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(54) **WASHING MACHINE**

(57) The present invention provides a washing machine (1) which can prevent a situation of damaging surrounding members due to a member of a driving mechanism (8) for rotating a washing drum (3), wherein the washing drum (3) can rotate in a manner of intersecting a perpendicular direction. A rotating part (6) is connected with the washing drum (3) in a manner of integral rotation. A nut member (35) is connected with the rotating part (6), and is in threaded connection with a threaded shaft (32), and moves along a front-rear direction (Y) along with rotation of the threaded shaft (32), so that the rotating part (6) rotates. A supporting part (31) for supporting the threaded shaft (32) in a manner of rotation is fixed to a base part (30). A detected part (52) arranged on the nut member (35) and configured to detect a rotating angle of the rotating part (6) is detected by a sensor (36). A rotation-stopping protrusion (51D) arranged on the nut member (35) is incorporated into a limiting part (38C) formed on the base part (30) and extending along the front-rear direction (Y) in a shape of a straight line.

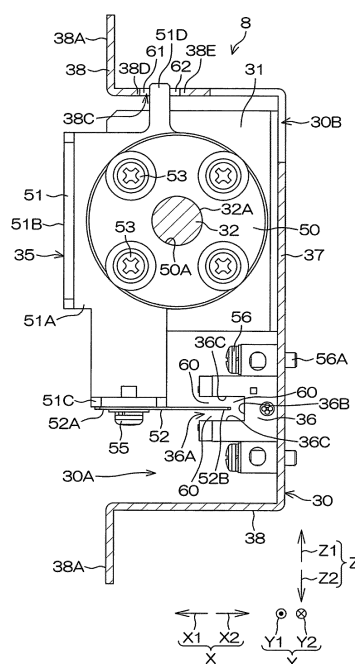


FIG. 4

Description

TECHNICAL FIELD

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

BACKGROUND

[0002] In a clothes 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 plate by means of an inclined rotation supporting shaft. The rotation supporting plate is supported by an outer frame of the clothes washing and drying machine by means of 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. With the rotation of the inclined rotation motor, 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 erected along a perpendicular direction during washing, rinse and dewatering.

[0003] In the clothes washing and drying machine described in the patent literature 1, the rotation operating rope installing part, the operating rope and other structures may freely move when a member of a driving mechanism for rotating the outer drum part is configured to assemble the driving mechanism, thereby colliding with surrounding members and damaging the surrounding members.

Existing Technical Literature

Patent Literature

[0004] Patent Literature 1: Japan specifically disclosed No. 4-166196 Bulletin

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 prevent a situation of damaging surrounding members due to a member of a driving mechanism for rotating a washing drum, wherein the washing drum can rotate in a manner of intersecting a perpendicular direction.

Solution for solving the problems

[0006] The present invention provides a washing machine,

including: a washing drum, accommodating washings and is rotatable in a manner of intersecting a perpendicular direction; a rotating part, connected to the washing drum in a manner of integral rotation; a threaded shaft; a motor for rotating the threaded shaft; a nut member, forming threaded connection with the threaded shaft and connected to the rotating part, and moving along an axial direction of the threaded shaft along with rotation of the threaded shaft, so that the rotating part rotates; a supporting part, for supporting the threaded shaft in a manner of rotation; a base part, fixed with the supporting part; a detected part, arranged on the nut member and configured to detect a rotating angle of the rotating part; a rotation-stopping protrusion, arranged on the nut member; a sensor, for detecting the detected part; and a limiting part, formed on the base part, extending along the axial direction in a shape of a straight line and incorporating the rotation-stopping protrusion.

[0007] In addition, in the present invention, the limiting part is formed in a shape of a groove; and part of the base part for overlocking an end part of the limiting part in the axial direction is configured in a position in contact with the rotation-stopping protrusion in the axial direction before the nut member comes into contact with the supporting part.

[0008] In addition, in the present invention, the base part includes a longitudinal wall and a transverse wall which extends transversely from the longitudinal wall and is provided with the sensor, and the base part is configured on the washing drum in transverse arrangement.

[0009] In addition, in the present invention, the sensor is a non-contact sensor for detecting the detected part in a non-contact manner.

Effects of the invention

[0010] According to the present invention, in the washing machine in which the rotating part is connected to the washing drum, which can rotate in a manner of intersecting a perpendicular direction, in a manner of integral rotation, the threaded shaft, the motor and the nut member forming threaded connection with the threaded shaft and connected to the rotating part form a driving mechanism for rotating the washing drum. For the driving mechanism, when the motor rotates the threaded shaft, the nut member moves along the axial direction of the threaded shaft so that the rotating part and the washing drum rotate. The sensor detects the detected part arranged on the nut member, thereby detecting a rotating angle of the rotating part.

[0011] When the nut member freely rotates around the threaded shaft in a state that the sensor is located around the detected part, the detected part may be collided with the sensor, thereby damaging the sensor. Therefore, the limiting part extending along the axial direction in the shape of the straight line is formed on the base part fixed with the supporting part for supporting the threaded shaft rotatably, and the rotation-stopping protrusion arranged

on the nut member is incorporated into the limiting part. In this case, movement of the rotation-stopping protrusion is limited by the limiting part of the base part, and thus the nut member cannot rotate around the threaded shaft. Therefore, a situation that the detected part is collided with the sensor can be prevented from occurring. As a result, a situation that the sensor is damaged due to the detected part can be prevented from occurring.

[0012] In addition, according to the present invention, the limiting part is formed in a shape of a groove. In this case, since part of the base part for overlocking an end part of the limiting part in the axial direction is configured in a position in contact with the rotation-stopping protrusion in the axial direction before the nut member comes into contact with the supporting part, a situation that the supporting part is damaged due to collision between the nut member and the supporting part can be prevented.

[0013] In addition, according to the present invention, the base part configured on the washing drum in transverse arrangement is provided with the sensor on the transverse wall extending from the longitudinal wall to the transverse direction. In this case, front end parts of screws and other fasteners for installing the sensor on the transverse wall are exposed from the transverse wall to an upper side or a lower side. Thus, the front end parts of the fasteners are not extended from the longitudinal wall to the transverse direction. Therefore, the front end parts of the fasteners can be prevented from contacting the washing drum, thereby realizing transverse spacing saving.

[0014] In addition, according to the present invention, under a condition that the sensor is the non-contact sensor, a situation that the sensor is damaged due to the detected part can be prevented from occurring.

BRIEF DESCRIPTION OF DRAWINGS

[0015]

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 driving mechanism included in a washing machine;

Fig. 3 is a left view illustrating the driving mechanism;

Fig. 4 is an A-A sectional view of Fig. 3;

Fig. 5 is a top view illustrating the driving mechanism;

Fig. 6 is a left view illustrating a driving mechanism in a variation example; and

Fig. 7 is a B-B sectional view of Fig. 6.

A list of reference numerals

[0016] 1: Washing machine; 3: Washing drum; 6: Rotating part; 30: Base part; 31: Supporting part; 32: Threaded shaft; 33: Motor; 35: Nut member; 36: Sensor; 37: Longitudinal wall; 38: Transverse wall; 38C: Limiting part; 38F: Front circumferential part; 38G: Rear circum-

ferential part; 51D: Rotation-stopping protrusion; 52: Detected part; X: Left-right direction; Y: Front-rear direction; Z: Up-down direction; θ : Rotating angle.

DETAILED DESCRIPTION

[0017] 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 approximately 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.

[0018] In the washing machine 1, although the washing machine 1 also includes a clothes washing and drying machine with a clothes drying function, the washing machine 1 is described by taking a washing machine which only executes washing operation without explaining the clothes drying function as an example below. 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 configured in the housing 2, a supporting frame 4, a hoisting rod 5, a rotating part 6, an unlocking mechanism 7 and a driving mechanism 8.

[0019] 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.

[0020] 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 bottomed cylindrical shape. An imaginary straight line passing through a center of a circle of the outer drum 10 is a central shaft J of the outer drum 10. In the washing process or the rinsing process, water is stored in the outer drum 10. A circular opening 10A through which the washings thrown in and taken out from the washing machine 1 pass is formed in an upper end part 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 configured in a same position when observed from the left-right direction X.

[0021] The inner drum 11 is, for example, made of metal, and is formed in a bottomed cylindrical shape smaller than the outer drum 10 by one circle. The washings are accommodated into the inner drum 11. A circular opening 11A through which the washings accommodated into the inner drum 11 pass is formed in an upper end part 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 shaft of the inner drum 11 is the above central shaft J. In a state that 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 opposite 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 can pass 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 shaft J by accepting a driving force from a motor (not shown) arranged in the housing 2.

[0022] The supporting frame 4 is made of metal, and includes a pair of left and right side plates 13 and a beam member 14 erected between lower end parts of the pair of side plates 13. Each side plate 13 is formed in an approximately rectangular shape when observed from the left-right direction X, and is thin in the left-right direction X. A washing drum 3 is configured between the pair of side plates 13.

[0023] For the outer drum 10 of the washing drum 3, the rotating shaft 12 protruding to the left side X1 penetrates through the side plate 13 on the left side X1, and is supported rotatably by the side plate 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 side plate 13 on the right side X2, and is supported rotatably by the side plate 13 on the right side X2 via a bearing (not shown). Thus, the washing drum 3 is supported by the supporting frame 4, and can rotate around the rotating shaft 12 in a manner of intersecting the up-down direction Z. Specifically, with rotation of the washing drum 3, the central shaft 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.

[0024] A crossing angle at a sharp angle between an imaginary reference shaft L extending along the up-down direction Z and the central shaft J is a rotating angle θ of the washing drum 3 relative to the reference shaft L. The

smaller the rotating angle θ , the closer to an erecting posture by the washing drum 3. 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, 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.

[0025] An opening 13A penetrating through the side plate 13 along the left-right direction X is formed in a region that the side plate 13 on the left side X1 is closer to the lower side Z2 than the rotating shaft 12. The opening 13A is formed in an approximately rectangular shape which is long in the front-rear direction Y. An accepting part 15 protruding to an outer side in the front-rear direction Y is arranged at a front end edge and a rear end edge of each side plate 13. The accepting part 15 can be formed integrally with the side plate 13, and can also be installed as, for example, another component made of resin, on the side plate 13.

[0026] Hoisting rods 5 are formed in a shape of a rod having a friction damper 16 at the lower end part. Four hoisting rods 5 are arranged, and one hoisting rod is respectively configured at four corners in the housing 2 when observed from top from the upper side Z1. The hoisting rods 5 are in a suspended state from the upper part of the housing 2, and specifically from a metal outer frame (not shown) forming part of the housing 2. In two hoisting rods 5 arranged front and back on the left side X1, a lower end part of the hoisting rod 5 on the front side Y1 is connected with the accepting part 15 at the front side Y1 of the side plate 13 on the left side X1, and a lower end part of the hoisting rod 5 on the rear side Y2 is connected with the accepting part 15 at the rear side Y2 of the side plate 13 on the left side X1. In two hoisting rods 5 arranged front and back on the right side X2, a lower end part of the hoisting rod 5 on the front side Y1 is connected with the accepting part 15 at the front side Y1 of the side plate 13 on the right side X2, and a lower end part of the hoisting rod 5 (not shown) on the rear side Y2 is connected with the accepting part 15 (not shown) at the rear side Y2 of the side plate 13 on the right side X2. Thus, the supporting frame 4 having the side plates 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 housing 2 via

the hoisting rods 5.

[0027] The rotating part 6 is an approximately 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 in 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 configured in arrangement along the rotating direction K. A spacing between adjacent concave parts 6C can be fixed or different due to the position of the rotating part 6. In the present embodiment, corresponding to 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 in Fig. 1, two concave parts 6C located on a rear-most side Y2 and an adjacent position are spaced by 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.

[0028] The rotating part 6 is configured to be closer to the left side X1 than the side plate 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 side plate 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.

[0029] In the rotating part 6 under the posture in Fig. 1, 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 of a 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. The guiding hole 6E in the up-down direction Z is located in the same position as the opening 13A of the side plate 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.

[0030] The unlocking mechanism 7 is fixed to a left side surface of the side plate 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 protrusion 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 to the front-rear direction Y. The actuator of the body part 17 is operated, so that the locking part 18 slides between an entering position for entering to the rear-most side Y2 and an exiting position for exiting to a front-most side Y1.

[0031] The locking part 18 in Fig. 1 is in the entering position. Under a condition that 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 entering 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 exiting position, since the locking part 18 leaves the concave part 6C, the rotating part 6 and the washing drum 3 are unlocked.

[0032] In Fig. 1, the locking part 18 in the entering 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 that 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 becomes another concave part 6C located at the rear side Y2, the rotating angle θ is decreased; and in a state that 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.

[0033] Fig. 2 is a three-dimensional diagram illustrating the driving mechanism 8. with reference to Fig. 2, the driving mechanism 8 includes a base part 30, a supporting part 31, a threaded shaft 32, a motor 33, a coupling 34, a nut member 35 and a sensor 36.

[0034] 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. In a pair of transverse walls 38, the transverse wall 38 on the upper side Z1 is continuous from an entire region of the upper end of the longitudinal wall 37 and extends to the left side X1, and the transverse wall 38 on the lower side Z2 is continuous from an almost entire region of the lower end of the longitudinal wall 37 and extends to the left side X1.

[0035] The left end part of each transverse wall 38 serves as a flange part 38A and is formed in a manner of being bent into an approximately right angle to the outer side of 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. An accommodating space 30A encircled by the longitudinal wall 37 and a pair of upper and lower transverse walls 38 is formed on the base part 30. The supporting part 31, the threaded shaft 32, the coupling 34, the nut member 35 and the sensor 36 are accommodated in the accommodating space 30A.

[0036] A limiting part 38C is formed on a part of the transverse wall 38 on the upper side Z1 closer to the right side X2 than the flange part 38A. The limiting part 38C is formed in a shape of a groove slenderly extending along the front-rear direction Y in a shape of a straight line. Therefore, a long edge direction of the limiting part 38C is the front-rear direction Y, and a short edge direction of the limiting part 38C is the left-right direction X. The limiting part 38C is formed by penetrating through the transverse wall 38 on the upper side Z1 along the up-down direction Z in the present embodiment, but can also be a concave part sunk to the upper side Z1 without penetrating through the transverse wall 38. The base part 30 has an opening 30B formed by continuously cutting away a part to enable the transverse wall 38 of the upper side Z1 to be closer to the right side X2 than the limiting part 38C and the upper end part of the longitudinal wall 37. Since part of the base part 30 is removed through the opening 30B, integral light weight of the base part 30 can be realized.

[0037] The base part 30 is configured between the side plate 13 on the left side X1 and the washing drum 3 in a manner of being parallel to the washing drum 3 along the left-right direction X, and a pair of upper and lower flange parts 38A are configured oppositely from circumferential parts of the openings 13A of the side plates 13 on the right side X2 and the left side X1 (with reference to Fig. 1). Screws 39 (with reference to Fig. 1) assembled on the side plate 13 on the left side X1 are also assembled on the threaded hole 38B of each flange part 38A. Thus, the base part 30 is fixed to the side plate 13 on the left side X1. The accommodating space 30A of the base part 30 is exposed from the side plate 13 on the left side X1 to the left side X1 via the opening 13A (with reference to Fig. 1).

[0038] A pair of supporting parts 31 are arranged separately along the front-rear direction Y. The supporting part 31 on the front side Y1 is configured on the front end part of the longitudinal wall 37 of the base part 30, and the supporting part 31 on the rear side Y2 is configured on the rear end part 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 to protrude 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 installed 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. The supporting part 31 on the front side Y1 is configured in such a manner that the base part 41 extends from the lower end of the body part 40 to the front side Y1, and is overlapped with the front end part of the longitudinal wall 37 when observed from the left side X1. The supporting part 31 on the rear side Y2 is configured in such a manner that the base part 41 extends from the lower end of the body part 40 to the rear side Y2, and is overlapped with the rear end part of the longitudinal wall 37 when observed 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.

[0039] 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 on an almost entire region of the outer circumferential surface. It should be noted that in each figure except Fig. 2, to facilitate illustration, a figure of the screw thread 32A of the threaded shaft 32 is omitted. The rear end part of the threaded shaft 32 is inserted into the 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.

[0040] The motor 33 is an ordinary electric motor, and has an output shaft 44 protruding to the rear side Y2 and configured 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 opposite, from the front side Y1, to part of the front end part 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 part and a lower end part of a left end part of the bracket 45 serve as a pair of upper and lower flange parts 45A, and is bent into an approximately right angle to the rear side Y2. A threaded hole 45B is formed in each flange part 45A.

[0041] The motor 33 is configured between the side plate 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 configured oppositely from circumferential parts of the openings 13A of the side plates 13 on the right side X2 and the left side X1 (with reference to Fig. 1). By assembling screws 46 (with reference to Fig. 1) assembled on the side plate 13 on the left side X1 to the threaded hole 45B of each flange part 45A, the motor 33 is fixed to the side plate 13 on the left side X1 via the bracket 45. The motor 33 in this state is exposed from the side plate 13 on the left side X1 to

the left side X1 via the opening 13A (with reference to Fig. 1).

[0042] The coupling 34 includes: a cylindrical output part 47 externally embedded into a rear end part 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 part of the threaded shaft 32 in a manner of integral rotation, and a buffer part 49 configured 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 in a state of being arranged alternately one by one in the circumferential directions of the output part 47 and the input part 48. The buffer part 49 is configured between the adjacent protrusion part 47A and the protrusion part 48A. The buffer part 49 is composed of rubber, a spring and other elastic bodies. The output shaft 44 and the threaded shaft 32 are connected via the coupling 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.

[0043] 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 50A (with reference to Fig. 4 below) 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 50A and the screw thread 32A of the threaded shaft 32 are in mutual threaded connection. When the threaded shaft 32 rotates with the driving of the motor 33, the nut member 35 integrally moves along the axial direction of the threaded shaft 32, i.e., the front-rear direction Y along with rotation of the threaded shaft 32.

[0044] 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 to the up-down direction Z, and is fixed to the body part 50 through the screws 53. At an upper end edge of the first part 51A, a rotation-stopping protrusion 51D protruding to the upper side Z1 is integrally arranged, and the rotation-stopping protrusion 51D is incorporated into the limiting part 38C (with reference to Fig. 4) of the transverse wall 38 of the upper side Z1 of the base part 30. The second part 51B is formed in a shape of a plate which is thin in the left-right direction X and extends to the up-down direction Z, protrudes from the left end edge of the first part 51A to the front side Y1, is configured to extend 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. 4). A through hole 51E penetrating through the second part 51B along the left-

right direction X is formed in the second part 51B.

[0045] 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 inserted into the extending part 6D from the left side X1 is inserted into the through hole 51E. The connecting pin 54 cannot be taken out of each through hole 51E 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 to 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 long edge direction 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.

[0046] 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 part 52B. The fixing part 52A is configured 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 screws 55. The front end part 52B is also called as a limiting part, and is formed in a shape of a rod extending from the front end part of the fixing part 52A to the right side X2.

[0047] 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, and as a sensor 36, can be selected from an optical sensor and other optical non-contact 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 quantity of the sensors 36 is the same as the quantity of the concave parts 6C of the rotating part 6. In other words, five sensors are arranged in the present embodiment, and each groove 36A is configured in a lower region of the longitudinal wall 37 of the base part 30 in arrangement along the front-rear direction Y in a manner of overlapping when observed from the front-rear direction Y. Each sensor 36 is fixed to the longitudinal wall 37 through the screw 56. The front end part 56A of the screw 56 is configured to extend from the longitudinal wall 37 to the right side X2 (with reference to Fig. 4). 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 rear adjacent position is narrower than the spacing be-

tween other adjacent sensors 36.

[0048] When the nut member 35 moves along the front-rear direction Y along with rotation of the threaded shaft 32, the front end part 52B of the detected part 52 arranged on the nut member 35 penetrates through the groove 36A of each sensor 36. Although detection light of the groove 36A is blocked by the front end part 52B in a state that the front end part 52B is embedded into the groove 36A, the front end part 52B does not contact the sensor 36 when penetrating through the groove 36A.

[0049] As shown in Fig. 2, in a state that the front end part 52B of the detected part 52 is 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). In another aspect, in a state that the front end part 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 angle of 5 degrees, 15 degrees, 30 degrees, 45 degrees and 60 degrees, the front end part 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.

[0050] Fig. 3 is a left view illustrating the driving mechanism 8. Fig. 4 is an A-A sectional view of Fig. 3. With reference to Fig. 4, each sensor 36 includes a groove bottom 36B and a pair of groove side surfaces 36C, wherein the groove bottom 36B is divided into a groove 36A from the right side X2, and a pair of groove side surfaces 36C extend parallelly from the groove bottom 36B to the left side X1. The groove bottom 36B is erected between right end edges of the pair of groove side surfaces 36C, an outline of the groove 36A when observed from the front-rear direction Y is formed by the groove bottom 36B and the pair of groove side surfaces 36C. The front end part 52B of the detected part 52 in a state of being embedded into the groove 36A from the left side X1 is configured away from both of the groove bottom 36B and the groove side surfaces 36C. Herein, a clearance between each of the groove bottom 36B and the groove side surfaces 36C and the front end part 52B is called as a clearance 60.

[0051] The rotation-stopping protrusion 51D is inserted into the limiting part 38C of the transverse wall 38 of the upper side Z1 of the base part 30 from the lower side Z2 in a manner of having a slight backlash in the short edge direction of the limiting part 38C, i.e., the left-right direction X. Therefore, a clearance 61 is set between a left side circumferential part 38D of the transverse wall 38

for overlocking the limiting part 38C from the left side X1 and the rotation-stopping protrusion 51D; a clearance 62 is set between a right side circumferential part 38E of the transverse wall 38 for overlocking the limiting part 38C from the right side X2 and the rotation-stopping protrusion 51D; and the clearance 61 and the clearance 62 are smaller than the clearance 60. Namely, in a state that the rotation-stopping protrusion 51D is incorporated into the limiting part 38C, a backlash of the rotation-stopping protrusion 51D in the short edge direction of the limiting part 38C is smaller than a backlash of the detected part 52 in the groove 36A of the sensor 36. Specifically, dimensions of the clearance 61 and the clearance 62 in the left-right direction X are smaller than the clearance 60 between the groove bottom 36B and the front end part 52B in the left-right direction X, and smaller than a dimension of the clearance 60 between the groove side surfaces 36C and the front end part 52B in the up-down direction Z.

[0052] When the driving mechanism 8 is assembled, the nut member 35 is sometimes in a free state relative to the threaded shaft 32. In this case, it can be contemplated that in a state that the detected part 52 is embedded into the groove 36A of the sensor 36, the nut member 35 rotates freely around the threaded shaft 32. In addition, it can be contemplated that in the washing operation process of the washing machine 1, especially in the dewatering process, the nut member 35 rotates around the threaded shaft 32 due to vibration. When the nut member 35 rotates, the front end part 52B of the detected part 52 which sways in the up-down direction Z with the rotation of the nut member 35 may collide with the groove bottom 36B and the groove side surfaces 36C of the sensor 36, thereby damaging the sensor 36 located around the detected part 52.

[0053] Therefore, as mentioned above, the rotation-stopping protrusion 51D arranged on the nut member 35 is incorporated into the limiting part 38C formed on the base part 30 and extending along the front-rear direction Y in a shape of a straight line; and the backlash of the rotation-stopping protrusion 51D in the short edge direction of the limiting part 38C is set to be smaller than the backlash of the detected part 52 in the groove 36A of the sensor 36. In this case, before the detected part 52 collides with the sensor 36, the rotation-stopping protrusion 51D firstly contacts the circumferential part of the limiting part 38C of the base part 30, i.e., the above left side circumferential part 38D and the right side circumferential part 38E. Therefore, movement of the rotation-stopping protrusion 51D in the short edge direction of the limiting part 38C is limited. Thus, the nut member 35 cannot rotate around the threaded shaft 32. Therefore, the detected part 52 can be prevented from colliding with the sensor 36. As a result, a situation that the sensor 36 is damaged due to the detected part 52 can be prevented from occurring.

[0054] Fig. 5 is a top view illustrating the driving mechanism 8. With reference to Fig. 5, a part of the transverse

wall 38 of the upper side Z1 of the base part 30 for overlocking the end part of the limiting part 38C in the front-rear direction Y includes: a front side circumferential part 38F for overlocking the front end of the limiting part 38C and a rear side circumferential part 38G for overlocking the rear end of the limiting part 38C. The front side circumferential part 38F is configured in a position in contact with the rotation-stopping protrusion 51D from the front side Y1 firstly before the nut member 35 comes into contact with the supporting part 31 (with reference to Fig. 2) on the front side Y1. The rear side circumferential part 38G is configured in a position in contact with the rotation-stopping protrusion 51D from the rear side Y2 firstly before the nut member 35 comes into contact with the supporting part 31 (with reference to Fig. 2) on the rear side Y2. Therefore, the front side circumferential part 38F is located in a position at least closer to the rear side Y2 than the body part 40 (with reference to Fig. 2) of the supporting part 31 on the front side Y1, and the rear side circumferential part 38G is located in a position at least closer to the front side Y1 than the body part 40 (with reference to Fig. 2) of the supporting part 31 on the rear side Y2.

[0055] In this case, before the nut member 35 comes into contact with the supporting part 31, the front side circumferential part 38F and the rear side circumferential part 38G as stopping parts firstly come into contact with the rotation-stopping protrusion 51D. Therefore, the supporting part 31 can be prevented from being deformed or the bearing 42 (with reference to Fig. 2) arranged on the supporting part 31 can be prevented from being damaged due to collision between the nut member 35 and the supporting part 31.

[0056] Fig. 6 is a left view illustrating the driving mechanism 8 in a variation example. Fig. 7 is a B-B sectional view of Fig. 6. In Fig. 6 and Fig. 7, a same reference numeral is given to a same part as a described part in Fig. 1 to Fig. 5, and illustration of the part is omitted. Although the sensor 36 is installed on the longitudinal wall 37 in above embodiments, the sensor 36 can be installed on one of the pair of upper and lower transverse walls 38 like variation examples shown in Fig. 6 and Fig. 7. In Fig. 6 and Fig. 7, as an embodiment, the sensor 36 is installed on the transverse wall 38 on the lower side Z2 from the upper side Z1 in a posture of enabling the groove 36A to face the upper side Z1. In this case, as shown in Fig. 7, the front end part 56A of the screw 56 used for installing the sensor 36 on the transverse wall 38 penetrates through the sensor 36 and the transverse wall 38 on the lower side Z2 from the upper side Z1, and is exposed from the transverse wall 38 to the lower side Z2. Thus, the front end part 56A of the screw 56 does not extend from the longitudinal wall 37 to the left-right direction X. Therefore, the front end part 56A of the screw 56 can be prevented from contacting the washing drum 3, thereby realizing spacing saving in the left-right direction X. It should be noted that under a condition that the sensor 36 is installed on the transverse wall 38 on the

upper side Z1 from the lower side Z2 in a posture of enabling the groove 36A to face the lower side Z2, the front end part 56A of the screw 56 used for installing the sensor 36 on the transverse wall 38 on the upper side Z1 is exposed from the transverse wall 38 on the upper side Z1 to the upper side Z1.

[0057] The present invention is not limited to embodiment described above, and can be changed in various modes within a scope recorded in claims.

[0058] For example, the sensor 36 is not limited to the above-mentioned non-contact sensor, and can also be a contact sensor. Under a condition that the sensor is the contact sensor, as mentioned above, the rotation of the nut member 35 around the threaded shaft 32 is limited. Therefore, a damaged degree of the sensor 36 due to contact between the detected part 52 of the nut member 35 and the sensor 36 can be prevented.

[0059] In addition, the limiting part 38C, which is incorporated into the rotation-stopping protrusion 51D of the nut member 35, of the base part 30 may not be formed on the above transverse wall 38 on the upper side Z1, and can be formed on the transverse wall 38 on the lower side Z2, and can also be formed on the longitudinal wall 37.

[0060] In addition, the detected part 52 may not be installed on the third part 51C of the connecting part 51 of the nut member 35, and the third part 51C performs a function of the detected part 52.

[0061] In addition, the above screw can be replaced with rivets and other fasteners.

[0062] 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 is rotatable in a manner of intersecting a perpendicular direction;
- a rotating part, connected to the washing drum in a manner of integral rotation;
- a threaded shaft;
- a motor, for rotating the threaded shaft;
- a nut member, forming threaded connection with the threaded shaft and connected to the rotating part, and moving along an axial direction of the threaded shaft along with rotation of the threaded shaft, so that the rotating part rotates;
- a supporting part, for supporting the threaded shaft in a manner of rotation;
- a base part, fixed with the supporting part;

- a detected part, arranged on the nut member
and configured to detect a rotating angle of the
rotating part;
a rotation-stopping protrusion, arranged on the
nut member; 5
a sensor, for detecting the detected part; and
a limiting part, formed on the base part, extend-
ing along the axial direction in a shape of a
straight line and incorporating the rotation-stop-
ping protrusion. 10
2. The washing machine according to claim 1, wherein
the limiting part is formed in a shape of a groove; and
part of the base part for overlocking an end part of
the limiting part in the axial direction is configured in 15
a position in contact with the rotation-stopping pro-
trusion in the axial direction before the nut member
comes into contact with the supporting part.
3. The washing machine according to claim 1 or 2, 20
wherein
the base part comprises a longitudinal wall and a
transverse wall which extends transversely from the
longitudinal wall and is provided with the sensor, and 25
the base part is configured on the washing drum in
transverse arrangement.
4. The washing machine according to any one of claims
1-3, wherein 30
the sensor is a non-contact sensor for detecting the
detected part in a non-contact manner.

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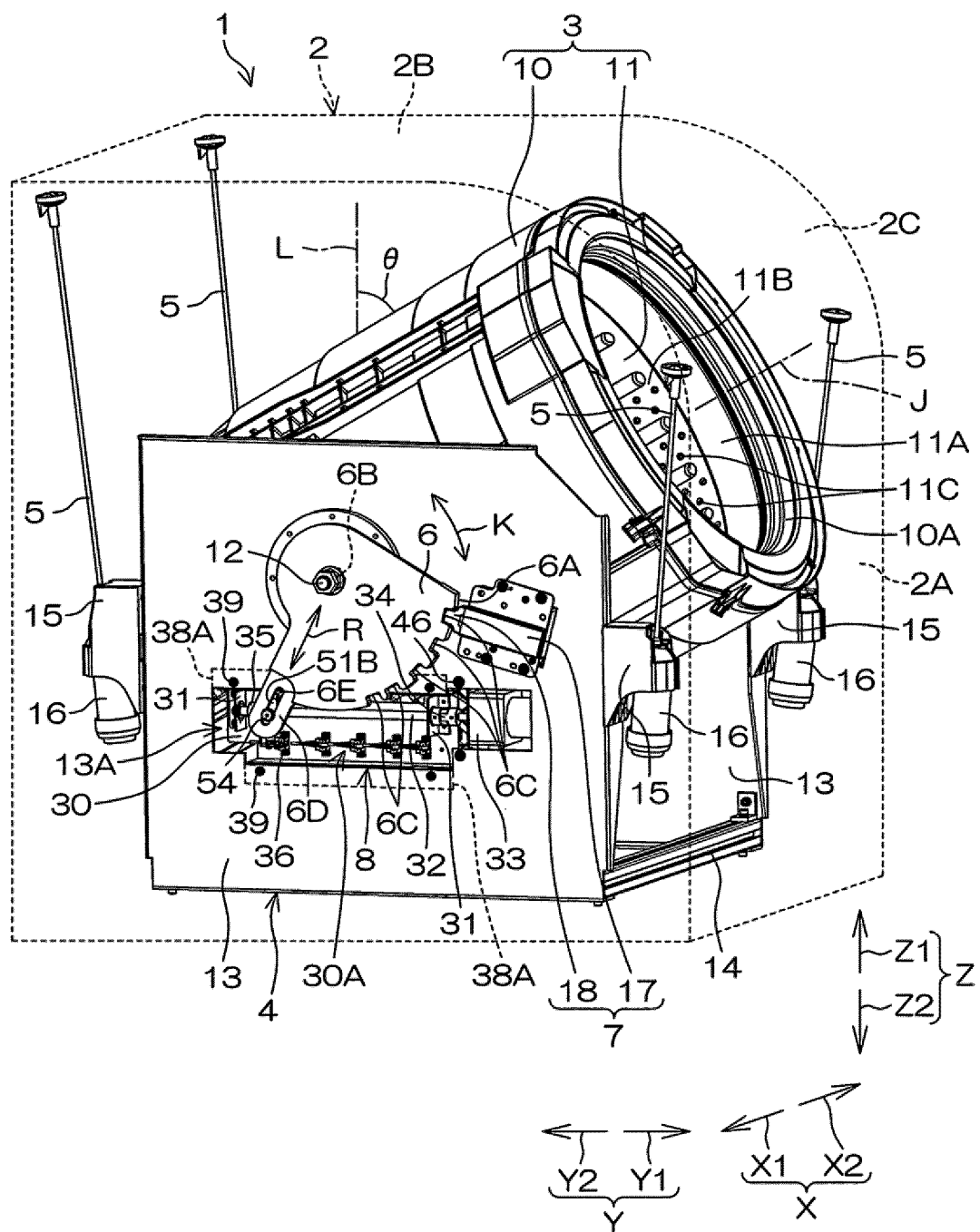


FIG. 1

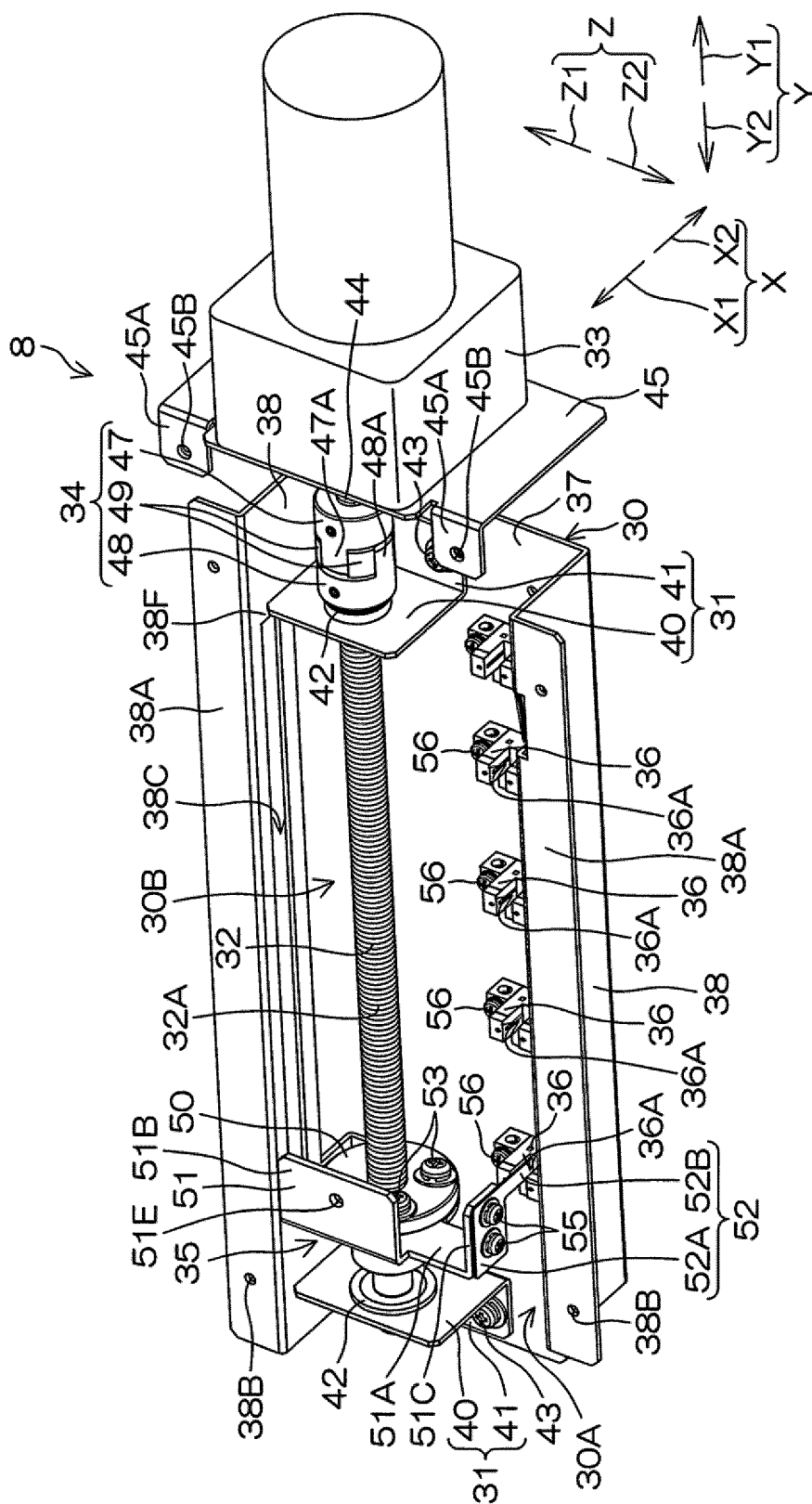


FIG. 2

FIG. 2

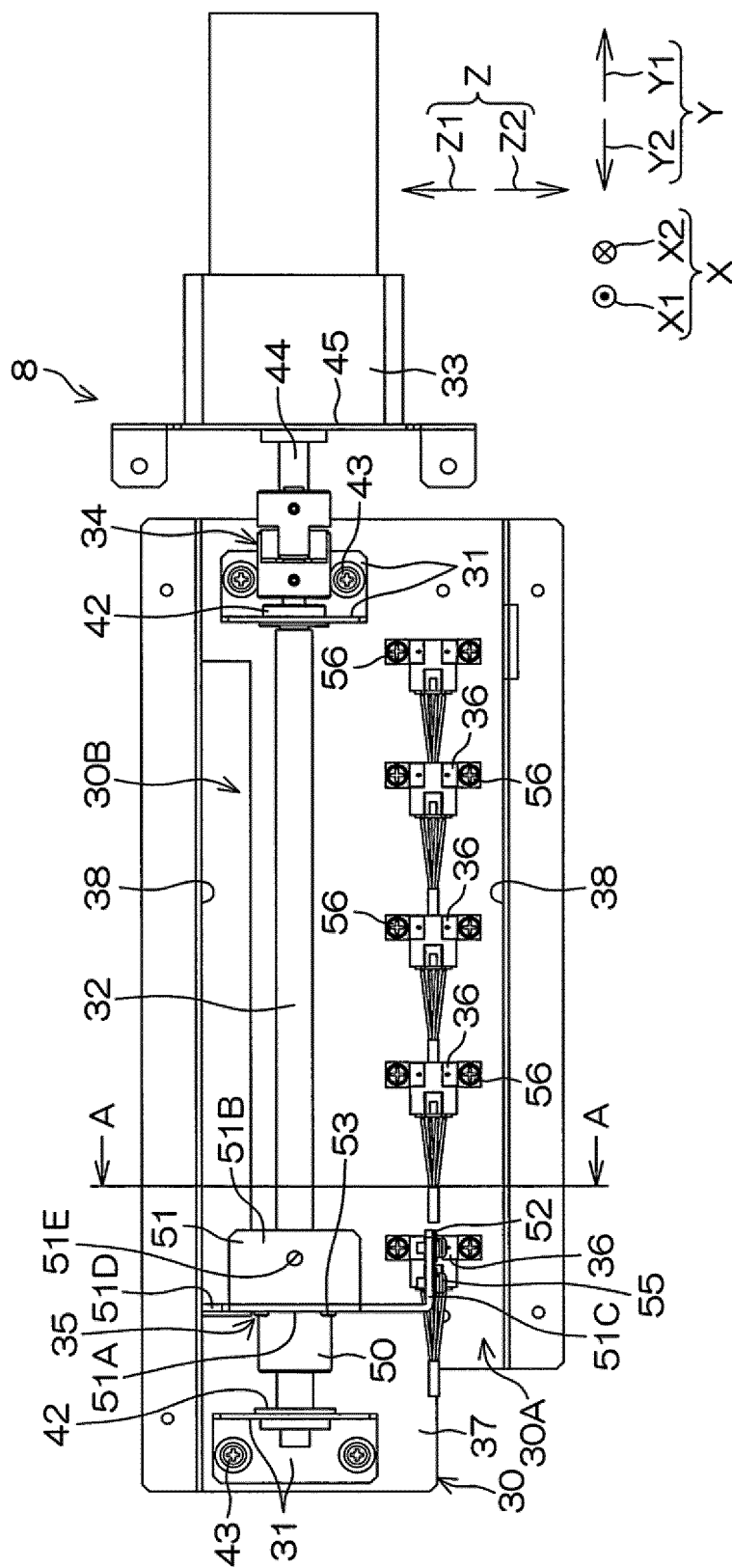


FIG. 3

FIG. 3

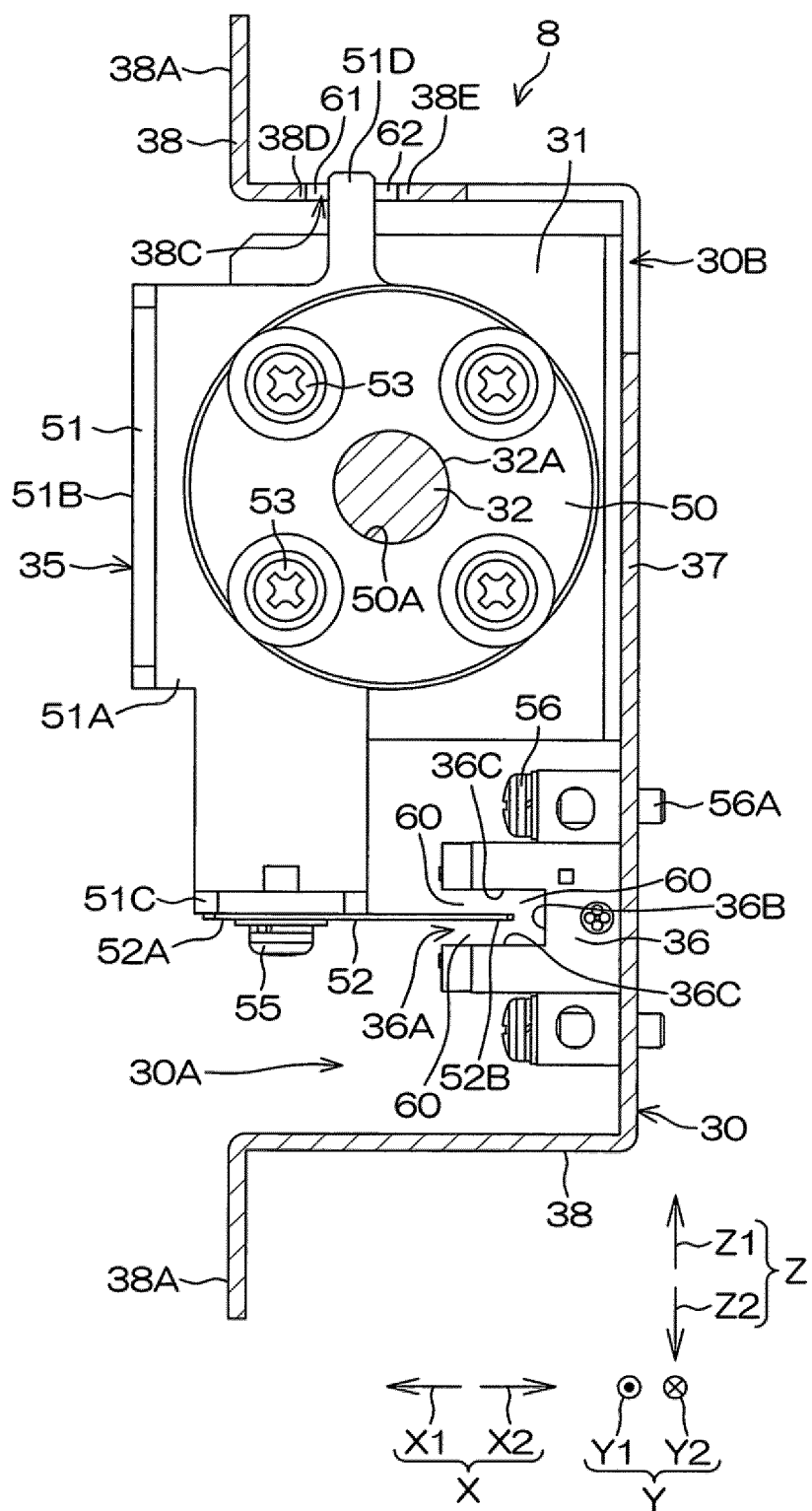


FIG. 4

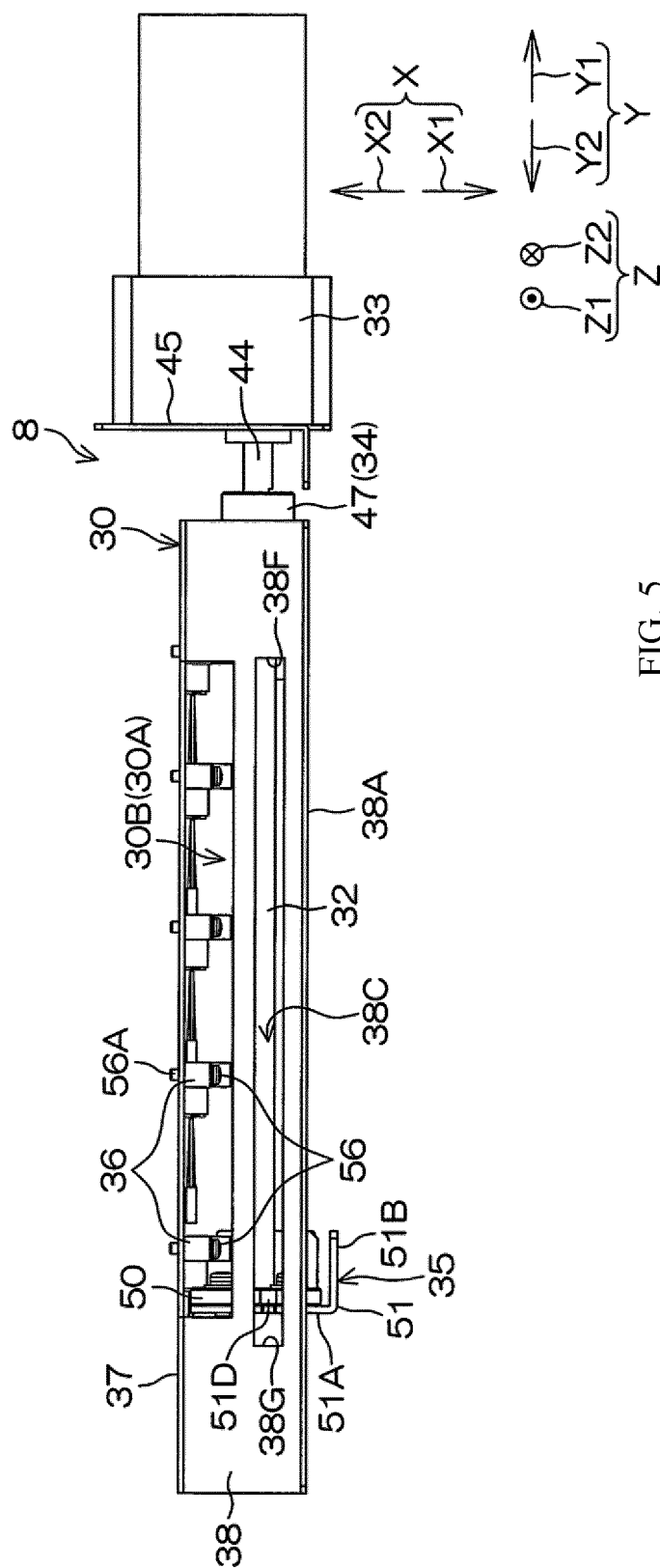


FIG. 5

FIG. 5

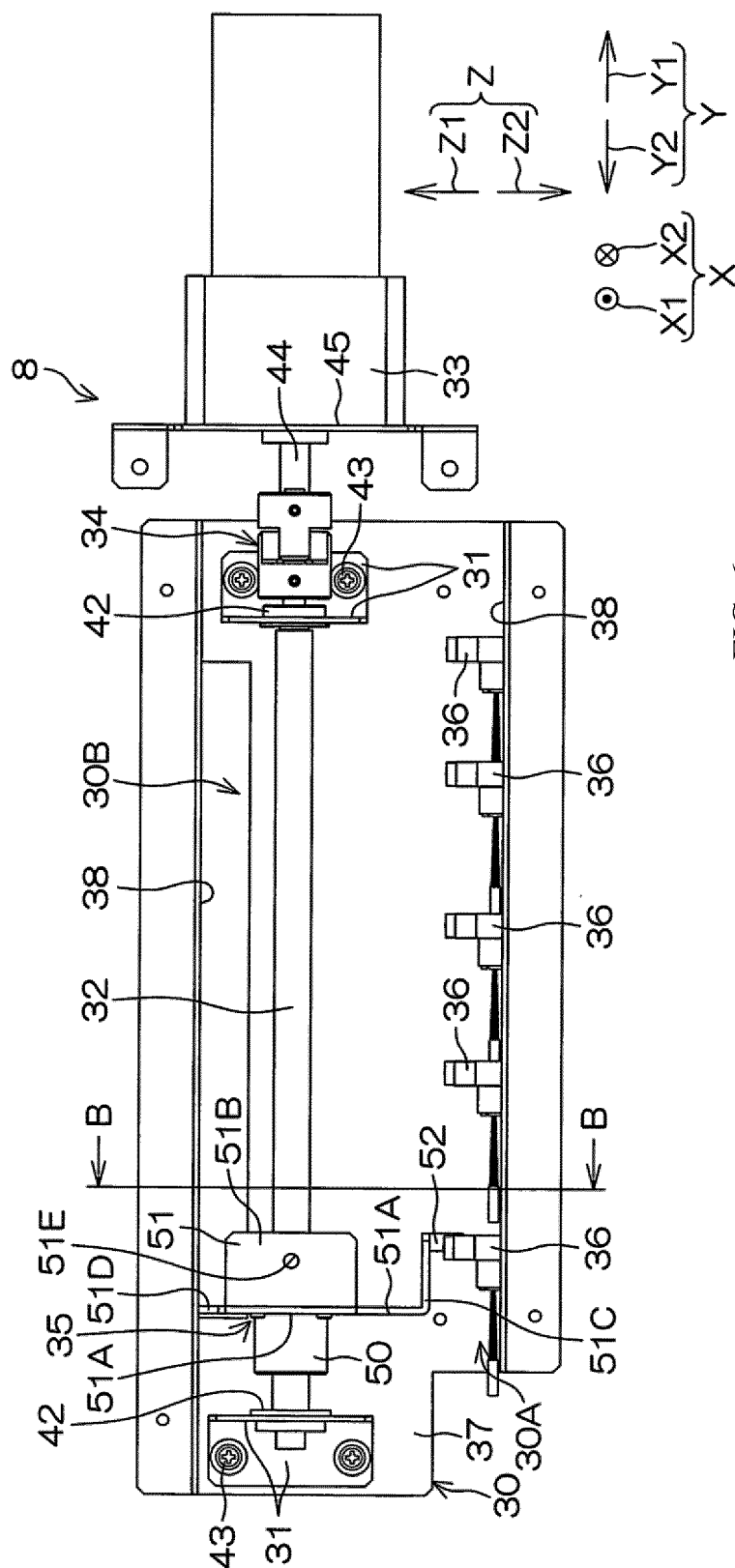


FIG. 6

FIG. 6

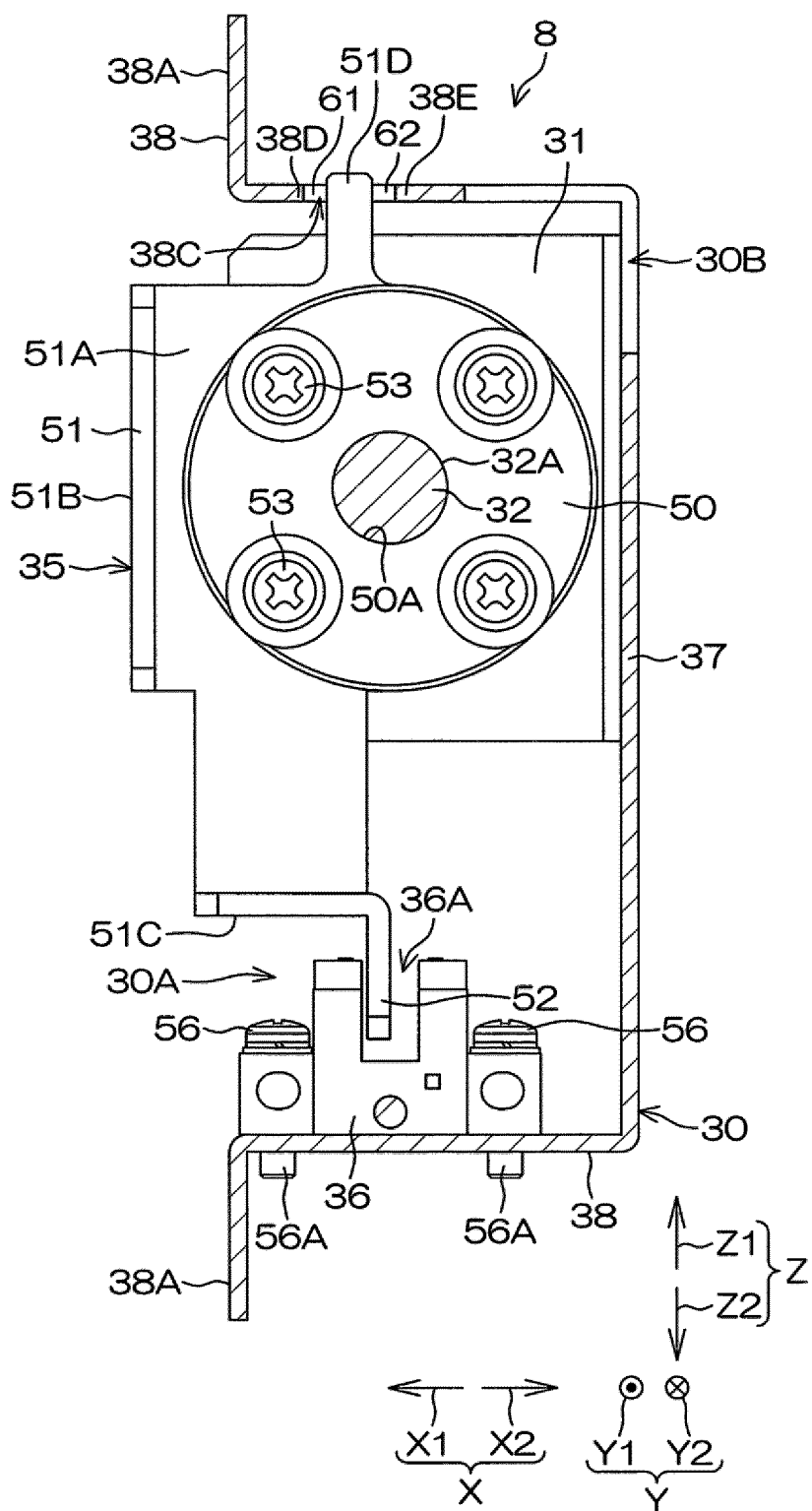


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/096688

A. CLASSIFICATION OF SUBJECT MATTER

D06F 23/06 (2006.01) i; D06F 37/02 (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: HAIER; NAKAGAWA, W.; KAWAMURA, T.; SATO, H.; NAKANISHI, T.; stop rotation, process, salient, cylinder, bucket, screw shaft, screw rod, drive, induce, HAIER w GROUP, limit+, restrict+, confin+, astrict+, trough?, groov???, slot, conduit, pin?, hole?, aperture?, cavity?, eyelet?, convex, wash+, laundry, jig+, nod+, rotat+, screw?, nut?, shaft?, motor?, sensor?, detect+, rod?, angle

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TW 201425684 A (CHIENKUO TECHNOLOGY UNIVERSITY), 01 July 2014 (01.07.2014), description, pages 7-10, and figures 1-12	1-4
A	CN 101250800 A (SANYO ELECTRIC CO., LTD.), 27 August 2008 (27.08.2008), the whole document	1-4
A	CN 201933310 U (WU, Shangzhe), 17 August 2011 (17.08.2011), the whole document	1-4
A	TW 465610 U (SANYO ELECTRIC CO., LTD.), 21 November 2001 (21.11.2001), the whole document	1-4
A	CN 1986943 A (SANYO ELECTRIC CO., LTD.), 27 June 2007 (27.06.2007), the whole document	1-4
A	CN 204343050 U (WHIRLPOOL CHINA CO., LTD.), 20 May 2015 (20.05.2015), the whole document	1-4

☒ 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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"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
04 November 2016 (04.11.2016)

Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2016/096688

C (Continuation).	DOCUMENTS CONSIDERED TO BE RELEVANT	
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP H04246400 A (SHARP K.K.), 02 September 1992 (02.09.1992), the whole document	1-4

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2016/096688

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CN 204343050 U	20 May 2015	None	
JP H04246400 A	02 September 1992	None	

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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