



(11)

EP 3 342 912 A1

(12)

EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:

04.07.2018 Bulletin 2018/27

(21) Application number: **16838582.1**

(22) Date of filing: 25.08.2016

(51) Int Cl.:

D06F 23/02 (2006.01)

D06F 37/22 (2006.01)

D06F 37/38 (2006.01)

D06F 23/06 (2006.01)

D06F 37/34 (2006.01)

(86) International application number:

PCT/CN2016/096687

(87) International publication number:

WO 2017/032324 (02.03.2017 Gazette 2017/09)

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR

Designated Extension States:

BA ME

Designated Validation States:

MA MD

(30) Priority: **25.08.2015 JP 2015166225**

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(54) **WASHING MACHINE**

(57) A washing machine (1) is provided. The washing machine can prevent a driving mechanism (8) for rotating a washing drum (3) from breaking down. The washing drum (3) is rotatable and intersects with a vertical direction (Z). The washing machine (1) includes: a washing drum (3) which is rotatable and intersects with an up-down direction (Z); a rotating part (6) having a plurality of concave parts (6C) arranged in a rotating direction (K) of the washing drum (3), and the rotating part is connected with the washing drum (3) so that the rotating part rotates integrally with the washing drum; and a locking part (18) for locking rotation of the rotating part (6) by fitting in the concave parts (6C). In the washing machine (1), a nut member (35) is in threaded connection with the threaded shaft (32) and connected to the rotating part (6) so that the nut member moves along the threaded shaft (32) along with rotation of the threaded shaft (32), thereby causing the rotating part (6) to rotate. A backlash between the locking part (18) fitted in the concave parts (6C) and the rotating part (6) is smaller than a backlash between the threaded shaft (32) and the nut member (35).

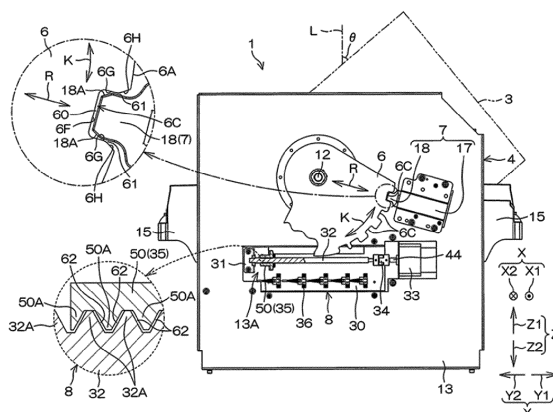


FIG.3

Description

TECHNICAL FIELD

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

BACKGROUND

[0002] In a washing-drying machine disclosed in patent literature 1 described below, an outer drum equipped with a rotating drum with washings thrown therein is supported by a rotation supporting plate via an inclined rotation supporting shaft. The rotation supporting plate is supported by an outer frame of the washing-drying machine via a suspended rod. The outer drum 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 of an inclined rotation motor arranged on the outer frame. With the rotation of the inclined rotation motor, the operating rope moves upwards or downwards, causing the outer drum to obliquely rotate around the inclined rotation supporting shaft. Thus, the outer drum is transversely inclined when the washings are thrown into the rotating drum, and the outer drum is erected in a vertical direction during washing, rinsing and dewatering.

[0003] In the washing-drying machine disclosed in the patent literature 1, the rotation operating rope installing part, the operating rope, the inclined rotation motor and other driving mechanism used for rotating the outer drum may break down due to collision caused by vibration generated in an operation process of the washing-drying machine.

Related Literatures

Patent Literature

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

SUMMARY

Problems to be solved by the disclosure

[0005] The present disclosure is proposed based on the above background, and aims to provide a washing machine capable of preventing a driving mechanism for rotating a washing drum from breaking down, where the washing drum can rotate in a direction intersected with a vertical direction.

Solution for solving the problems

[0006] The present disclosure provides a washing machine including: a washing drum for accommodating washings, where the washing drum is rotatable and in-

tersects with a vertical direction; a rotating part having a plurality of concave parts arranged in a rotating direction of the washing drum, where the rotating part is connected with the washing drum so that the rotating part rotates integrally with the washing drum; a locking part for locking rotation of the rotating part by fitting in the concave parts or unlocking the rotating part by retracting from the concave parts; a threaded shaft; a motor for driving the threaded shaft to rotate; and a nut member. The nut member is in threaded connection with the threaded shaft and connected to the rotating part, so that the nut member moves along the threaded shaft as the threaded shaft rotates, thereby causing the rotating part to rotate. A backlash between the locking part fitted in the concave parts and the rotating part is smaller than a backlash between the threaded shaft and the nut member.

[0007] In addition, the present disclosure provides a washing machine including: a washing drum for accommodating washings, where the washing drum is rotatable and intersects with a vertical direction; a rotating part, where the rotating part is connected with the washing drum so that the rotating part rotates integrally with the washing drum; a threaded shaft; a motor for driving the threaded shaft to rotate; a nut member, where the nut member is in threaded connection with the threaded shaft and connected to the rotating part, so that the nut member moves along the threaded shaft as the threaded shaft rotates, thereby causing the rotating part to rotate; and a pair of supporting parts. The supporting parts support both side parts of the threaded shaft in an axial direction so that the threaded shaft is rotatable.

[0008] In addition, in the present disclosure, the washing machine includes a coupling for connecting an output shaft of the motor and the threaded shaft.

[0009] In addition, in the present disclosure, the threaded shaft and the nut member are formed with trapezoidal threads.

Effects of the disclosure

[0010] According to the present disclosure, in the washing machine, the rotating part, which is connected to the washing drum so that the rotating part rotates integrally with the washing machine, has a plurality of concave parts arranged in a rotating direction of the washing drum. The washing drum is rotatable and intersects with a vertical direction. When the locking part is fitted in the concave parts to lock the rotation of the rotating part, the position of the washing drum in the rotating direction is locked. In another aspect, when the locking part is retracted from the concave parts to unlock the rotating part, the washing drum can rotate.

[0011] The threaded shaft, the motor and the nut member in threaded connection with the threaded shaft and connected to the rotating part form a driving mechanism for rotating the washing drum. In the driving mechanism, when the motor drives the threaded shaft to rotate, the nut member moves along the threaded shaft so that the

rotating part and the washing drum rotate.

[0012] A backlash between the locking part fitted in the concave parts and the rotating part is smaller than a backlash between the threaded shaft and the nut member. Therefore, in a state that the locking part is fitted in the concave parts, even if vibration generated by the washing drum during the washing operation is transferred to the rotating part, the vibration is absorbed by the backlash between the locking part and the rotating part. Therefore, the vibration will not be transferred to the nut member, the threaded shaft and the motor. Thus, the driving mechanism is prevented from breaking down.

[0013] In addition, according to the present disclosure, in the washing machine in which the rotating part is connected to the washing drum, which is rotatable and intersects with a vertical direction, so that the rotating part rotates integrally with the washing drum, the threaded shaft, the motor and the nut member in threaded connection with the threaded shaft and connected to the rotating part form a driving mechanism for rotating the washing drum. In the driving mechanism, when the motor drives the threaded shaft to rotate, the nut member moves along the threaded shaft so that the rotating part and the washing drum rotate.

[0014] Both side parts of the threaded shaft in an axial direction are supported by a pair of supporting parts so that the threaded shaft is rotatable. Thus, supporting rigidity of the threaded shaft can be improved, so that the threaded shaft is difficult to vibrate. Therefore, even if vibration generated by the washing drum in washing operation is transferred to the rotating part, the vibration will not be transferred to the threaded shaft and the motor. Therefore, the driving mechanism is prevented from breaking down.

[0015] In addition, according to the present disclosure, the output shaft of the motor is connected with the threaded shaft via the coupling. Therefore, the vibration generated by the washing drum in operation of the washing machine is absorbed by the coupling. Thus, the vibration will not be transferred to the motor. Thus, the driving mechanism is prevented from breaking down.

[0016] In addition, as mentioned above, according to the present disclosure, since it is difficult to transfer the vibration generated by the washing drum in the operation of the washing machine to the driving mechanism, the threaded shaft and the nut member formed with the trapezoidal threads can be prevented from being damaged.

BRIEF DESCRIPTION OF DRAWINGS

[0017]

FIG. 1 is a schematic perspective view illustrating a washing machine according to an embodiment of the present disclosure;

FIG. 2 is a perspective view illustrating a driving mechanism included in a washing machine;

FIG. 3 is a left view illustrating main parts of a wash-

ing machine; and

FIG. 4 is a perspective view illustrating main parts of a washing machine according to a modified example.

List of reference numerals

[0018] 1: washing machine; 3: washing drum; 6: rotating part; 6C: concave part; 18: locking part; 31: supporting part; 32: threaded shaft; 32B: both side parts; 33: motor; 34: coupling; 35: nut member; 44: output shaft; K: rotating direction; Y: front-rear direction; and Z: up-down direction.

DETAILED DESCRIPTION

[0019] Embodiments of the present disclosure are specifically described below with reference to drawings. FIG. 1 is a schematic perspective view illustrating a washing machine 1 according to an embodiment of the present disclosure. 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 direction substantially orthogonal to a paper surface of FIG. 1 is called as a left-right direction X. The up-down direction Z is the vertical 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] The washing machine 1 may be a washing-drying machine having a drying function. However, the drying function is omitted hereinafter, and the washing machine 1 is described by taking a washing machine which only executes a washing operation 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 configured in the housing 2, a supporting frame 4, a suspended rod 5, a rotating part 6, an unlocking mechanism 7 and a driving mechanism 8.

[0021] For example, the housing 2 is made from metal, and is formed into a box shape. The housing 2 is provided with a connecting surface 2C for connecting a front surface 2A and an upper surface 2B. For example, the connecting surface 2C is an inclined surface descending towards the front side Y1. An outlet/inlet (not shown) for throwing in and taking out washings from the washing machine 1 is formed across 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 from resin, and is formed into a bottomed cylindrical shape. An imaginary straight line passing through a cent-

er of a circle of the outer drum 10 is a central shaft 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 is formed at an upper end of the outer drum 10 on a side opposite to the bottom wall (not shown) to allow the washings thrown in and taken out from the washing machine 1 to pass therethrough. A pair of metal rotary shafts 12 protruding outwards in the left-right direction X is arranged on left and right side surfaces of the outer drum 10 respectively. Only the rotary shaft 12 on the left side X1 is shown in FIG.1. The pair of rotary shafts 12 is configured at a same position when observed from the left-right direction X.

[0023] The inner drum 11 is, made from, for example, metal, and is formed into a bottomed cylindrical shape slightly smaller than the outer drum 10. The washings are accommodated in the inner drum 11. A circular opening 11A is formed at an upper end of the inner drum 11 on a side opposite to the bottom wall (not shown) to allow the washings accommodated in the inner drum 11 to pass therethrough. The inner drum 11 is coaxially accommodated in 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 in the outer drum 10, the opening 11A of the inner drum 11 is located at an inner side of the 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 so that 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 the bottom wall of the inner drum 11 to allow water in the outer drum 10 to circulate 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 that in the inner drum 11. In the washing operation, the inner drum 11 receives a driving force from a motor (not shown) arranged in the housing 2 to rotate around the central shaft J.

[0024] The supporting frame 4 is made from metal, and includes a pair of left and right side plates 13 and a beam member 14 erected between lower ends of the pair of side plates 13. Each side plate 13 is formed into a substantially rectangular shape when observed from the left-right direction X, and is thin in the left-right direction X. The washing drum 3 is arranged between the pair of side plates 13.

[0025] For the outer drum 10 of the washing drum 3, the rotary shaft 12 protruding to the left side X1 penetrates through the side plate 13 on the left side X1, and is rotatably supported by the side plate 13 on the left side X1 via a bearing (not shown). For the outer drum 10, the rotary shaft 12 protruding to the right side X2 (not shown) penetrates through the side plate 13 on the right side X2, and is rotatably supported 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 is rotatable around the rotary shaft 12 to intersect with 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 in 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] An intersection angle of acute angle between an imaginary reference shaft L extending along the up-down direction Z and the central shaft J is a rotation angle θ of the washing drum 3 relative to the reference shaft L. As the rotation angle θ decreases, the washing drum 3 approaches to be in an upright posture. As the rotation angle θ increases, the washing drum 3 tilts towards the front side Y1 so that the opening 10A of the outer drum 10 and the opening 11A of the inner drum 11 face the front side Y1. The rotation 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 application example in the washing machine 1, when the washings are thrown into the washing drum 3 at the beginning of the washing operation, the rotation angle θ is set as 45 degrees so 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 rotation 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 rotation angle θ is changed between 5 degrees and 60 degrees.

[0027] The side plate 13 on the left side X1 is formed with an opening 13A penetrating through the side plate 13 along the left-right direction X at a region closer to the lower side Z2 than the rotary shaft 12. The opening 13A is formed as a substantially rectangular shape elongated in the front-rear direction Y. A receiving part 15 protruding outwards in the front-rear direction Y is arranged at a front end edge and a rear end edge of each side plate 13. The receiving part 15 can be formed integrally with the side plate 13, or be installed on the side plate 13 as, for example, another member made from resin.

[0028] There are four suspended rods 5. Each suspended rod 5 is formed into a shape of a rod having a friction damper 16 at the lower end, and is configured at four corners of the housing 2 respectively when observed from top from the upper side Z1. These suspended rods 5 are in a suspended state through the upper part of the housing 2 (specifically, through a metal outer frame (not shown) of the housing 2). In two suspended rods 5 arranged front and back on the left side X1, a lower end of the suspended rod 5 on the front side Y1 is connected with the receiving part 15 at the front side Y1 of the side plate 13 on the left side X1, and a lower end of the suspended rod 5 on the rear side Y2 is connected with the receiving part 15 at the rear side Y2 of the side plate 13 on the left side X1. In two suspended rods 5 arranged front and back on the right side X2, a lower end of the suspended rod 5 on the front side Y1 is connected with the receiving part 15 at the front side Y1 of the side plate 13 on the right side X2, and a lower end of the suspended

rod 5 (not shown) on the rear side Y2 is connected with the receiving 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 suspended rods 5.

[0029] The rotating part 6 is a substantially sectorial 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 as 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 at 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 (herein, five concave parts 6C) are formed on the outer circumferential edge 6A. These concave parts 6C are sunken towards the through hole 6B, penetrate through the rotating part 6 in the left-right direction X, and are arranged and configured along the rotating direction K. A spacing between adjacent concave parts 6C is constant or different due to the position of the rotating part 6. In the present embodiment, corresponding to the rotation angle θ set as 5 degrees, 15 degrees, 30 degrees, 45 degrees and 60 degrees, in the rotating part 6 in the posture of FIG. 1, the concave part 6C located on the rear-most side Y2 and the concave part 6C immediately before the concave part 6C located on the rear-most side Y2 are spaced by 10 degrees in the rotating direction K (i.e., in the circumferential direction with the through hole 6B as a center), and the spacing between other adjacent concave parts 6C is 15 degrees.

[0030] 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 rotary shaft 12, protruding to the left side X1 and penetrating through the side plate 13 on the left side X1, of the outer drum 10 of the washing drum 3 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 via the rotary shaft 12 so that the washing drum 3 rotates integrally with the rotating part 6.

[0031] In the rotating part 6 in the posture of FIG. 1, at the rear end of the outer circumferential edge 6A, an extended part 6D protruding to the lower side Z2, specifically protruding outwards in a radial direction R of the rotating part 6 with the through hole 6B as a center, is integrally arranged. The extended part 6D is formed as a plate which is long in the radial direction R and thin in the left-right direction X. The extended part 6D is formed with a guiding hole 6E which is long in the radial direction R and penetrates through the extended part 6D along the left-right direction X. Both ends of the guiding hole 6E in long edge direction are in a blocked state. The guiding hole 6E and the opening 13A of the side plate 13 on the left side X1 are located at the same position in the

up-down direction Z. No matter what angle from 5 degrees to 60 degrees the rotation angle θ has, the guiding hole 6E is always opposite to the opening 13A from the left side X1.

[0032] 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 to protrude to the rear side Y2 from the body part 17, strictly protruding to the rear upper side, and is supported by the body part 17 so that the locking part 18 can slide in 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 a retracted position for retracting to a front-most side Y1.

[0033] 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 and the locking part 18 are in the same position in the rotating direction K, the locking part 18 enters the entering position, thereby being fitted in the concave part 6C in the same position in the rotating direction K. As a result, rotation of the rotating part 6 and the washing drum 3 is locked. In this state, when the locking part 18 retracts to the retracted position, since the locking part 18 leaves the concave part 6C, the rotating part 6 and the washing drum 3 are unlocked.

[0034] In FIG. 1, the locking part 18 in the entering position is in a state of being fitted in the concave part 6C located at the upper-most side Z1 and the front-most side Y1. At this moment, the rotation of the rotating part 6 and the washing drum 3 is locked with the rotation angle θ being 60 degrees. As the concave part 6C in which the locking part 18 is fitted becomes another concave part 6C located at the rear side Y2, the rotation angle θ decreases. In a state that the locking part 18 is fitted in the concave part 6C at the rear-most side Y2, the rotation angle θ is 5 degrees. In this state, the rotation of the rotating part 6 and the washing drum 3 is locked.

[0035] FIG. 2 is a perspective view 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.

[0036] The base part 30 is formed by, for example, bending a metal plate, and integrally includes a longitudinal wall 37 and a pair of transverse walls 38 (i.e., an upper transverse wall 38 and a lower transverse wall 38). The longitudinal wall 37 is formed as 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 as a rectangular plate which is thin in the up-down direction Z and long in the front-rear direction Y. In the pair of transverse walls 38, the transverse wall 38 on the upper side Z1 is continuous throughout 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

almost throughout the lower end of the longitudinal wall 37 and extends to the left side X1.

[0037] The left end of each transverse wall 38 serves as a flange part 38A, and is formed in an entire region in the front-rear direction Y by bending into a substantially right angle outward in the up-down direction Z. The flange part 38A of the transverse wall 38 on the upper side Z1 is formed by bending towards the upper side Z1, and the flange part 38A of the transverse wall 38 on the lower side Z2 is formed by bending towards the lower side Z2. Each flange part 38A is formed with a threaded hole 38B. An accommodating space 30A encircled by the longitudinal wall 37 and the pair of transverse walls 38 is formed in 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.

[0038] The base part 30 is arranged between the side plate 13 on the left side X1 and the washing drum 3, and the upper and lower flange parts 38A are opposed to the periphery of the opening 13A of the side plate 13 on the left side X1 from the right side X2 (with reference to FIG. 1). The screw 39 (with reference to FIG. 1) assembled on the side plate 13 on the left side X1 is 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).

[0039] The supporting part 31 is formed by, for example, bending a metal plate, and 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. The body part 40 is equipped with a bearing 42 which is annular when observed in the front-rear direction Y. The bearing 42 is configured to be at least exposed from a front surface of the body part 40. The base part 41 is in a shape of a plate which is thin in the left-right direction X, extends from the lower end of the body part 40 to the rear side Y2, and is arranged to be overlapped with the rear end of the longitudinal wall 37 from the left side X1. The supporting part 31 is fixed to the base part 30 by assembling a screw 43 on the base part 41 and the longitudinal wall 37.

[0040] The threaded shaft 32 is formed as a cylinder elongated in the front-rear direction Y, and a screw thread 32A extending helically is formed over almost entire region of the outer circumferential surface thereof. It should be noted that in figures other than FIG. 2, to facilitate illustration, the screw thread 32A of the threaded shaft 32 is omitted. The rear end of the threaded shaft 32 is inserted into the annular bearing 42 of the supporting part 31. In this state, the threaded shaft 32 is cantilever-supported by the supporting part 31 so that the threaded shaft 32 revolves on its axis.

[0041] The motor 33 is a general electric motor, and has an output shaft 44 protruding to the rear side Y2 and arranged 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, and is opposed, from the front side Y1, to the front end of the threaded shaft 32. An upper end and a lower end of a left end part of the bracket 45 is bent a substantially right angle to the rear side Y2 to serve as an upper flange part 45A and a lower flange part 45A. Each flange part 45A is formed with a threaded hole 45B.

[0042] The motor 33 is arranged between the side plate 13 on the left side X1 and the washing drum 3 at a position closer to the front side Y1 than the base part 30, and the flange parts 45A of the bracket 45 are opposed to the periphery of the opening 13A of the side plate 13 on the left side X1 from the right side X2 (with reference to FIG. 1). By assembling the screw 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).

[0043] The coupling 34 includes: a cylindrical output part 47, which is externally embedded into a rear end of the output shaft 44 of the motor 33 so that the cylindrical output part 47 integrally rotates with the output shaft 44; a cylindrical input part 48, which is externally embedded into a front end of the threaded shaft 32 so that the cylindrical input part 48 integrally rotates with the threaded shaft 32, and a buffer part 49 arranged between the output part 47 and the input part 48. The cylindrical output part 47 has a plurality of protrusions 47A arranged along the circumferential direction and protruding to the rear side Y2. The cylindrical input part 48 has a plurality of protrusions 48A arranged along the circumferential direction and protruding to the front side Y1. The protrusions 47A and the protrusions 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 arranged between the adjacent protrusion 47A and the protrusion 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 so that the output shaft 44 and the threaded shaft 32 rotate integrally. Therefore, when the motor 33 is driven to rotate the output shaft 44, the threaded shaft 32 rotates integrally with the output shaft 44.

[0044] The nut member 35 includes a body part 50, a connecting part 51 and a detected part 52. The body part 50 is formed as an annular nut having a screw thread 50A (with reference to FIG. 3 below) which extends helically on the inner circumferential surface, and is externally fitted in 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 along with the driving of the motor 33, the nut member 35 integrally moves in the axial direction of the threaded shaft 32 (i.e., the front-rear direction Y) along with rotation of the threaded shaft 32.

[0045] 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 as a plate which is thin in the front-rear direction Y and extends in the up-down direction Z, and is fixed to the body part 50 through a screw 53. The second part 51B is formed as a plate which is thin in the left-right direction X and extends in the up-down direction Z, protrudes from the left end edge of the first part 51A to the front side Y1, and is opposed to the body part 50 from the left side X1. The second part 51B is formed with a through hole 51D penetrating through the second part 51B along the left-right direction X.

[0046] The second part 51B is opposed to the extended part 6D of the rotating part 6 from the right side X2. The connecting pin 54 (with reference to FIG. 1) inserted into the guiding hole 6E of the extended part 6D from the left side X1 is inserted into the through hole 51D. The connecting pin 54 cannot be taken out from 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 in 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 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 as 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 opposed to the body part 50 from the lower side Z2.

[0047] The detected part 52 is formed as 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 arranged to be overlapped with the third part 51C of the connecting part 51 from the lower side Z2, and is fixed to the third part 51C through a screw 55. The front end part 52B is formed to extend from the front end part of the fixing part 52A to the right side X2.

[0048] The sensor 36 is configured to detect the rotation angle θ of the washing drum 3 according to the position of the nut member 35 in the front-rear direction Y. The sensor 36 may be an optical sensor such as a photo sensor. When the photo sensor is adopted, the sensor 36 is formed with a groove 36A penetrating through the sensor 36 in the front-rear direction Y at the left side surface thereof. In the sensor 36, the detection light transects the groove 36A along the up-down direction Z. The quantity of the sensor 36 is the same as the quantity of the concave part 6C of the rotating part 6. In other words, five sensors are arranged in the present embod-

iment, and each groove 36A is arranged in a lower region of the longitudinal wall 37 of the base part 30 in the front-rear direction Y so that the grooves are overlapped when observed in the front-rear direction Y. Each sensor 36 is fixed to the longitudinal wall 37 via a screw 56. The spacing between adjacent sensors 36 is set to be suitable to the spacing between adjacent concave parts 6C. Therefore, in the present embodiment, although the spacing between the adjacent sensors 36 among the four sensors 36 on the rear side Y2 is constant, the spacing between the sensor 36 located on the front-most side Y1 and the sensor 36 immediately after the sensor 36 located on the front-most side Y1 is narrower than the spacing between other adjacent sensors 36.

[0049] When the nut member 35 moves in 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. In a state that the front end part 52B is fitted in the groove 36A, detection light of the groove 36A is blocked by the front end part 52B.

[0050] As shown in FIG. 2, when the front end part 52B of the detected part 52 is fitted in 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 rotation angle θ of the washing drum 3 is 60 degrees (with reference to FIG. 1). On the other hand, when the front end part 52B of the detected part 52 is fitted in 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 rotation angle θ of the washing drum 3 is 5 degrees. When the rotation 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 fitted in the groove 36A of a certain sensor 36. Therefore, the five sensors 36 uniformly detect whether the rotation angle θ is 5 degrees, 15 degrees, 30 degrees, 45 degrees or 60 degrees.

[0051] FIG. 3 is a left view illustrating main parts of a washing machine 1, and specifically the side plate 13 on the left side X1 of the supporting frame 4 and circumferential parts thereof. In FIG. 3, the left side part of the threaded shaft 32 and the nut member 35 are shown in cross section by hatching, and the extended part 6D of the rotating part 6 and the circumferential part thereof are omitted. In FIG. 3, although an enlarged view of parts encircled by a dash-dotted circle and part of an enlarged view of parts encircled by a dotted line circle are shown, scales in the enlarged views are different.

[0052] The enlarged view of parts encircled by the dash-dotted circle in FIG. 3 shows a state that the locking part 18 at the entering position is fitted in a certain concave part 6C of the rotating part 6. For the concave part 6C, the bottom is marked as 6F, and a pair of side surfaces extending from both ends of the bottom 6F towards

the outer circumferential edge 6A of the rotating part 6 to the radial direction R in the rotating direction K is marked as 6G. A backlash between the locking part 18 fitted in the concave part 6C and the rotating part 6 is formed by a clearance 60 and a clearance 61. The clearance 60 is a clearance in the radial direction R between the bottom 6F of the concave part 6C and the locking part 18, and the clearance 61 is a clearance in the rotating direction K between each side surface 6G and the locking part 18. Since the pair of side surfaces 6G are formed to bend in an approximating manner, the clearance 61 between a most protruding part of the side surfaces 6G and the locking part 18 is as small as zero.

[0053] It should be noted that, the locking part 18 is formed with a pair of inclined surfaces 18A at both ends of the front end part of the locking part 18 in the rotating direction K, and a pair of inclined surfaces 6H is formed on an end part farthest from the bottom 6F of the pair of side surfaces 6G of the concave part 6C. The inclined surfaces 18A approach to each other as they are closer to the bottom 6F of the concave part 6C. The inclined surfaces 6H are away from each other as being away from the bottom 6F. Entering of the locking part 18 is guided by the inclined surfaces 18A and the inclined surfaces 6H. Thus, the locking part 18 can be smoothly fitted in the concave part 6C.

[0054] The enlarged view of parts encircled by the dotted line circle in FIG. 3 shows the threaded shaft 32 and the nut member 35 in threaded connection. The screw thread 32A of the threaded shaft 32 and the screw thread 50A of the body part 50 of the nut member 35 have trapezoidal sections. Therefore, the threaded shaft 32 and the nut member 35 are formed by trapezoidal threads. The backlash between the threaded shaft 32 and the nut member 35 is formed by the clearance 62 between adjacent screw thread 32A and screw thread 50A in the front-rear direction Y.

[0055] The above clearance 60 and the clearance 61 are set to be smaller than the clearance 62. That is to say, the backlash between the locking part 18 fitting in the concave part 6C and the rotating part 6 is smaller than the backlash between the threaded shaft 32 and the nut member 35. Therefore, in a state that the locking part 18 is fitted in the concave part 6C, even if vibration generated by the washing drum 3 during the washing operation is transferred to the rotating part 6, the vibration is absorbed by the backlash between the locking part 18 and the rotating part 6. Therefore, the vibration will not be transferred to the nut member 35, the threaded shaft 32, the coupling 34 and the motor 33. Thus, a burden borne by the driving mechanism 8 due to the vibration generated by the washing drum 3 can be reduced. Therefore, the fault of the driving mechanism 8 can be inhibited, and especially, the screw thread 32A and the screw thread 50A can be inhibited from being damaged.

[0056] In addition, since the output shaft 44 of the motor 33 is connected with the threaded shaft 32 via the coupling 34, the vibration generated by the washing drum 3

in an operation process of the washing machine 1 is absorbed by the buffer part 49 (with reference to FIG. 2) of the coupling 34 and will not be transferred to the motor 33. Thus, the fault of the driving mechanism 8 can be further inhibited.

[0057] FIG. 4 is a perspective view illustrating main parts of a washing machine 1 according to a modified example. In FIG. 4, parts that have been described with reference to FIG. 1 to FIG. 3 have same reference numerals as that illustrated in FIG. 1 to FIG. 3, and illustrations of thereof are omitted. In the embodiment according to FIG. 1 to FIG. 3, only one supporting part 31 is provided to cantilever support the threaded shaft 32. In the modified example shown in FIG. 4, a pair of supporting parts 31 is arranged separately along the front-rear direction Y. The supporting parts 31 are arranged to support both side parts 32B of the threaded shaft 32 in the front-rear direction Y through each bearing 42 so that the threaded shaft 32 is rotatable. In this case, supporting rigidity of the threaded shaft 32 can be improved. Thus, the threaded shaft 32 is difficult to vibrate. Therefore, even if vibration generated by the washing drum 3 during the washing operation is transferred to the rotating part 6, the vibration will not be transferred to the threaded shaft 32, the coupling 34 and the motor 33. Thus, the fault of the driving mechanism 8 can be inhibited.

[0058] It should be noted that a structure for supporting the threaded shaft 32 on both ends thereof by a pair of supporting parts 31 like the modified example is also applicable to embodiments in FIG. 1 to FIG. 3. In addition, both side parts 32B, supported by the pair of supporting parts 31, of the threaded shaft 32 may be both ends of the threaded shaft 32, and may also be parts which deviate from both ends to a central side of the threaded shaft 32 in the front-rear direction Y. In addition, more than three supporting parts 31 may be arranged.

[0059] The present disclosure is not limited to embodiments described above, and can be changed in various modes within a scope recited in the claims.

[0060] For example, the unlocking mechanism 7 and the concave part 6C of the rotating part 6 can be omitted as long as the following structure is adopted: in the structure, the movement of the nut member 35 in the front-rear direction Y (i.e., the rotation of the washing drum 3) is limited when the driving of the motor 33 is stopped. Thus, stepless adjustment of the rotation angle θ can be achieved.

Claims

1. A washing machine, comprising:

a washing drum for accommodating washings, wherein the washing drum is rotatable and intersects with a vertical direction;
a rotating part having a plurality of concave parts arranged in a rotating direction of the washing

drum, wherein the rotating part is connected with the washing drum so that the rotating part rotates integrally with the washing drum;
 a locking part for locking rotation of the rotating part by fitting in the concave parts or unlocking the rotating part by retracting from the concave parts;
 a threaded shaft;
 a motor for driving the threaded shaft to rotate;
 and
 a nut member, wherein the nut member is in threaded connection with the threaded shaft and connected to the rotating part, so that the nut member moves along the threaded shaft as the threaded shaft rotates, thereby causing the rotating part to rotate,
 wherein a backlash between the locking part fitted in the concave parts and the rotating part is smaller than a backlash between the threaded shaft and the nut member.

2. A washing machine, comprising:

a washing drum for accommodating washings, wherein the washing drum is rotatable and intersects with a vertical direction;
 a rotating part, wherein the rotating part is connected with the washing drum so that the rotating part rotates integrally with the washing drum;
 a threaded shaft;
 a motor for driving the threaded shaft to rotate;
 a nut member, wherein the nut member is in threaded connection with the threaded shaft and connected to the rotating part, so that the nut member moves along the threaded shaft as the threaded shaft rotates, thereby causing the rotating part to rotate; and
 a pair of supporting parts, wherein the supporting parts support both side parts of the threaded shaft in an axial direction so that the threaded shaft is rotatable.

3. The washing machine according to claim 1 or 2, further comprising: a coupling for connecting an output shaft of the motor and the threaded shaft.
4. The washing machine according to any one of claims 1-3, wherein the threaded shaft and the nut member are formed with trapezoidal threads.

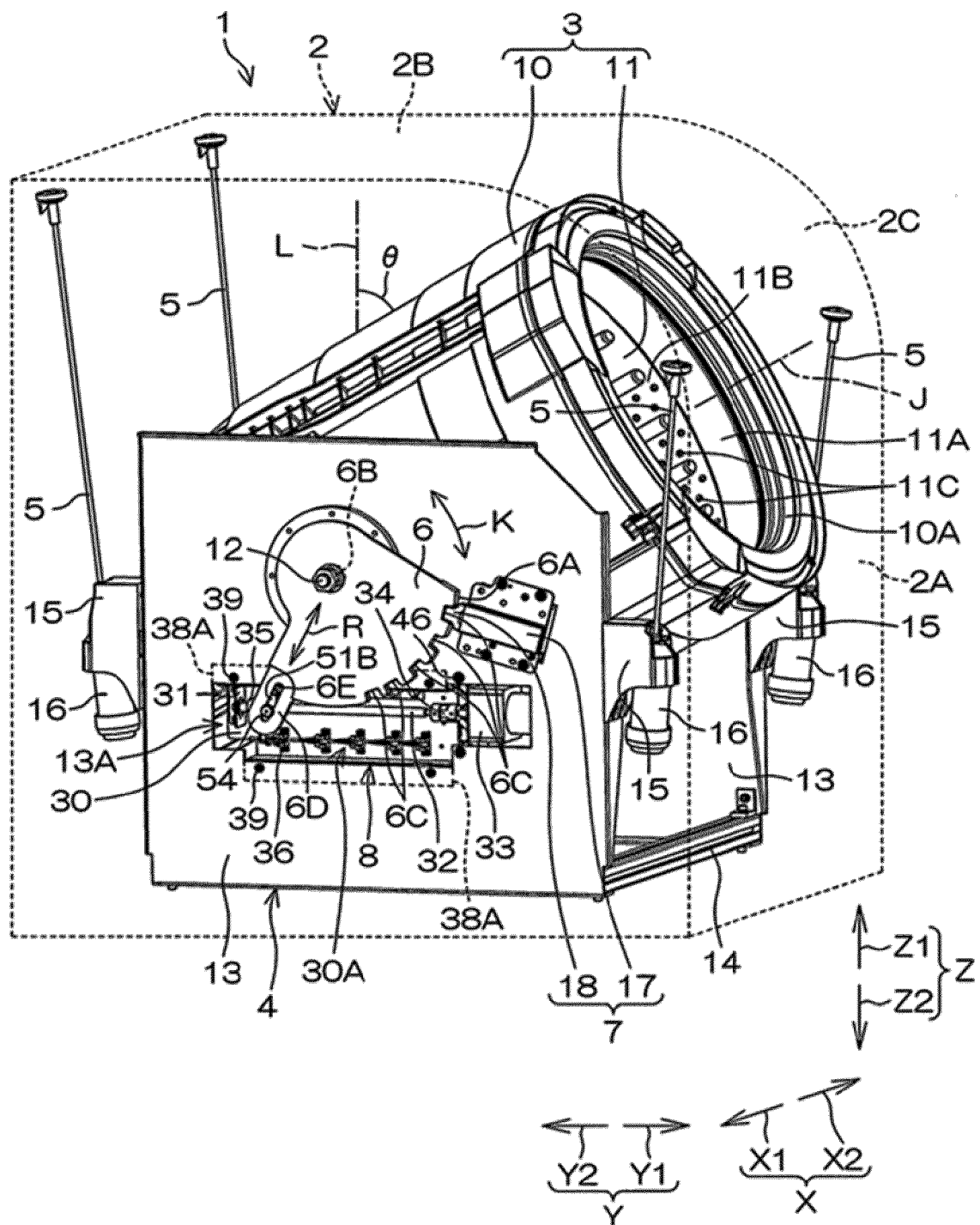


FIG. 1

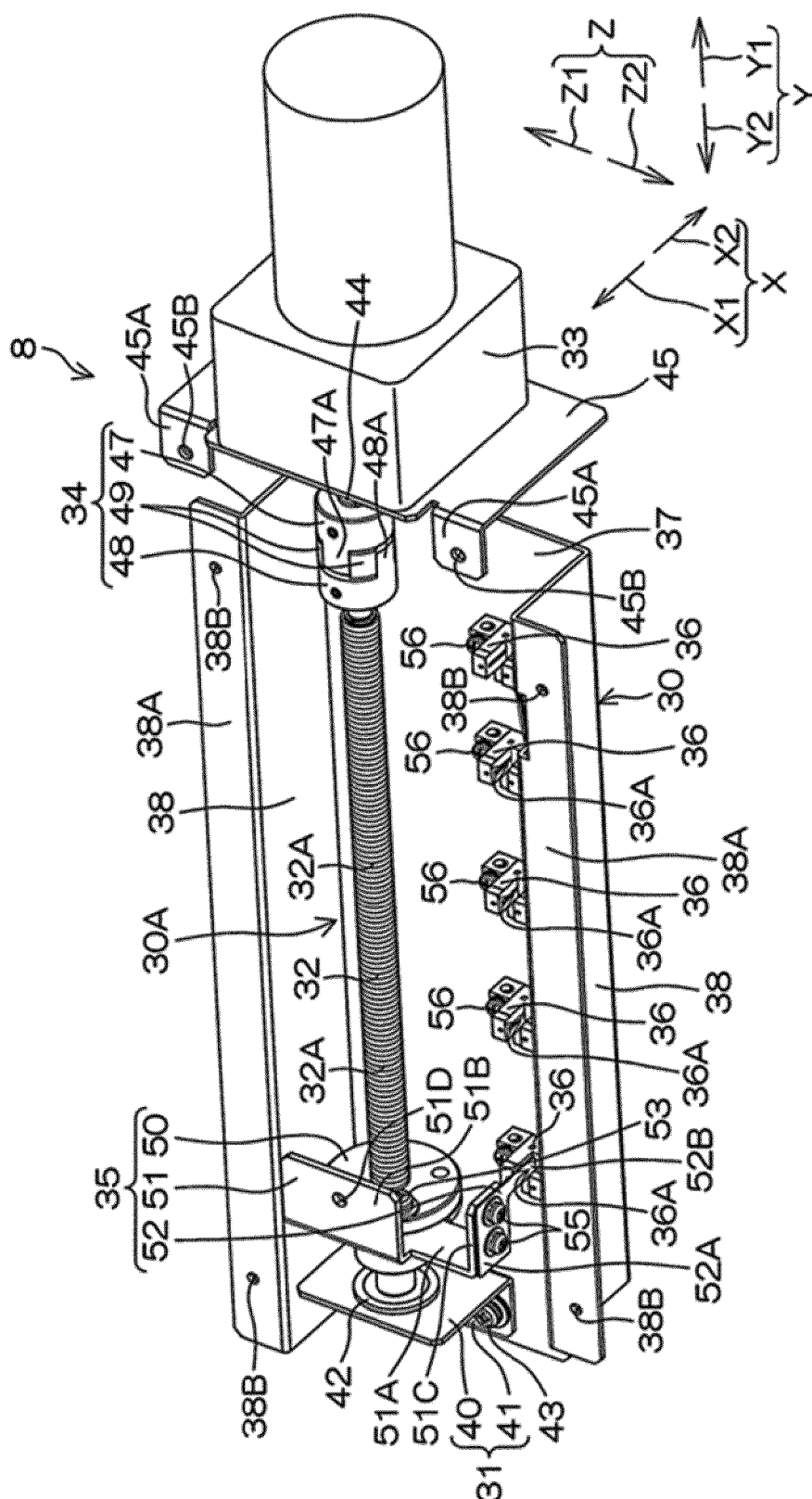


FIG. 2

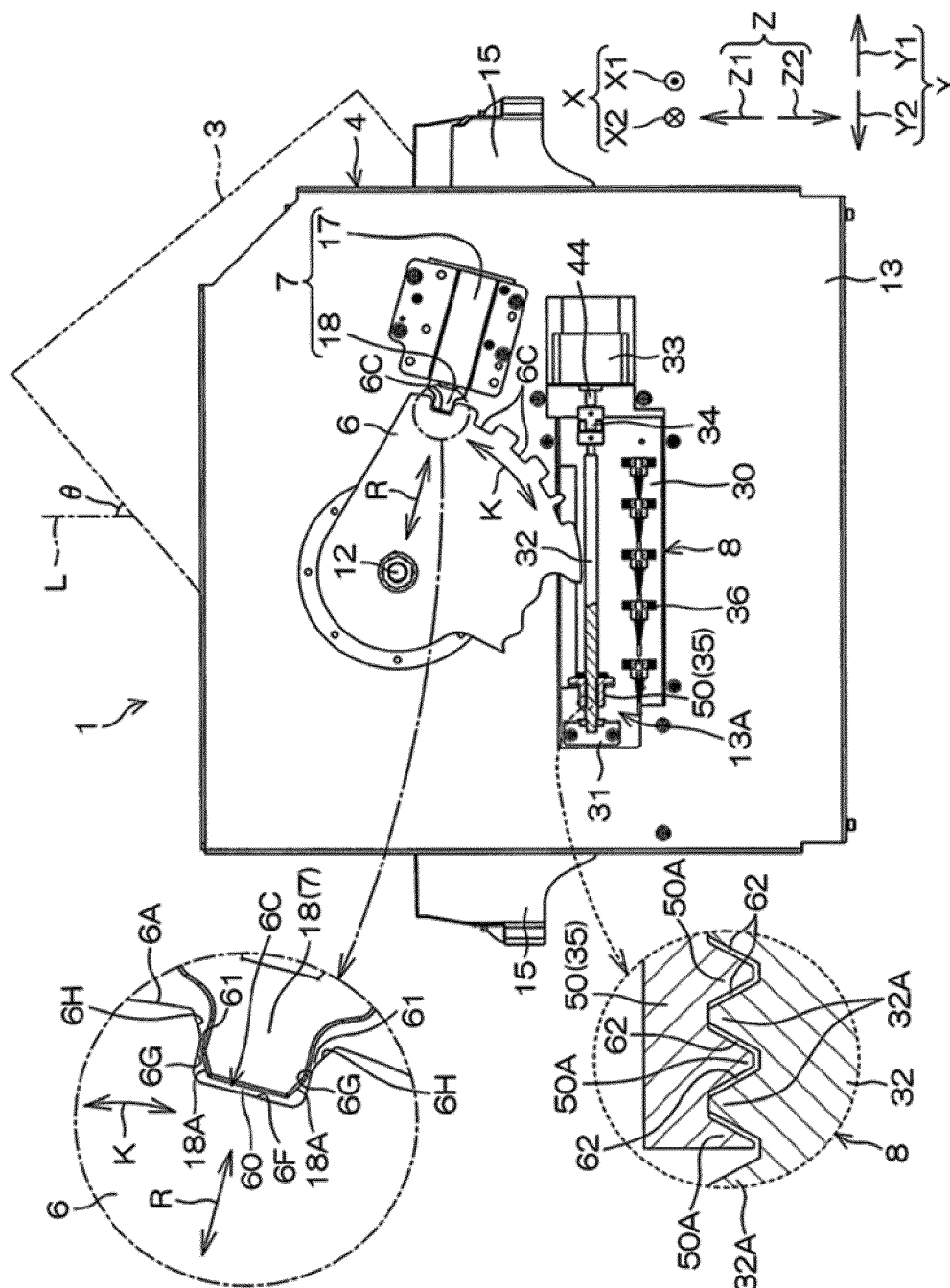


FIG. 3

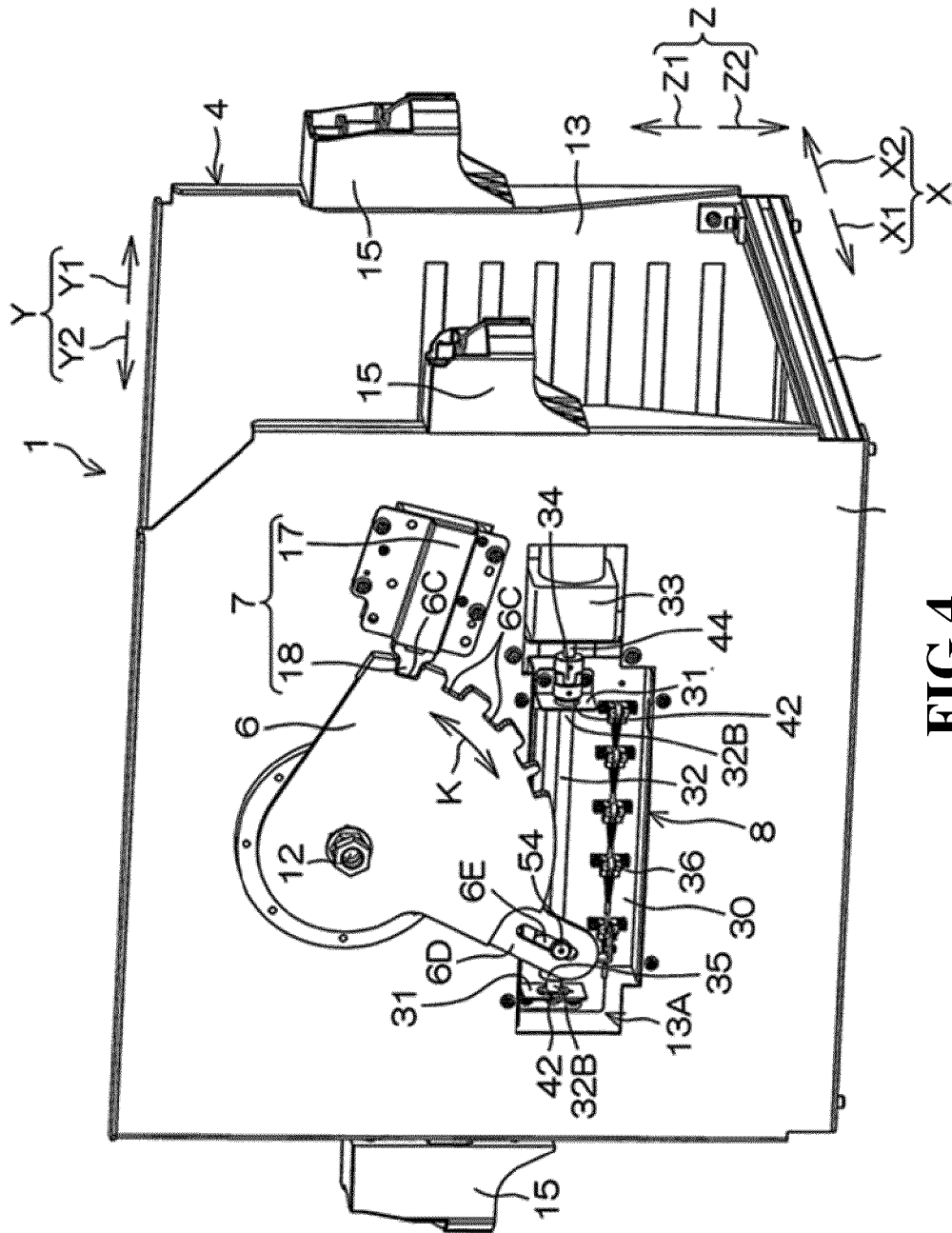


FIG.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2016/096687

A. CLASSIFICATION OF SUBJECT MATTER		
D06F 23/02 (2006.01) i; D06F 23/06 (2006.01) i; D06F 37/22 (2006.01) i; D06F 37/34 (2006.01) i; D06F 37/38 (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: bucket, lock, wash, fan, drive, jig+, nod+, oscillat+, pendul+, swing+, wigg+, wagg+, motor?, screw?, pin?, teeth, concav+, trough+, groove?, slot?, notch+, lock+		
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 201933310 U (WU, Shangzhe) 17 August 2011 (17.08.2011) the whole document	1-4
A	CN 203668702 U (JINAN UNIVERSITY) 25 June 2014 (25.06.2014) the whole document	1-4
A	CN 202576942 U (LIN, Meili) 05 December 2012 (05.12.2012) the whole document	1-4
A	US 2742772 A (ROMINE, JOSEPH C.) 24 April 1956 (24.04.1956) the whole document	1-4
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
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Date of the actual completion of the international search	Date of mailing of the international search report	
07 November 2016	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	

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

INTERNATIONAL SEARCH REPORT
Information on patent family membersInternational application No.
PCT/CN2016/096687

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
TW 201425684 A	01 July 2014	None	
CN 201933310 U	17 August 2011	None	
CN 203668702 U	25 June 2014	None	
CN 202576942 U	05 December 2012	None	
US 2742772 A	24 April 1956	None	

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REFERENCES CITED IN THE DESCRIPTION

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