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(72) Inventors:
• **NAKANISHI, Takashi**
Tokyo 100-0005 (JP)
• **KAWAMURA, Tamotsu**
Tokyo 100-0005 (JP)
• **YOSHIDA, Kenji**
Tokyo 100-0005 (JP)
• **SATO, Hiroki**
Tokyo 100-0005 (JP)
• **NAKAGAWA, Wataru**
Tokyo 100-0005 (JP)

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(71) Applicants:
• **Qingdao Haier Washing Machine Co., Ltd.**
Shandong 266101 (CN)
• **Aqua Co., Ltd**
Chiyoda-ku
Tokyo 100-0005 (JP)

(74) Representative: **Bertsch, Florian Oliver**
Kraus & Weisert
Patentanwälte PartGmbB
Thomas-Wimmer-Ring 15
80539 München (DE)

(54) **WASHING MACHINE**

(57) The present invention provides a washing machine, which can save an installation space and can increase rigidity of a part for rotatably supporting a washing drum in a structure including the washing drum. The washing drum (3) can rotate in a manner of crossing with a perpendicular direction. The washing machine (1) includes: a washing drum (3) capable of rotating in a manner of crossing with an up-down direction (Z); a supporting member (13) arranged on an outer side of the washing drum (3) and rotatably supporting the washing drum (3); a bent part (13F) arranged on the supporting members (13) and bent to a side of the washing drum (3); and an elastic supporting member (5) mounted on the bent part (13F) and elastically supporting the supporting member (13).

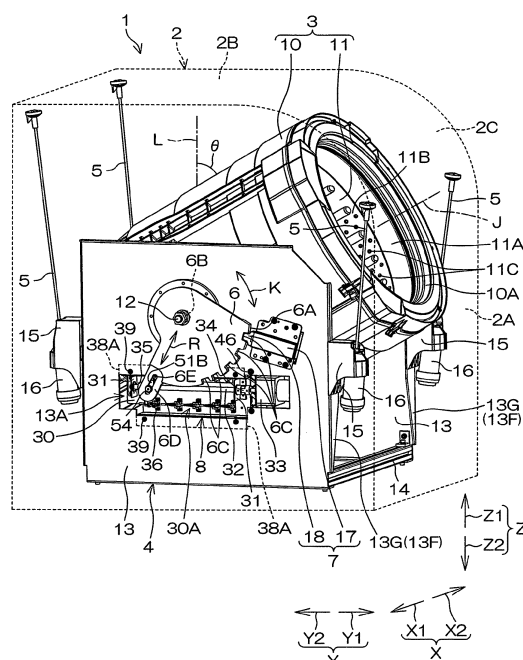


FIG. 1

Description**TECHNICAL FIELD**

[0001] The present invention relates to a washing machine.

BACKGROUND

[0002] In a washing and drying machine described in a following patent literature 1, an outer drum part assembled with a rotating drum part with washings thrown therein is supported by a rotation supporting member through an inclined rotation supporting shaft. A pair of rotation supporting members is arranged in a manner of sandwiching the outer drum part, and each rotation supporting member is supported by an outer frame of the washing and drying machine through a hoisting rod. The outer drum part is provided with a rotation operating rope installing part, and an operating rope connected to the rotation operating rope installing part is coiled on a drum arranged on an inclined rotation motor of the outer frame. As the inclined rotation motor rotates, the operating rope moves upwards or downwards. Thus, the outer drum part obliquely rotates around the inclined rotation supporting shaft. Thus, the outer drum part is transversely inclined when the washings are thrown into the rotating drum part, and the outer drum part is disposed along a perpendicular direction during washing, rinse and dewatering.

[0003] In the washing and drying machine described in patent literature 1, a part for mounting a hoisting rod of each rotation supporting member is located on an outer side surface of the rotation supporting member opposite to the outer drum part side. In this way, since the hoisting rod is configured in a manner of extending to the outer side of the rotation supporting member and may cause the washing and drying machine to become larger, it is difficult to reduce the space occupied by the washing and drying machine. In addition, rigidity of the rotation supporting member which rotatably supports the outer drum part is expected to be increased.

Related Technical Literature**Patent Literature**

[0004] Patent Literature 1: Japanese Laid-open patent publication No. 4-166196

SUMMARY**Problems to be solved by the invention**

[0005] The present invention is based on the background, and aims to provide a washing machine which can save an installation space and can increase rigidity of a part for rotatably supporting a washing drum in a structure including the washing drum, where the washing

drum can rotate in a manner of crossing with a perpendicular direction.

Solution for solving the problems

[0006] The present invention provides a washing machine, including: a washing drum accommodating washings and rotating in a manner of crossing with a perpendicular direction; a supporting member arranged on an outer side of the washing drum and rotatably supporting the washing drum; a bent part arranged on the supporting members and bent towards a side of the washing drum; and an elastic supporting member mounted on the bent part and elastically supporting the supporting member.

[0007] In addition, in some embodiments of the present invention, the washing machine includes a driving mechanism arranged between the supporting member and the washing drum and rotating the washing drum.

[0008] In addition, in some embodiments of the present invention, the driving mechanism includes a base part formed in a locally bent manner and mounted on the supporting member.

[0009] In addition, in some embodiments of the present invention, the washing machine is sandwiched between a pair of the supporting members; and the washing machine includes a beam member arranged between the pair of the supporting members.

[0010] In addition, in some embodiments of the present invention, the washing machine is sandwiched between a pair of the supporting members; the washing machine includes a supporting frame which is an integral supporting frame integrally having the pair of the supporting members; and a bottom member arranged between lower ends of the pair of the supporting members.

Effects of the invention

[0011] According to the present invention, in the washing machine including the washing drum, the supporting member arranged on the outer side of the washing drum rotatably supports the washing drum, the washing drum can rotate in a manner of crossing with a perpendicular direction.

[0012] The bent part, which is bent towards the washing drum, is arranged on the supporting member. Thus, rigidity of the supporting member can be increased. The elastic supporting member for elastically supporting the supporting member is mounted on the bent part. In this case, since the elastic supporting member is arranged on the side where the washing drum is (i.e., the inner side of the supporting member) rather than in a manner of extending to a side of the supporting member opposite to the washing drum (i.e., an outer side), the washing machine can become smaller. Thus, an installation space of the washing machine can be reduced.

[0013] In addition, according to some embodiments of the present invention, since the driving mechanism for rotating the washing drum is not arranged between the

supporting member and the washing drum rather than in a manner of extending to the outer side of the supporting member, the washing machine can become smaller. Thus, an installation space of the washing machine can be reduced.

[0014] In addition, according to some embodiments of the present invention, the base part, mounted on the supporting member, of the driving mechanism is formed in a locally bent manner, so that the rigidity can be increased. Thus, since the supporting member is strengthened through the base part, the rigidity of the supporting members can be further increased.

[0015] In addition, according to some embodiments of the present invention, the beam member is arranged between a pair of the supporting members, which are arranged in a manner of sandwiching the washing drum. Thus, the rigidity of the supporting members can be further increased.

[0016] In addition, according to some embodiments of the present invention, a pair of the supporting members arranged in a manner of sandwiching the washing drum and the bottom member arranged between the lower ends of the pair of the supporting members are integrated to form the integral supporting frame, so that the rigidity of the supporting members can be further increased.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

Fig. 1 is a schematic three-dimensional diagram illustrating a washing machine in an embodiment of the present invention.

Fig. 2 is a three-dimensional diagram illustrating a supporting member of a supporting frame included in a washing machine.

Fig. 3 is a three-dimensional diagram illustrating a washing machine.

Fig. 4 is a three-dimensional diagram illustrating a driving mechanism included in a washing machine.

Fig. 5 is a left view of a supporting member and a driving mechanism.

Fig. 6 is a sectional view along A-A of Fig. 5.

Fig. 7 is a three-dimensional diagram illustrating a washing machine in a variant example.

List of reference numerals

[0018] 1: washing machine; 3: washing drum; 4: supporting frame; 5: elastic supporting member; 8: driving mechanism; 13: supporting member; 13F: bent part; 14: beam member; 30: base part; 60: bottom member; and Z: up-down direction.

DETAILED DESCRIPTION

[0019] Embodiments of the present invention are specifically described below with reference to drawings. Fig.

1 is a schematic three-dimensional diagram illustrating a washing machine 1 in an embodiment of the present invention. An up-down direction in Fig. 1 is called as an up-down direction Z of the washing machine 1; a left-right direction in Fig. 1 is called as a front-rear direction Y of the washing machine 1; and a transverse direction substantially orthogonal to paper of Fig. 1 is called as a left-right direction X. The up-down direction Z is also a perpendicular direction. In the up-down direction Z, an upper side is called as an upper side Z1; and a lower side is called as a lower side Z2. In the front-rear direction Y, a right side in Fig. 1 is called as a front side Y1; and a left side in Fig. 1 is called as a rear side Y2. In the left-right direction X, an outer side of the paper of Fig. 1 is called as a left side X1; and an inner side of the paper of Fig. 1 is called as a right side X2.

[0020] In the washing machine 1, although the washing machine 1 also includes a washing and drying machine with a clothes drying function, the washing machine 1 hereafter, which only executes washing operation without explaining the clothes drying function, is taken as an example. The washing operation includes a washing process, a rinsing process and a dewatering process. The washing machine 1 includes: a housing 2, a washing drum 3 arranged in the housing 2, a supporting frame 4, an elastic supporting member 5, a rotating part 6, an unlocking mechanism 7 and a driving mechanism 8.

[0021] The housing 2 is, for example, made of metal, and is formed in a shape of a box. A connecting surface 2C for connecting a front surface 2A and an upper surface 2B is arranged on the housing 2. The connecting surface 2C is, for example, an inclined surface which drops towards the front side Y1. An outlet-inlet (not shown) for throwing in and taking out washings from the washing machine 1 is formed in a manner of bridging the front surface 2A and the connecting surface 2C.

[0022] The washing drum 3 includes an outer drum 10 and an inner drum 11. The outer drum 10 is, for example, made of resin, and is formed in a cylindrical shape with a bottom. An imaginary straight line passing through a center of a circle of the outer drum 10 is a central axis J of the outer drum 10. In the washing process and the rinsing process, water is stored in the outer drum 10. A circular opening 10A through which the washings are thrown in and taken out from the washing machine 1 is formed on an upper end of the outer drum 10 on an opposite side of a bottom wall (not shown). Metal rotating shafts 12 protruding to an outer side of the left-right direction X are arranged one by one on left and right side surfaces of the outer drum 10. Fig. 1 only shows the rotating shaft 12 on the left side X1. The pair of left and right rotating shafts 12 are disposed in a same position when observed from the left-right direction X.

[0023] The inner drum 11 is, for example, made of metal, and is formed in a cylindrical shape with a bottom. The inner drum 11 is smaller than the outer drum 10. The washings are accommodated into the inner drum 11. A circular opening 11A through which the washings are ac-

commodated into the inner drum 11 is formed on an upper end of the inner drum 11 on an opposite side of a bottom wall (not shown). The inner drum 11 is coaxially accommodated into the outer drum 10. Therefore, the central axis of the inner drum 11 is the above central axis J. In a state where the inner drum 11 is accommodated into the outer drum 10, an opening 11A of the inner drum 11 is located at an inner side of an opening 10A of the outer drum 10. The opening 10A and the opening 11A are directed to the outlet-inlet (not shown) of the housing 2. Thus, the washings can be thrown in and taken out of the inner drum 11. A plurality of through holes 11C are formed in a circumferential wall 11B and a bottom wall of the inner drum 11; and water in the outer drum 10 passes between the outer drum 10 and the inner drum 11 via the through holes 11C. Therefore, a water level in the outer drum 10 is consistent with a water level in the inner drum 11. In washing operation, the inner drum 11 rotates around the central axis J under a driving force from a motor (not shown) arranged in the housing 2.

[0024] The supporting frame 4 is made of metal, and includes a pair of left and right supporting members 13 and beam members 14 arranged between lower ends of the pair of the supporting members 13. A washing drum 3 is arranged between the pair of the supporting members 13. Therefore, the pair of the supporting members 13 is arranged on an outer side of the washing drum 3 in a manner of sandwiching the washing drum 3 from the left-right direction X. Each supporting member 13 is rectangular when observed from the left-right direction X and is formed in a shape of a plate which is thin in the left-right direction X. In other words, each supporting member 13 has a specific thickness in opposite direction of the washing drum 3, i.e., in the left-right direction X.

[0025] For the outer drum 10 of the washing drum 3, the rotating shaft 12 protruding to the left side X1 penetrates through the supporting member 13 on the left side X1, and is rotatably supported by the supporting member 13 on the left side X1 via a bearing (not shown). For the outer drum 10, the rotating shaft 12 (not shown) protruding to the right side X2 penetrates through the supporting member 13 on the right side X2, and is rotatably supported by the supporting member 13 on the right side X2 via a bearing (not shown). Thus, the washing drum 3 is supported by the supporting members 13 on the left and right sides of the supporting frame 4, and can rotate around the rotating shaft 12 in a manner of crossing with the up-down direction Z. Specifically, with rotation of the washing drum 3, the central axis J of the outer drum 10 and the inner drum 11 is inclined to the front-rear direction Y relative to the up-down direction Z. A rotating direction of the washing drum 3 is called as a rotating direction K.

[0026] A crossing angle, which is a sharp angle between an imaginary reference axis L extending along the up-down direction Z and the central axis J, is a rotating angle θ of the washing drum 3 relative to the reference axis L. The smaller the rotating angle θ is, the closer to the vertical posture the washing drum 3 is. The larger the

rotating angle θ is, the more inclined to the front side Y1 the washing drum 3 is in such a manner that the opening 10A of the outer drum 10 and the opening 11A of the inner drum 11 face the front side Y1. The rotating angle θ can be changed at, for example, five levels of 5 degrees, 15 degrees, 30 degrees, 45 degrees and 60 degrees. In this case, as an example of application in the washing machine 1, when the washings are thrown in the washing drum 3 at the beginning of the washing operation, the rotating angle θ is set as 45 degrees in such a manner that throwing of the washings becomes easy; and then, under a condition of detecting a load of the washings or supplying water to the washing drum 3, the rotating angle θ is set as 5 degrees. Then, in the washing process and the rinsing process, in order to promote position alternation of the washings in the inner drum 11 to realize efficient washing and rinsing, the rotating angle θ is set to change between 5 degrees and 60 degrees.

[0027] An opening 13A penetrating through the supporting member 13 on the left side X1 along the left-right direction X is formed in a region of the supporting member 13 on the left side X1 and closer to the lower side Z2 than the rotating shaft 12. The opening 13A is formed in a substantially rectangular shape which is long in the front-rear direction Y. Referring to the three-dimensional diagram (i.e., Fig. 2) of the supporting member 13 on the left side X1, a circular opening 13B into which the rotating shaft 12 is inserted and through which the rotating part 6 is located is formed at the upper side Z1 of the opening 13A of the supporting member 13 on the left side X1, as well as a rectangular opening 13C located closer to the front side Y1 than the opening 13B and into which the unlocking mechanism 7 is embedded is formed at the upper side Z1 of the opening 13A of the supporting member 13 on the left side X1.

[0028] For each supporting member 13, an inclined part 13D from which an angle on the front upper side is cut off obliquely is formed; and the entire region of the upper end, which is closer to the rear side Y2 than the inclined part 13D, forms a flange part 13E bent into a substantially right angle to an side opposite to the side of washing drum 3 in the left-right direction X. Herein, the side of washing drum 3 in the left-right direction X means an inner side of the supporting member 13, i.e., the right side X2 with respect to the supporting member 13 on the left side X1 and the left side X1 with respect to the supporting member 13 on the right side X2. In turn, the side opposite to the side of washing drum 3 in the left-right direction X means an outer side of the supporting member 13, i.e., the left side X1 with respect to the supporting member 13 on the left side X1 and the right side X2 with respect to the supporting member 13 on the right side X2.

[0029] A bent part 13F bent to the side of washing drum 3 is integrally provided on each supporting member 13. The bent part 13F includes a front bent part 13G, a rear bent part 13H and a lower bent part 13I. The front bent part 13G is formed into a shape of a belt which extends along the up-down direction Z by bending an almost en-

tire region of the front end of the supporting member 13 closer to the lower side Z2 than the inclined part 13D towards the washing drum 3 side into a substantially right angle. The rear bent part 13H is formed into a shape of a belt which extends along the up-down direction Z by bending an almost entire region of the rear end of the supporting member 13 towards the washing drum 3 side into a substantially right angle. The lower bent part 13I is formed into a shape of a belt which extends along the front-rear direction Y by bending an almost entire region of the lower end of the supporting member 13 towards the washing drum 3 side into a substantially right angle.

[0030] The rigidity of the supporting member 13, and especially the bending rigidity of the left-right direction X, can be increased through the bent part 13F. It should be noted that the flange part 13E arranged on the upper end of the supporting member 13 is also conducive to increasing the rigidity of the supporting member 13. Since the overall resonant frequency of the supporting frame 4 of the supporting member 13 increases by increasing the rigidity of the supporting member 13 in this manner, vibration of the supporting frame 4 during high-speed rotation of the inner drum 11 can be inhibited especially in the dewatering process.

[0031] The front bent part 13G and the rear bent part 13H each is cut from the side of washing drum 3 along the up-down direction Z to form a notch 13K, such that the upper part 13J is narrower than the lower part 13L along the left-right direction X. The notch 13K is located in a position which is reachable to the vibrating washing drum 3 in washing operation. Therefore, the washing drum 3 can be prevented from contacting with the front bent part 13G and the rear bent part 13H in the washing operation. A plurality of large or small through holes 13M penetrating through the lower part 13L along the front-rear direction Y are formed in the upper region of the lower part 13L. An edge of the side of washing drum 3 on the lower region of the lower part 13L is formed in such a manner: the edge is inclined to a side opposite to the side of washing drum 3 as dropping to the lower side Z2. Thus, the lower region of the lower part 13L becomes narrow in the left-right direction X as dropping to the lower side Z2.

[0032] With reference to the three-dimensional diagram (i.e., Fig. 3) for observing the washing machine 1 from the lower side Z2, accepting parts 15 are fixed on the upper regions of the respective lower parts 13L of the front bent part 13G and the rear bent part 13H. Each accepting part 15 is made of, for example, resin, and is formed into a shape of a box which is slightly longer in the up-down direction Z. A concave part 15A sinking from a lower surface to the upper side Z1 is formed in each accepting part 15. The accepting part 15 is arranged to be opposite to the lower part 13L of the front bent part 13G from the front side Y1 and opposite to the lower part 13L of the rear bent part 13H from the rear side Y2. A claw (not shown) arranged on the accepting part 15 is embedded into part of the through holes 13M (with ref-

erence to Fig. 2) in the upper region of the lower part 13L, so that the accepting part 15 is located on the lower part 13L. Screws (not shown) penetrating through other through holes 13M in the upper region of the lower part 13L are assembled on the accepting part 15, so that the accepting part 15 is fixed to the lower part 13L.

[0033] The elastic supporting members 5 are also called as hoisting rods, and are formed in a shape of rod which has a length in the vertical direction and has a friction damper 16 at the lower end. There are four elastic supporting members 5 arranged at four corners in the housing 2 when observed from top, i.e., from the upper side Z1. The elastic supporting members 5 are in a state of being suspended from the upper part of the housing 2, and specifically from a metal outer frame (not shown) forming part of the housing 2.

[0034] Among two elastic supporting members 5 arranged front and back on the left side X1, a lower end of the elastic supporting member 5 on the front side Y1 is connected with the accepting part 15 of a front bent part 13G of the supporting member 13 arranged at the left side X1, and a lower end of the elastic supporting member 5 on the rear side Y2 is connected with the accepting part 15 of a rear bent part 13H of the supporting member 13 arranged on the left side X1. Among two elastic supporting members 5 arranged front and back on the right side X2, a lower end of the elastic supporting member 5 on the front side Y1 is connected with the accepting part 15 of the front bent part 13G of the supporting member 13 arranged on the right side X2, and a lower end of the elastic supporting member 5 (not shown) on the rear side Y2 is connected with the accepting part 15 (not shown) of the rear bent part 13H of the supporting member 13 arranged on the right side X2.

[0035] The lower end of each elastic supporting member 5 is embedded into the concave part 15A of the accepting part 15 from the lower side Z2 and thus is connected with the accepting part 15, and is mounted on the front bent part 13G or the rear bent part 13H through the accepting part 15. A stick-shaped part of the elastic supporting member closer to the upper side Z1 than the lower end penetrates through the accepting part 15, extends to the upper side Z1 of the accepting part 15 and is connected with the outer frame (not shown). Thus, the supporting frame 4 having the supporting member 13, the washing drum 3 supported by the supporting frame 4, and the motor (not shown) for rotating the inner drum 11 are elastically supported by the elastic supporting member 5.

[0036] The elastic supporting member 5 mounted on the front bent part 13G and the rear bent part 13H which are bent from the supporting member 13 to the side of washing drum 3 in the left-right direction X is arranged on the side of washing drum (i.e., the inner side of the supporting member 13) rather than in a manner of extending to a side of the supporting member 13 opposite to the washing drum (i.e., an outer side). Thus, the washing machine 1 can become smaller in the left-right direc-

tion X. Thus, an installation space of the washing machine 1 can be reduced. Therefore, since the size of the washing machine 1 having structures of the rotating part 6, the unlocking mechanism 7 and the driving mechanism 8 for rotating the washing drum 3 can be controlled to be the same as a common washing machine without such structures, the washing machine 1 can be arranged on a waterproof disk of an existing size.

[0037] Two beam members 14 are arranged and each is formed into a shape of column which is thin and is long in the left-right direction X. The two beam members 14 are respectively arranged between the front end and between the rear end of the lower bent part 13I of a pair of the supporting members 13. Thus, the rigidity of each supporting member 13 and the integral rigidity of the supporting frame 4 are further increased. As a result, since distortion between a pair of the supporting members 13 can be inhibited, a situation of applying a burden to the rotating shaft 12 of the washing drum 3 due to the distortion can be inhibited.

[0038] The rotating part 6 is a substantially fan-shaped metal plate which is thin in the left-right direction X and protrudes to the front side Y1 when observed from the left-right direction X. The rotating part 6 has an outer circumferential edge 6A which is formed in a circular arc shape along the rotating direction K and protrudes to the front side Y1. A through hole 6B penetrating through the rotating part 6 along the left-right direction X is formed in a position on the rotating part 6 consistent with a center of curvature of the outer circumferential edge 6A. A plurality of concave parts 6C are formed at the outer circumferential edge 6A, and five concave parts 6C are formed herein. The concave parts 6C are sunken towards the through hole 6B, penetrate through the rotating part 6 along the left-right direction X, and are arranged along the rotating direction K. The spacing between adjacent concave parts 6C can be fixed or can be changed according to the position of the rotating part 6. In the present embodiment, for the rotating angle θ set as 5 degrees, 15 degrees, 30 degrees, 45 degrees and 60 degrees, in the rotating part 6 under a posture as shown in Fig. 3, the spacing between two concave parts 6C located on a rear-most side Y2 and the position adjacent to the rear-most side Y2 is 10 degrees in the rotating direction K, i.e., in the circumferential direction using the through hole 6B as a center; and the spacing between other adjacent concave parts 6C is fixed as 15 degrees.

[0039] The rotating part 6 is arranged to be closer to the left side X1 than the supporting member 13 on the left side X1. The rotating shaft 12 of the outer drum 10 of the washing drum 3, protruding to the left side X1 and penetrating through the supporting member 13 on the left side X1, is inserted into the through hole 6B of the rotating part 6, and is fixed to the rotating part 6. Thus, the rotating part 6 is connected to the washing drum 3 in a manner of integral rotation via the rotating shaft 12.

[0040] In the rotating part 6 under the posture in Fig. 3, at the rear end of the outer circumferential edge 6A,

an extending part 6D protruding to the lower side Z2 and specifically protruding to the outer side in the radial direction R of the rotating part 6 using the through hole 6B as a center is integrally arranged. The extending part 6D is formed in a shape of a plate which is long in the radial direction R and thin in the left-right direction X. A guiding hole 6E which is long in the radial direction R and penetrates through the extending part 6D along the left-right direction X is formed in the extending part 6D. Both ends of a long edge direction of the guiding hole 6E are in a blocked state. In the up-down direction Z, the guiding hole 6E is located in the same position as the opening 13A of the supporting member 13 on the left side X1. Regardless of a value of the rotating angle θ from 5 degrees to 60 degrees, the guiding hole 6E is always opposite to the opening 13A from the left side X1.

[0041] The unlocking mechanism 7 is fixed to a left side surface of the supporting member 13 on the left side X1. The unlocking mechanism 7 includes a body part 17 and a locking part 18. An actuator (not shown) composed of a solenoid and the like is arranged on the body part 17. The locking part 18 is formed in a shape of a bulge protruding from the body part 17 to the rear side Y2, and strictly protruding to the rear upper side, and is supported by the body part 17 in a manner of sliding in the front-rear direction Y. The actuator of the body part 17 operates, so that the locking part 18 slides between an in-position for entering to the rear-most side Y2 and an out-position for exiting to a front-most side Y1.

[0042] The locking part 18 in Fig. 3 is in the in-position. Under a condition where any concave part 6C of the rotating part 6 is in the same position as the locking part 18 in the rotating direction K, the locking part 18 enters the in-position, thereby being embedded into the concave part 6C in the same position in the rotating direction K. Thus, rotation of the rotating part 6 and the washing drum 3 is locked. In this state, when the locking part 18 exits to the out-position, since the locking part 18 leaves the concave part 6C, the rotating part 6 and the washing drum 3 are unlocked.

[0043] In Fig. 3, the locking part 18 in the in-position is in a state of being embedded into the concave part 6C located at the upper-most side Z1 and the front-most side Y1. At this moment, in a state where the rotating angle θ is 60 degrees, the rotation of the rotating part 6 and the washing drum 3 is locked. As the concave part 6C into which the locking part 18 is embedded is another concave part 6C located at the rear side Y2, the rotating angle θ is decreased; and in a state where the locking part 18 is embedded into the concave part 6C at the rear-most side Y2, the rotating angle θ is 5 degrees. In this state, the rotation of the rotating part 6 and the washing drum 3 is locked.

[0044] Fig. 4 is a three-dimensional diagram illustrating a driving mechanism 8. With reference to Fig. 4, the driving mechanism 8 is a mechanism for rotating the washing drum 3, and includes a base part 30, a supporting part 31, a threaded shaft 32, a motor 33, a coupler 34, a nut

member 35 and a sensor 36.

[0045] The base part 30 is formed by, for example, bending a metal plate, and integrally includes a longitudinal wall 37 and a pair of upper and lower transverse walls 38. The longitudinal wall 37 is formed in a shape of a rectangular plate which is thin in the left-right direction X and long in the front-rear direction Y. Each transverse wall 38 is formed in a shape of a rectangular plate which is thin in the up-down direction Z and long in the front-rear direction Y. For the pair of transverse walls 38, the transverse wall 38 on the upper side Z1 is continuous for the entire upper end of the longitudinal wall 37 and extends from the upper end to the left side X1, and the transverse wall 38 on the lower side Z2 is continuous for almost entire lower end of the longitudinal wall 37 and extends from the lower end to the left side X1.

[0046] The left end of each transverse wall 38 serves as a flange part 38A and is formed in a manner of being bent into a substantially right angle to the outer side in the up-down direction Z of the entire region throughout the front-rear direction Y. The flange part 38A of the transverse wall 38 on the upper side Z1 is formed in a manner of bending to the upper side Z1, and the flange part 38A of the transverse wall 38 on the lower side Z2 is formed in a manner of bending to the lower side Z2. A threaded hole 38B is formed in each flange part 38A.

[0047] In this way, the base part 30 is formed in a manner of being bent into a shape of a crank on a boundary line between the longitudinal wall 37 and the transverse walls 38 and a circumferential local part of the flange part 38A. An accommodating space 30A enclosed by the longitudinal wall 37 and the pair of upper and lower transverse walls 38 is formed on the base part 30. The supporting part 31, the threaded shaft 32, the coupler 34, the nut member 35 and the sensor 36 are accommodated in the accommodating space 30A.

[0048] The base part 30 is disposed between the supporting member 13 on the left side X1 and the washing drum 3 in a manner of being arranged along the left-right direction X relative to the washing drum 3, and a pair of upper and lower flange parts 38A are arranged oppositely from circumferential parts of the openings 13A of the supporting members 13 on the right side X2 and the left side X1 (with reference to Fig. 1). A screw 39, which is assembled on the supporting member 13 on the left side X1 (with reference to Fig. 1), is also assembled in the threaded hole 38B of each flange part 38A, so that the base part 30 is mounted on the supporting member 13 on the left side X1. Since the base part 30 formed in the locally bent manner as mentioned above can increase rigidity, the supporting member 13 is strengthened through the base part 30. Thus, the rigidity of the supporting member 13 can be further increased. The accommodating space 30A of the base part 30 is exposed from the supporting member 13 on the left side X1 to the left side X1 via the opening 13A (with reference to Fig. 1).

[0049] A pair of supporting parts 31 are arranged away from each other along the front-rear direction Y. The sup-

porting part 31 on the front side Y1 is arranged on the front end of the longitudinal wall 37 of the base part 30, and the supporting part 31 on the rear side Y2 is arranged on the rear end of the longitudinal wall 37. Each supporting part 31 is formed by, for example, bending the metal plate. Each supporting part 31 integrally includes a body part 40 and a base part 41. The body part 40 is in a shape of a plate which is thin in the front-rear direction Y, and is configured in a manner of protruding from the left side surface of the longitudinal wall 37 of the base part 30 to the left side X1. A bearing 42 which is annular when observed from the front-rear direction Y is mounted on the body part 40 in a manner of penetrating through the body part 40 along the front-rear direction Y. The base part 41 is in a shape of a plate which is thin in the left-right direction X. For the supporting part 31 on the front side Y1, the base part 41 extends from the lower end of the body part 40 to the front side Y1, and is configured in a manner of being overlapped with the front end part of the longitudinal wall 37 from the left side X1. For the supporting part 31 on the rear side Y2, the base part 41 extends from the lower end of the body part 40 to the rear side Y2, and is arranged in a manner of being overlapped with the rear end of the longitudinal wall 37 from the left side X1. By assembling the screws 43 on the base part 41 and the longitudinal wall 37, each supporting part 31 is fixed to the base part 30.

[0050] The threaded shaft 32 is formed in a cylindrical shape slenderly extending along the front-rear direction Y, and a screw thread 32A which extends helically is formed almost on the entire outer circumferential surface. It should be noted that in each figure except Fig. 4, to facilitate illustration, the screw thread 32A of the threaded shaft 32 is omitted. The front end of the threaded shaft 32 is inserted into the annular bearing 42 of the supporting part 31 on the front side Y1, and the rear end of the threaded shaft 32 is inserted into an annular bearing 42 of the supporting part 31 on the rear side Y2. In this state, the threaded shaft 32 is supported on both ends by a pair of front and rear supporting parts 31 in a manner of rotation.

[0051] The motor 33 is a common electric motor, and has an output shaft 44 protruding to the rear side Y2 and disposed coaxially with the threaded shaft 32. The motor 33 is provided with a platy bracket 45, which is thin in the front-rear direction Y, from the rear side Y2. The output shaft 44 is exposed from the bracket 45 to the rear side Y2. The output shaft 44 is arranged to be opposite, from the front side Y1, to part of the front end of the threaded shaft 32 extending further to the front side Y1 than the body part 40 of the supporting part 31 on the front side Y1. An upper end and a lower end of a left end of the bracket 45 serve as a pair of upper and lower flange parts 45A, and are bent into a substantially right angle to the rear side Y2. A threaded hole 45B is formed in each flange part 45A.

[0052] The motor 33 is disposed between the supporting member 13 on the left side X1 and the washing drum

3 in a position closer to the front side Y1 than the base part 30, the flange parts 45A of the bracket 45 are arranged oppositely from circumferential parts of the openings 13A of the supporting members 13 on the right side X2 and the left side X1 (with reference to Fig. 1). By assembling the screw 46 (with reference to Fig. 1), which is assembled on the supporting member 13 on the left side X1, to the threaded hole 45B of each flange part 45A, the motor 33 is fixed to the supporting member 13 on the left side X1 via the bracket 45. The motor 33 in this state is exposed from the supporting member 13 on the left side X1 to the left side X1 via the opening 13A (with reference to Fig. 1).

[0053] The coupler 34 includes: a cylindrical output part 47 externally embedded into a rear end of the output shaft 44 of the motor 33 in a manner of integral rotation, a cylindrical input part 48 externally embedded into a front end of the threaded shaft 32 in a manner of integral rotation, and a buffer part 49 disposed between the output part 47 and the input part 48. The cylindrical output part 47 has a plurality of protrusion parts 47A arranged along the circumferential direction and protruding to the rear side Y2. The cylindrical input part 48 has a plurality of protrusion parts 48A arranged along the circumferential direction and protruding to the front side Y1. The protrusion part 47A and the protrusion part 48A are alternatively arranged in the circumferential directions of the output part 47 and the input part 48. The buffer part 49 is configured between the protrusion part 47A and the adjacent protrusion part 48A. The buffer part 49 is composed of an elastomer such as rubber and spring. The output shaft 44 and the threaded shaft 32 are connected via the coupler 34 in a manner of integral connection. Therefore, when the motor 33 is driven to rotate the output shaft 44, the threaded shaft 32 and the output shaft 44 rotate integrally.

[0054] The nut member 35 includes a body part 50, a connecting part 51 and a detected part 52. The body part 50 is formed on an annular nut having a screw thread (not shown) which extends helically on the inner circumferential surface, and is externally embedded into the threaded shaft 32 in such a manner that the screw thread of the nut and the screw thread 32A of the threaded shaft 32 are in mutual threaded connection. When the motor 33 drives the threaded shaft 32 to rotate, the nut member 35 integrally moves along the axial direction (i.e., the front-rear direction Y) of the threaded shaft 32, along with rotation of the threaded shaft 32.

[0055] The connecting part 51 is formed, for example, by bending a metal plate, and integrally includes a first part 51A, a second part 51B and a third part 51C. The first part 51A is formed in a shape of a plate which is thin in the front-rear direction Y and extends along the up-down direction Z, and is fixed to the body part 50 through the screws 53. The second part 51B is formed in a shape of a plate which is thin in the left-right direction X and extends along the up-down direction Z, and is arranged in a manner of protruding from the left end edge of the

first part 51A to the front side Y1 and extending from the accommodating space 30A of the base part 30 to the left side X1, and is opposite to the body part 50 from the left side X1 (with reference to Fig. 6 below). A through hole 51D penetrating through the second part 51B along the left-right direction X is formed in the second part 51B.

[0056] The second part 51B is opposite to the extending part 6D of the rotating part 6 from the right side X2. A connecting pin 54 (with reference to Fig. 1) of the guiding hole 6E, which is inserted into the extending part 6D from the left side X1, is inserted into the through hole 51D. The connecting pin 54 cannot be taken out of each through hole 51D and guiding hole 6E. The nut member 35 is connected with the rotating part 6 via the connecting pin 54. Therefore, when the nut member 35 moves along the front-rear direction Y along with rotation of the threaded shaft 32, the rotating part 6 is pulled along the front-rear direction Y by the nut member 35, so as to rotate with the washing drum 3. When the rotating part 6 rotates, the connecting pin 54 moves along the direction of the long edge of the guiding hole 6E in the guiding hole 6E. The third part 51C is formed in a shape of a plate which is thin in the up-down direction Z, protrudes from the lower end edge of the first part 51A to the front side Y1, and is opposite to the body part 50 from the lower side Z2.

[0057] The detected part 52 is formed in a shape of a plate which is thin in the left-right direction X, and integrally includes a fixing part 52A and a front end 52B. The fixing part 52A is arranged in a manner of overlapping with the third part 51C of the connecting part 51 from the lower side Z2, and is fixed to the third part 51C through the screw 55. The front end 52B is also called as a limiting part, and is formed in a shape of a rod extending from the front end of the fixing part 52A to the right side X2.

[0058] The sensor 36 is a sensor for detecting the rotating angle θ of the washing drum 3 according to a position of the nut member 35 in the front-rear direction Y. The sensor 36 can be selected from an optical sensor and other non-contact optical sensors. When the optical sensor is used, a groove 36A sunken to the right side X2 and penetrating through the sensor 36 along the front-rear direction Y is formed in the left side surface of the sensor 36. The sensor 36 is in such a state that light transects the groove 36A along the up-down direction Z. The number of the sensors 36 is the same as the number of the concave parts 6C of the rotating part 6. In other words, five sensors are arranged in the present embodiment, and all the groove 36A are arranged in a lower region of the longitudinal wall 37 of the base part 30 along the front-rear direction Y in a manner of overlapping with each other when observed from the front-rear direction Y. Each sensor 36 is fixed to the longitudinal wall 37 through the screw 56. The spacing between adjacent sensors 36 is set correspondingly to the spacing between adjacent concave parts 6C. Therefore, in the present embodiment, although the spacing between the adjacent sensors 36 in the four sensors 36 on the rear side Y2 is fixed, the spacing between two sensors 36 located on

the front-most side Y1 and the adjacent rear position is narrower than the spacing between other adjacent sensors 36.

[0059] When the nut member 35 moves along the front-rear direction Y along with rotation of the threaded shaft 32, the front end 52B of the detected part 52 arranged on the nut member 35 penetrates through the groove 36A of each sensor 36. Detection light of the groove 36A is blocked by the front end 52B in a state of being embedded into the groove 36A.

[0060] As shown in Fig. 4, when the front end part 52B of the detected part 52 is in a state of being embedded into the groove 36A of the sensor 36 on the rear-most side Y2, the above locking part 18 is located at the upper-most side Z1 and is in the same position as the concave part 6C on the front-most side Y1 in the rotating direction K; and the rotating angle θ of the washing drum 3 is 60 degrees (with reference to Fig. 1). On the other hand, in a state that the front end 52B of the detected part 52 is embedded into the groove 36A of the sensor 36 on the front-most side Y1, the locking part 18 is in the same position as the concave part 6C on the rear-most side Y2 in Fig. 1 in the rotating direction K; and the rotating angle θ of the washing drum 3 is 5 degrees. When the rotating angle θ is any of 5 degrees, 15 degrees, 30 degrees, 45 degrees and 60 degrees, the front end 52B of the detected part 52 is in a state of being embedded into the groove 36A of a certain sensor 36. Therefore, five sensors 36 uniformly detect the detected part 52 on the nut member 35 in a non-contact manner, thereby detecting the rotating angle θ from 5 degrees, 15 degrees, 30 degrees, 45 degrees and 60 degrees.

[0061] Fig. 5 is a left view of a supporting member 13 and a driving mechanism 8 on the left side X1. Fig. 6 is a sectional view along A-A of Fig. 5. In Fig. 6, to facilitate description, the front bent part 13G is shown with a dotted line. With reference to Fig. 6, for the driving mechanism 8, although the second part 51B of the connecting part 51 is arranged in a manner of extending further to the left side X1 than the supporting member 13 on the left side X1, the driving mechanism 8 is almost integrally arranged on the inner side of the supporting member 13 on the left side X1, i.e., between the supporting member 13 and the washing drum 3. Specifically, most part of the driving mechanism 8 except the second part 51B is arranged in such a manner that outlines of the front bent part 13G and the rear bent part 13H accommodated in the supporting member 13 on the left side X1 when observed from the front-rear direction Y are contained in the inner side. In this way, since the driving mechanism 8 is arranged between the supporting member 13 and the washing drum 3 rather than in a manner of extending to the outer side of the supporting member 13, the washing machine 1 can become smaller in the left-right direction X. Thus, an installation space of the washing machine 1 can be saved.

[0062] Fig. 7 is a three-dimensional diagram illustrating a washing machine 1 in a variant example when observed

from the lower side Z2. The supporting frame 4 includes a pair of the supporting members 13 and columnar beam members 14 (with reference to Fig. 3) arranged between a pair of the supporting members 13 in above embodiments. Instead, the supporting frame 4, as shown in Fig. 7, may also be an integral member with a U shape, and integrally includes a pair of the supporting members 13 and a platy bottom member 60 erected between the lower end parts of a pair of the supporting members 13. The integral supporting frame 4 can increase the rigidity of each supporting member 13 and may also increase the integral rigidity of the supporting frame 4. As a result, since the distortion between a pair of the supporting members 13 can be inhibited, a situation of applying a burden to the rotating shaft 12 of the washing drum 3 due to the distortion can be inhibited.

[0063] The present invention is not limited to embodiments described above, and can be changed in various modes within a scope recorded in claims.

[0064] In addition, as long as the movement of the nut member 35 in the front-rear direction Y, i.e., the rotation of the washing drum 3, can be limited when the driving of the motor 33 is stopped, the unlocking mechanism 7 and the concave part 6C of the rotating part 6 can be omitted. Thus, stepless adjustment can be made to the rotating angle θ .

Claims

1. A washing machine, comprising:

a washing drum accommodating washings and rotating in a manner of crossing with a perpendicular direction;
a supporting member arranged on an outer side of the washing drum and rotatably supporting the washing drum;
a bent part arranged on the supporting member and bent to a side of the washing drum; and
an elastic supporting member mounted on the bent part and elastically supporting the supporting member.

2. The washing machine according to claim 1, wherein the washing machine further comprises a driving mechanism arranged between the supporting member and the washing drum and rotating the washing drum.

3. The washing machine according to claim 2, wherein the driving mechanism comprises a base part formed in a locally bent manner and mounted on the supporting member.

4. The washing machine according to any one of claims 1-3, wherein the washing drum is sandwiched between a pair of

the supporting members; and
the washing machine comprises a beam member
arranged between the pair of the supporting mem-
bers.

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5. The washing machine according to any one of claims
1-3, wherein

the washing machine is sandwiched between a pair
of the supporting members; and

the washing machine comprises a supporting frame, 10
the supporting frame is an integral supporting frame

integrally having the pair of the supporting members
and a bottom member arranged between lower ends
of the pair of the supporting members.

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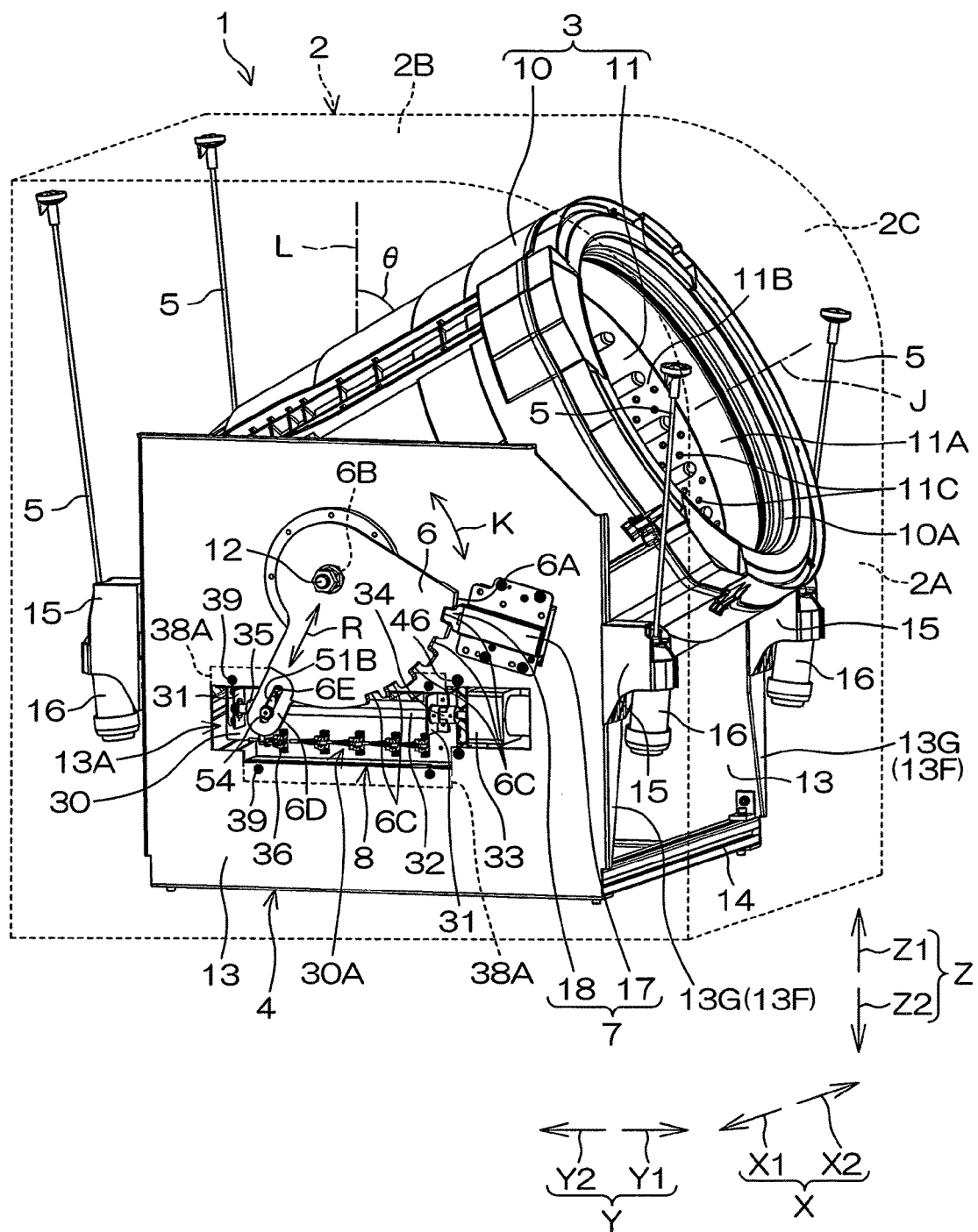


FIG. 1

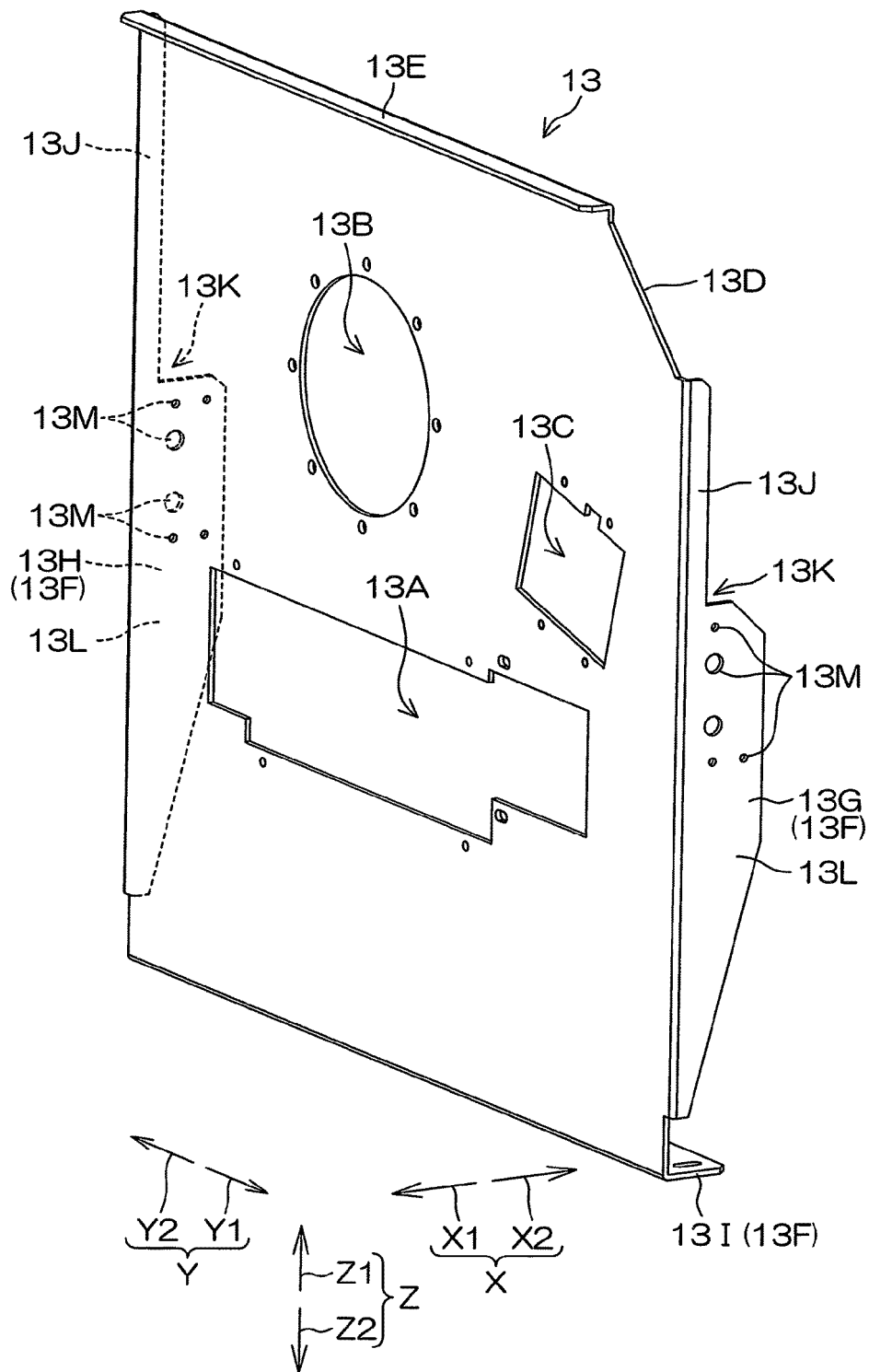


FIG. 2

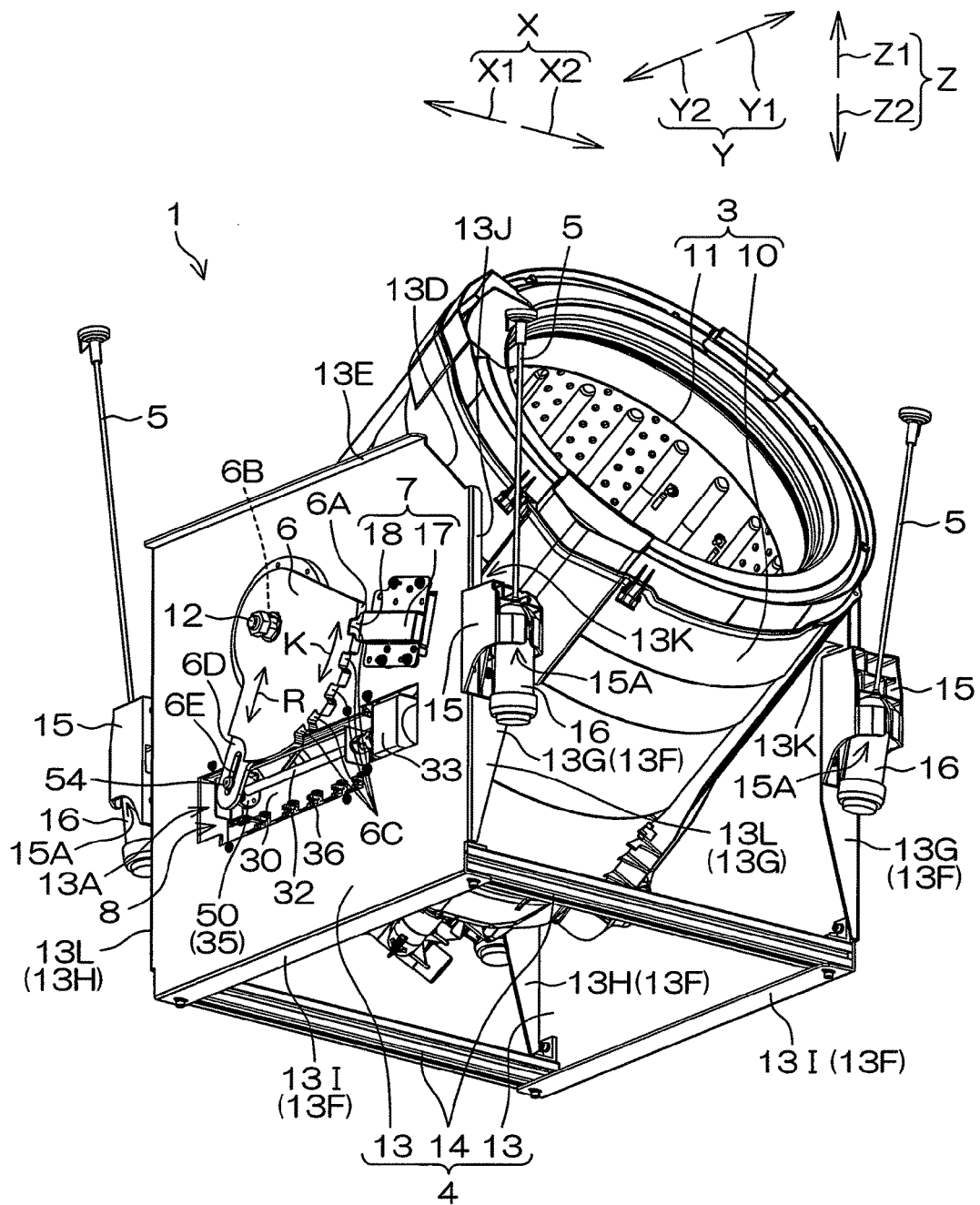


FIG. 3

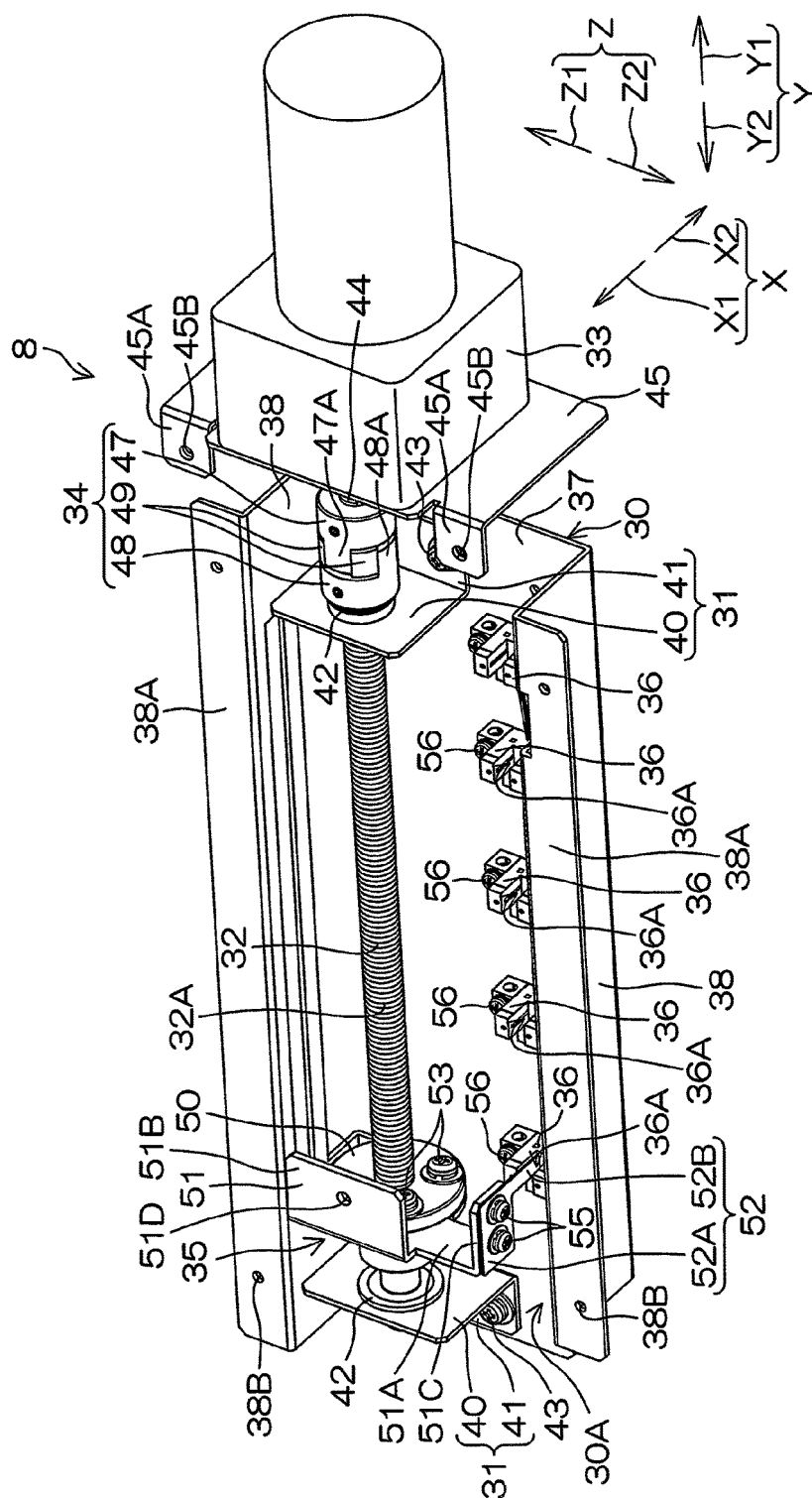


FIG. 4

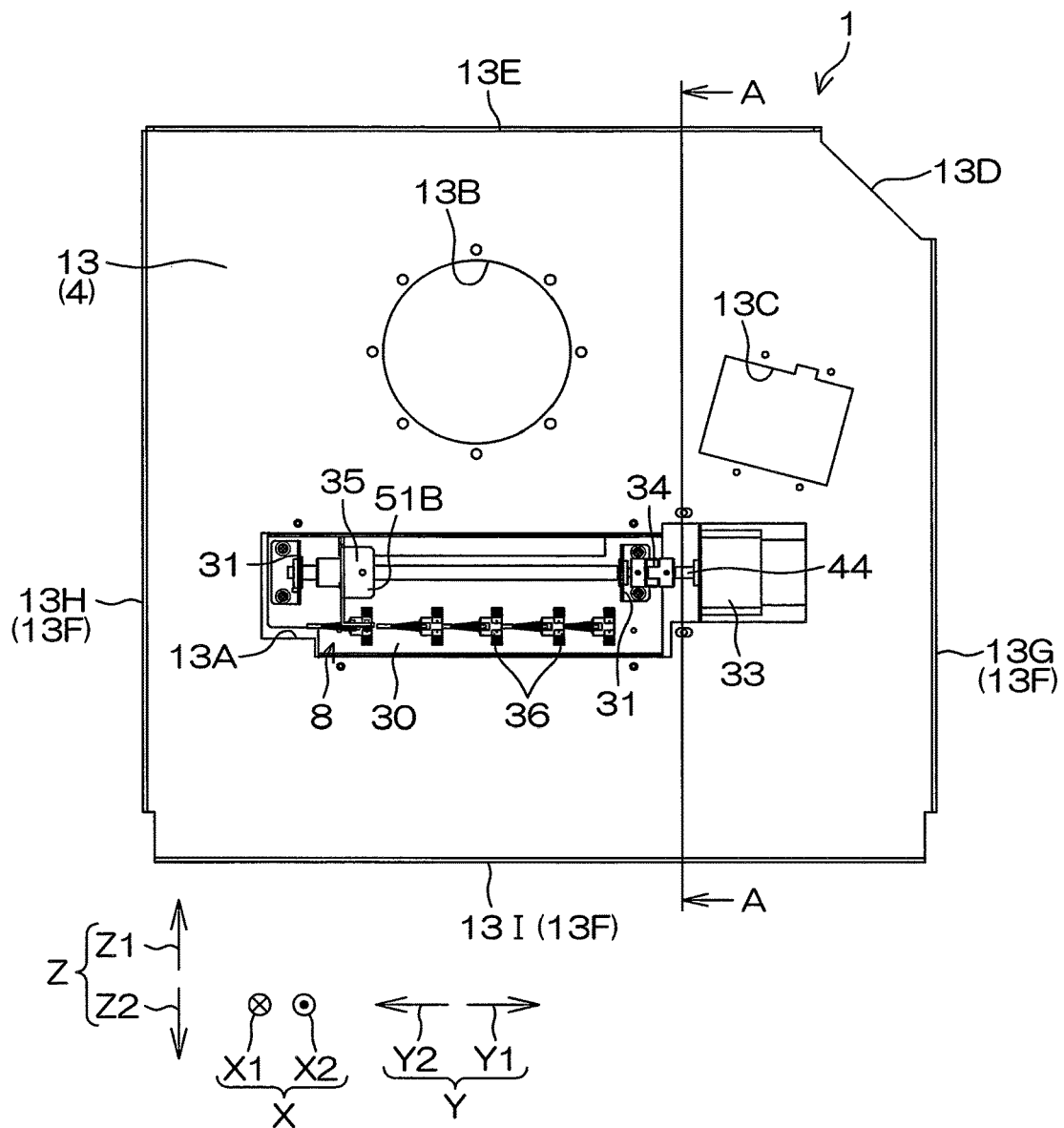


FIG. 5

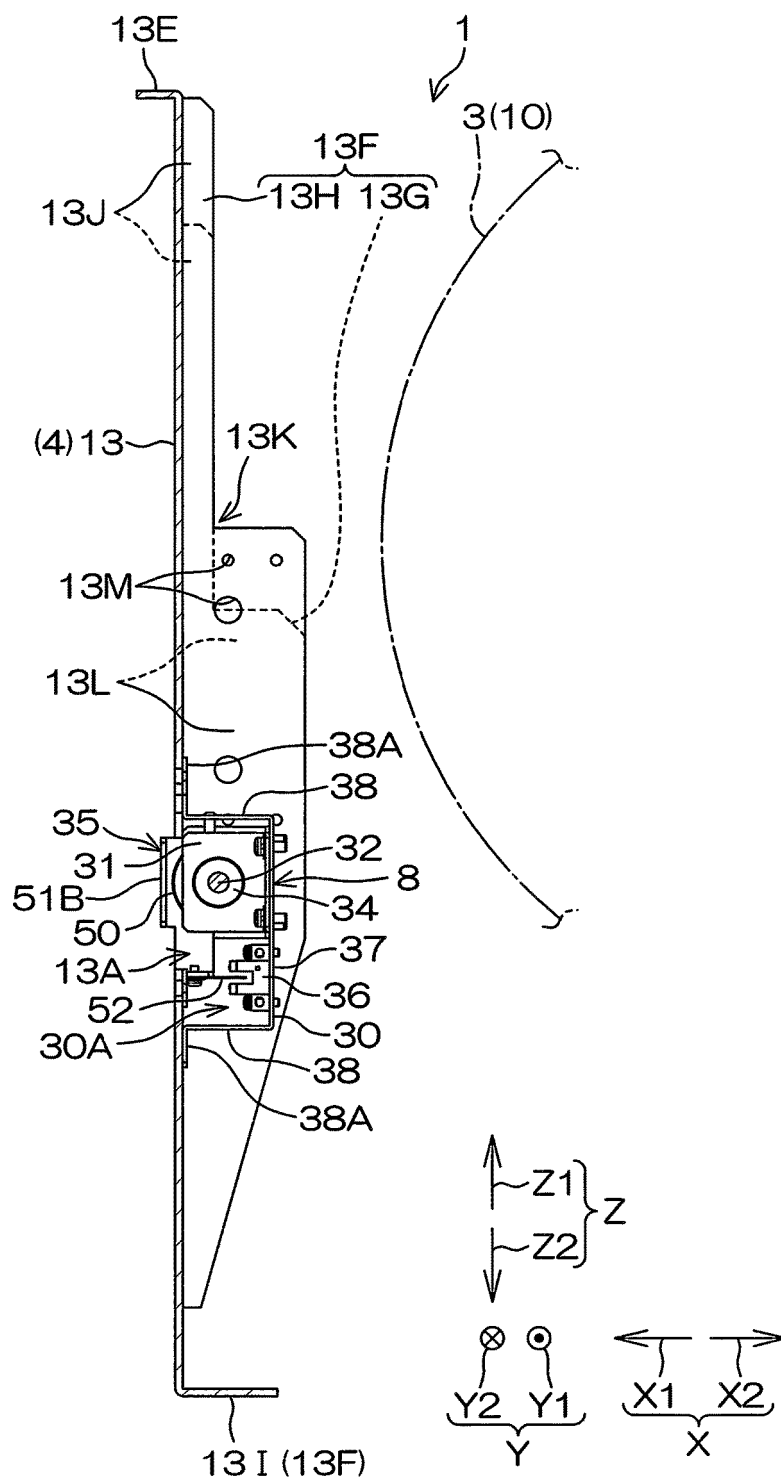


FIG. 6

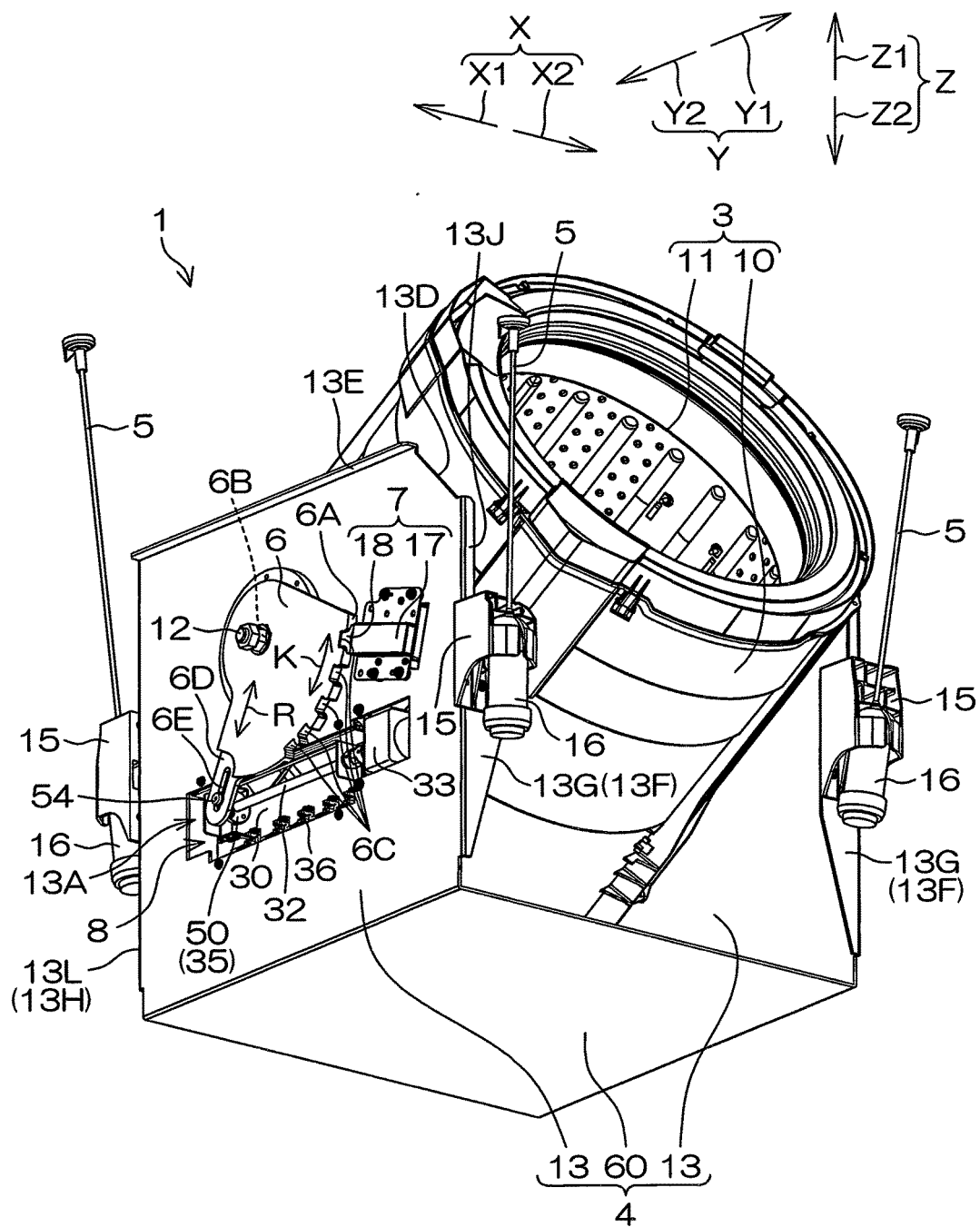


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/096689

A. CLASSIFICATION OF SUBJECT MATTER

D06F 37/20 (2006.01) i; D06F 49/06 (2006.01) i
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: washing machine, bucket, canister, housing, plate, frame, spring?, elast+, flexib+, suspend+, hang+,
rope?, flap+, bend+, bent+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2002292185 A (NIPPON KENTETSU CO., LTD. et al.) 08 October 2002 (08.10.2002) description, paragraphs [0014]-[0022] and figures 1-5	1-5
A	JP 2000271383 A (NIPPON KENTETSU CO., LTD. et al.) 03 October 2000 (03.10.2000) the whole document	1-5
A	FR 1543336 A (PHILIPS N. V.) 25 20 1968 (25.20.1968) the whole document	1-5
A	JPH 0549793 A (SANYO ELECTRIC CO.) 02 March 1993 (02.03.1993) the whole document	1-5
A	JP 2006000302 A (HITACHI HOME & LIFE SOLUTIONS) 05 January 2006 (05.01.2006) the whole document	1-5

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search 07 November 2016	Date of mailing of the international search report 15 November 2016
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer CHEN, Weitai Telephone No. (86-10) 010-62414387

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/096689

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JPH 04166196 A (HITACHI LTD.) 12 June 1992 (12.06.1992) the whole document	1-5
A	CN 102587083 A (SHARP KABUSHIK KAISHA) 18 July 2012 (18.07.2012) the whole document	1-5

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INTERNATIONAL SEARCH REPORT
 Information on patent family members

 International application No.
 PCT/CN2016/096689

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		DE 1585864 A1	28 January 1971
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JP 2006000302 A	05 January 2006	None	
JPH 04166196 A	12 June 1992	None	
CN 102587083 A	18 July 2012	JP 2012143289 A	02 August 2012

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 4166196 A [0004]