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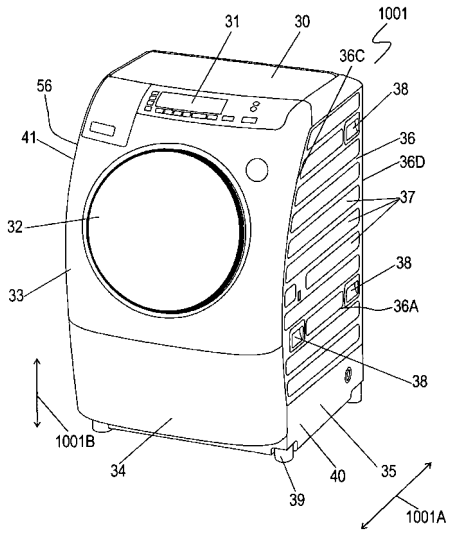
(54) Drum type washing machine

(57) A drum type washing machine (1001) includes a housing (41), a drum (83) accommodated in the housing (41), a motor (81) accommodated in the housing (41). The side plate (36) has plural dents (37) provided therein extending in a longitudinal direction extending horizontally. Widths of plural dents (37) in a vertical direction are larger than a width of an area between dents adjacent to each other out of the plural dents (37) in the vertical direction. The side plate (36) is rigid, accordingly preventing the drum type washing machine (1001) from vibrating even when the rotation speed of the drum (83) increases.

Fig. 1A



EP 2 163 676 A2

Description

TECHNICAL FIELD

[0001] The present invention relates to a drum type washing machine including a housing.

BACKGROUND OF THE INVENTION

[0002] Fig. 6 is a perspective view of conventional drum type washing machine 501 disclosed in Japanese Laid-Open Patent Publication No.2007-195859. Drum type washing machine 501 includes housing 121. Housing 121 has an essentially box shape, and includes control panel 5 placed at front, front cover 112 placed at front, lower front cover 113 covering the lower part of front cover 112, leg stand 114 having legs 114A attached thereto, upper cover 111 placed at a top, right side plate 102 placed at right, left side plate 101 placed at left. The control panel has various control keys and a display. Front cover 112 has door 2, upper cover 111, front cover 112, lower front cover 113. Leg stand 114 is made of synthetic resin which is shaped easily. Right side plate 102 and left side plate 101 are made of steel plates having large strength, and are placed symmetrically to each other in right and left. Housing 121 has an essentially parallelepiped shape which is elongate in a vertical direction.

[0003] Fig. 7 is a perspective view of frame 121A constituting housing 121. Frame 121A is a base frame portions, such as upper cover 111, front cover 112, lower front cover 113, leg stand 114, and leg 114A, made of synthetic resin are removed from housing 121. Front frame 103 is fixed to from a front edge of left side plate 101 to a front edge of right side plate 102. Front frame 103 pivotally supports door 2 to allow door 2 to open and close. Door 2 includes door frame 52 and transparent window door 53 made of transparent material, such as heat-resistant glass. Door frame 52 holds door 52 within the frame.

[0004] Upper front reinforcement plate 105 and upper back reinforcement plate 106 are fixed from an upper edge of left side plate 101 and to an upper edge of right side plate 102. Front reinforcement plate 104 is fixed from a lower edge of left side plate 101 to a lower edge of right side plate 102 striding, thus providing frame 121A. Front frame plate 103, upper front reinforcement plate 105, upper back reinforcement plate 106, and front reinforcement plate 104 are made of steel plates.

[0005] In drum type washing machine 501, right side plate 102 and left side plate 101 support constituent members of housing 121, thus being required top have large strength. On the other hand, the steel plates constituting right side plate 102, left side plate 101, and other constituent members are required to be thin from perspectives of weight reduction of housing 121 and conservation of natural resources. For satisfying such requirements, plural dents 120 are formed in right side plate 102 and left side plate 101 and extend in a vertical direction. If side plate 101 and 102 have thicknesses of 0.6 mm, dents 120 have depths of about 1 mm.

[0006] In the case that housing 121 is not so rigid, when the drum spins at a high speed for spin-drying, side plate 101 and 102 may vibrate largely. Especially when side plates 101 and 102 have resonance frequencies close to the spinning frequency of the drum, side plates 101 and 102 resonate with the frequency and vibrate morse. In order to stand the vibration, the steel sheets of side plates 101 and 102 cannot be thin.

[0007] When a large downward load is applied to the upper portion of opening door 2 or to housing 121, side plates 101 and 102 suspend the load, accordingly preventing the steel plates for side plate 101 and 102 from being thin.

SUMMARY OF THE INVENTION

[0008] A drum type washing machine includes a housing, a drum accommodated in the housing, a motor accommodated in the housing. The side plate has plural dents provided therein extending in a longitudinal direction extending horizontally. Widths of plural dents in a vertical direction are larger than a width of an area between dents adjacent to each other out of the plural dents in the vertical direction.

[0009] The side plate is rigid, accordingly preventing the drum type washing machine from vibrating even when the rotation speed of the drum increases.

BRIEF DESCRIPTION OF DRAWINGS

[0010]

Fig. 1A is a perspective view of a drum type washing machine according to an exemplary embodiment of the present invention.

Fig. 1B is a cross sectional view of the drum type washing machine according to the embodiment.

Fig. 2A is a front view of a side plate of the drum type washing machine according to the embodiment.

Fig, 2B is a cross sectional view of the side plate at line 2B-2B shown in Fig. 2A.

Fig. 2C shows a resonance frequency of the side plate according to the embodiment.

Fig. 3A is a front view of another side plate according to the embodiment.

Fig. 3B is a cross sectional view of the side plate at line 3B-3B shown in Fig. 3A.

Fig. 4A is a front view of a further side plate according to the embodiment 3.

Fig. 4B is a cross sectional view of the side plate at line 4B-4B shown in Fig. 4A.

Fig. 5A is a front view of a further side plate according to the embodiment.

Fig. 5B is a cross sectional view of the side plate at line 5B-5B shown in Fig. 5A.

Fig. 6 is a perspective view of a conventional drum

type washing machine.

Fig. 7 is a perspective view of a frame constituting a housing of the conventional drum type washing machine.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0011] Figs. 1A and 1B are a perspective view and a cross sectional view of drum type washing machine 1001 according to an exemplary embodiment of the present invention. As shown in Fig. 1A, drum type washing machine 1001 includes housing 41 having an essentially parallelepiped shape which is elongate in a vertical direction. Housing 41 includes upper cover 30 placed at a top, control panel 31 placed at upper front, front cover 33 placed at middle front, lower front cover 34 placed at lower front, leg stand 35 placed at lower part, and side plates 36 and 56 placed on sides of the housing. Control panel 31 includes control buttons and a display. Door 32 is mounted to front cover 33. Leg 39 is attached to leg stand 35. Side plates 36 and 56 are made of steel plates having an essentially rectangular shape which is elongated in a vertical direction, and support an entire weight of housing 41 together with leg stand 35. Side plates 36 and 56 are connected to front cover 33.

[0012] Drum type washing machine 1001 includes housing 41, water tub 82 accommodated in the housing, suspension 84 fixing water tub 82 to housing 41, motor 81 fixed to water tub 82, drum 83 accommodated in water tub 82, and driver 85 driving motor 81. Laundry, such as clothes, is put in drum 83 while door 32 opens and closes. Suspension 84, motor 81, and drum 83 are accommodated in housing 41. Motor 81 driven by driver 85D rotates drum 83 about rotation axis 81A to wash and spin-dry the laundry.

[0013] Handle 38 for hand-carrying machine 1001 and flat portion 40 adapted to have a seal indicating a warning sign are provided on side plate 36. Further, plural dents 37 are formed in side plate 36 and extend in longitudinal direction 1001A extending horizontally The dents 37 extend from front edge 36C to rear edge 36D of surface 36A of side plate 36. Side plate 56 has dents similarly to side plate 36. Dents 37 increases rigidity of side plate 36 and 56.

[0014] Fig. 2A is a front view of side plate 36. Fig. 2B is a cross sectional view of side plate 36 at line 2B-2B shown in Fig. 2A. Side plate 36 has surface 36A and surface 36B opposite to surface 36A. Plural dents 37 are formed in surface 36A of side plate 36, and extend in longitudinal direction 1001A extending horizontally. Side plate 36 includes areas 87 which are provided between dents 37 out of plural dents 37 and are connected with dents 37. Dents 37 has concave surface 37A which is a part of surface 36A of side plate 36 and convex surface 37B opposite to concave surface 37A. Convex surface 37B is a part of surface 36B. Area 87 of side plate 36 has surface 87A which is a part of surface 36A and surface 87B opposite to surface 87A. Surface 87B is a part of surface 36B. Surface 87A of area 87 of side plate 36 is connected with concave surfaces 37A of dents 37, and surface 67B is connected to convex surfaces 37B of dents 37. Dent 37 has width P in vertical direction 100B. Concave surface 37A of dent 37 has depth Q. Area 87 provided between adjacent dents 37 has width T in vertical direction 1001B. Dent 37A is formed by pressing and drawing a steel sheet providing side plate 36 and 56. In the press process, dent 37 plastically deforms, but area 87 does not deform. Since housing 41 has substantially a parallelepiped shape elongated vertically, side plate 36 (56) has a longer width in vertical direction 1001B than in horizontal direction (longitudinal direction 1001A of dent 37).

[0015] Width P of dent 37 is larger than width T of area 87 provided between dents 37. Width P of dent 37 in the vertical down direction is larger than space (width T) provided between dents 37 adjacent to each other out of plural dents 37. This arrangement allows dents 37 of side plate 36 (56) plastically deforming to be larger than areas 87 which do not deform, thus increasing rigidity of side plate 36 (56).

[0016] Samples of examples of side plate 36 (56) according to the embodiment were produced. The samples were made of steel plates having thicknesses of 0.6 mm and having eleven dents 37 provided therein. Width P of dent 37 was about 50 mm in vertical direction 1001B. Depth Q of concave surface 37A was about 3.5 mm.

[0017] Sample of a comparative example of side plate 102 of conventional drum type washing machine 501 shown in Fig. 6 were produced with using a steel plate having a thickness of 0.6 mm. Comparative example had four dents 120 extending in the vertical direction. The depth of dent 120 was 1 mm.

[0018] Fig. 2C shows resonance frequencies of the examples and the comparative example are shown in Fig. 2C. A primary resonance frequency, a second-order resonance frequency, a third-order resonance frequency, and fourth-order resonance frequency of the example are higher than those of the comparative example, respectively. Side plates 36 and 102 vibrate largely when the plates vibrate at a frequency close to the resonance frequencies shown in Fig. 2, increasing the vibration of the housing.

[0019] When rotating for spin-drying, drum 83 rotates at about 1600 r/min. at a vibration frequency of 26.6 Hz. Primary resonance frequency of 18.8 Hz of the comparative sample is closer to the vibration frequency of 26.6 Hz than the primary frequency 37.6 Hz of the working sample is. Accordingly, drum type washing machine 1001 having side plate 36 (56) according to the embodiment vibrates less than conventional drum type washing machine 501 during the spin-drying.

[0020] Plural dents 37 increases rigidity of side plate 36, and allow the resonance frequencies of side plate 36 away from the vibration frequency of the spin-drying, accordingly reducing vibration of housing 41. This can raise

the rotation speed at the spin-drying to reduce the time for the spin-drying, and allow side plate 36 to be thin to reduce material of side plate 36.

[0021] Side plate 36 has substantially a rectangle shape elongated in vertical direction 1001B, that is, has a larger width in vertical direction 1001B than in the horizontal direction. Therefore, width P of dent 37 is determined to be a certain value, and allows a large number of dents 37 to be formed in side plate 36, thereby increasing the rigidity of side plate 36.

[0022] Distance S between an outside periphery of side plate 36, typically rear side periphery 36D, and dent 37 is shorter than width P of dent 37. This structure allows the area of dent 37 plastically deforming may be as large as possible, further increasing rigidity of side plate 36.

[0023] Fig. 3A is a front view of another side plate 136 according to the embodiment. Fig. 3B is a cross sectional view of side plate 136 at line 3B-3B shown in Fig. 3A. In Figs. 3A and 3B, components identical to those of side plate 36 in Figs. 2A and 2B are dented by the same reference numerals, and their description will be omitted.

[0024] An outside periphery of side plate 136 has a shape identical to that of side plate 36 shown in Figs. 2A and 2B. Side plate 136 has dents 137 instead of dents 37 formed in side plate 36 shown in Figs. 2A and 2B. Dent 137 is different from dent 37 in its cross sectional shape in vertical direction 1001B. The cross section of the dent has substantially a circular arc shape. This configuration reduces an expansion rate of the material of side plate 136 in vertical direction 1001B, reducing a warp and a twist during press process. This configuration also reduces a tightening force for pressing die to reduce cost, and raising the resonance frequency of side plate 136. According to the embodiment, the circular arc has radius R of about 90 mm and depth Q is about 3.5 mm.

[0025] Fig. 4A is a front view of further side plate 236 according to the embodiment. Fig. 4B is a cross sectional view of side plate 236 at line 4B-4B shown in Fig. 4A. In Figs. 4A and 4B, components identical to those of side plate 136 in Figs. 3A and 3B are denoted by the same reference numerals, and their description will be omitted.

[0026] An outside periphery of side plate 236 has a shape identical to that of side plate 136 shown in Figs. 3A and 3B. Side plate 236 has dents 237 provided therein instead of dents 137 formed in side plate 136 in Figs. 3A and 3B. Dent 237 has substantially a circular arc shape in vertical direction 1001B similarly shown in Figs. 2A and 2B. Dent 237 is different from dent 37 in a shape of both ends in longitudinal direction 1001A. The end portion has a semi-circular shape, that is, ends 237C and 237D have semi-circular shapes. Ends 237C and 237C having the semi-circular shapes allow dent 237 to have a gradually concave surface, thereby reducing a warp and a twist during the press process. According to the embodiment, dent 237 has width P of about 50 mm and maximum depth Q of about 3.5 mm. Each of ends 237C and 237D has radius V of about 25 mm.

[0027] Fig. 5A is a front view of further side plate 336 according to the embodiment. Fig. 5B is a cross sectional view of side plate 336 at line 5B-5B shown in Fig. 5A. In Figs. 5A and 5B, components identical to those of side plate 136 shown in Figs. 3A and 3B are denoted by the same reference numerals, and their description will be omitted.

[0028] An outside periphery of side plate 336 has a shape identical to that of side plate 136 shown in Figs. 3A and 3B. Side plate 336 has dents 337 provided therein instead of dents 137 formed in side plate 136 in Figs. 3A and 3B. Dent 337 has substantially a circular arc shape in vertical direction 1001B, similarly shown in Figs. 2A and 2B. Dent 337 is different from dent 37 in shapes of both ends in longitudinal direction 1001A. Ends 337C and 337D have shapes along outside peripheries 336C and 336D of side plate 336, respectively. Each of ends 337C and 337D have slope 45 slanting to a bottom of dent 337 at a predetermined angle to longitudinal direction 1001A. This arrangement allows surface 336A of side plate 336 to be connected gradually with the bottom of dent 337. This reduces a warp and a twist in a press process, reduces vibration during the spin-drying, and presents a neat outlook of the machine. According to the embodiment, dent 337 has width P of about 50 mm and depth Q of about 3.5 mm.

[0029] The embodiment does not limit the scope of the present invention.

Claims

1. A drum type washing machine comprising:

   a housing having a front cover and a side plate, the side plate being connected to the front cover;
   a drum for storing laundry, the drum being accommodated in the housing;
   a motor for rotating the drum, the motor being accommodated in the housing; and
   a door for putting in and taking out the laundry, the door being mounted to the front cover of the housing, wherein
   the side plate is made of a steel sheet,
   the side plate has a plurality of dents provided therein, the plurality of dents extending in a longitudinal direction extending horizontally, and
   widths of the plurality of dents in a vertical direction are larger than a width of an area between dents adjacent to each other out of the plurality of dents in the vertical direction.

2. The washing machine of claim 1, wherein a cross section of each the plurality of dents in the vertical direction has a circular arc shape.

3. The drum type washing machine of claim 1 or 2, wherein both ends of each of the plurality of dents in the longitudinal direction have circular arc shapes.

4. The drum type washing machine of claim 1 or 2, wherein both ends of each of the plurality of dents in the longitudinal direction has shapes along an outer periphery of the side plate.

Fig. 1A

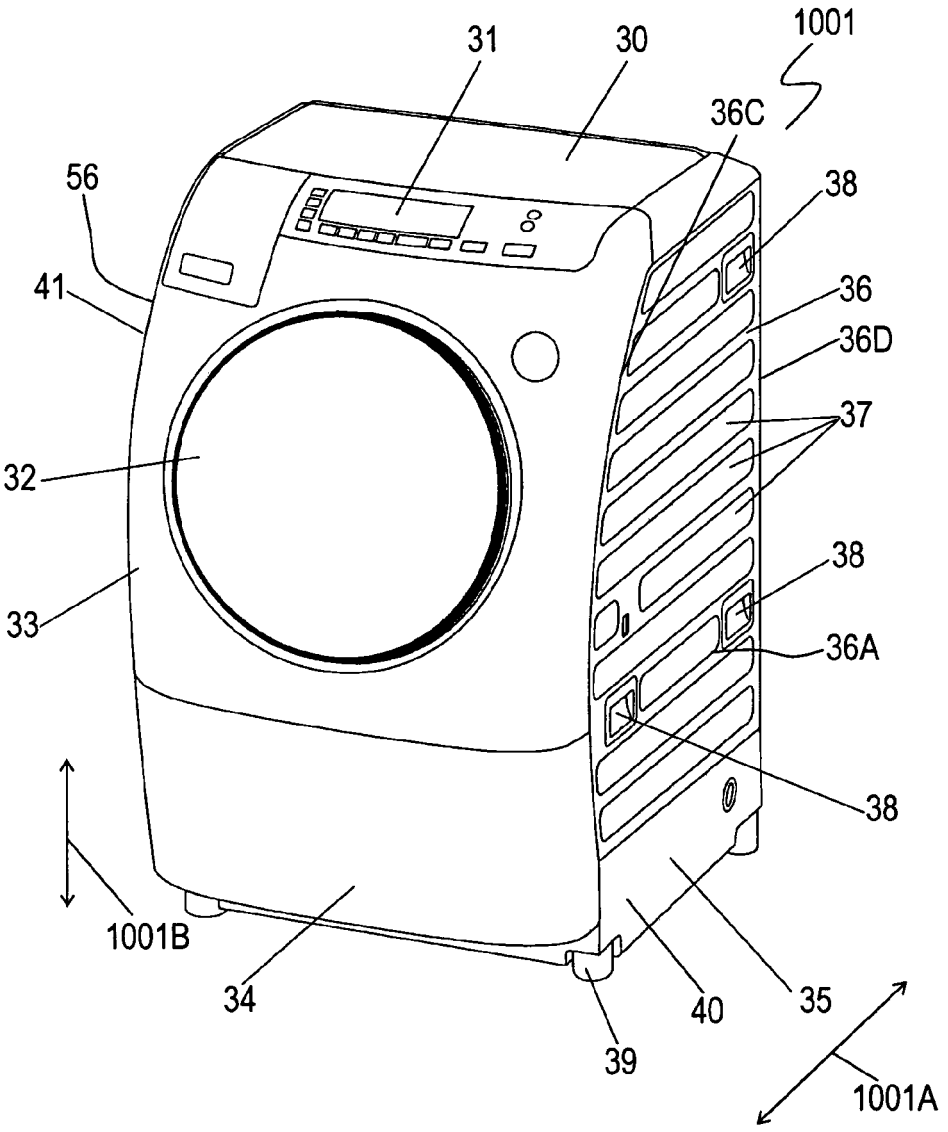

31
30
1001
36C
56
38
41
36
36D
37
32
38
33
36A
38
1001B
34
40
35
39
1001A

Fig. 1B

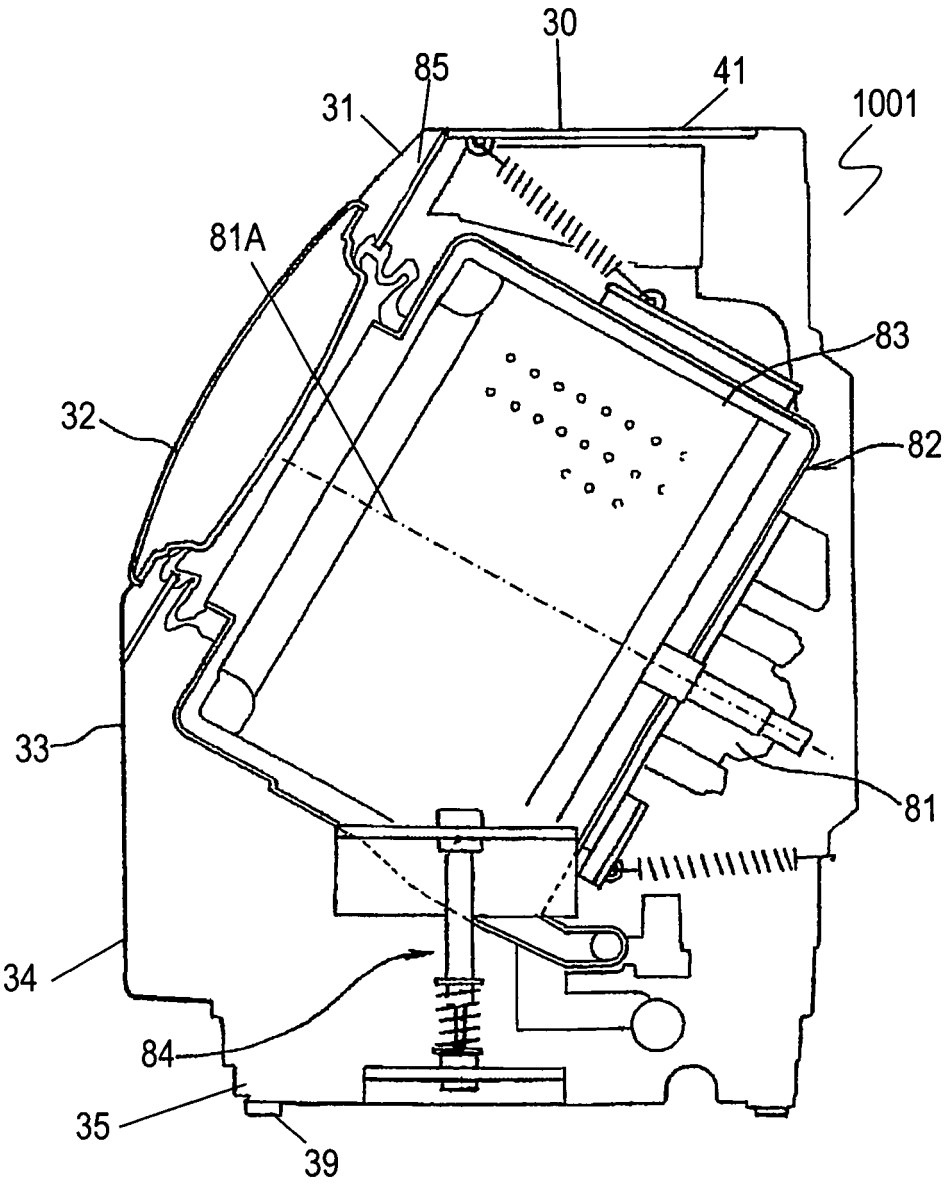


Fig. 2B

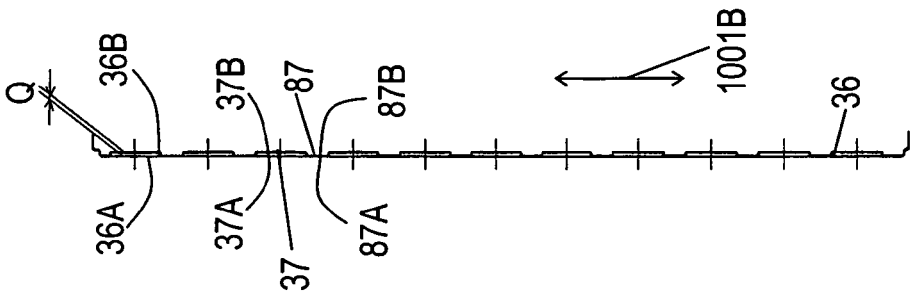

Q
36B
37B
87
87B
1001B
36
36A
37A
37
87A

Fig. 2A

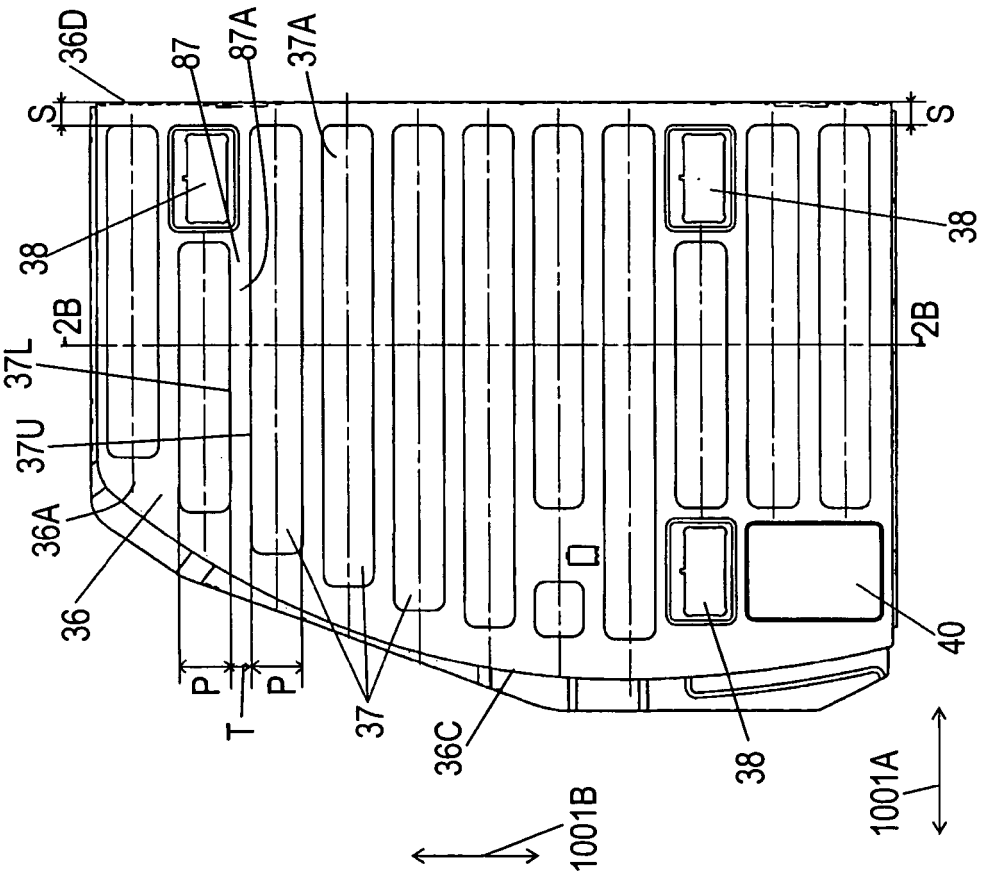

36D
87
87A
37A
S
S
38
38
2B
2B
37L
37U
36A
36
P
T
P
37
36C
38
40
1001B
1001A

Fig. 2C

	Primary Resonance Frequency	Second-Order Resonance Frequency	Third-Order Resonance Frequency	Fourth-Order Resonance Frequency
Example	37.6 Hz	46.6 Hz	59.4 Hz	76.7 Hz
Comparative Example	18.8 Hz	42.2 Hz	48.4 Hz	59.4 Hz

Fig. 3B

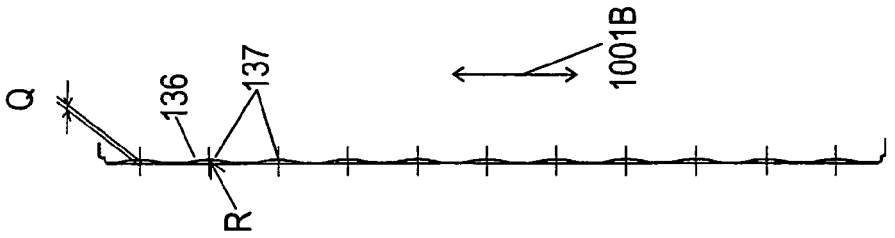


Fig. 3A

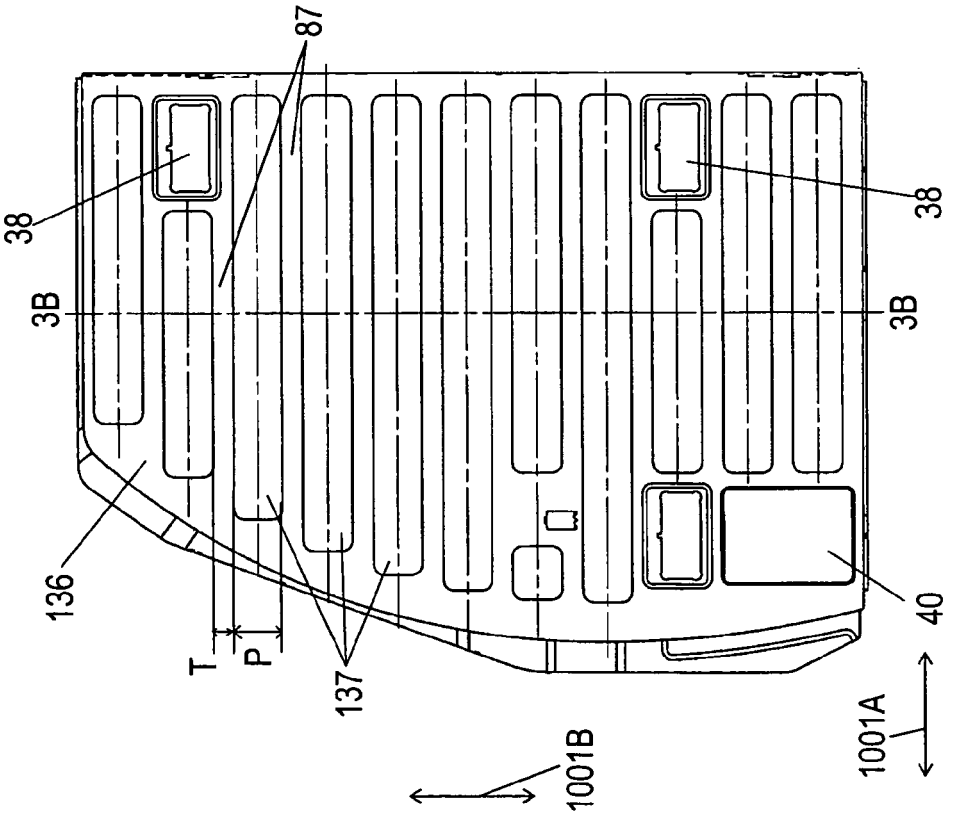


Fig. 4B

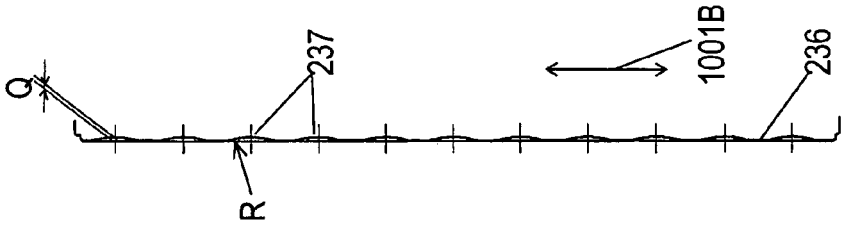
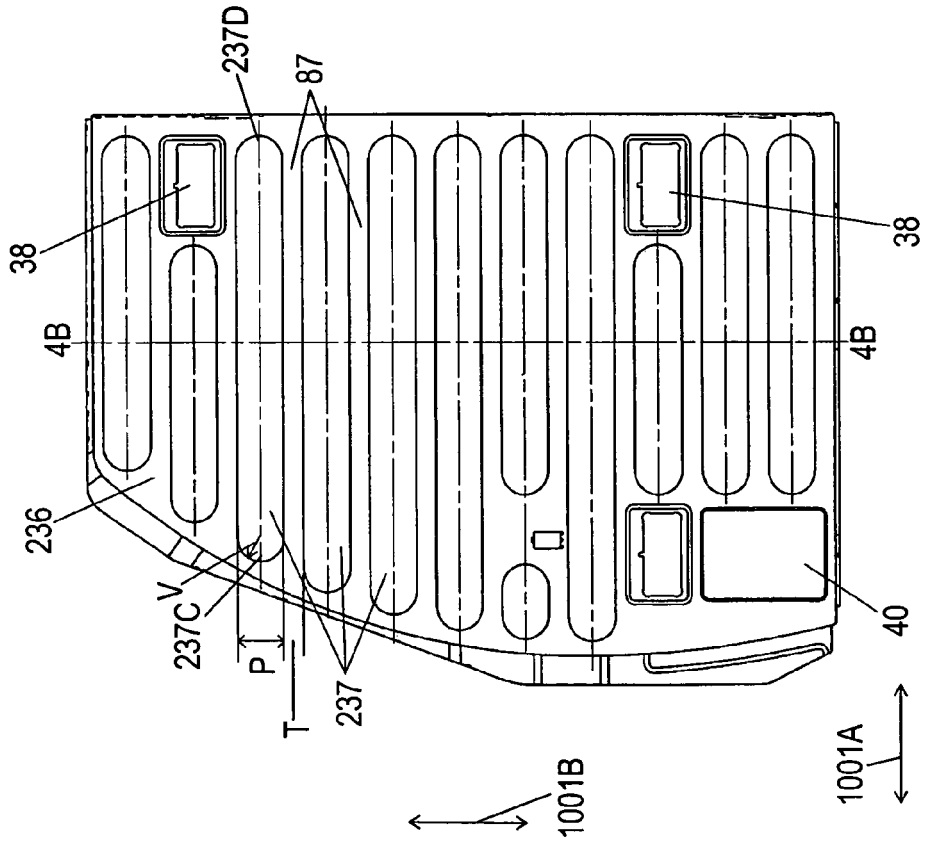

Q
237
1001B
236
R

Fig. 4A


237D
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38
38
4B
4B
236
V
237C
P
T
237
40
1001B
1001A

Fig. 5B

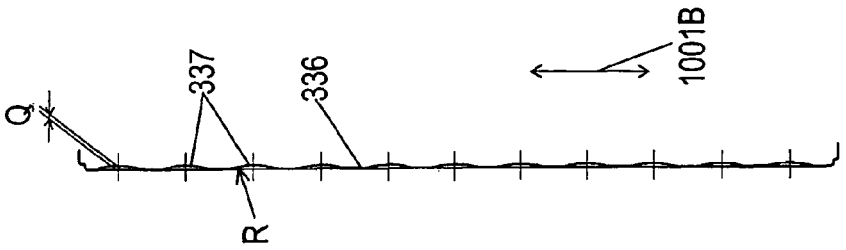

Q
337
336
1001B
R

Fig. 5A

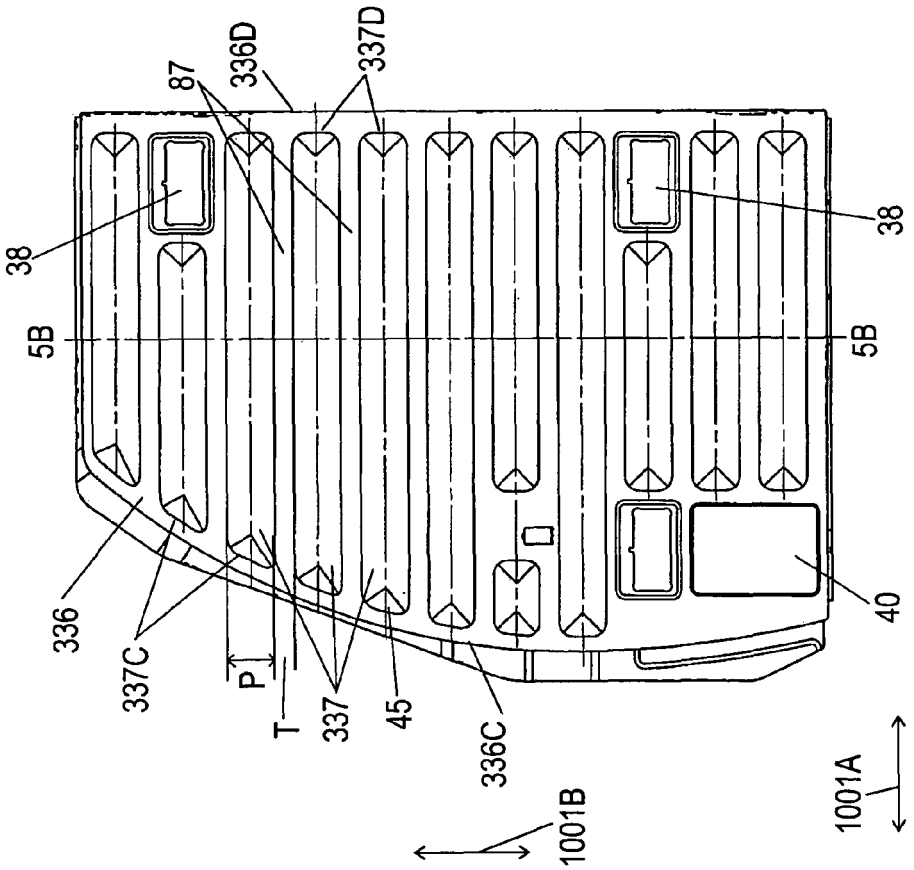

87
336D
337D
38
38
5B
5B
336
337C
P
T
337
45
336C
40
1001B
1001A

Fig. 6

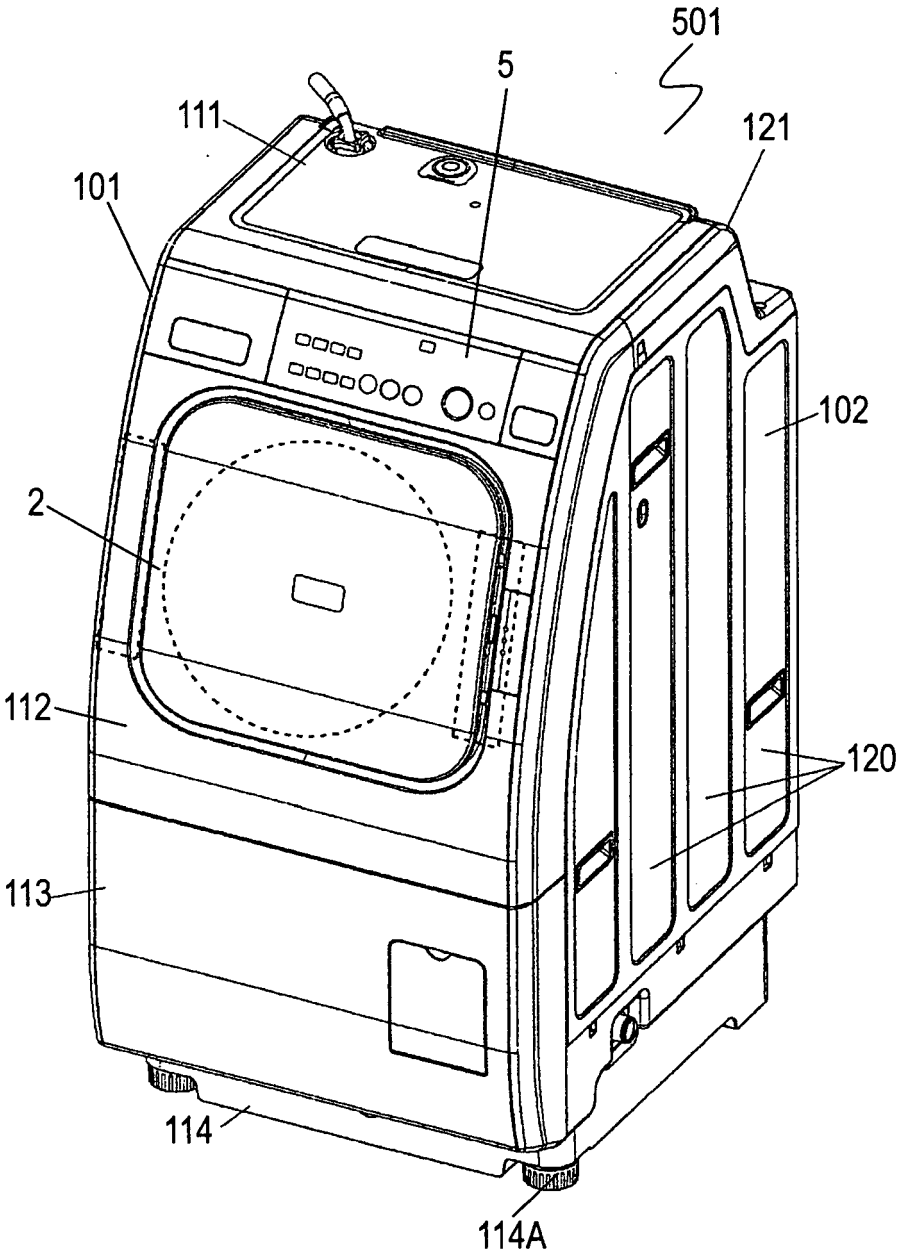
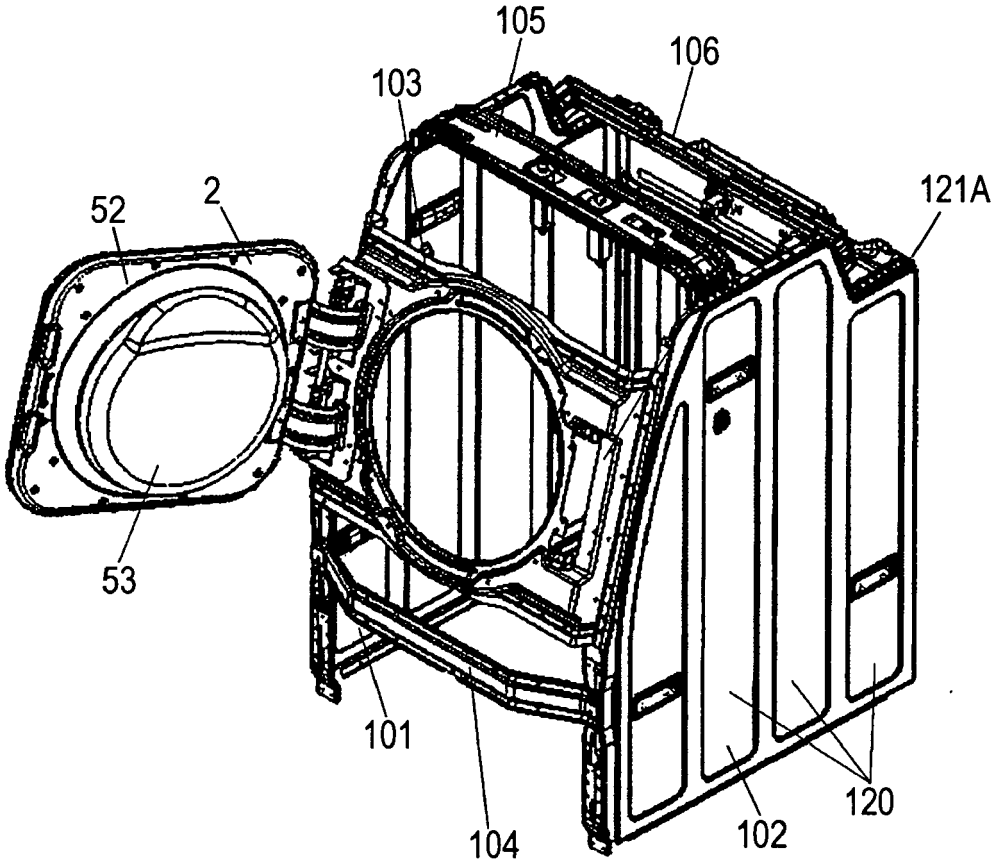


Fig. 7



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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