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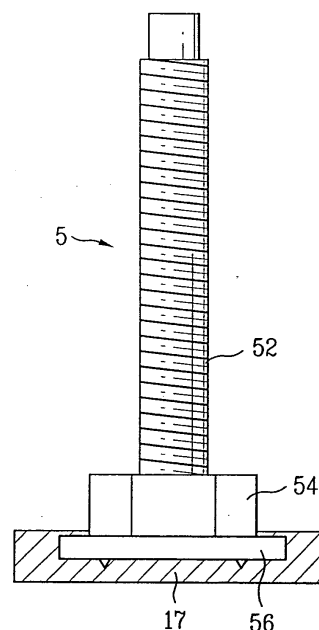
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(54) **Member for washing machine for reducing vibration**

(57) Washing machine including a cabinet forming an outside shape of the washing machine, legs (5) fitted to a bottom of the cabinet for supporting the cabinet, and leg pads (17) joined to an underside of the legs respectively for attenuating vibration taken place when the washing machine is operated, wherein the leg pad (17) is formed of block copolymer of hard blocks and soft blocks, thereby attenuating vibration.

FIG. 10



Description

[0001] The present invention relates to members for washing machines for reducing vibration. More particularly a washing machine with reduced vibration during operation.

[0002] The washing machine removes contaminants from laundry by applying energy such by impact using, for example, a pulsator, a rotating drum or an agitator. The drum washing machine rotates a drum to drop the laundry to create an impact. The pulsator, or the agitator washing machine creates an impact by means of a rotating pulsator or agitator connected to a shaft vertically mounted in a washing tub.

[0003] Thus washing machines wash laundry by impacting the laundry mostly with mechanical means. This causes in general vibration. To address this, washing machines are provided with different vibration attenuation means.

[0004] Before starting description of a related art vibration attenuating method, as an example of a related art washing machine, the drum washing machine will be described with reference to FIGS. 1 and 2.

[0005] A cabinet 3, a body of the washing machine, is provided with a front portion 34, side portions 32, an upper cover 38, and a lower base 36. The front portion 34 of the cabinet has a door 4 mounted to be opened/closed, and the base 36 has legs 5 for supporting the washing machine on a floor on which the washing machine is installed.

[0006] The cabinet 3 has a tub 7 for holding washing water, and a drum 9 rotatably mounted therein for laundry. The drum 9 has a motor 11 connected to it for generating a driving force to rotate the drum 9.

[0007] Upon putting the washing machine into operation, the drum 9 rotates at a high speed, according to which vibration is occurs. Particularly, since the drum 9 rotates at a high speed in a spinning cycle, the vibration is pronounced. According to this, different kinds of means are provided to the washing machine for reducing the vibration produced or to attenuate the generated vibration.

[0008] For example, for preventing and reducing transmission of the vibration from the drum 9 to the cabinet 3, and the like, there are springs 13 between the tub 7 and the upper cover 38, and dampers 15 between the tub 7 and the base 36. Moreover, the material or thickness of the side portions 32 and/or base 36 of the cabinet 3 are chosen, or recesses 32a can be formed in the side portions 32 of the cabinet 3. As illustrated in FIG 3 in detail, a leg pad 17 of a vibration absorbing material can be fitted to the leg 5.

[0009] However, the related art vibration attenuating methods and washing machines have the following problems.

[0010] First, any correlation between the different kinds of vibration attenuating means has not been clear. This limits the reduction of vibration overall.

[0011] Second, effective attenuation of the vibration over all ranges of rotating speed of the drum or the motor of the washing machine has been difficult. For an example, if the damping properties of the dampers are designed for attenuation of transient vibration mostly caused by non-uniform distribution of the laundry when commencing a spinning cycle, the vibration can actually become heavier at the rated spinning speed. Conversely, if the damping properties are designed differently, transient vibration occurs if the vibration at the rated spinning speed is reduced. Moreover, in the case of the leg pad, since the range of the rotation speed of the washing machine effective for attenuating the vibration is fixed substantially depending on the material of the leg pad, it is difficult to attenuate vibration effectively over all ranges of rotation speed of the washing machine.

[0012] An aspect of the present invention is defined in the accompanying independent claims. Some preferred features are recited in the dependent claims.

[0013] An embodiment of the present invention is directed to a washing machine that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

[0014] An object of embodiments of the present invention is to provide effective attenuation of vibration in a washing machine.

[0015] Another object of embodiments of the present invention is to provide effective attenuation of vibration of a washing machine in which vibration attenuation is effective over a broad range of rotation speeds of the washing machine.

[0016] Additional features and advantages of the invention will be set forth in the description which follows, and in part will be apparent to those having ordinary skill in the art upon examination of the following 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.

[0017] To achieve these objects and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, the washing machine may include a cabinet forming an outside shape of the washing machine, legs fitted to a bottom of the cabinet for supporting the cabinet, and leg pads joined to an underside of the legs respectively for attenuating vibration occurring when the washing machine is operated, wherein the leg pad is formed of block copolymer of hard blocks and soft blocks.

[0018] The leg pad includes a first member in contact with a floor having the washing machine installed thereon, and a second member in contact with the first member, wherein, preferably, at least one of the first member and the second member is the block copolymer of hard blocks and soft blocks.

[0019] Preferably, the hard block is a material which

has required mechanical properties, and the soft block is a material which has vibration attenuation characteristics. Preferably, the soft block has a glass transition temperature of room temperature, and more preferably, $-30^{\circ}\text{C} \sim 30^{\circ}\text{C}$.

[0020] Preferably, the leg pad of the washing machine installed on a slippery floor has a Shore hardness of approx. 80, and preferably the leg pad of the washing machine installed on a non-slippery floor has a Shore hardness of approx. 30.

[0021] Preferably, the hard block is polystyrene, and the soft block is polyisoprene, and more preferably, the soft block is vinyl-polyisoprene. The block copolymer is preferably blended with at least one selected from olefin based thermo plastic resin, ethylene- α olefin copolymer, ethylene-vinylacetate copolymer, ethylene-ethylacrylate copolymer, styrene-butadiene-styrene copolymer, and styrene-isoprene-styrene copolymer.

[0022] In other embodiment of the present invention, there is provided a washing machine including a cabinet forming an outside shape of the washing machine, a tub in the cabinet for holding washing water, a drum rotatably mounted in the tub, dampers fitted between a base of the cabinet and the tub for reducing transmission of vibration from the drum, wherein the damper is coupled to the cabinet, with a first damping member in contact with the damper, and a second damping member in contact with the first damping member placed inbetween, and at least one of the first damping member, and the second damping member is block copolymer of hard blocks and soft blocks.

[0023] Also, the hard block is a material which has required mechanical properties, and the soft block is a material which has vibration attenuation characteristics.

[0024] It is to be understood that both the foregoing description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention claimed.

[0025] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention.

[0026] In the drawings;

FIG. 1 illustrates a perspective view of a related art drum washing machine;

FIG. 2 illustrates a longitudinal section of FIG. 1;

FIG. 3 illustrates a side view of the leg in FIG. 1;

FIGS. 4 and 5 illustrate graphs each showing a principle and effect of a washing machine with reduced vibration in accordance with a preferred embodiment of the present invention;

FIG. 6 illustrates a structure of a leg pad applicable to a washing machine with reduced vibration in accordance with a preferred embodiment of the

present invention, schematically;

FIG. 7 illustrates a comparative graph of damping forces of the leg pads of the present invention and the related art;

FIG. 8 illustrates a disassembled perspective view of a leg and a leg pad in accordance with a preferred embodiment of the present invention;

FIG. 9 illustrates a side view of FIG. 8;

FIG. 10 illustrates a section of a leg and a leg pad in accordance with another preferred embodiment of the present invention;

FIG. 11 illustrates a section of a leg and a leg pad in accordance with still another preferred embodiment of the present invention;

FIG. 12 illustrates a section of a leg pad in accordance with another preferred embodiment of the present invention;

FIG. 13 illustrates a section of a variation of FIG. 12;

FIGS. 14A and 14B illustrate a section and a plan view of a leg pad in accordance with another preferred embodiment of the present invention, respectively;

FIGS. 15A and 15B illustrate a section and a plan view of a variation of FIGS. 14A or 14B;

FIGS. 16 and 17 illustrate sections each showing a leg pad in accordance with another preferred embodiment of the present invention; and

FIGS. 18 ~ 21 illustrate sections each showing a detail of a damper fastening portion in a washing machine with reduced vibration of the present invention.

[0027] A principle of a washing machine with a reduced vibration will be described, with reference to FIGS. 4 and 5.

[0028] Of various methods for attenuating vibration, the inventor has searched the most effective methods. As a result, of various approaches, such as dampers, material, thickness and shape of the cabinet, and material of the leg pad, it turns out that optimization of the leg pad is the most effective for reduction of the vibration. Test results verifying that proper design of the leg pad is the most effective for reduction of the vibration are illustrated in FIGS. 4 and 5.

[0029] FIGS. 4 and 5 illustrate graphs each showing principle and effect of a washing machine with reduced vibration in accordance with a preferred embodiment of the present invention. That is, vibrations of different washing machines (hereafter called "samples"), in which various parameters generally known to be effective for vibration are varied, are measured in spinning processes in which vibration can cause the most serious problem. In the vibration measurement, a 400g of eccentricity is provided, and the vibration is measured at a right side upper corner 'A' and at a right side central portion 'B' of the cabinet with a vibration measuring apparatus (EQP/2).

[0030] FIG. 4 illustrates the test result the a right side

portion of the cabinet, and FIG. 5 illustrates a test result at a left side portion of the cabinet. In FIGS. 4 and 5, A (Max) denotes a greatest vibration measured at the upper corner, and A(Normal) denotes a normal vibration measured at the upper corner. Likewise, B(Max) denotes a greatest vibration measured at the central portion, and B(Normal) denotes a normal vibration measured at the central portion.

[0031] Sample 1 denotes a drum washing machine in which a 0.15mm bead depth is added to a general bead depth formed at the side of the cabinet, and the leg pad is formed of butyl rubber as in the related art. Sample 1a denotes the same washing machine as sample 1, except that the material of the leg pad is different. Sample 2 denotes a drum washing machine in which bead depth is not changed, and material of the leg pad is also the butyl rubber. Sample 2a denotes a washing machine the same as sample 2, except that the material of the leg pad is different.

[0032] The material for the leg pad used in sample 1a and sample 2a, showed to the invention that the best result is obtained from among many materials studied and tested.

[0033] Upon reviewing test results of sample 1 and sample 2 with leg pads that are the same, and only the bead depths are different, it was noted that deeper bead depth is effective for attenuation of vibration to some extent. However, it was observed that the correlation between the bead depth and the vibration attenuation is not clear.

[0034] However, upon reviewing test results of sample 1 and sample 1a, or sample 2 and sample 2a, in which bead depths are the same, and the leg pads are different, it was noted that a proper leg pad is very effective for attenuating vibration.

[0035] Moreover, upon reviewing test results of sample 1a and sample 2a, it was noted that optimization of the material of the leg pad is more effective for vibration attenuation than the bead depth.

[0036] Therefore, for effective vibration attenuation, it is particularly preferable that the leg pad is designed properly. Therefore, it is preferable that, first of all, the most suitable leg pad, particularly, the most suitable material of the leg pad is used for attenuation of the vibration, and the other vibration attenuation parameters are taken into consideration. According to this, the inventor further studied which the leg pad would be most suitable for vibration attenuation.

[0037] First of all, it is required that the leg pad has an excellent vibration attenuating characteristic. However, for use as the leg pad it is required necessary for it to meet other conditions. For an example, its mechanical properties, such as hardness, its anti-slip property for preventing the washing machine from moving from an installed place, its formability for ease of fabrication, and the like have to be considered. Because, even if the vibration attenuation characteristic is satisfied, if the material fails to have a proper hardness, resonance can

occur at a certain range of rotation speed of the washing machine, to cause the washing machine to 'walk' across the floor. If friction with the floor is not adequate, it is liable that the washing machine will move too easily across the floor.

[0038] At the end, even though it is required that the leg pad meets these other conditions in addition to the vibration attenuating characteristic, selection of an optimal leg pad has not proved possible up to now. Accordingly, up to now, as the leg pad, metal, plastic, isobutylene-isoprene rubber, or the like is used, each material has advantages, and disadvantages. Even though metal or plastic, with a comparatively high hardness, has a resonance range outside of the typical rotation speed of the washing machine, it is liable that the leg pad of metal or plastic causes walking of washing machine in almost all ranges of the rotation speed, regardless of the rotation speed. Moreover, the leg pad of metal or plastic is liable to cause slipping of the washing machine because the metal or plastic has low frictional engagement with the floor. In the case of the butyl rubber, since the butyl rubber has a resonance range coincident with a low rotation speed range of the washing machine, it is required that the washing machine is better to pass this resonance range quickly. Also, the leg pad of butyl rubber is liable to cause walking of the washing machine in the low rotation speed range, even though the walking is comparatively rare at high rotation speeds.

[0039] The inventor has found that use of a block copolymer of hard blocks and soft blocks is surprisingly very effective as the material of the leg pad. That is, as illustrated in FIG 6, the inventor has found that the leg pad is preferably formed of a copolymer in which the hard blocks HS and the soft blocks SS make a net form. Because the use of the leg pad of the copolymer of the hard blocks HS and the soft blocks SS enables selection of a material that meets required mechanical properties, such as hardness, i.e. the hard blocks, and a material that meets required vibration attenuation characteristic, i.e the soft blocks. According to this, the leg pad can be designed comparatively easily to meet the vibration attenuation characteristics while other conditions are also met.

[0040] In view of vibration attenuation, it is preferable that a material that has a glass transition is used as the block copolymer, particularly, the soft block. A material of which the glass transition temperature is close to a temperature at which the washing machine is used is better still. While thermal movement in chain forms of polymers in the net becomes violent at higher temperatures than the glass transition temperature, creating a rubbery state, the thermal movement is suppressed at temperatures below the glass transition temperature, and it then becomes glassy due to reduction of its own volume, and has poor vibration attenuation qualities.

[0041] Since amorphous polymers, such as rubber, exhibit the glass transition, it is preferable that rubber is selected as the leg pad. The butyl rubber used presently

also exhibits the glass transition. However, as described before, the leg pad is required to have other properties which the butyl rubber, in the form of a copolymer prepared by copolymerizing a small amount of isoprene with isobutylene, cannot meet. In view of the vibration attenuation characteristic, it is difficult to obtain the desired adequate vibration attenuation effect because the butyl rubber has a glass transition temperature in the range of $-40^{\circ}\text{C} \sim -60^{\circ}\text{C}$, which is substantially lower than the temperature of use of the washing machine. As shown in FIG 7, in the case of butyl rubber, though the butyl rubber has a uniform damping force in a broad temperature range in which the washing machine is used in a more realistic temperature range of use of the washing machine, the damping force of the leg pad of the butyl rubber is poorer than the leg pad of the block copolymer.

[0042] As described, preferably, the leg pad of the present invention is formed of a block copolymer of hard blocks and soft blocks, wherein the hard blocks are selected with mechanical considerations in mind, and the soft blocks are selected with vibration attenuation in mind.

[0043] Accordingly, it is preferable that a material is selected as the soft block, of which the glass transition temperature is in the vicinity of the temperature of use of the washing machine. Of course, it is preferable that a material is selected for the hard blocks in view of requirements of mechanical properties, such as hardness. For an example, in the case of a washing machine installed on a slippery floor of cement or tile, it is preferable that the hardness of the leg pad is high. In general, it is preferable that the Shore hardness is approx. 80. In contrast to this, in the case of wood flooring, it is preferable that the hardness is low, in general, approx. 30 in Shore A hardness.

[0044] As a result of tests on various materials, the inventor has found that the hard block can be polystyrene, and the soft block can be polyisoprene, particularly, vinyl-polyisoprene.

[0045] In fabrication of the leg pad, though the block copolymer may be used solely, at least one selected from olefin based thermoplastic resin, ethylene- α olefin copolymer, ethylene-vinylacetate copolymer, ethylene-ethylacrylate copolymer, styrene-butadiene-styrene copolymer, and styrene-isoprene-styrene copolymer may be blended with the block copolymer. Moreover, additives, such as a cross-linker, filler, and/or softener may be introduced into a base material of the block copolymer, that is known to a person skilled in the field of art, of which detailed description will be omitted.

[0046] As described, the leg pad of the block copolymer of hard block and soft block enables fabrication of a leg pad that satisfies the vibration attenuation characteristic and other required properties very well.

[0047] In order to verify this, a test was carried out on a material that substantially satisfies the above conditions among commercially available materials. The material used in the test is Kuraray Hybrar. The Hybrar, a

block copolymer of polystyrene and polyisoprene, has a glass transition temperature in the vicinity of room temperature of approx. $-19^{\circ}\text{C} \sim -8^{\circ}\text{C}$. As shown in FIG. 7, it is verified that the leg pad of the Hybrar has very good damping properties in the vicinity of room temperature. In FIG 4 or 5, the material of the leg pad in the sample 1a and the sample 2a is Hybrar. Of course, the material suitable for the leg pad is not limited to Hybrar, and any material that satisfies above conditions can be used.

[0048] It is also preferable that the leg pad has, not only an excellent vibration attenuation characteristic, but also excellent formability and workability for the sake of the production costs of the washing machine. Hybrar has a better anti-slip characteristic than butyl rubber, and particularly, maintains good friction even in a watery environment compared to other rubbers. Moreover, since the Hybrar can be used as a thermoplastic resin that can be injection molded or extrusion molded, or a thermosetting resin that can be pressed, the Hybrar also has the advantage of good formability. However, if it is intended to use the Hybrar as the thermosetting resin, a separate cross-linker is required.

[0049] Referring to FIG 8, an embodiment is shown in which the leg is joined to the leg pad by a predetermined method. In general, the leg 5 includes a cylindrical body 52, and a hexagonal head 54 at a bottom end of the body 52. It is preferable that the body 52 has an external thread for easy height adjustment. The head 54 is used for easy turning of the body 52 for adjustment of the height.

[0050] The leg pad 17 is fitted to a bottom end of the leg 5. Though the leg pad 17 may be fitted to the head 54 of the leg 5 directly, it is preferable that an enlarged base portion 56 may be further formed in a lower portion of the head 54 forming a fitting area for easy fitting.

[0051] The leg 5 and the leg pad 17 may be joined by insert molding, bonding, or other methods. For an example, as shown in FIG. 9, the leg 5 and the leg pad 17 may be joined with an adhesive. As shown in FIG 10, the leg 5 and the leg pad 17 may be joined by insert molding. As shown in FIG 11, a recess 17a having part of a lower portion of the leg pad 17 cut away therefrom in a circumferential direction may be formed, and the leg 5 and the leg pad 17 may be joined with an annular resilient clip 19 that embraces the enlarged portion 56 of the leg and the recess 17a in the leg pad 17.

[0052] In the meantime, though a leg pad formed of one material, i.e., the block copolymer is described in the above embodiment, as a result of study, the inventor has found that it is possible to form the leg pad of more than two materials. That is, it is preferable that the leg pad is formed of a first member in contact with a floor and a second member in contact with the first member. One of the first and second members can be formed of block copolymer, and the other one formed in other material, such as butyl rubber. Because the material of the leg pad, i.e., the block copolymer for the hard blocks, and the soft blocks may undergo plastic deformation

over time, degradation vibration attenuation can result. Particularly, the vibration attenuation effect can become poor in the low temperature range.

[0053] Referring to FIG. 12, the leg pad 17 includes a first member 17a in contact with a floor having the washing machine installed thereon, and a second member 17b fitted to the first member 17a, wherein it is preferable that one of the first member 17a and the second member 17b is formed of butyl rubber, and the other one is formed of block copolymer. For the sake of description, the cross hatching (for an example, reference symbol 17b in FIG. 12) denote that the material is block copolymer, and the dots (for an example, reference symbol 17a in FIG. 12) denotes that the material is butyl rubber.

[0054] Though the first member 17a may be formed of butyl rubber, and the second member 17b may be formed of block copolymer, as shown in FIG. 13, the first member 17a can be formed of block copolymer, and the second member 17b can be formed of butyl rubber. Because the block copolymer has better contact with the floor, it is favorable that the first member 17a is formed of the block copolymer.

[0055] Referring to FIGS. 14A and 14B, the first member 17a may have a projection 170 having the second member 17b passing through it. Or, as shown in FIGS. 15A and 15B, the first member 17a may have a plurality of projections 170 having the second member 17b passing through them.

[0056] Referring to FIGS. 16 and 17, a third member 17c of the same material as the first member 17a may be fitted to top of the second member 17b.

[0057] The first member 17a, the second member 17b, and the third member 17c may be joined by bonding, or double injection molding, and the leg pad 17 and the leg may be joined by bonding, insert molding, or mechanical joining, as described before.

[0058] In the study made by the inventor, it turns out that the principle of the present invention is applicable not only to the leg, but also to other components, used in the washing machine and the like as a vibration attenuator. Particularly, it is preferable that the principle of the present invention is applied to the damper fitted between the base of the cabinet and the tub for preventing vibration of the washing machine and the like being transmitted to the cabinet.

[0059] The application of the principle of the present invention to the damper of the drum washing machine will be described with reference to FIG. 18.

[0060] One end of the damper 15 is fixed to the base 36 with a damping member 100 placed in between. In this instance, though the damping member 100 may be formed of one material solely, i.e., the block copolymer, as a result of study of the inventor, it is found out that it is possible to form the damping member 100 of the present invention of more than two materials. For an example, one is formed of block copolymer, and the other one is formed of other material, such as butyl rubber. The block copolymer of the hard blocks, and the soft

blocks may undergo plastic deformation after a certain time period, resulting in poor vibration attenuation. Particularly, the vibration attenuation effect can become poor in a low temperature range.

[0061] For the sake of description, cross hatching (for an example, reference symbol 120 in FIGS. 18 ~ 21) denotes that the material is block copolymer, and the dot marks on the section (for an example, a reference symbol 110 in FIGS. 18 ~ 21) denote that the material is butyl rubber.

[0062] Referring to FIG 18, the damper 15 is fixed to the base 36 with a first damping member 110 in contact with the damper 15. A second damping member 120 is in contact with the first damping member 110 placed in-between, wherein one of the first damping member 110 and the second damping member 120 is a block copolymer of hard blocks and soft blocks.

[0063] In more detail, the damper 15 has a hollow coupling portion 15a at one end (the portion nearest to the base of cabinet). The coupling portion 15a has a cylindrical first damping member 110 fitted therein, and a cylindrical second damping member 120 is fitted in the hollow of the first damping member 110. There is a bracket 16 fixed to the base 36, having one side open to receive the damper.

[0064] The coupling portion 15a of the damper 15, the first damping member 110, and the second damping member 120 are positioned in the opening of the bracket 16, and, in this arrangement, a bolt 16a is passed through the bracket 16, and the second damping member 120, so that the damper 15 is fitted between the tub and the cabinet.

[0065] Referring to FIG 18, the first damping member 110 may be formed of butyl rubber, and the second damping member 120 formed of block copolymer. However, as shown in FIG 19, it is preferable that the first damping member 110 is formed of the block copolymer, and the second damping member 120 is formed of butyl rubber. This is because it is favorable in view of vibration attenuation that the first damping member 110 that comes into contact with the damper 15 at first is formed of the block copolymer.

[0066] Moreover, referring to FIGS. 20 and 21, it may also be possible that a third damping member 130, formed of the same material as the material of the first damping member 110, is fitted on an inside of the second damping member 120. Of course, it is also possible that the third damping member 130 is fitted on an outside of the first damping member 110.

[0067] Besides the first damping member 110, the second damping member 120, and the third damping member 130 being joined by bonding or double injection molding, the components may alternatively be joined by other methods.

[0068] Though a drum washing machine is illustrated and described in the above embodiments, the present invention is not limited to this. That is, the present invention is applicable to the pulsator washing machine, and

the agitator washing machine, too. Moreover, the present invention is applicable, not only to a leg joined to the cabinet, but also to other components that are used for attenuation of vibration in the washing machine.

[0069] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

[0070] As has been described, the method for attenuating vibration of a washing machine, and a washing machine thereof has the following advantages.

[0071] First, vibration can be attenuated effectively by selecting the leg pads, properly. That is, vibration of the washing machine can be reduced effectively while changes in design, and cabinet material, thickness, and bead depth that raise production costs increases are minimized. That is, by proper selection of the damping member of the damper, and the leg pad of which design and effect verification are comparatively easy, the vibration can be attenuated very effectively.

[0072] Second, the present invention permits selection of a leg pad which meets, not only the vibration attenuation characteristic, but also other necessary properties, such as hardness, and anti-slip characteristics. At the same time, the invention can make a washing machine design effective in vibration attenuation over all ranges of rotation speed of the washing machine.

Claims

1. A washing machine comprising:

a cabinet forming an outside shape of the washing machine;
supports fitted to the cabinet; and
a support pad joined to an underside of the leg for attenuating vibration when the washing machine is operated,

wherein the support pad is formed of block copolymer of hard blocks and soft blocks.

2. The washing machine as claimed in claim 1, wherein the pad includes;

a first member for contacting a floor and
a second member in contact with the first member,

wherein at least one of the first member and the second member is the block copolymer of hard blocks and soft blocks.

3. The washing machine as claimed in claim 1 or 2,

wherein the hard block is a material which has suitable mechanical properties, and the soft block is a material which has vibration attenuation properties.

4. The washing machine as claimed in claim 1, 2 or 3, wherein the soft block has a glass transition temperature at room temperature.

5. The washing machine as claimed in claim 4, wherein the glass transition temperature is -30°C ~ 30°C.

6. The washing machine as claimed in claim 3, wherein the pad of the washing machine has a Shore hardness of approx. 80.

7. The washing machine as claimed in claim 3, wherein the pad of the washing machine has a Shore hardness of approx. 30.

8. The washing machine as claimed in claim 1, 2 or 3, wherein the hard block is polystyrene, and the soft block is polyisoprene.

9. The washing machine as claimed in claim 1, 2 or 3, wherein the soft block is vinyl-polyisoprene.

10. The washing machine as claimed in claim 9, wherein the block copolymer is blended with at least one selected from olefin based thermo plastic resin, ethylene- α olefin copolymer, ethylene-vinylacetate copolymer, ethylene-ethylacrylate copolymer, styrene-butadiene-styrene copolymer, and styrene-isoprene-styrene copolymer.

11. The washing machine as claimed in claim 3, wherein the support and the pad are joined by being bonded with an adhesive, by insert molding, or by a resilient clip.

12. The washing machine as claimed in claim 2, wherein the first member has at least one projection projecting into the second member.

13. The washing machine as claimed in claim 2, wherein the second member has a third member in contact therewith, made of the same material as the first member.

14. A washing machine comprising:

a cabinet;
a tub in the cabinet for holding washing water;
and
dampers fitted between a base of the cabinet and the tub for reducing transmission of vibration from the drum,

wherein the damper is coupled to the cabinet,

a first damping member being in contact with the damper, and a second damping member being in contact with the first damping member placed inbetween, at least one of the first damping member and the second damping member being block copolymer of hard blocks and soft blocks. 5

15. The washing machine as claimed in claim 14, wherein the second damping member has a third damping member in contact therewith, made of the same material as the first damping member. 10

16. The washing machine as claimed in claim 14 or 15, wherein the hard block is a material which has suitable mechanical properties, and the soft block is a material which has vibration attenuation properties. 15

17. The washing machine as claimed in claim 16, wherein the soft block has a glass transition temperature at room temperature. 20

18. The washing machine as claimed in claim 17, wherein the glass transition temperature is $-30^{\circ}\text{C} \sim 30^{\circ}\text{C}$. 25

19. The washing machine as claimed in claim 16, wherein the hard block is polystyrene, and the soft block is polyisoprene, for example vinyl-polyisoprene. 30

20. The washing machine as claimed in claim 19, wherein the block copolymer is blended with at least one selected from olefin based thermo plastic resin, ethylene- α olefin copolymer, ethylene-vinylacetate copolymer, ethylene-ethylacrylate copolymer, styrene-butadiene-styrene copolymer, and styrene-isoprene-styrene copolymer. 35

21. A vibration attenuating member for a washing machine comprising a block copolymer of hard blocks and soft blocks, the member being, for example, a support or a damper. 40

45

50

55

FIG. 1
Related Art

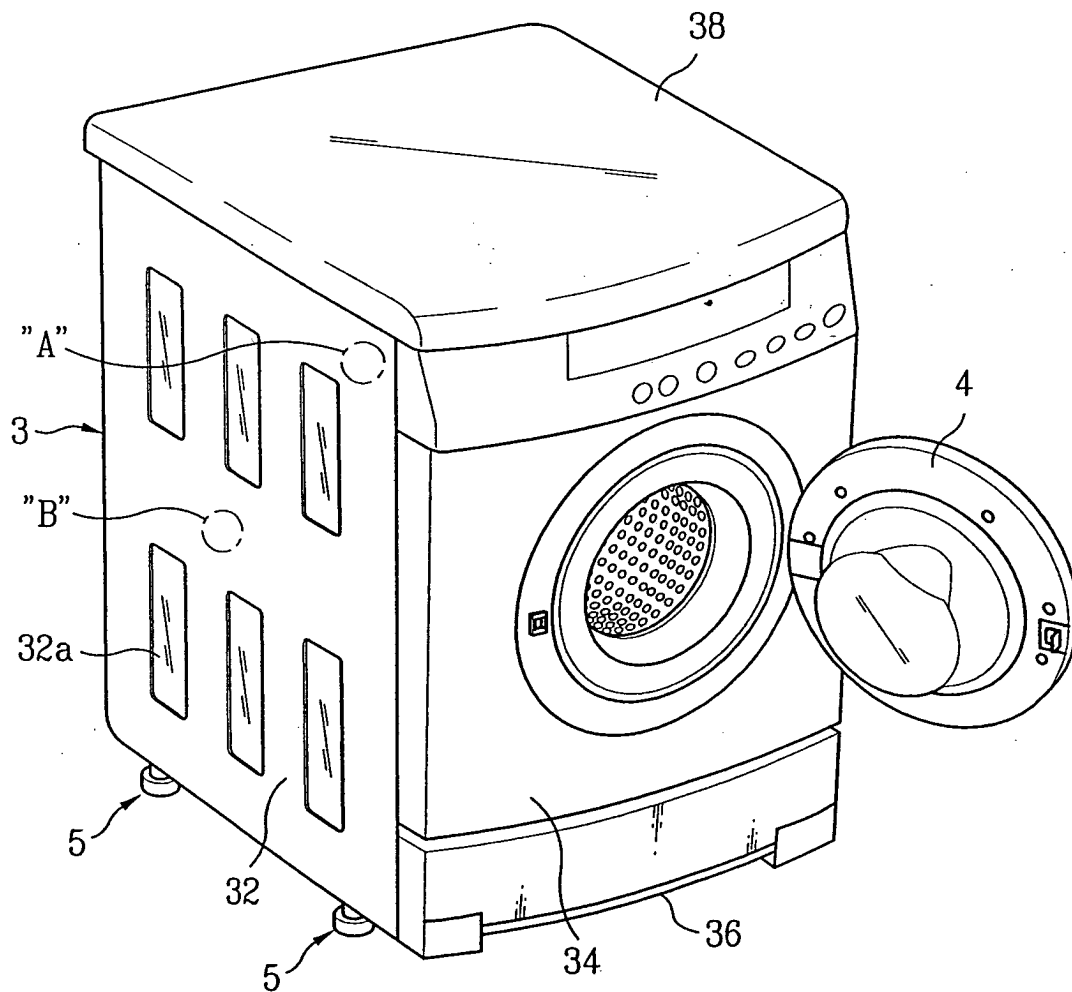


FIG. 2
Related Art

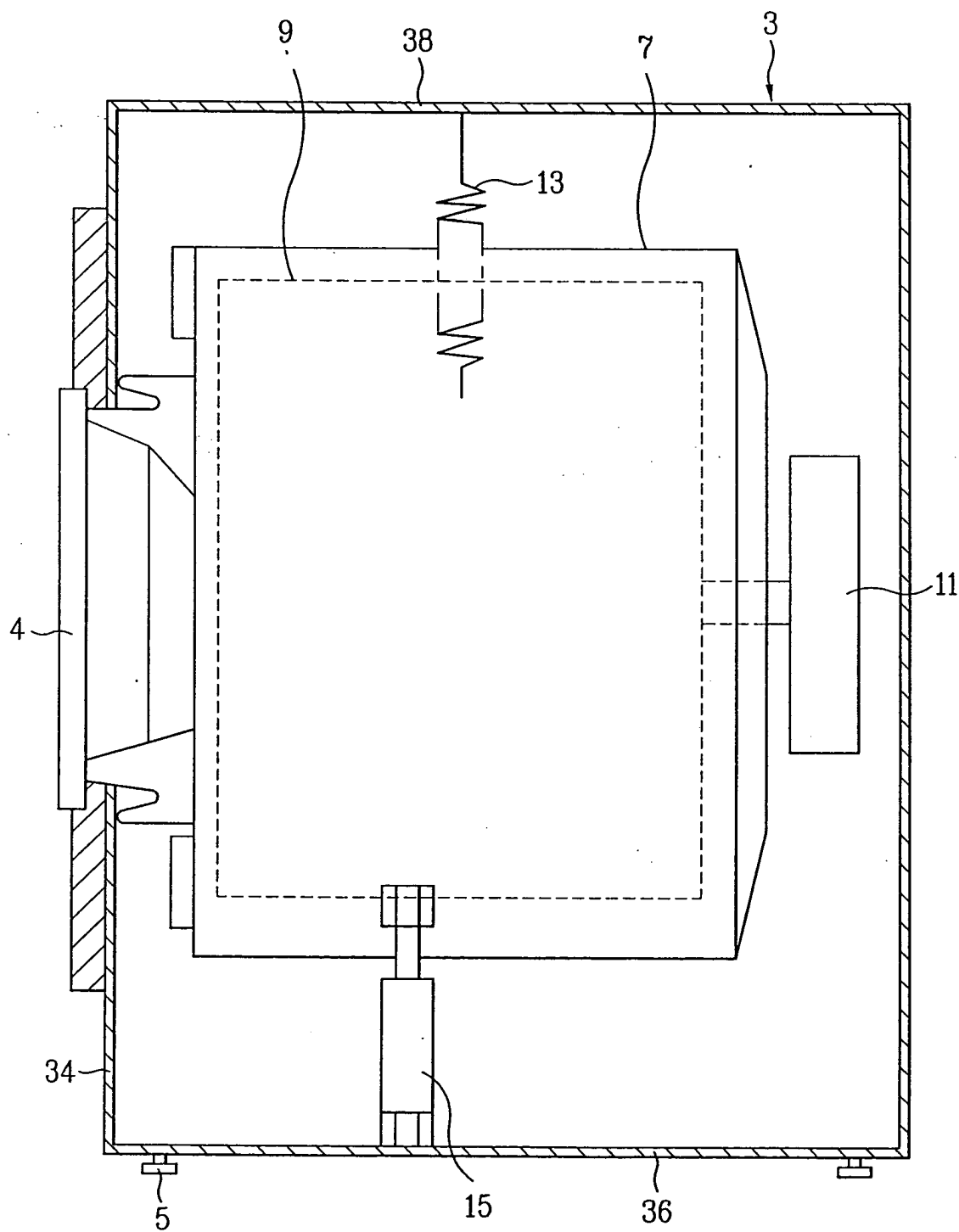


FIG. 3
Related Art

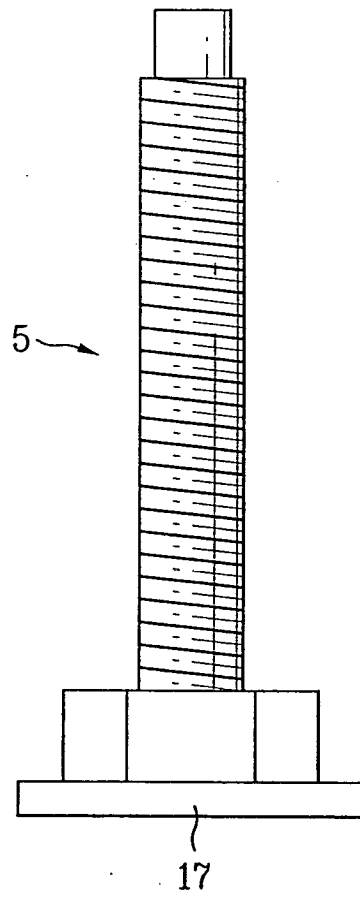


FIG. 4

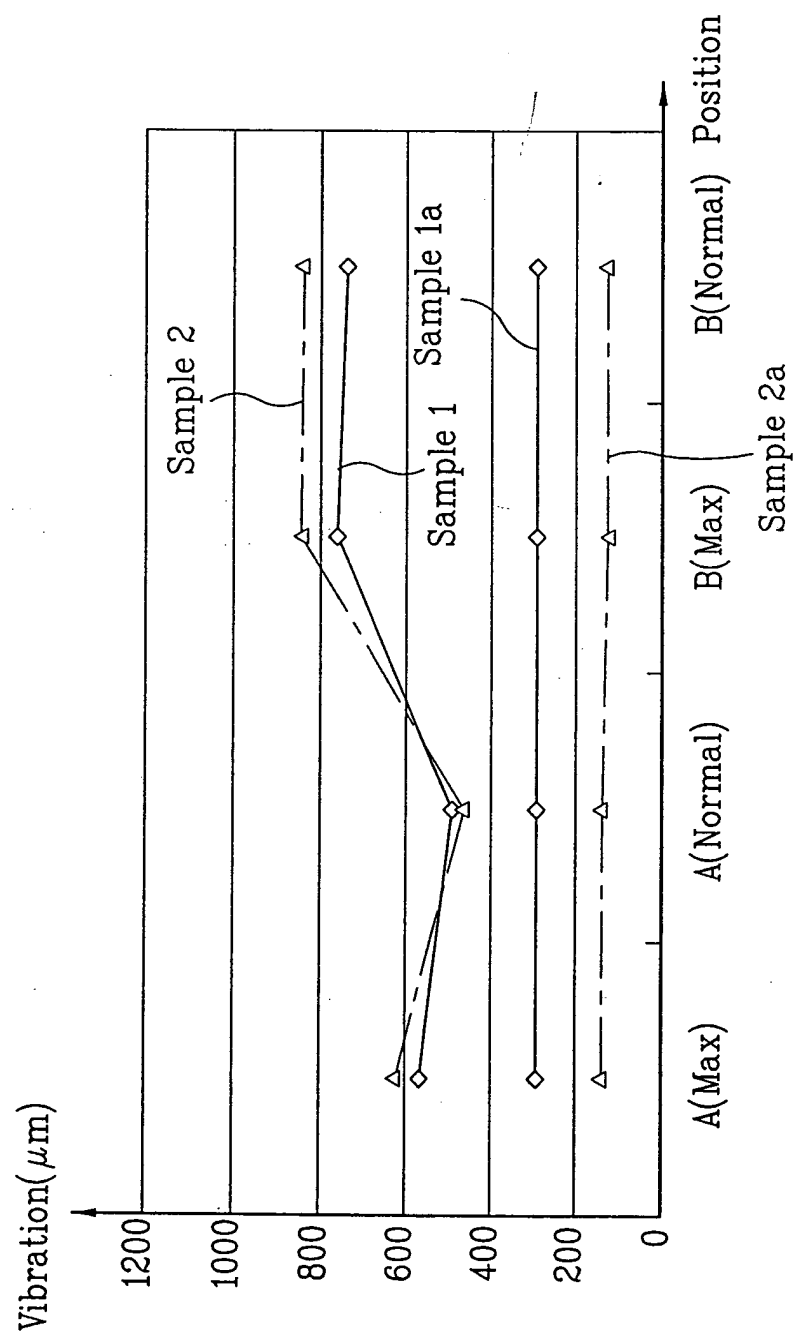


FIG. 5

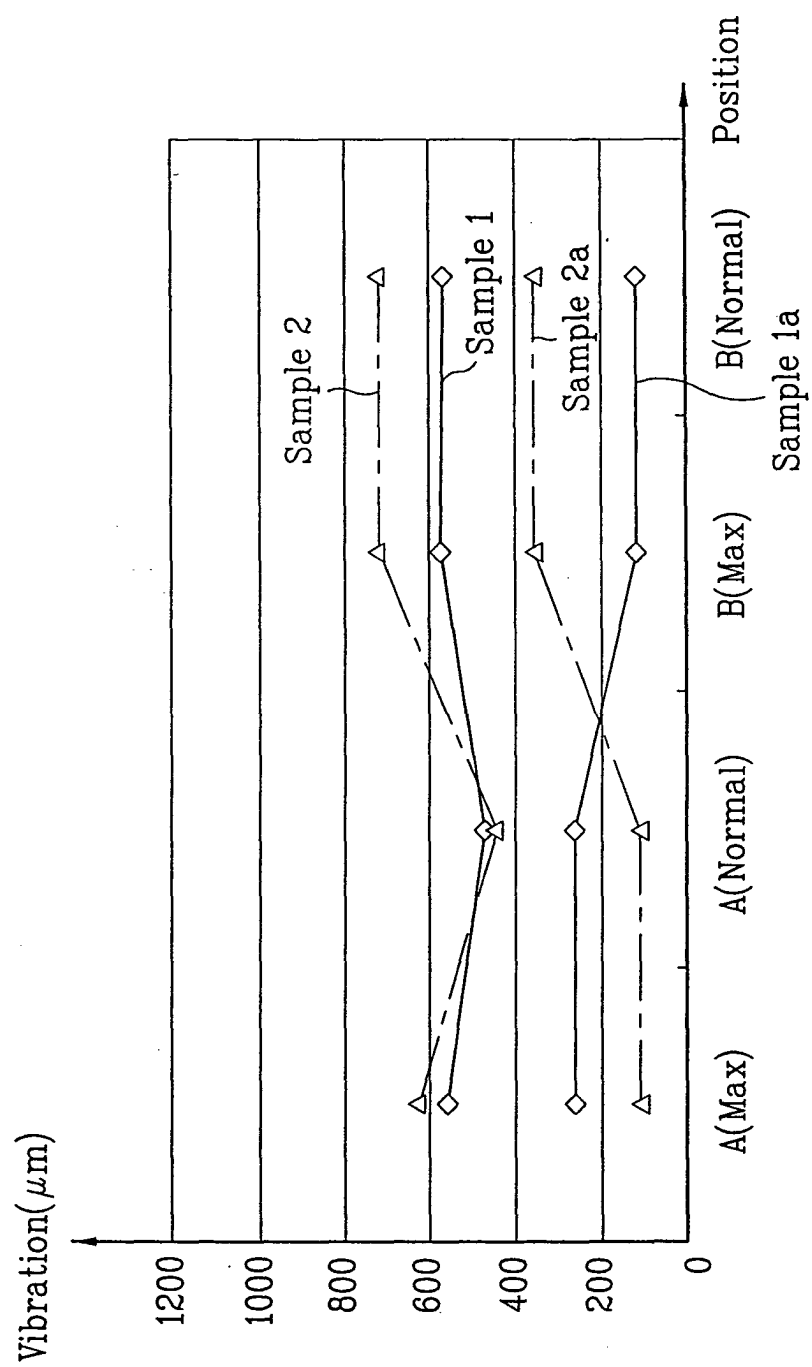


FIG. 6

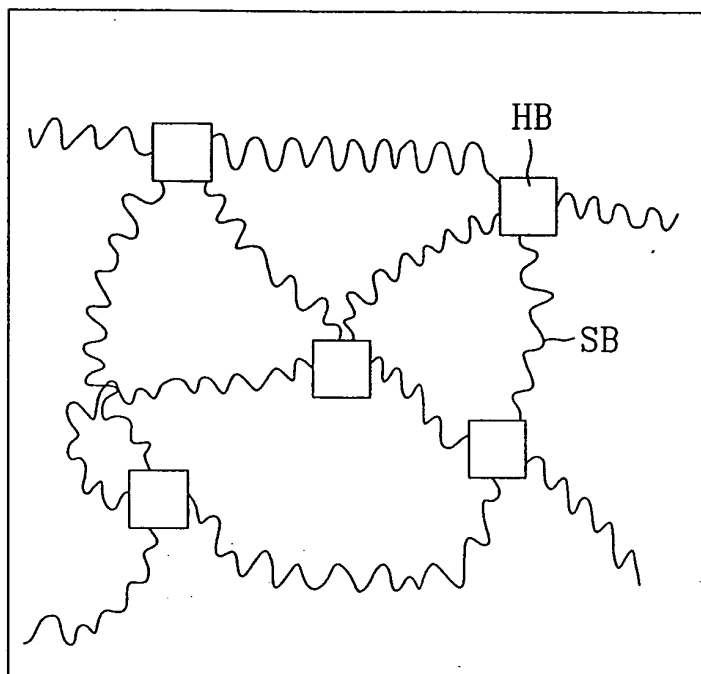


FIG. 7

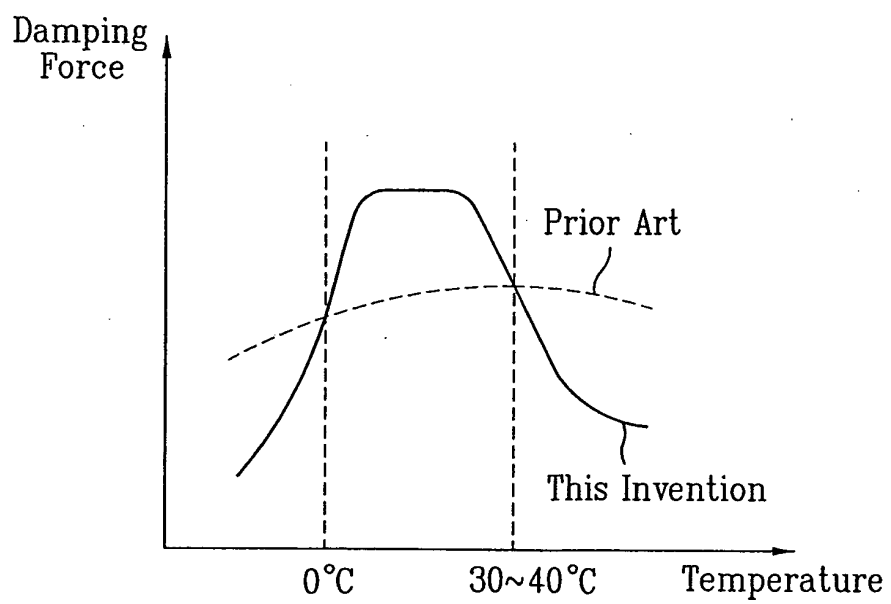


FIG. 8

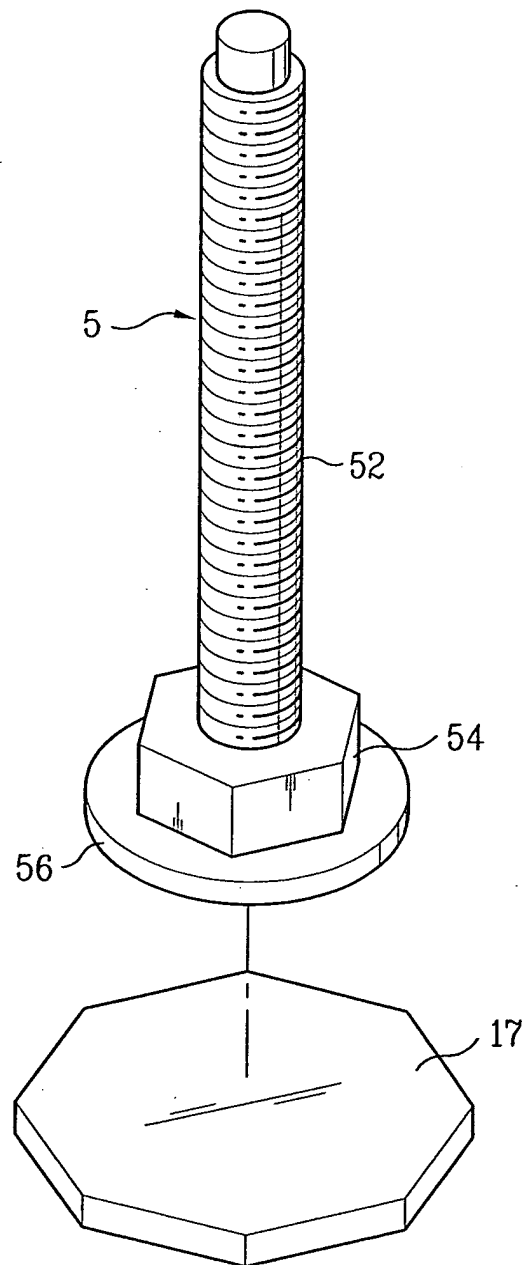


FIG. 9

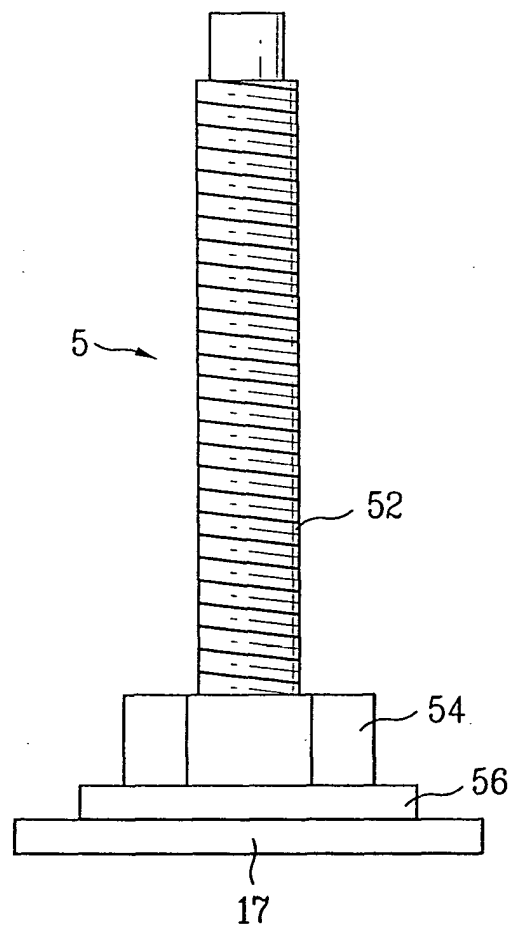


FIG. 10

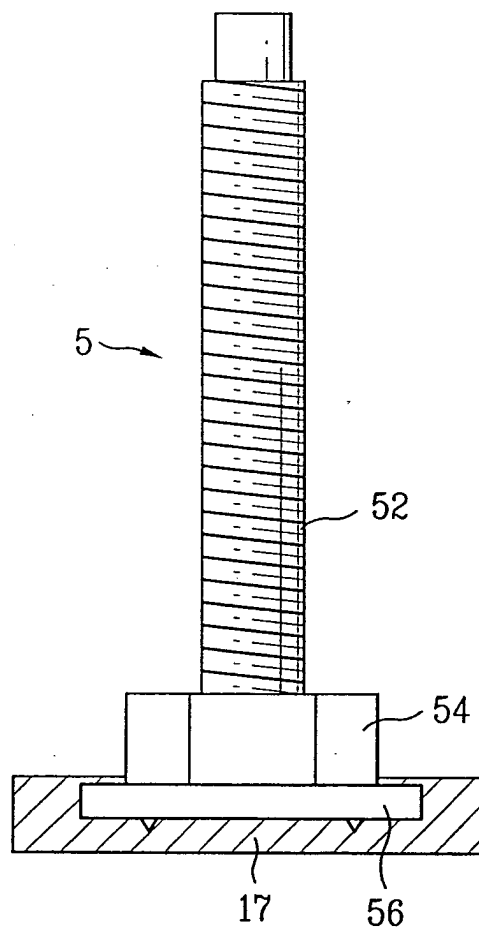


FIG. 11

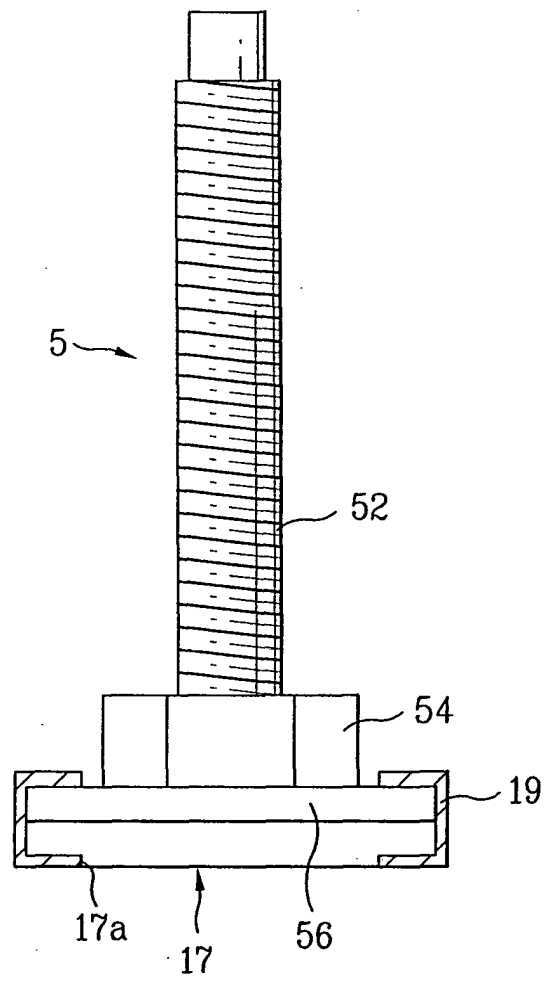


FIG. 12

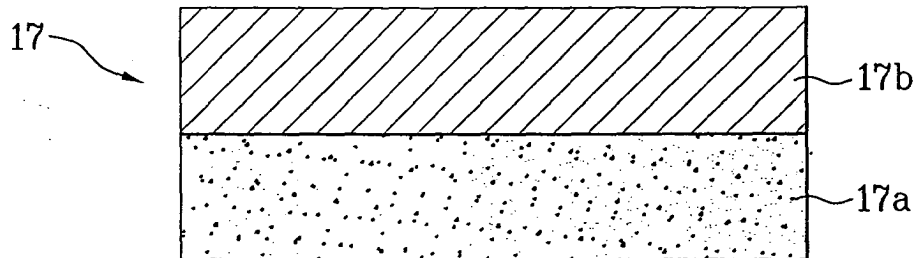


FIG. 13

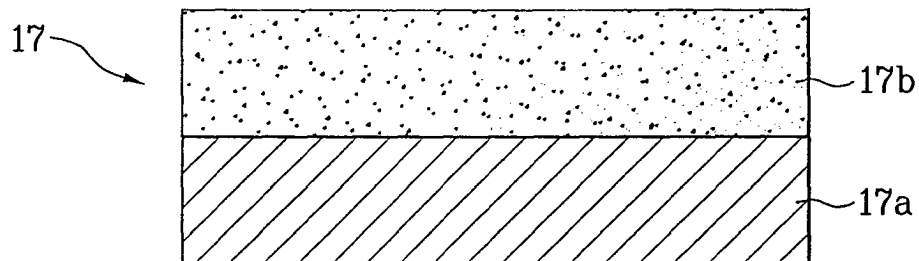


FIG. 14a

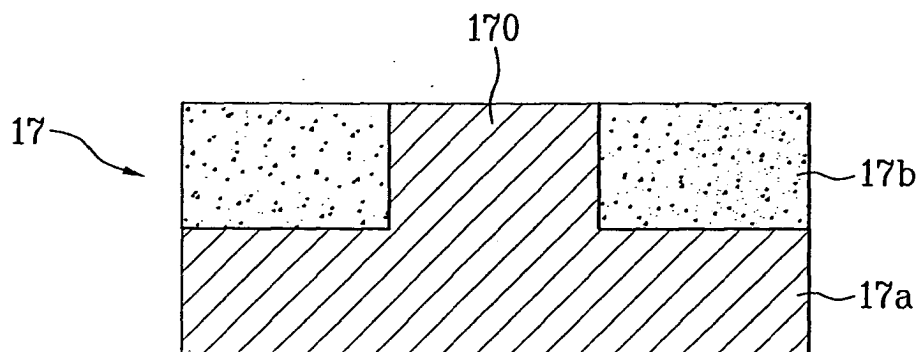


FIG. 14b

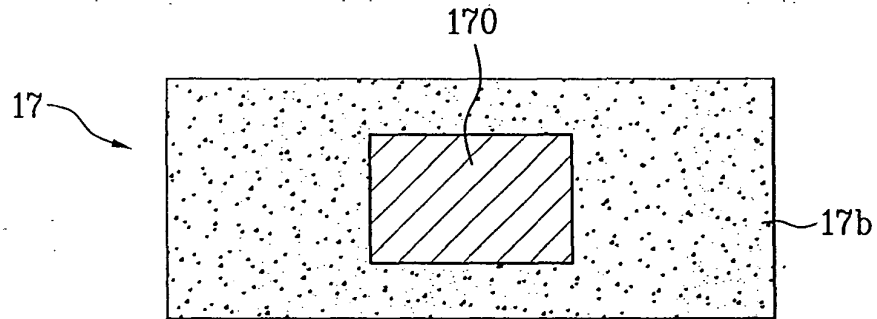


FIG. 15a

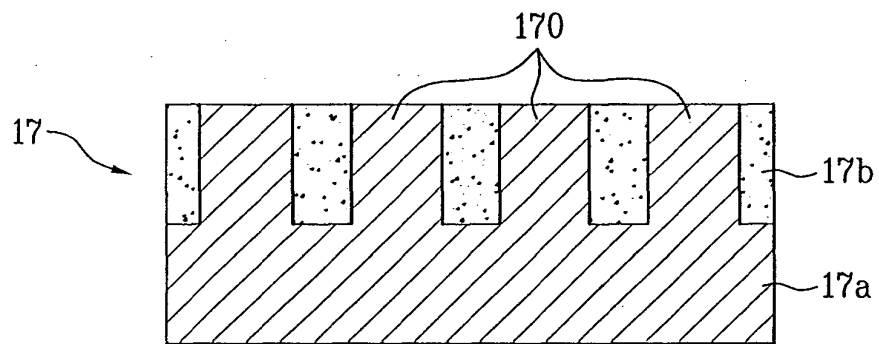


FIG. 15b

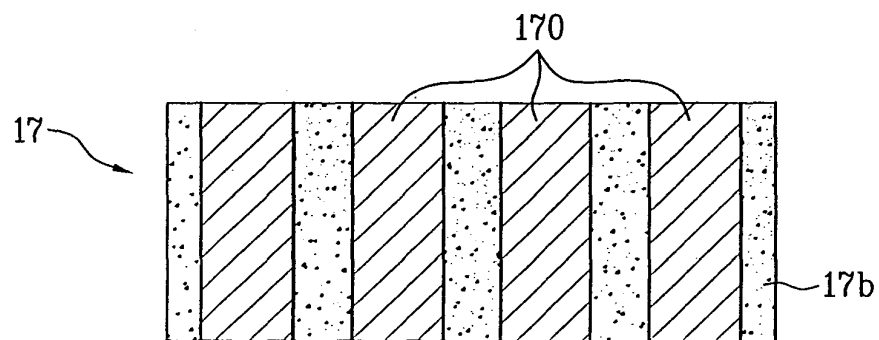


FIG. 16

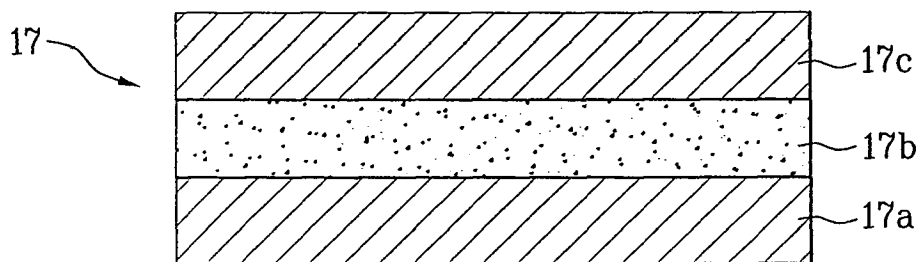


FIG. 17

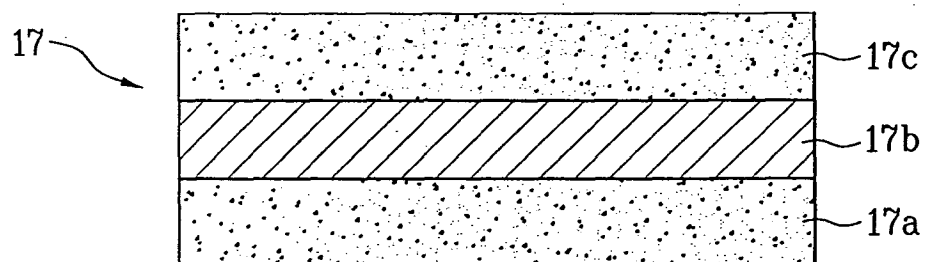


FIG. 18

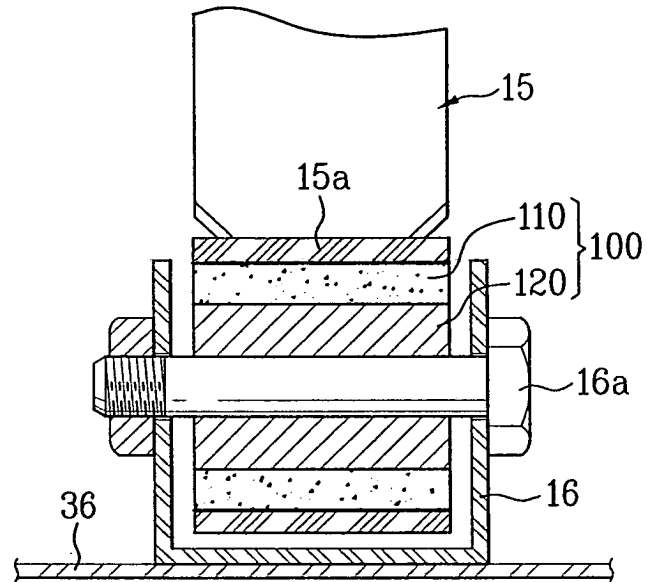


FIG. 19

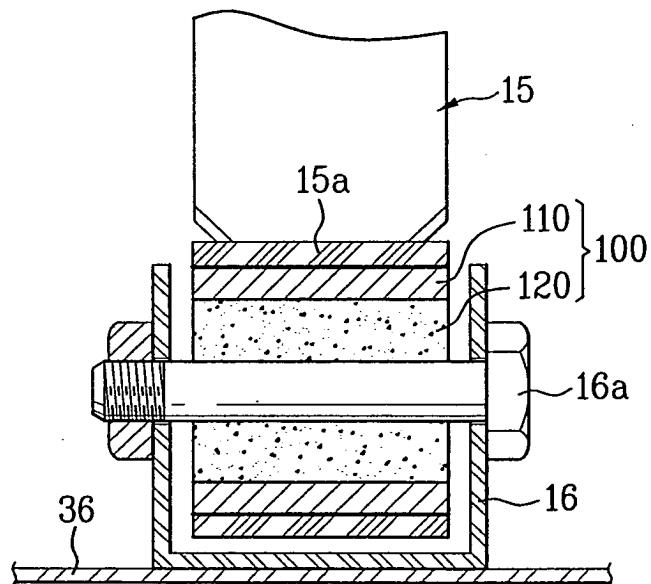


FIG. 20

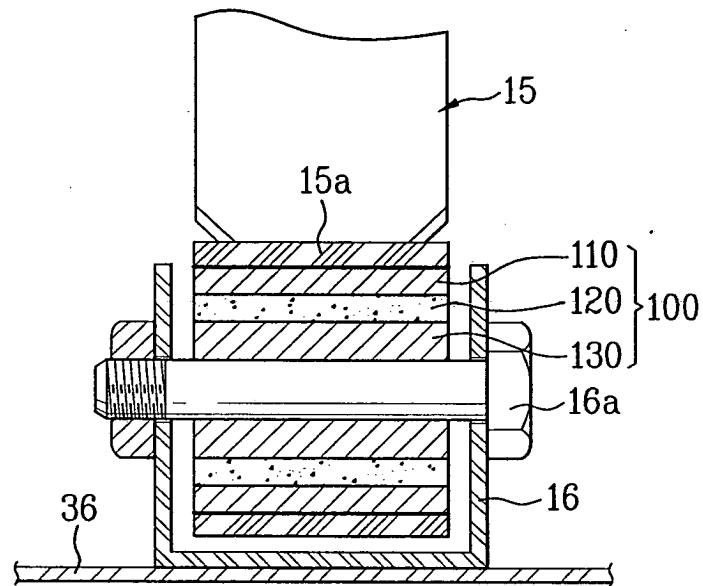


FIG. 21

