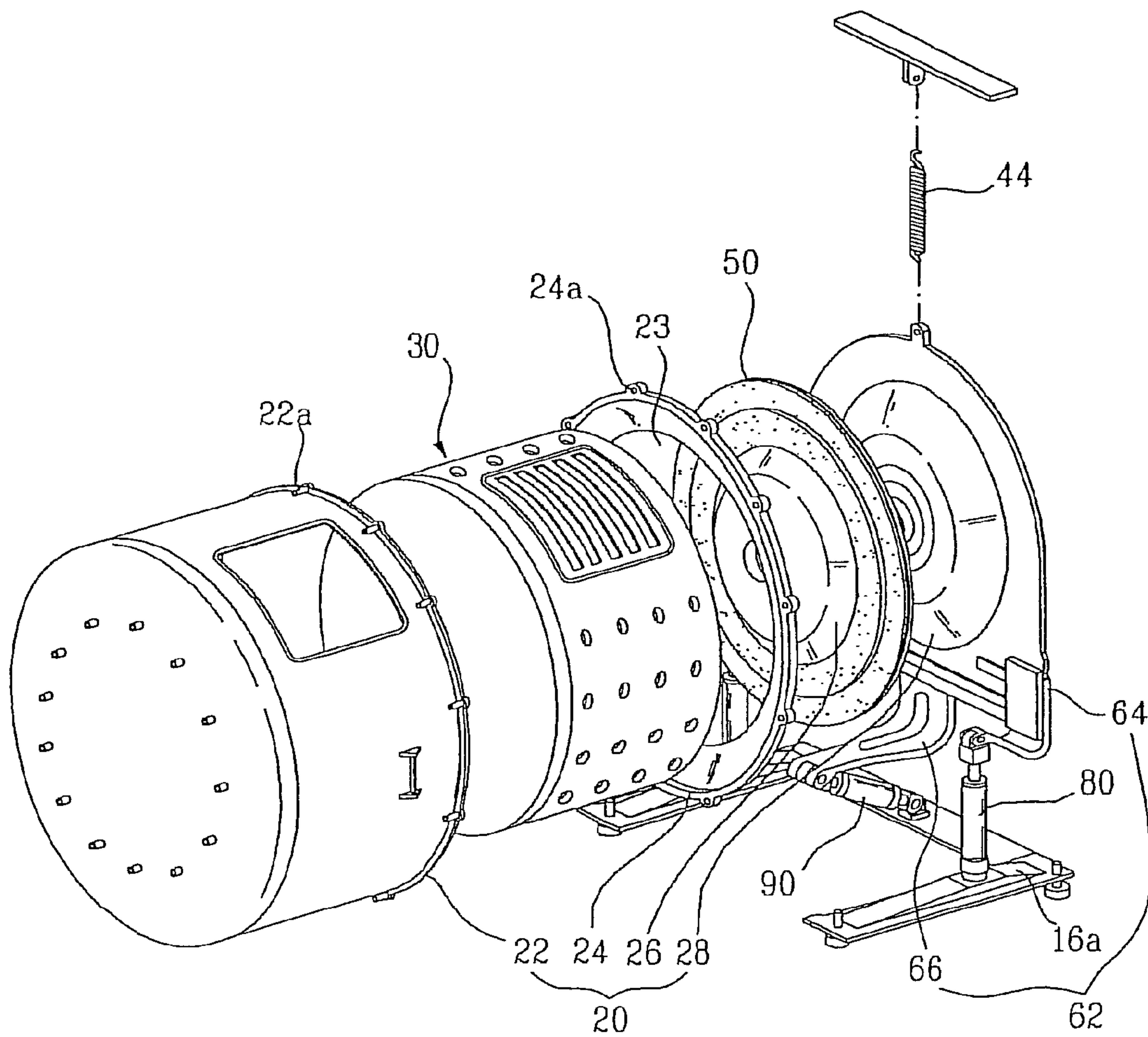
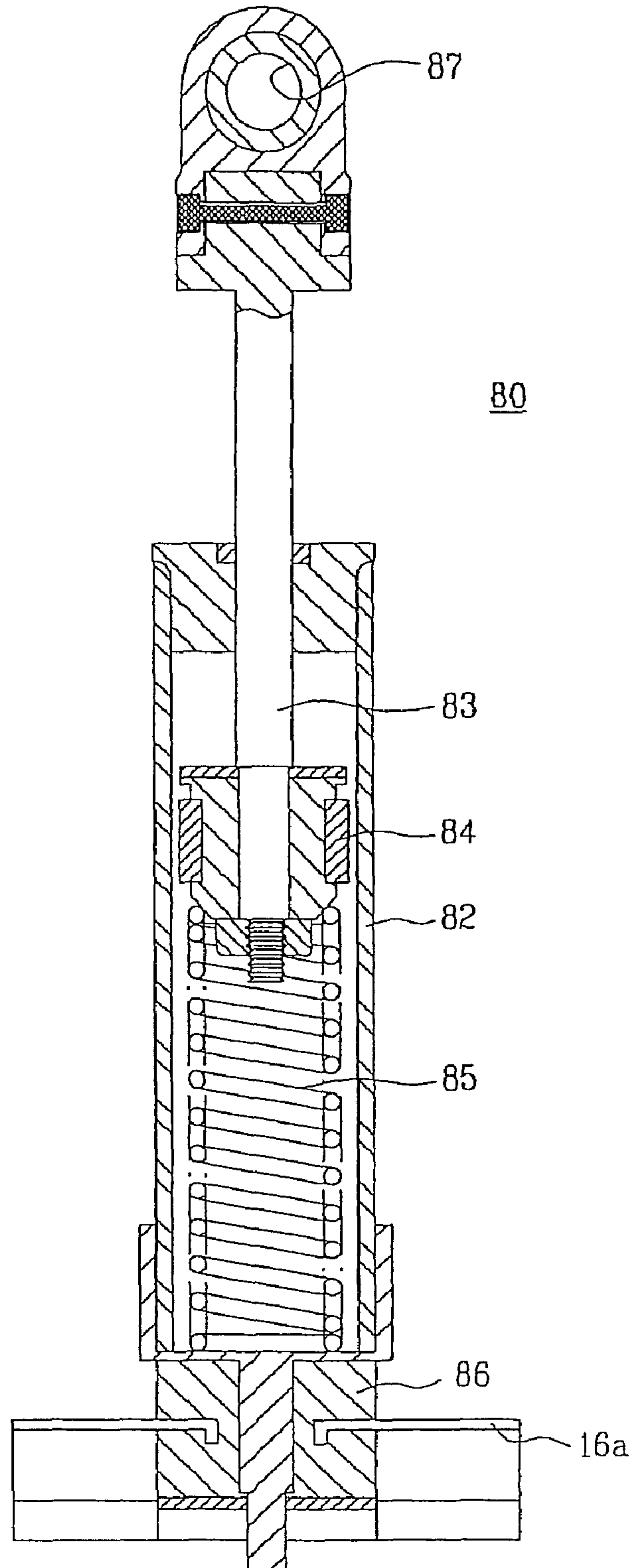


FIG. 6



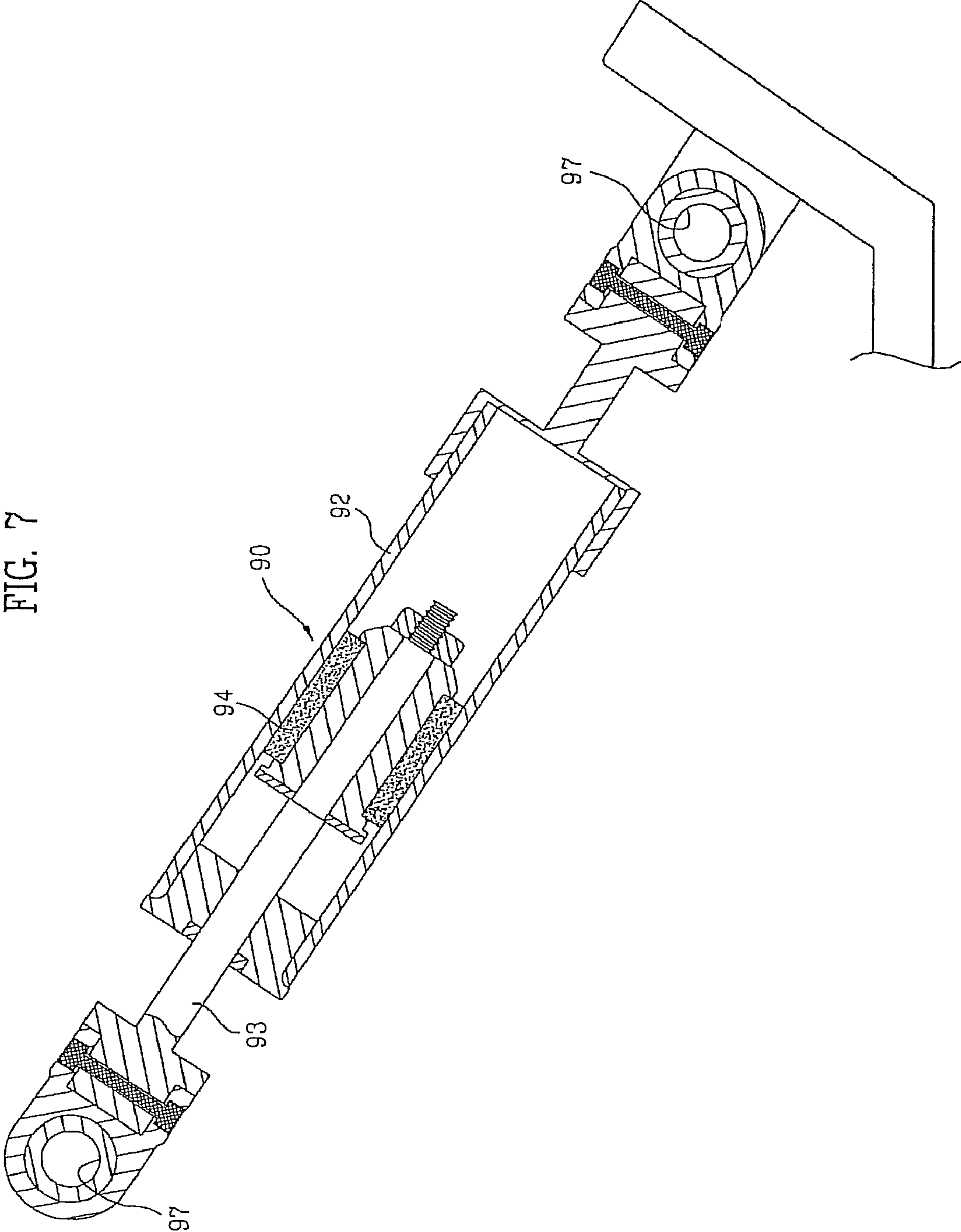


FIG. 7

FIG. 8

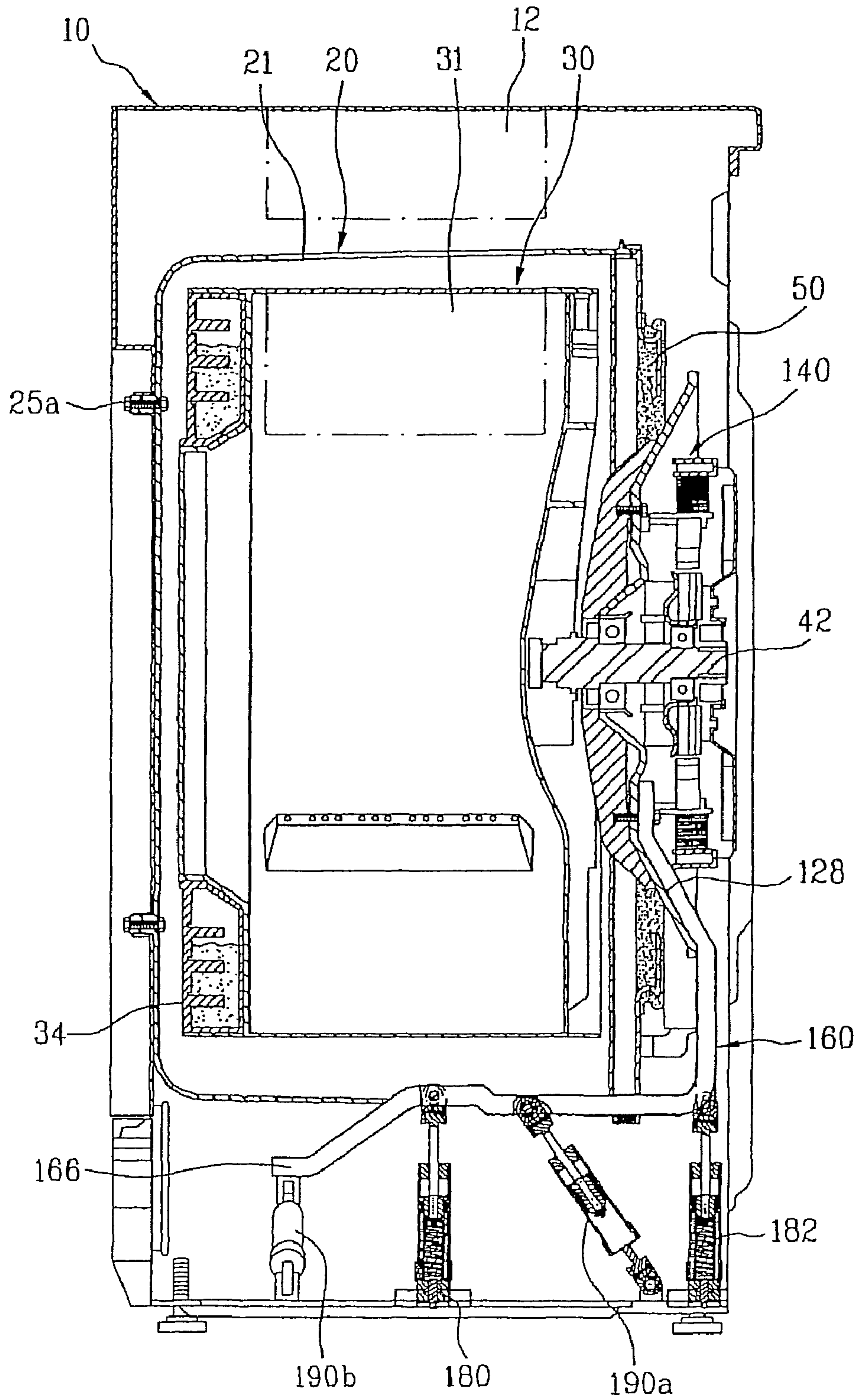


FIG. 9

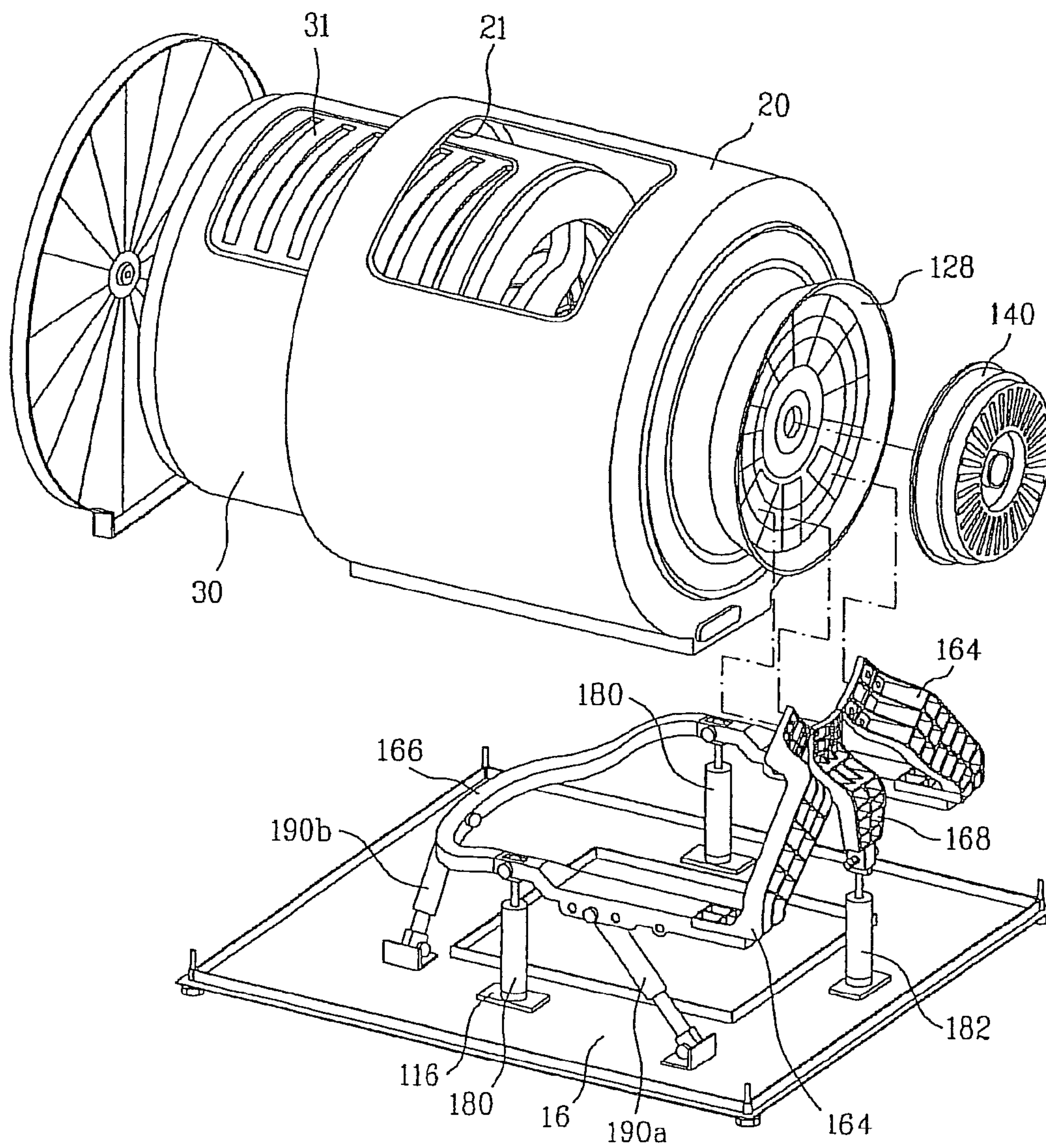
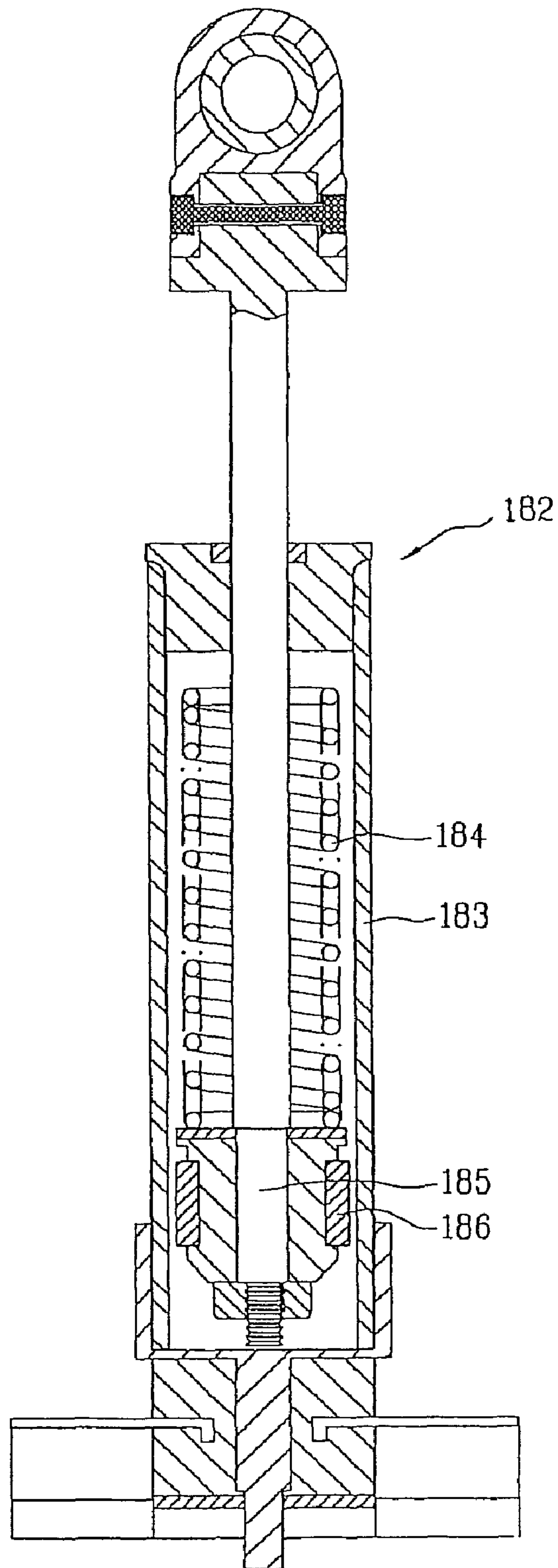


FIG. 10



DRUM TYPE WASHING MACHINE

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

More than one reissue application has been filed for the reissue of U.S. Pat. No. 7,536,882. The reissue applications are application Ser. Nos. 13/116,059, 13/116,077, 13/116,089, 13/116,096, 13/116,105, 13/116,114, 13/116,147, and 13/116,159 (the present application), all of which are divisional reissues of U.S. Pat. No. 7,536,882.

This application claims the benefit of the Korean Patent Application No. 10-2006-0028358, filed on Mar. 29, 2006, and Korean Patent Application No. 10-2006-0033255, filed on Apr. 12, 2006, which are hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a washing machine, and more particularly, to a drum type washing machine. Although the present invention is suitable for a wide scope of applications, it is particularly suitable for facilitating laundry to be loaded and unloaded from the washing machine with a maximum capacity within a predetermined volume.

2. Discussion of the Related Art

Generally, a drum type washing machine according to a related art has the following configuration.

FIG. 1 is a cross-sectional diagram of a drum type washing machine according to the related art, and FIG. 2 is a cross-sectional diagram according to a cutting line II-II shown in FIG. 1.

Referring to FIG. 1 and FIG. 2, a drum type washing machine according to the related art consists of a cabinet 1 having a base 1a and a door 1b, a tub 2 provided within the cabinet 1 to be fixed thereto, a drum 3 rotatably provided within the tub 2 to rotate laundry and water by a lift 3a, a motor 4 rotating the drum 3, and a spring 5, damper 6, and balancer 7 attenuating vibration transferred to the tub 2.

The drum 3 is provided with a multitude of holes 3b to enable water stored in the tub 2 to be introduced into the drum 3. The lift 3a is provided on an inner surface of the drum 3. The lift 3a is rotated together with the drum 3 to lift the laundry loaded within the drum 3 together with the water.

The tub 2 is provided lobe spaced apart from inner lateral sides of the cabinet 1. Both sides of an upper end of the tub 2 are hung within the cabinet 1 via springs 5. The damper 6 is hinged between the tub 2 and the base 1a to be supported over the base 1a. And, the springs 5 and dampers 6 attenuate the vibration carried to the cabinet 1 from the tub 2.

The door 1b of the cabinet 1 is rotatably provided to a front side 1d of the cabinet 1 to enable the laundry to be loaded. Front sides 2d and 3d of the tub 2 and the drum 3 are provided with openings 2c and 3c to communicate with a hole (not shown in the drawings) opened by the door 1b, respectively.

A gasket 8 is provided between the front side 1d of the cabinet 1 having the door 1b assembled thereto and the front side 2d of the tub 2 to prevent leakage of the water. In particular, the gasket 8 seals the space between the inner lateral side of the cabinet 1 and the front side 2d of the tub 2.

And, the motor 4 is provided to a backside of the tub 2 to rotate the drum 3 provided within the tub 2.

However, the related art drum type washing machine has the following problems or disadvantages.

First of all, if vibration is generated from an inside of the drum 3 of the related art drum type washing machine due to the imbalance in washing or dewatering, both of the drum 3 and the tub 2 are shaken as one body. And, the springs and dampers 5 and 6 are configured to attenuate the vibration.

Since the tub 2 vibrates, the outer circumference of the tub 2 and the cabinet 1 should be sufficiently spaced apart from each other with a gap ('a' in FIG. 1 or 'b' in FIG. 2) to prevent the cabinet 1 and the tub 2 from colliding with each other. This restricts the capacity or volume of the tub 2 within the cabinet 1 having a fixed size.

Secondly, since the door 1b for loading and unloading the laundry and the openings 2c and 3c of the tub and drum are provided to face the front side of the washing machine, a user has to bend or sit down to load the laundry in the washing machine. This causes inconvenience to the user in using the washing machine.

SUMMARY

Accordingly, the present invention is directed to a drum type washing machine that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An advantage of the present invention is to provide a drum type washing machine, by which vibration may be efficiently attenuated in a manner of providing a maximum capacity within a cabinet of fixed size.

Another advantage of the present invention is to provide a drum type washing machine, by which a user does not have to bend over or sit down to load laundry in the washing machine.

Additional advantages features of the invention will be set forth in the description which follows, and in part will be apparent from the description or may be learned from practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a drum type washing machine according to the present invention includes a cabinet forming an exterior of the drum type washing machine, a tub fixed within the cabinet, the tub having a laundry loading entrance at an outer circumference of the tub, a drum rotatably provided within the tub, the drum having an opening on a lateral side of the drum to communicate with the laundry loading entrance of the tub, a motor assembly provided next to one side of the drum to rotate the drum, and a suspension assembly provided to support a weight of the drum and attenuate vibration of the drum.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and should not be construed as limiting the scope of the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification illustrate embodiments of the invention and together with the description serve to explain the principles of the invention. In the drawings:

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FIG. 1 is a cross-sectional diagram of a drum type washing machine according to a related art;

FIG. 2 is a cross-sectional diagram according to a cutting line II-II shown in FIG. 1;

FIG. 3 is a cross-sectional diagram of a drum type washing machine according to one embodiment of the present invention;

FIG. 4 is a cross-sectional diagram of a drum type washing machine according to another embodiment of the present invention;

FIG. 5 is an exploded perspective diagram of a tub, a drum and a suspension assembly of a drum type washing machine according to another embodiment of the present invention;

FIG. 6 is a cross-sectional diagram of a main damper shown in FIG. 5;

FIG. 7 is a cross-sectional diagram of a sub-damper shown in FIG. 5;

FIG. 8 is a cross-sectional diagram of a drum type washing machine according to a further embodiment of the present invention;

FIG. 9 is an exploded perspective diagram of a tub, a drum and a suspension assembly of a drum type washing machine according to a further embodiment of the present invention; and

FIG. 10 is a cross-sectional diagram of a rear damper shown in FIG. 9.

DETAILED DESCRIPTION

Reference will now be made in detail to an embodiment of the present invention, examples of which are illustrated in the accompanying drawings.

FIG. 3 is a cross-sectional diagram of a drum type washing machine according to one embodiment of the present invention.

Referring to FIG. 3, a drum type washing machine according to one embodiment of the present invention includes a cabinet 10 forming an exterior of the washing machine, a tube 20 fixed within the cabinet 10 to store water therein, a drum 30 rotatably provided within the tub 20, a motor assembly 40 providing a rotational force to the drum 30, and a suspension assembly 70 supporting a weight of the drum 30 and attenuating vibration of the drum 30.

In particular, the cabinet 10 forms the exterior of the drum type washing machine and includes a top cover 13 forming an upper side and a base 16.

Unlike the related art tub, the tub 20 of the present embodiment is fixed within the cabinet 10. That is, the tub 20 is directly assembled to an inner front side of the cabinet 10 of the washing machine, for example, via bolts. It should be appreciated, however, that the tub 20 may be fixed within the cabinet 10 in various ways.

A laundry loading entrance 21 is provided on an outer circumference of the tub 20 instead of being provided on the front side of the tub 20. Preferably, the laundry loading entrance 21 is provided to a position facing an upper side from a lateral side of the outer circumference to facilitate a user to load and unload the laundry. Alternatively, the laundry loading entrance 21 may be provided at another position of the outer circumference of the tub 20.

Optionally, a door 12 for loading the laundry may be provided to a position of the cabinet 10 to oppose the laundry loading entrance 21 of the tub 20.

A door assembly 31 may be provided to the drum 30 to communicate with the laundry loading entrance 21. Preferably, the laundry loading entrance 21 and the door assembly 31 are configured to be opened or closed if necessary.

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Whenever the drum 30 of the drum type washing machine according to the present embodiment invention stops, it may always stop at a position where the door assembly 31 of the drum 30 and the laundry loading entrance 21 of the tub 20 may communicate with each other. Hence, a user is able to load the laundry in the drum 30 without bending over uncomfortably. And, the user is also able to look down on an inside of the drum 30, thereby enhancing the convenience in using the drum type washing machine.

The drum 30 is rotatably provided within the tub 20. The drum 30 is installed to be spaced apart from the tub 20 with a prescribed gap in-between to prevent a collision with the tub 20 due to vibration. And, at least one lift 32 may be provided to an inner circumference of the drum 30 to lift up the laundry.

The motor assembly 40 is provided on one side of the drum 30 to rotate the drum 30.

The motor assembly 40 includes a motor 41 generating a rotational force, a rotational shaft 42 transferring the rotational force of the motor 41 to the drum 30, and a bearing housing 28 rotatably supporting the rotational shaft 42.

Preferably, the motor assembly 40 is provided on one side of the drum 30 instead of being provided on both sides of the drum 30.

In particular, the rotational shaft 42 for rotating the drum 30 is provided on one side of the drum 30 only to maximize a volume within the drum 30.

The suspension assembly 70 is provided to support the weight of the drum 30 and attenuate the vibration of the drum 30.

Preferably, the suspension assembly 70 is configured to support the drum 30 by supporting the bearing housing 28.

As the drum 30 vibrates, so does the motor assembly 40. So, the suspension assembly 70 supports the bearing housing 28, thereby supporting the weight of the drum 30 and attenuating the vibration.

The above-configured suspension assembly 70 may include a damper bracket 72 extending from the bearing housing 28 and an attenuating part provided between the damper bracket 72 and the cabinet 10 to support the damper bracket 72 and attenuate the vibration simultaneously.

In the present embodiment, the attenuating part may include a damper 80 having one end connected to the damper bracket 72 and the other end connected to the base 16.

The damper bracket 72 may be configured to extend to each lower side of the outer circumference of the tub 20 from the bearing housing 28.

FIG. 3 shows the cross-section of the drum type washing machine according to one embodiment of the present invention.

And, the damper 80 of the drum type washing machine according to one embodiment of the present invention is preferably provided at a planar weight center between the entire elements (e.g., the drum 30, the motor assembly 40 for driving the drum 30, the damper bracket 72 assembled to the motor assembly 40, etc.) supported by the damper 80.

The above-configured damper 80 supports the weight of the drum 30, the weight of the motor assembly 40 for the rotation of the drum 30, and the like and plays a role in attenuating the vibration in a vertical direction. In the following description, the damper 80 attenuating the vertical vibration of the drum 30 is called a main damper 80.

And, the damper bracket 72 assembled to the main damper 80 to be supported by the main damper 80 shall be called a main damper bracket 72 in the following description.

FIG. 6 is a cross-sectional diagram of the main damper 80.

Referring to FIG. 6, the main damper 80 preferably includes a cylinder 82, a piston 83 reciprocating within the

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cylinder **82** according to vibration and motion of the drum **30**, and a spring **85** elastically supporting the piston **83**.

In this case, since the main damper **80** is provided between the main damper bracket **72** and the base **16** to support the weight of the drum **30** upwardly, a compressive weight is normally applied to the main damper **80**.

Therefore, it is preferable that the spring **85** is configured to generate an elastic force when the piston **83** enters the cylinder **82**.

A frictional member **84** is provided to the piston **82** to come into contact with an inner circumference of the cylinder **82**. When the drum **30** vibrates, the frictional member **84** may be configured to attenuate the vibration by making a motion of friction with the inner circumference of the cylinder **82** according to a motion of the piston **83**.

In particular, the weight applied to the main damper **80** is elastically supported by the spring **85** and the vibration transferred from the main damper **80** is attenuated by the frictional member **84**.

Preferably, one end of the main damper **80** joined to the main damper bracket **72** includes a hinge joint **87**, while the other end of the main damper **80** joined to the base **16** is configured to be fixed to the base **16** by an elastic material based rubber bushing **86**.

Since the main damper **80** is joined to the main damper bracket **72** by the hinge joint **87**, it may have a relative degree of freedom against a motion of the drum **30**. So, it is able to prevent the vibration or motion of the drum **30** from being directly carried to the cabinet **10**.

Both of the weight of the drum **30** and the weight of the motor assembly **40** for the rotation of the drum **30** are directly applied to the base **16** to which the main damper **80** is joined. To reinforce the base **16**, a reinforcing part for rigidity reinforcement may be provided to the portion of the base to which the main damper **80** is joined.

The reinforcing part may be provided by the curved portion ('**16a**' in FIG. 5) of the base **16** to which the main damper **80** is joined. Alternatively, the reinforcing part may include a separate bracket ('**116**' in FIG. 9).

Referring back to FIG. 3, to prevent the drum **30** from inclining to one side, an elastic member **44** may be further provided to elastically support the backside of the drum **30**. One end of the elastic member **44** is connected to an inner surface of the top cover **13** of the cabinet **10** and the other end of the elastic member **44** is connected to an upper side of the motor assembly **40**.

In particular the elastic member **44** may include a spring. One end of the elastic member **44** is hung on the inner surface of the top cover **13** and the other end of the elastic member **44** is hooked on an upper end of the bearing housing **28**. Thus, the backside of the drum **30** is elastically hung on the top cover **13**, whereby the drum **30** is prevented from inclining to one side.

A user loads laundry into the drum **30** via the laundry loading entrance **21**, which is provided on the lateral side of the outer circumference of the tub **20**, and the door assembly **31**, which is provided on the lateral side of the outer circumference of the drum **30**, and then executes the corresponding washing.

Vibration is generated from the drum **30** in the course of washing and then attenuated by the main damper **80** through the main damper bracket **72**. Moreover, the front side of the tub **20** is directly assembled to the front inside of the cabinet **10** to be fixed thereto. So, if vibration or shock is delivered to the tub **20** assembled in one body to the cabinet **10**, the weight of the cabinet **10** itself being added to raise the rigidity of the tub **20** rather than the tub **20** itself is shaken by the vibration

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or shock. Hence, it is able to enhance the overall vibration characteristics of the drum type washing machine.

Another embodiment of the present invention is explained as follows.

In the aforesaid embodiment of the present invention, the suspension assembly **70** supporting the drum **30** includes a pair of the main dampers **80**. Yet, in the present embodiment, a suspension assembly **70** may further include a sub-damper attenuating horizontal vibration of a drum **30**.

A drum type washing machine according to another embodiment of the present invention is shown in FIGS. 4 to 7.

In describing a drum type washing machine according to another embodiment of the present invention, the same names and reference numbers shall be used for the same parts of the former embodiment.

First of all, a drum type washing machine according to another embodiment of the present invention includes a cabinet **10** forming an exterior of the drum type washing machine, a tub **20** provided within the cabinet **10** to be directly assembled thereto, a drum **30** rotatably provided within the tub **20**, a motor assembly **40** provided in rear of the tub **20** to include a motor **41** rotating the drum **30**, a bearing housing **28** configuring a backside of the tub **20** to support the rotating shaft **42** of the motor **41**, a shock absorbing means **50** provided between the bearing housing **28** and the tub **20** for sealing an internal space of the tub **20** and for absorbing vibration or shock transferred to the tub **20** from the motor **40**, and a suspension assembly **60** supporting the drum to attenuate the vibration or shock transferred to the bearing housing **28**.

A door **12** is provided on a lateral outer circumference of the cabinet **10** instead of being provided on a front side of the cabinet **10**. And, a base **16** defines a bottom side of the cabinet **10**.

The tub **20**, as shown in FIG. 4, includes a tub body **22** directly assembled to an inside of a front side **11** of the cabinet **10**, the tub body **22** having a laundry loading entrance **21** at a lateral outer circumference to communicate with the door **12** of the cabinet **10**, a tub cover **24** assembled to a backside of the tub body **22** to enclose the drum **30**, the tub cover **24** having an opening **23** at its center, a tub bracket **26** closing the opening **23** of the tub cover **24**, and the bearing housing **28** assembled to a backside of the tub bracket **26** to configure the motor assembly rotating the drum, the bearing housing **28** configured to support the rotating shaft **42**.

The tub body **22**, as shown in FIG. 4 and FIG. 5, is fixed to the cabinet **10** by being locked to the inside of the front side of the cabinet **10** by screws **25a**. The tub cover **24** is assembled by accommodating the drum **30** therein. In particular, the tub cover **24** is assembled by being locked to the locking holes **22a** and **24a** on the outer circumferences of the tub body **22** and the tub cover **24** by screws **25c**. The opening **23** of the tub cover **24** is sealed by the tub bracket **26** and the shock absorbing means **50**. The bearing housing **28** is assembled to the backside of the tub bracket **26** by screws **25b**. In this case, the bearing housing **28** is provided with bearing (not shown in the drawings) to enable the rotational shaft **42** to be smoothly rotated and the rotational shaft **42** is supported by the bearing.

The shock absorbing means **50** is provided to absorb vibration or shock generated from the drum **30** and the motor **40** in performing washing or dewatering. The shock absorbing means **50** is formed of an elastic material that contracts or expands against the vibration or shock. And, the shock absorbing means **50** may include a backside gasket provided along an outer circumference of the tub bracket **26** to seal the opening **23**. In the present embodiment, the shock absorbing means **50** is implemented by the backside gasket that simul-

taneously achieves both a sealing function and a shock absorbing function between the tub cover 24 and the tub bracket 26.

Alternatively, the shock absorbing means 50 may be individually configured according to each of the functions. In particular, a sealing member (not shown in the drawings) having the sealing function is inserted between the tub cover 24 and the tub bracket 26 and the shock absorbing means 50 is provided between the bearing housing 28 and the tub bracket 26.

Hence, even if the vibration or shock is generated from the drum 30 or the motor assembly 40 joined to the drum 30, since the shock absorbing means 50 is provided between the drum 30 and the tub 20, the vibration or shock is delivered to the tub 20 after having been buffered via the shock absorbing means instead of being directly carried to the tub 20. The vibration or shock delivered to the tub 20 is then attenuated or reduced by each rigidity and weight of the tub 20 and the cabinet 10.

The motor 40 is assembled to the backside of the bearing housing 28. The rotational shaft 42 of the motor 40 passes through both of the bearing housing 28 and the tub bracket 26 to be fixed to the backside of the drum 30.

The drum 30 is rotated by the rotating shaft 42 of the motor 40. And, at least one lift 32 is provided to an inner surface of the drum 30 to lift a laundry. And, a liquid balancer 34 is provided to a front side of the drum 30. In this case, the liquid balancer 34 plays a role in balancing the drum 30 to suppress the vibration of the drum 30.

The suspension assembly 60 is provided to support the weight of the drum 30 and attenuate the vibration of the drum 30.

In the present embodiment, the suspension assembly 60 may include a damper bracket 62 extending from the bearing housing 28 and an attenuating part supporting the damper bracket 66 to support the drum 30.

And, the attenuating part may include a pair of main dampers 80 supporting the weight of the drum 30 to attenuate the vertical vibration of the drum 30 and a sub-damper 90 attenuating the horizontal vibration of the drum 30.

Moreover the damper bracket 62 may include a pair of main damper brackets 64 joined to a pair of the main dampers 80, respectively and a sub-damper bracket 66 joined to the sub-damper 90.

In particular, the main damper bracket 64 joined to the main damper 80 is configured to have one end to be fixed to one of both lower corner of the bearing housing 28 and the other end bent toward a front side of the tub 20. And, the main damper 80 is joined to the corresponding portion bent toward the front side of the tub 20.

Preferably, the main damper 80 is installed vertical to the base 16. This is because the main damper 80 supports the vertical weights of the drum 30, bearing housing 28, and motor 40 and also plays a role in attenuating the vertical vibration.

In particular, a pair of the main damper brackets 64 are provided to both of the lower corners of the bearing housing 28 toward the front side of the tub 20 and a pair of the main dampers 80 are joined to a pair of the main damper brackets 64, respectively.

One end of the sub-damper bracket 66 joined to the sub-damper 90 is fixed to a center of a lower side of the bearing housing 28, while the other end extends to a prescribed length toward the front side of the tub 20. And, the sub-damper 90 is joined to the portion of the sub-damper bracket 66 extending toward the front side of the tub 20.

In this case, the sub-damper 90 is configured to attenuate the horizontal vibration of the drum 30. In particular, the

sub-damper 90 is preferably configured to incline a front to rear direction of the drum 30 to attenuate the front to rear direction vibration generated from over-vibration of the drum 30.

Alternatively, the sub-damper 90 may be provided in a right to left direction to attenuate the right to left vibration.

Since the configuration of the main damper 80 is identical to that of the aforesaid main damper 80 of the former embodiment of the present invention, details of the main damper 80 are omitted in the following description.

FIG. 7 is a cross-sectional diagram of the sub-damper 90 according to an embodiment of the present invention.

Referring to FIG. 7, the sub-damper 90 includes a cylinder 92 having a hollow configuration, a piston 93 reciprocating within the cylinder 92 according to a motion of the drum 30, and a frictional member 94 provided to the piston 93 to attenuate vibration energy by frictional movement against an inner surface of the cylinder 92.

Preferably, the sub-damper 90 is provided between the sub-damper bracket 66 and the base 16 configuring the bottom side of the cabinet 10. More preferably, both ends of the sub-damper 90 are joined by hinges 97 thereto.

Therefore, if the drum 30 vibrates back and forth, the sub-damper 90 contracts and expands in a direction of the vibration of the drum 30 to attenuate the corresponding vibration.

Similar to the former embodiment, the present embodiment may further include a reinforcing part provided a portion for joining the main damper 80 or the sub-damper 90 to the base 16 of the cabinet 10 to reinforce rigidity.

In this case, the reinforcing part may include a curved part 16a provided to the portion for joining the main damper 80 or the sub-damper 90 to the cabinet 10 or a separate bracket ('116' in FIG. 9).

Referring to FIG. 4, an elastic member 44, such as a coil spring, a string made of rubber and the like, may be provided to an inner surface of the top cover 13 forming a topside of the cabinet 10 to elastically hang the bearing housing 28. In particular, the elastic member 44 elastically supports a rear portion of the drum 30 to prevent the drum 30 from inclining to one side.

Therefore, the vibration or shock generated from the drum 30 is transferred to the rotational shaft 42 of the motor connected to the drum 30 and the bearing housing 28 supporting the rotational shaft 42. In this case, the transferred vibration or shock is primarily absorbed by the contraction or expansion of the shock absorbing means 50 and the rest of the vibration or shock is then delivered to the main dampers 80 and the sub-damper via the main damper brackets 64 and the sub-damper bracket 66, respectively. So, the vibration or shock generated from the drum 30 may be reduced in a manner that the main dampers 80 attenuate the vertical vibration of the vibration delivered to the main dampers 80 and the sub-damper 90 while the sub-damper 90 attenuates the horizontal vibration of the vibration delivered to the main dampers 80 and the sub-damper 90.

Hence, the horizontal vibration generated from the drum 30 is attenuated as well as the vertical vibration, whereby the drum 30 may be supported more stably.

A drum type washing machine according to a further embodiment of the present invention is explained as follows.

FIGS. 8 to 10 are diagram of a drum type washing machine according to a further embodiment of the present invention.

In describing a drum type washing machine according to a further embodiment of the present invention, the same names and reference numbers shall be used for the same parts of the former embodiment.

Referring to FIGS. 8 to 10, a drum type washing machine according to a further embodiment of the present invention includes a cabinet 10 defining an exterior of the drum type washing machine, a tub 20 fixed within the cabinet 10 to store water therein, a drum 30 rotatably provided within the tub 20, a motor assembly 140 provided next to one side of the drum 30 to rotate the drum 30, and a suspension assembly 160 provided to support a weight of the drum 30 and attenuate vibration of the drum 30.

A laundry loading entrance 21 is provided to an outer circumference of the tub 20 to load and unload laundry. And, a door assembly 31 is provided to a specific portion of the drum 30 to communicate with the laundry loading entrance 21.

Moreover, a door 12 may be provided to a specific portion of the cabinet to communicate with the laundry loading entrance 21.

Since the cabinet 10, the tub 20, the drum 30 and the motor assembly 140 of the drum type washing machine according to the further embodiment of the present invention are identical to those of the drum type washing machine according to the former embodiment of the present invention, the corresponding descriptions are referred to in the previous description for convenience of explanation.

Meanwhile, the suspension assembly 160 of the drum type washing machine according to the further embodiment of the present invention includes a damper bracket joined to the bearing housing 128 and an attenuating part joined to the damper bracket to attenuate vibration. In this case, the attenuating part supports a weight of the drum 30 and a weight of the motor assembly 140 driving the drum 30.

The attenuating part may include a main damper 180 supporting the weight of the drum 30 to attenuate vertical vibration and a rear damper 182 attenuating the vertical vibration of the drum to prevent the drum 30 from inclining to one side.

And, the damper bracket may include at least one main damper bracket 164 joined to the main damper 180 and a rear damper bracket 168 joined to the rear damper 182.

Preferably, the at least one main damper bracket 164 joined to the main damper 180 extends from the bearing housing 128 to an outside of an outer circumference of the tub 20 toward each lower lateral side of the tub 20 in a direction of a diameter of the tub 20 and then extends toward a front side of the tub 20 to a prescribed length. And, the main damper 180 is preferably joined to an end portion of the extending portion of the main damper bracket 164.

Preferably, the main damper 180 is provided vertical to the base 16. This is because the main damper 180 plays a role in supporting vertical weights of the drum 30, bearing housing 128 and motor assembly 140 and attenuating the vertical vibration.

In particular, a pair of main damper brackets 164 are provided to extend from both lateral sides of the bearing housing 128 toward the front side of the tub 20, respectively. And, a pair of main dampers 180 are provided to be joined to a pair of the main damper brackets 164, respectively.

Since each of the above-configured main dampers 180 has the same configuration of the aforesaid main damper 80 of the former embodiment of the present invention, its details are omitted in the following description.

Preferably, one end of the rear damper bracket 168 joined to the rear damper 182 is fixed to a lower center of the bearing housing 128 and the other end is configured to extend to a prescribed length toward the base 16. And, the rear damper 182 is vertically joined to an end portion of the other end of the rear damper bracket 168.

FIG. 8 is a cross-sectional diagram of a drum type washing machine according to a further embodiment of the present invention. For convenience of explanation, the main damper bracket 164 is represented as a perspective diagram instead of a cross-sectional diagram.

The main damper 180, as shown in FIG. 9, is provided under each of both of the lower sides of the drum 30 and the rear damper 182 is provided under a rear side of the drum 30. In this case, since a pair of the main dampers 180 are provided under both of the lower sides of the drum 30, the pair of main dampers 180 and the rear damper 182 are provided to configure a triangle.

Namely, three dampers are provided to attenuate the vertical vibration of the drum 30.

The rear damper 182 is the element that prevents the drum 30 from inclining to a front or rear side of the drum 30. Generally, the drum 30 tends to incline to one side owing to a center of weight. Since the heavy motor assembly 140 is normally provided next to the backside of the drum 30, the center of weight of the drum 30 lies in a rear part of the drum 30 rather than a central part of the drum 30 when the drum 30 is empty.

Hence, a pair of the main dampers 180 and the rear damper 182 prevent the drum 30 from drooping while supporting the weight of the drum 30.

In this case, the function and configuration of the rear damper 182 may vary according to an installed position of the corresponding main damper 180.

In particular, if the main damper 180 is provided to a position enabling the empty drum 30 to keep its balance, when laundry and water are loaded in the drum 30, the drum 30 inclines forward while a rear side of the drum 30 relatively rises upward.

In this case, the rear damper 182, as shown in FIG. 10, preferably includes a cylinder 183, a piston 185 reciprocating within the cylinder 183 to attenuate vibration, a frictional member 186 attached to the piston 185, and a spring 184 supporting the piston 185 to provide an elastic force when the piston 185 is pulled out, thereby elastically pulling down the rear side of the drum 30 not to rise. Alternatively, the rear damper 182 may be configured identical to that shown in FIG. 6 to provide an elastic force when the spring 85 is pulled.

If the rear side of the drum 30 is designed to fall when laundry and water are loaded in the empty drum 30 tending to incline backward, the rear damper 182, as shown in FIG. 6, preferably includes the cylinder 82, the piston 83 reciprocating within the cylinder 82 to attenuate vibration, and the spring 85 supporting the piston 83 to activate an elastic force when the piston 83 enters the cylinder 82. In particular, the rear damper 182 elastically supports the rear side of the drum 30 to prevent the rear side of the drum 30 from falling downward.

In this case, positions for installing the main dampers 180 and the rear damper 182 are preferably decided to enable a center of weight working by the drum 30, the motor assembly 140, and the like to exist within the triangle configured by the main dampers 180 and the rear damper 182.

Although the other end portions of the side for joining the main damper brackets 164 of the main dampers 180 and the rear damper 182 and the sub-damper bracket 166 thereto may be directly joined to the base 16, the forming parts ('16a' in FIG. 5) or the reinforcing plates 116 of the former embodiments may be provided to prevent the transformation of the base 16.

Meanwhile, the suspension assembly of the present embodiment may further include sub-dampers 190a and 190b attenuating the horizontal vibration of the drum 30 in addition

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to the main dampers **180** and the rear damper **182** that attenuate the vertical vibration by supporting the weight of the drum **30**.

The horizontal vibration of the drum **30** includes a front-to-rear vibration of the drum **30** and a right-to-left vibration of the drum **30**. And, the horizontal vibration tends to be generated in case that the drum **30** is in an over-vibrating state.

To attenuate the horizontal vibration, the sub-dampers **190a** and **190b** may be provided to incline in a front-to-rear or right-to-left direction.

In particular, if the sub-damper **190a** is provided to incline in the front-to-rear direction, the front-to-rear horizontal vibration of the drum **30** will be attenuated. If the sub-damper **190b** is provided to incline in the right-to-left direction, the right-to-left horizontal vibration of the drum **30** will be attenuated.

Of course, either the sub-damper **190a** or the sub-damper **190b** may be selectively provided to incline in either the front-to-rear direction or the right-to-left direction. Alternatively, both of the sub-dampers **190a** and **190b** may be provided to incline in the front-to-rear direction and the right-to-left direction, respectively.

Preferably, one end of the sub-dampers **190a** and **190b** are hinged to one side of the main damper bracket **164** and the other end of the sub-dampers **190a** and **190b** are hinged to the base **16**.

A sub-damper bracket **166** joined to the sub-dampers **190a** and **190b** may be separately provided. The sub-damper bracket **166** may be configured to be joined to the main damper bracket **164**. Alternatively, the sub-damper bracket (not shown in the drawing) may be configured to be directly joined to the bearing housing **128**.

The above-configured sub-dampers **190a** and **190b** may have the same configurations of the aforesaid sub-dampers **190a** and **190b** of the former embodiment of the present invention.

In the drum type washing machine according to the further embodiment of the present invention, since the tub **20** is directly fixed to the cabinet **10** so as not to fluctuate, the tub **20** may avoid colliding with the cabinet **10**. Hence, a diameter of the tub **20** may be increased to extend a capacity or volume of the drum **30**.

Since one side of the rotating drum **30** is supported instead of both sides of the rotating drum **30**, an internal volume of the drum **30** may be further extended and the number of parts may be reduced. Hence, productivity may be enhanced.

Since the drum **30** is supported by three points using the main dampers **180** and the rear damper **182**, the drum **30** may be prevented from inclining to one side according to the variation of the center of weight attributed to the loaded laundry and water.

Since the sub-dampers **190a** and **190b** are provided to attenuate the front-to-rear and right-to-rear directional vibrations, it is able to effectively suppress the horizontal vibration of the drum **30**.

Accordingly, the embodiment of the present invention provides the following effects or advantages.

First of all, since a tub is directly fixed to a cabinet so as not to fluctuate, it is able to increase a diameter of the tub. Hence, a volume or capacity of a drum may be considerably increased.

Secondly, since a laundry loading entrance and a door assembly are provided on a lateral side of an outer circumference of a drum to load and unload laundry in the drum instead of a front side of the drum, a user does not bend over to load the laundry in the drum and is able to conveniently

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look down on an inside of the drum. Hence, the present invention enhances user's convenience.

Thirdly, a rotational shaft and a motor assembly to rotate a drum are provided to one side of the drum only and one side of the drum is supported only. So, it is unnecessary to support both ends of the drum. Hence, a volume or capacity of the drum may be increased.

Fourthly, a front side of a tub is directly joined and fixed to an inner surface of a front side of a cabinet. In case that vibration or shock is delivered to the tub assembled in one body of the cabinet, a weight of the cabinet is added to increase rigidity of the tub rather than the tub shaking because of the vibration or shock. Hence, an overall vibration characteristic of a drum type washing machine may be enhanced.

It will be apparent to those skilled in the art that various modifications and variations may be made without departing from the spirit or scope of the inventions. Thus, it is intended that the claims cover the modifications and variations of this invention provided they come within the scope of the claims and their equivalents.

What is claimed is:

[1. A drum type washing machine comprising:

a cabinet forming an exterior of the drum type washing machine;

a tub fixed within the cabinet, the tub defining a space where water for washing laundry is held and having a laundry loading entrance at an outer circumference of the tub;

a drum rotatably provided within the space of the tub, the drum having an opening on a lateral circumferential side thereof to communicate with the laundry loading entrance of the tub;

a motor assembly provided next to one side of the drum to rotate the drum the motor assembly including a rotational shaft connected to the drum;

a plate through which the rotational shaft passes, the plate covering part of the space of the tube therebetween; and a gasket connected between the tub and the plate, the gasket covering part of the space of the tub therebetween; and a suspension assembly provided to support a weight of the drum and attenuate vibration of the drum.]

[2. The drum type washing machine of claim 1, the motor assembly comprising:

a motor generating a rotational force;

and

a bearing housing rotatably supporting the rotational shaft, and the suspension assembly comprising:

at least one damper bracket extending from the bearing housing; and

an attenuating part provided between the at least one damper bracket and the cabinet to support the drum via the at least one damper bracket.]

[3. The drum type washing machine of claim 2, the attenuating part comprising a pair of main dampers provided to support the weight of the drum and attenuate vertical vibration of the drum.]

[4. The drum type washing machine of claim 3, the attenuating part further comprising a sub-damper provided to attenuate horizontal vibration of the drum.]

[5. The drum type washing machine of claim 4, wherein the at least one damper bracket is configured to be bent toward a front side of the tub from a center of the bearing housing and wherein one end of the sub-damper is joined to an end portion of the at least one damper bracket.]

[6. The drum type washing machine of claim 4, wherein the sub-damper is connected to both of the at least one damper bracket and the cabinet.]

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[7. The drum type washing machine of claim 3, the attenuating part further comprising an elastic member connecting the bearing housing on a topside of the cabinet.]

[8. The drum type washing machine of claim 3, the at least two main dampers, each comprising:

a cylinder;

a piston provided to reciprocate within the cylinder according to a motion of the drum to attenuate the vibration of the drum; and

a spring configured to elastically support the piston.]

[9. The drum type washing machine of claim 8, wherein a frictional member is provided to an outer circumference of the piston to attenuate the vibration by making a frictional movement against an inner circumference of the cylinder according to a motion of the piston.]

[10. The drum type washing machine of claim 8, wherein each of the at least two main dampers is connected to the corresponding damper bracket.]

[11. The drum type washing machine of claim 2, the attenuating part comprising at least three dampers provided to support the weight of the drum and attenuate vertical vibration of the drum.]

[12. The drum type washing machine of claim 11, the attenuating part comprising:

at least two main dampers provided to support the weight of the drum; and

at least one rear damper provided to prevent the drum from inclining to one side.]

[13. The drum type washing machine of claim 12, wherein the rear damper is configured to prevent the drum from inclining to a front or rear side of the drum.]

[14. The drum type washing machine of claim 12, the at least one damper bracket comprising a rear damper bracket configured to extend from the bearing housing to a center of a lower outer circumference of the tub to be joined to the at least one rear damper.]

[15. The drum type washing machine of claim 14, wherein each of the at least two main dampers is connected to the corresponding main damper bracket and wherein the rear damper is hinged to the rear damper bracket.]

[16. The drum type washing machine of claim 12, the at least two main dampers, each comprising:

a cylinder;

a piston provided to reciprocate within the cylinder according to a motion of the drum to attenuate the vibration of the drum; and

a spring configured to support the piston and have an elastic force when the piston enters the cylinder.]

[17. The drum type washing machine of claim 12, the rear damper comprising:

a cylinder;

a piston provided to reciprocate within the cylinder according to a motion of the drum to attenuate the vibration of the drum; and

a spring configured to support the piston and have an elastic force when the piston is pulled out of the cylinder.]

[18. The drum type washing machine of claim 11, further comprising a sub-damper provided to attenuate horizontal vibration of the drum.]

[19. A drum type washing machine comprising:

a cabinet forming an exterior of the drum type washing machine;

a tub fixed within the cabinet, the tub having a laundry loading entrance at an outer circumference of the tub;

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a drum rotatably provided within the tub, the drum having an opening on a lateral circumferential side of the drum to communicate with the laundry loading entrance of the tub;

a motor assembly provided next to one side of the drum to rotate the drum, the motor assembly including a rotational shaft connected to the drum and a bearing housing to rotatably support the rotational shaft; and

a suspension assembly provided to support a weight of the drum and attenuate vibration of the drum,

wherein the suspension assembly includes at least one damper bracket which is configured to be bent toward a front side of the tub from the bearing housing and a damper which is connected to the at least one damper bracket.]

[20. A drum type washing machine comprising:

a cabinet forming an exterior of the drum type washing machine;

a tub fixed within the cabinet, the tub having a laundry loading entrance at an outer circumference of the tub;

a drum rotatably provided within the tub, the drum having an opening on a lateral circumferential side of the drum to communicate with the laundry loading entrance of the tub;

a motor assembly provided next to one side of the drum to rotate the drum, the motor assembly including a rotational shaft connected to the drum and a bearing housing to rotatably support the rotational shaft; and

a suspension assembly provided to support a weight of the drum and attenuate vibration of the drum, the suspension assembly comprising at least two damper brackets and at least two dampers, wherein

each of the at least two damper brackets extends from the bearing housing to an outside of each lower side of an outer circumference of the tub, and is bent toward a front side of the drum, and extends to a prescribed length, and the two dampers are connected to the two damper brackets, respectively.]

21. A drum type washing machine, comprising:

a tub configured to hold water therein, wherein the tub is fixed to a cabinet;

a drum rotatably disposed in the tub;

a shaft connected to the drum;

a bearing housing that rotatably supports the shaft;

a motor that rotates the shaft;

a gasket that seals an opening of the tub and allows the bearing housing to move relatively to the tub;

a suspension connected to the bearing housing, the suspension comprising at least one center damper vertically disposed with respect to a base of the cabinet at a substantially center position under a rotational axis of the drum; and

a bracket which is connected to the bearing housing, extends rearward, and is connected to the at least one center damper.

22. The drum type washing machine of claim 21, wherein the at least one center damper is arranged spaced away from the tub in the rotational axis direction.

23. The drum type washing machine of claim 21, wherein the at least one center damper is connected to a lower center portion of the bearing housing.

24. The drum type washing machine of claim 21, wherein the suspension further comprises an inclined damper disposed at a left or right side of the rotational axis.

25. The drum type washing machine of claim 21, wherein the suspension further comprises a plurality of dampers arranged under the tub.

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26. The drum type washing machine of claim 25, wherein the plurality of dampers is arranged at both left and right sides with respect to the rotational axis.

27. The drum type washing machine of claim 25, wherein the plurality of dampers comprises an inclined damper.

28. The drum type washing machine of claim 25, wherein the plurality of dampers comprises a damper which is vertically disposed.

29. The drum type washing machine of claim 25, wherein the plurality of dampers comprises two vertical dampers and two inclined dampers.

30. The drum type washing machine of claim 21, wherein the at least one center damper comprises a spring damper.

31. The drum type washing machine of claim 21, wherein an upper end of the at least one center damper is positioned farther spaced away from the drum in the rotational axis direction than a front surface of the bearing housing.

32. The drum type washing machine of claim 21, wherein the at least one center damper is connected hingedly at an upper end and fixed by a bushing at a lower end.

33. A drum type washing machine, comprising:

a tub configured to hold water therein, wherein the tub is fixed to a cabinet;

a drum rotatably disposed in the tub;

a shaft connected to the drum;

a bearing housing that rotatably supports the shaft;

a motor that rotates the shaft;

a gasket that seals an opening of the tub and allows the bearing housing to move relatively to the tub;

a suspension assembly connected to the bearing housing that reduces vibration of the drum, the suspension assembly comprising at least one center damper vertically disposed with respect to a base of the cabinet at a substantially center position under a rotational axis of the drum; and

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a bracket which is connected to the bearing housing, extends rearward, and is connected to the at least one center damper.

34. The drum type washing machine of claim 33, wherein the at least one center damper is arranged spaced away from the tub in the rotational axis direction.

35. The drum type washing machine of claim 33, wherein the at least one center damper is connected to a lower center portion of the bearing housing.

36. The drum type washing machine of claim 33, wherein the suspension assembly further comprises an inclined damper disposed at a left or right side of the rotational axis.

37. The drum type washing machine of claim 33, wherein the suspension assembly further comprises a plurality of dampers arranged under the tub.

38. The drum type washing machine of claim 37, wherein the plurality of dampers is arranged at both left and right sides with respect to the rotational axis.

39. The drum type washing machine of claim 37, wherein the plurality of dampers comprises an inclined damper.

40. The drum type washing machine of claim 37, wherein the plurality of dampers comprises a damper which is vertically disposed.

41. The drum type washing machine of claim 37, wherein the plurality of dampers comprises two vertical dampers and two inclined dampers.

42. The drum type washing machine of claim 33, wherein the at least one center damper comprises a spring damper.

43. The drum type washing machine of claim 33, wherein an upper end of the at least one center damper is positioned farther spaced away from the drum in the rotational axis direction than a front surface of the bearing housing.

44. The drum type washing machine of claim 33, wherein the at least one center damper is connected hingedly at an upper end and fixed by a bushing at a lower end.

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