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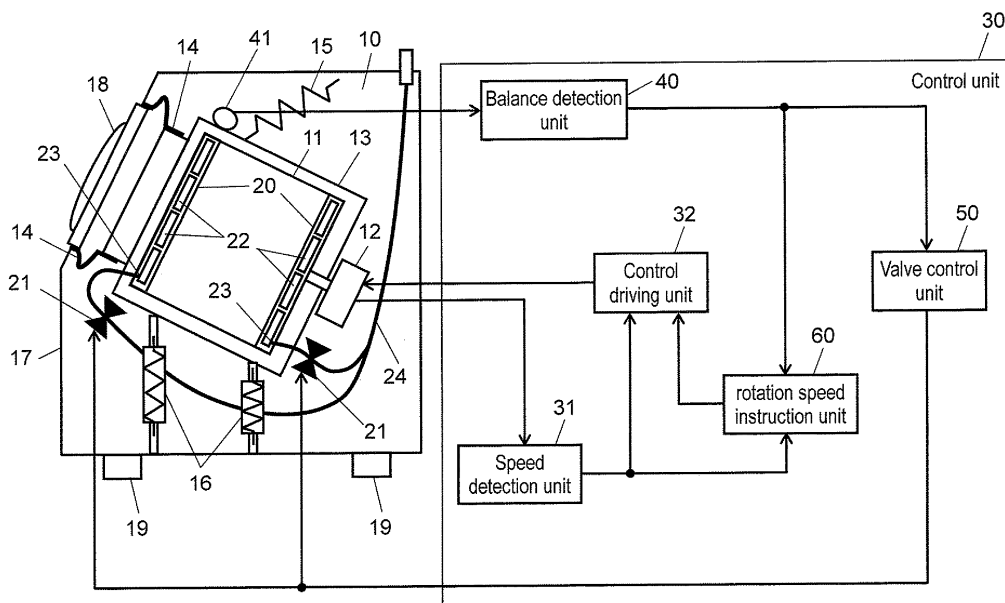
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(54) **WASHING MACHINE**

(57) A washing tub (11) is provided with a fluid balancer (20) having a plurality of storage compartments (20) storing a fluid injected from the outside thereof. A control unit (30) controls the injection into storage compartments (22) in accordance with the output of a vibration detection unit (41) detecting the vibration of a water tub (13), and alongside decides the rotation speed of a

motor (12) when the fluid is injected into storage compartments (22) in accordance with the rotation speed of the motor (12) and the output of the vibration detection unit (41). Accordingly, the injection into storage compartments (22) is performed in accordance with the vibration and the rotation speed, and the vibration caused by the unbalanced laundry is reduced.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine that performs washing, rinsing, spinning, and drying.

BACKGROUND ART

[0002] In general, washing machines are largely classified into a pulsator type washing machine washing laundry (for example, clothes) by using a water stream and a drum type washing machine washing (that is, beating-washing) laundry by dropping the laundry. In the pulsator type washing machine, the laundry is inserted into or extracted from the top side of the washing machine. For this reason, the direction of the washing tub is the vertical direction. Accordingly, the pulsator type washing machine is called a vertical washing machine. On the contrary, the direction of the washing tub of the drum type washing machine is the horizontal direction. Accordingly, the drum type washing machine is called a horizontal washing machine. For the same reason, a clothes dryer is of a horizontal type.

[0003] The drum type washing machine includes a rotary tub, and the rotary tub serves as both a washing tub and a spinning tub (hereinafter, referred to as a washing tub). When the laundry inside the washing tub is unbalanced, a large vibration may easily occur during spinning. In order to handle the large vibration, there is known a washing machine that corrects the unbalanced amount by using a fluid balancer in which a liquid with a large specific gravity is inserted into a hollow container.

[0004] As the existing drum type washing machine, there is known a washing machine which includes a fluid balancer divided into a plurality of parts in the radial direction and having a communication hole provided in a partition plate in order to reduce vibration and noise of a washing tub generated by the unbalance of the laundry during spinning. For example, a washing machine disclosed in Patent Literature 1 includes: a washing machine body, a washing tub supported by a suspension or a damper and has a bearing provided at a bottom thereof, a drum having a rotary shaft provided at a bottom thereof and rotates about the rotary shaft, a pulley attached to the rotary shaft and disposed at the outside of a water tank, and a motor for driving the drum via the pulley and a belt. Here, a plurality of fluid balancers divided in the radial direction is provided around the end of the washing tub in the axial direction.

[0005] As the existing drum type washing machine, there is known a washing machine which includes a plurality of empty storage compartments and is configured to detect a state of balance in the laundry, and alongside to inject a fluid into the storage compartments at the opposite side of the detected unbalanced position of the laundry. Accordingly, the unbalance of the laundry is cor-

rected, and the vibration of the washing tub during spinning is reduced. For example, in a washing machine disclosed in Patent Literature 2, the interval of partition plates circumferentially dividing an annular passage formed inside a balancer is set to be 30° or less, and the area of an outer peripheral side communication hole is made small.

[0006] As the existing drum type washing machine, there is known a washing machine which includes an injection-type fluid balancer correcting an unbalanced state of laundry by injecting fluid therein, wherein the injection is performed by adjusting the rotation speed of a washing tub in accordance with the unbalanced amount of the laundry. For example, in a washing machine disclosed in Patent Literature 3, an opening/closing portion is provided at a passage in order to move a fluid inside a storage compartment of a fluid balancer of a washing tub. When the eccentric load of laundry is present at the top side of the washing tub by the opening/closing of the opening/closing portion, the fluid is made to move to the opposite side of the eccentric load. When the eccentric load is present at the bottom side of the washing tub, the fluid is made not to move due to its own weight.

[0007] However, in the washing machine disclosed in Patent Literature 1, the fluid may not move to the opposite side of the unbalanced position of the laundry at the resonance rotation speed of the washing tub when spinning is activated. That is, there is a problem in that the vibration of the washing tub during the spinning is not reduced.

[0008] In the washing machine disclosed in Patent Literature 2, when the rotation speed approaches the critical rotation speed of the washing tub during the normal spinning, the fluid of the fluid balancer moves to the unbalanced position of the laundry. Alternatively, the fluid of the fluid balancer moves by the vibration. That is, there is a problem in that the vibration of the washing tub during the spinning is not reduced.

[0009] In the washing machine disclosed in Patent Literature 3, the washing tub becomes balanced by using the fluid balancer on the basis of the relationship between the centrifugal force and its own weight and a variation in speed at the time of activating the spinning. However, since there is a non-linear factor such as friction when the rotation of the washing tub is continued, stability operation of the washing tub is difficult. That is, there is a problem in that the vibration of the washing tub is not reduced during the spinning.

PRIOR ART DOCUMENT

PATENT LITERATURE

[0010]

[PTL 1] Japanese Patent No. 3106511

[PTL 2] Japanese Patent Unexamined Publication No. 2008-209502

[PTL 3] Japanese Patent Unexamined Publication

No. 2008-325811

DISCLOSURE OF THE INVENTION

[0011] The invention is made to solve the above-described problems, and provides a washing machine reducing a vibration of the washing tub during spinning by using a fluid balancer.

[0012] A washing machine of the invention includes: a washing tub for receiving laundry; a fluid balancer provided in the washing tub; a motor for rotationally driving the washing tub; a water tub having the washing tub provided therein; a vibration detection unit for detecting a vibration of the water tub; and a control unit. Furthermore, in the washing machine of the invention, the fluid balancer includes a plurality of storage compartments for storing a fluid injected from the outside thereof. Furthermore, in the washing machine of the invention, the control unit controls injection of the fluid into the storage compartments in accordance with an output of the vibration detection unit, and alongside decides a rotation speed of the motor when injecting the fluid is into the storage compartments in accordance with the rotation speed of the motor and the output of the vibration detection unit. Accordingly, it is possible to inject the fluid into the storage compartments of the fluid balancer in accordance with the vibration and the rotation speed, and to reduce the vibration caused by the unbalanced laundry.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

Fig. 1 is a block diagram illustrating a washing machine of a first embodiment of the invention.

Fig. 2 is a flowchart illustrating a spinning step of the washing machine of the embodiment.

Fig. 3 is a flowchart illustrating a spinning step of a washing machine of a second embodiment of the invention.

Fig. 4 is a flowchart illustrating a spinning step of a washing machine of a third embodiment of the invention.

Fig. 5 is a flowchart illustrating a spinning step of a washing machine of a fourth embodiment of the invention.

Fig. 6 is a flowchart illustrating a spinning step of a washing machine of a fifth embodiment of the invention.

Fig. 7 is a flowchart illustrating a spinning step of a washing machine of a sixth embodiment of the invention.

Fig. 8 is a flowchart illustrating a spinning step of a washing machine of a seventh embodiment of the invention.

PREFERRED EMBODIMENTS FOR CARRYING OUT THE INVENTION

First Embodiment

[0014] Fig. 1 is a block diagram illustrating a washing machine of a first embodiment of the invention. In Fig. 1, housing cover 17 of the washing machine includes an insertion opening 18 into or from which laundry is inserted or extracted and anti-vibration rubber 19 which serves as a leg portion when the washing machine is installed on a floor. The interior of housing cover 17 is provided with mechanism 10 of the washing machine including water tub 13 where water enters, washing tub 11 disposed inside water tub 13 and accommodating laundry, and motor 12 disposed outside water tub 13 and rotating washing tub 11 while controlling the speed thereof. Motor 12 is configured as a brushless motor. Seal packing 14 is provided between the periphery of insertion opening 18 of housing cover 17 and the opening of water tub 13 so that any gap is not formed therebetween.

[0015] The posture of water tub 13 is kept by support spring 15. Furthermore, damper mechanism 16 is provided between water tub 13 and housing cover 17 to support them. Damper mechanism 16 has both functions of a spring component and a damper component, and reduces the generation of a vibration when washing tub 11 rotates. Damper mechanism 16 and anti-vibration rubber 19 suppress the vibration of washing tub 11 from being transferred to the floor.

[0016] Fluid balancer 20 is provided in at least one of front and rear surfaces of washing tub 11. Fluid balancer 20 is a donut-shaped container having a plurality of storage compartments 22. The fluid is injected into storage compartments 22 in a manner such that it enters from injection opening 23 to storage compartments 22 via injection paths 24. Furthermore, the injection of the fluid into storage compartments 22 is performed by controlling valve 21. The open/close control of valve 21 or the rotation control of motor 12 is performed by control unit 30. Furthermore, the fluid injected into storage compartments 22 is, for example, water.

[0017] Speed detection unit 31 detects the speed of motor 12 from a hall IC (not shown) provided in motor 12. Control driving unit 32 drives motor 12 on the basis of a difference between the rotation speed (rpm) detected by speed detection unit 31 and the target rotation speed from rotation speed instruction unit 60.

[0018] When washing tub 11 rotates while the laundry is greatly unbalanced, the vibration thereof increases. The vibration of washing tub 11 is transferred to water tub 13. Vibration detection unit 41 is provided in water tub 13 and detects the vibration of water tub 13. That is, vibration detection unit 41 indirectly detects the vibration of washing tub 11. Balance detection unit 40 detects by estimating the unbalanced position of the laundry and the unbalanced amount of the laundry on the basis of the vibration detection signal from vibration detection unit 41.

[0019] Valve control unit 50 controls the amount of water injected into storage compartments 22 of fluid balancer 20 by controlling the opening/closing operation of valve 21. Furthermore, valve control unit 50 controls the opening/closing operation of valve 21 on the basis of the unbalanced amount of the laundry estimated by balance detection unit 40.

[0020] Here, vibration detection unit 41 is configured as, for example, a three-axis acceleration sensor. Furthermore, vibration detection unit 41 may estimate the vibration on the basis of the control current to motor 12 or the rotation speed (rpm) of motor 12 (r/min). Furthermore, rotation speed instruction unit 60 decides the target rotation speed of motor 12 in accordance with the output from balance detection unit 40 and the rotation speed obtained when vibration detection unit 41 detects the vibration.

[0021] Fig. 2 is a flowchart illustrating a spinning step of a drum type washing machine of the first embodiment. First, the spinning is performed in a manner such that moisture contained in the laundry is separated by a centrifugal force. The centrifugal force is generated by the rotation of washing tub 11 caused by the rotational driving of motor 12.

[0022] When the spinning step is started (step S101), motor 12 is driven at a constant rotation speed of 120 r/min by control driving unit 32 (step S102). The rotation speed is equal to or less than the resonance rotation speed of the support mechanism system of support spring 15 or damper mechanism 16.

[0023] Next, the unbalance of the laundry is estimated by balance detection unit 40 (step S103). When the laundry is unbalanced, a vibration is generated in washing tub 11. The vibration is detected by vibration detection unit 41. Balance detection unit 40 estimates the unbalanced position and the unbalanced amount of the laundry on the basis of the vibration detection signal obtained from vibration detection unit 41.

[0024] In step S104, balance detection unit 40 determines whether the unbalanced amount is a threshold value (for example, 600 g) or more. When the unbalanced amount is less than the threshold value (No in step S104), the current process proceeds to step S106, and control driving unit 32 increases the rotation speed of motor 12. On the other hand, when the unbalanced amount is a threshold value or more (Yes in step S104), valve control unit 50 opens valve 21 to inject a fluid into fluid balancer 20 (step S105). Specifically, the process is performed as bellow. Balance detection unit 40 estimates the unbalanced position of the laundry as well as the unbalanced degree of the laundry. On the basis of the estimation result, the fluid is injected into storage compartments 22 at the opposite side of the unbalanced position of the laundry. The injection is performed by synchronizing the opening/closing operation of valve 21 with the rotation of motor 12. In this case, the fluid is injected in a manner synchronized with rotation at 120 r/min. Accordingly, the rotation of washing tub 11 becomes balanced. When the

rotation of washing tub 11 becomes balanced, control driving unit 32 increases the rotation speed of motor 12 (step S106).

[0025] When the rotation speed of motor 12 increases, it finally reaches the resonance rotation speed. In step S107, balance detection unit 40 determines whether the resonance is detected. When resonance is detected (Yes in step S107), the current process returns to step S105. That is, the fluid is injected into fluid balancer 20, and the rotation of washing tub 11 becomes balanced again. On the other hand, when the resonance is not detected (No in step S107), motor 12 is driven at a constant rotation speed of 400 r/min by control driving unit 32 (step S108). Since the resonance rotation speed also becomes different in accordance with the water separating state of the laundry (that is, the spinning degree), even in step S110 and step S113 below, washing tub 11 becomes balanced again.

[0026] In step S109, balance detection unit 40 determines whether the unbalanced amount increases. When the unbalanced amount does not increase (No in step S109), motor 12 is driven at a constant rotation speed of 800 r/min by control driving unit 32 (step S111). On the other hand, when the unbalanced amount increases (Yes in step S109), valve control unit 50 opens valve 21 and injects the fluid into fluid balancer 20 (step S110). The injection is performed by synchronizing the opening/closing operation of valve 21 with the rotation of motor 12. In this case, the fluid is injected in a manner synchronized with the rotation at 400 r/min. Accordingly, the rotation of washing tub 11 becomes balanced. When the rotation of washing tub 11 becomes balanced, motor 12 is driven at a constant rotation speed of 800 r/min by control driving unit 32 (step S111).

[0027] In the same manner, in step S112, balance detection unit 40 determines whether the unbalanced amount increases. When the unbalanced amount does not increase (No in step S112), motor 12 is driven at a constant rotation speed of 1200 r/min by control driving unit 32 (step S114). On the other hand, when the unbalanced amount increases (Yes in step S112), valve control unit 50 opens valve 21 and injects the fluid into fluid balancer 20 (step S113). The injection is performed by synchronizing the opening/closing operation of valve 21 with the rotation of motor 12. In this case, the fluid may be injected in a manner synchronized with the rotation at 800 r/min. Accordingly, the rotation of washing tub 11 becomes balanced. When the rotation of washing tub 11 becomes balanced, motor 12 is driven at a constant rotation speed of 1200 r/min by control driving unit 32 (step S114). Furthermore, in steps S105, S110, and S113, the injection operations to fluid balancer 20 are performed when the rotation speed of motor 12 is 120 r/min, 400 r/min, and 800 r/min.

[0028] Here, the final rotation speed (the final spinning rotation speed) is decided before the spinning step ends. In step S115, balance detection unit 40 determines whether the vibration is detected. When the vibration is

not detected (No in step S115), the final spinning rotation speed is decided as 1600 r/min. Accordingly, motor 12 is driven at a constant rotation speed of 1600 r/min by control driving unit 32 (step S116). Subsequently, motor 12 is decelerated and stopped (step S118). On the other hand, when the vibration is detected (Yes in step S115), the final spinning rotation speed is decided as 1200 r/min. Accordingly, motor 12 is driven while keeping the rotation speed of 1200 r/min without increasing the rotation speed (step S108). Subsequently, motor 12 is decelerated and stopped (step S118).

[0029] When motor 12 is stopped, water injected into storage compartments 22 is discharged from, for example, a discharge hole provided in storage compartments 22. That is, the fluid is discharged from the fluid balancer (step S119). In this manner, the spinning step ends (step S120). Furthermore, since the water injected into storage compartments 22 moves outward by a centrifugal force when washing tub 11 rotates at 120 r/min or more, the water is not discharged from the discharge hole.

[0030] In the embodiment, the injection to fluid balancer 20 is performed three times in the spinning step. On the other hand, when the unbalanced amount of the laundry is small, the number of times of injecting the fluid into fluid balancer 20 may be small. Conversely, when the unbalanced amount of the laundry is large, the number of times of injecting the fluid into fluid balancer 20 may be large.

[0031] Here, in step S105, the rotation speed upon injecting the fluid into fluid balancer 20 is 120 r/min. The resonance rotation speed of the translation vibration mode of water tub 13 and the support mechanism is 140 r/min or less. The rotation speed upon injecting the fluid into fluid balancer 20 is not limited to 120 r/min, and may be the resonance rotation speed or less. Furthermore, in step S110, the rotation speed upon injecting the fluid into fluid balancer 20 is 400 r/min. The resonance rotation speed of the oscillation vibration mode of water tub 13 and the support mechanism is 300 r/min or more. The rotation speed upon injecting the fluid into fluid balancer 20 is not limited to 400 r/min, and may be the resonance rotation speed or more. Furthermore, in step S113, the rotation speed upon injecting the fluid into fluid balancer 20 is 800 r/min, but may be the minimum rotation speed or more in the spinning step.

[0032] As described above, control unit 30 controls the opening/closing operation of valve 21 used for the injection to fluid balancer 20 by using valve control unit 50 on the basis of the rotation speed of motor 12 and the unbalanced amount detected by balance detection unit 40. That is, the fluid is appropriately injected into storage compartments 22 at the opposite side of the unbalanced position of the laundry in order to correct the unbalanced state of the laundry. Accordingly, the vibration at the critical rotation speed during the spinning and the rapid rotation may be corrected. Accordingly, in the spinning step, the vibration of washing tub 11 may be reduced.

[0033] Noise may be reduced with the reduction of the

vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

Second Embodiment

[0034] Fig. 3 is a flowchart of a spinning step of a drum type washing machine of a second embodiment of the invention. Furthermore, the description will be made by giving the same reference numerals to the same steps as those of the first embodiment shown in Fig. 2. As shown in Fig. 3, the embodiment is different from the first embodiment in that the current process returns to step S102 when the resonance is detected in the resonance detection in step S177 (Yes in step S177).

[0035] The spinning step of the embodiment is the same as that of the first embodiment from step S101 to step S106. Here, if the resonance is detected (Yes in step S177) when the rotation speed of motor 12 increases from 120 r/min (step S106), the current process returns to step S102. Accordingly, motor 12 is decelerated up to 120 r/min, and returns to the initial spinning state. Subsequently, the fluid is injected into fluid balancer 20 again (step S105). Furthermore, if the resonance is not detected (No in step S177) when the rotation speed of motor 12 increases from 120 r/min (step S106), the current process proceeds to step S108. The following steps are the same as those of the first embodiment until the spinning step of step S120 ends.

[0036] Since step S177 is added, if the resonance is detected even when the rotation speed of motor 12 increases by means of rotation speed instruction unit 60, motor 12 is first decelerated and the fluid is injected into fluid balancer 20 again. That is, washing tub 11 may become balanced and the vibration of washing tub 11 may be reduced. Furthermore, noise may be reduced with the reduction of the vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

Third Embodiment

[0037] Fig. 4 is a flowchart illustrating a spinning step of a drum type washing machine of a third embodiment. Furthermore, the description will be made by giving the same reference numerals to the same steps as those of the first embodiment shown in Fig. 2. As shown in Fig. 4, the embodiment is different from the first embodiment in that an increase in rotation speed is stopped and the rotation speed is controlled to be constant (step S173) if vibration detection unit 41 detects the vibration (step S171) and the unbalanced amount increases (Yes in step S172) even when the rotation speed increases (step S106). Furthermore, the embodiment is different from the first embodiment in that an increase in rotation speed

is stopped and the rotation speed is controlled to be constant (step S183) if the unbalanced amount increases (Yes in step S182) even when motor 12 rotates at 800 r/min (step S111).

[0038] The spinning step of the embodiment is the same as that of the first embodiment from step S101 to step S106. Here, when the rotation speed of motor 12 increases from 120 r/min (step S106), the vibration is continuously detected (step S171). When the unbalanced amount increases (Yes in step S172), an increase in rotation speed is stopped and the rotation speed is controlled to be constant (step S173). Then, in the same manner as the first embodiment, the fluid is injected into fluid balancer 20 (step S110), and the rotation speed of motor 12 is set to 800 r/min in a balanced state (step S111). On the other hand, when the unbalanced amount does not increase (No in step S172), the rotation speed of motor 12 is set to 800 r/min (step S111).

[0039] Subsequently, when the unbalanced amount increases again (Yes in step S182), an increase in rotation speed is stopped and the rotation speed is controlled to be constant (step S183). Then, in the same manner as the first embodiment, the fluid is injected into fluid balancer 20 (step S113), and the rotation speed of motor 12 is set to 1200 r/min in a balanced state (step S114). On the other hand, when the unbalanced amount does not increase (No in step S182), the rotation speed of motor 12 is set to 1200 r/min (step S114). The following steps are the same as those of the first embodiment until the spinning step of step S120 ends.

[0040] Since steps S171, S172, and S173 are added, even when the rotation speed of motor 12 increases by rotation speed instruction unit 60, an increase in rotation speed is stopped and the fluid is injected into fluid balancer 20 again. That is, washing tub 11 may become balanced and the vibration of washing tub 11 may be reduced. Furthermore, noise may be reduced with the reduction of the vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

Fourth Embodiment

[0041] Fig. 5 is a flowchart illustrating a spinning step of a drum type washing machine of a fourth embodiment of the invention. Furthermore, the description will be made by giving the same reference numerals to the same steps as those of the first embodiment shown in Fig. 2 and the third embodiment shown in Fig. 4. As shown in Fig. 5, the embodiment is different from the third embodiment in that the current process returns to step S102 if the rotation speed is a predetermined rotation speed or less (No in step S131) when the unbalanced amount increases in step S172 (Yes in step S172).

[0042] The spinning step of the embodiment is the same as that of the third embodiment from step S101 to

step S172. Here, when the unbalanced amount increases (Yes in step S172), it is determined whether the rotation speed is a predetermined rotation speed or more (step S131). When the rotation speed is the predetermined rotation speed or less (No in step S131), the current process returns to step S102 so that the rotation speed returns to 120 r/min again. On the other hand, when the rotation speed is the predetermined rotation speed or more (Yes in step S131), an increase in rotation speed is stopped and the rotation speed is controlled to be constant (step S132). Then, the fluid is injected into fluid balancer 20 (step S113), and the rotation speed of motor 12 is set to 1200 r/min in a balanced state (step S114). Furthermore, when the unbalanced amount does not increase (No in step S172), the rotation speed of motor 12 is set to 1200 r/min (step S114). The following steps are the same as those of the first embodiment until the spinning step of step S120 ends.

[0043] Since steps S131 and S132 are added, the fluid is injected into fluid balancer 20 again in accordance with the rotation speed when the unbalanced amount increases. Alternatively, the current process proceeds to the initial spinning step again in accordance with the rotation speed. That is, washing tub 11 may become balanced and the vibration of washing tub 11 may be reduced. Furthermore, noise may be reduced with the reduction of the vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

Fifth Embodiment

[0044] Fig. 6 is a flowchart illustrating a spinning step of a drum type washing machine of a fifth embodiment of the invention. Furthermore, the description will be made by giving the same reference numerals to the same steps as those of the first embodiment shown in Fig. 2 and the fourth embodiment shown in Fig. 5. As shown in Fig. 6, the embodiment is different from the fourth embodiment in that the current process returns to step S102 if the elapsed time from the start of the spinning to the current rotation speed is less than a predetermined time (No in step S141) when the unbalanced amount increases in step S172 (Yes in step S172).

[0045] The spinning step of the embodiment is the same as that of the fourth embodiment from step S101 to step S172. Here, when the unbalanced amount increases (Yes in step S172), it is determined whether the elapsed time from the start of the spinning to the current rotation speed is a predetermined time or more (that is, the predetermined time is elapsed) (step S141). When the elapsed time is less than the predetermined time (No in step S141), the current process returns to step S102, and the rotation speed returns to 120 r/min again. On the other hand, when the elapsed time is the predetermined time or more (that is, the predetermined time is elapsed)

(Yes in step S141), an increase in rotation speed is stopped and the rotation speed is controlled to be constant (step S132). Then, the fluid is injected into fluid balancer 20 (step S113), and the rotation speed of motor 12 is set to 1200 r/min in a balanced state (step S114). Furthermore, when the unbalanced amount does not increase (No in step S172), the rotation speed of motor 12 is set to 1200 r/min (step S114). The following steps are the same as those of the first embodiment until the spinning step of step S120 ends.

[0046] Since step S141 is added, when the unbalanced amount increases, the fluid is injected into fluid balancer 20 again with the elapsed time from the start of the spinning. Alternatively, the current process proceeds to the initial spinning step again in accordance with the rotation speed. That is, washing tub 11 may become balanced and the vibration of washing tub 11 may be reduced. Furthermore, noise may be reduced with the reduction of the vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

Sixth Embodiment

[0047] Fig. 7 is a flowchart illustrating a spinning step of a drum type washing machine of a sixth embodiment of the invention. Furthermore, the description will be made by giving the same reference numerals to the same steps as those of the first embodiment shown in Fig. 2. As shown in Fig. 7, the embodiment is different from the first embodiment in that it is determined to return to the initial spinning step (step S102) or to proceed to a step of detangling the laundry (step S153) in accordance with the number of retries when the resonance is detected (Yes in step S187).

[0048] The spinning step of the embodiment is the same as that of the first embodiment from step S101 to step S106. Here, if the resonance is detected (Yes in step S187) when the rotation speed of motor 12 increases from 120 r/min (step S106), the number of retries is counted (step S151). Next, it is determined whether the number of retries is a predetermined number of times or less (step S152). When the number of retries is the predetermined number of times or less (Yes in step S152), the current process returns to step S102, that is, the initial spinning step. Accordingly, the rotation speed of motor 12 is decelerated to 120 r/min, and the fluid is injected into fluid balancer 20 again (step S105). On the other hand, when the number of retries is more than the predetermined number of times (No in step S152), it is determined that washing tub 11 is difficult to become balanced by using fluid balancer 20, and the current process proceeds to the laundry detangling step (step S153). The laundry detangling step indicates a step, for example, water is supplied to washing tub 11 again and the laundry is floated to reduce the unbalanced amount of the laundry. Alter-

natively, the laundry may be detangled by performing a rinsing step. Furthermore, when the resonance is not detected (No in step S187), the current process proceeds to step S108. The following steps are the same as those of the first embodiment.

[0049] Since steps S151, S152, and S153 are added, even when balancing of washing tub 11 is difficult to obtain by using fluid balancer 20, washing tub 11 may become balanced again by detangling the laundry, and the vibration of washing tub 11 may be reduced. Furthermore, noise may be reduced with the reduction of the vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

Seventh Embodiment

[0050] Fig. 8 is a flowchart illustrating a spinning step of a drum type washing machine of a seventh embodiment of the invention. Furthermore, the description will be made by giving the same reference numerals to the same steps as those of the first embodiment shown in Fig. 2. As shown in Fig. 8, the embodiment is different from the first embodiment in that the rotation speed is controlled to be constant (step S152) and the current process returns to step S105 when the water supply is detected (Yes in step S151) while the rotation speed increases (step S106).

[0051] The spinning step of the embodiment is the same as that of the first embodiment from step S101 to step S106. Here, if the water supply is detected (Yes in step S151) when the rotation speed of motor 12 increases from 120 r/min (step S106), the rotation speed is controlled to be constant (step S152). Subsequently, the current process returns step S105, and the fluid is injected into fluid balancer 20 again. Here, the water supply is performed, for example, when the laundry is detangled. Alternatively, the water supply is performed when the rinsing is performed. On the other hand, when the water supply is not detected (No in step S151), the current process proceeds to step S107. The following steps are the same as those of the first embodiment.

[0052] Since steps S151 and S152 are added, the current process proceeds to the initial spinning step in accordance with the water supply state, that is, the change in the condition of the laundry inside washing tub 11. That is, washing tub 11 may become balanced and the vibration of washing tub 11 may be reduced. Furthermore, noise may be reduced with the reduction of the vibration of washing tub 11. Furthermore, since the vibration of washing tub 11 is reduced, the spinning rotation speed may be increased. Since the spinning rotation speed increases, the spinning time may be shortened.

INDUSTRIAL APPLICABILITY

[0053] As described above, since the invention may

reduce the vibration of the washing tub at the spinning step of the drum type washing machine, the invention may also be used in any washing machine except for the drum type.

DESCRIPTION OF REFERENCE NUMERALS AND SIGNS

[0054]

- 11: WASHING TUB
- 12: MOTOR
- 13: WATER TUB
- 20: FLUID BALANCER
- 22: STORAGE COMPARTMENT
- 30: CONTROL UNIT
- 41: VIBRATION DETECTION UNIT

Claims

1. A washing machine comprising:

a washing tub for receiving laundry;
 a fluid balancer provided in the washing tub;
 a motor for rotationally driving the washing tub;
 a water tub having the washing tub provided therein;
 a vibration detection unit for detecting a vibration of the water tub; and
 a control unit for controlling the motor, wherein the fluid balancer includes a plurality of storage compartments for storing a fluid injected from the outside thereof, and wherein the control unit controls injection of the fluid into the storage compartments in accordance with an output of the vibration detection unit, and alongside decides a rotation speed of the motor when injecting the fluid into the storage compartments in accordance with a preceding rotation speed of the motor and the output of the vibration detection unit.

- 2. The washing machine of claim 1, wherein the control unit decides the rotation speed of the motor by selecting from at least two different speeds when injecting the fluid into the storage compartments in a process of increasing the rotation speed of the motor.
- 3. The washing machine of claim 1, wherein the control unit decides the rotation speed of the motor as to be smaller than a resonance rotation speed when injecting the fluid into the storage compartments.
- 4. The washing machine of claim 1, wherein the control unit decides the rotation speed of the motor as to be larger than a resonance rotation speed when injecting the fluid into the storage compartments.

5. The washing machine of claim 1, wherein the control unit injects the fluid into the storage compartments after decelerating rotation of the motor when the injection is made again due to vibration detected by the vibration detection unit after the first injection.

6. The washing machine of claim 1, wherein the control unit injects the fluid into the storage compartments again at the same rotation speed of the motor when the vibration detection unit detects vibration after the first injection.

FIG. 1

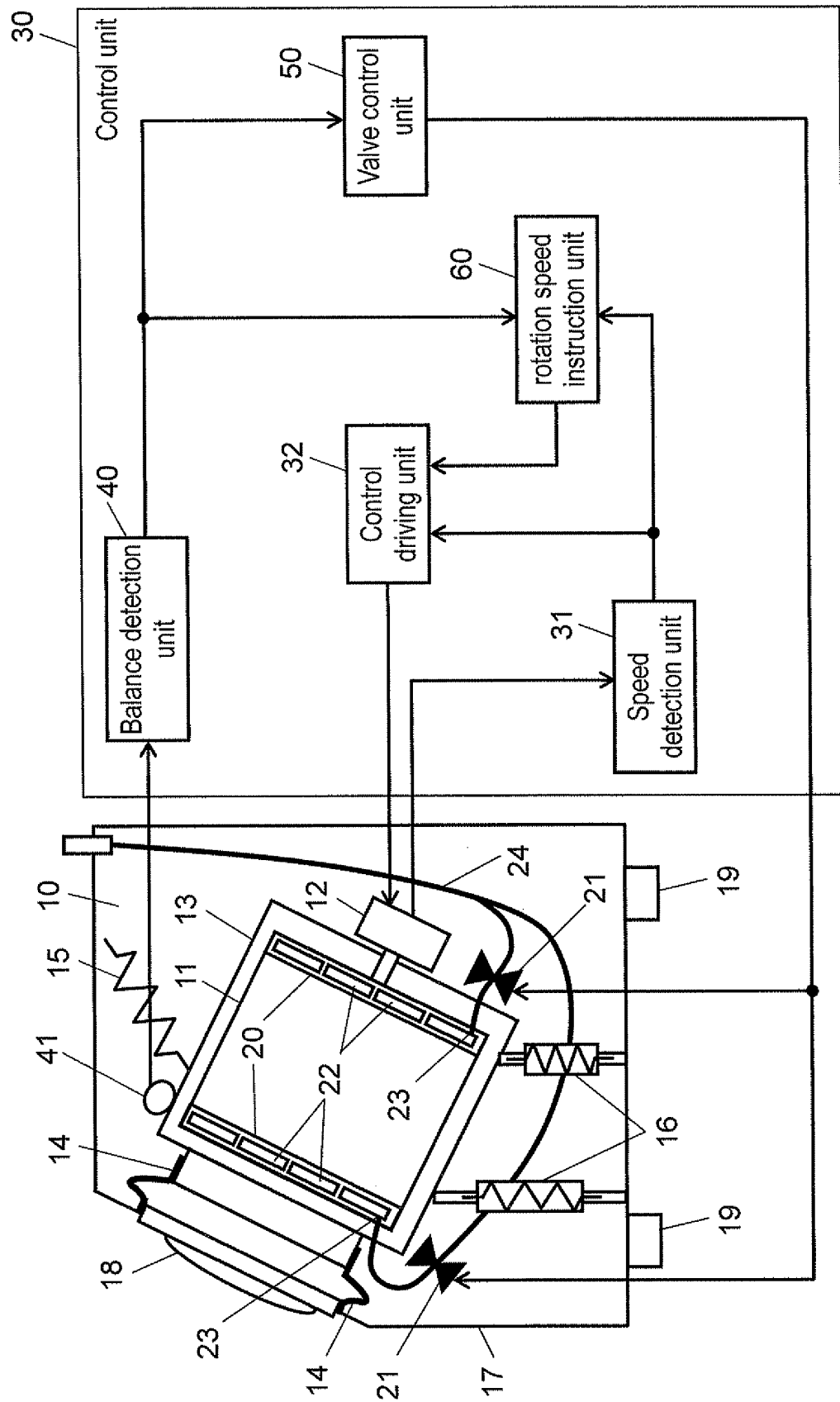


FIG. 2

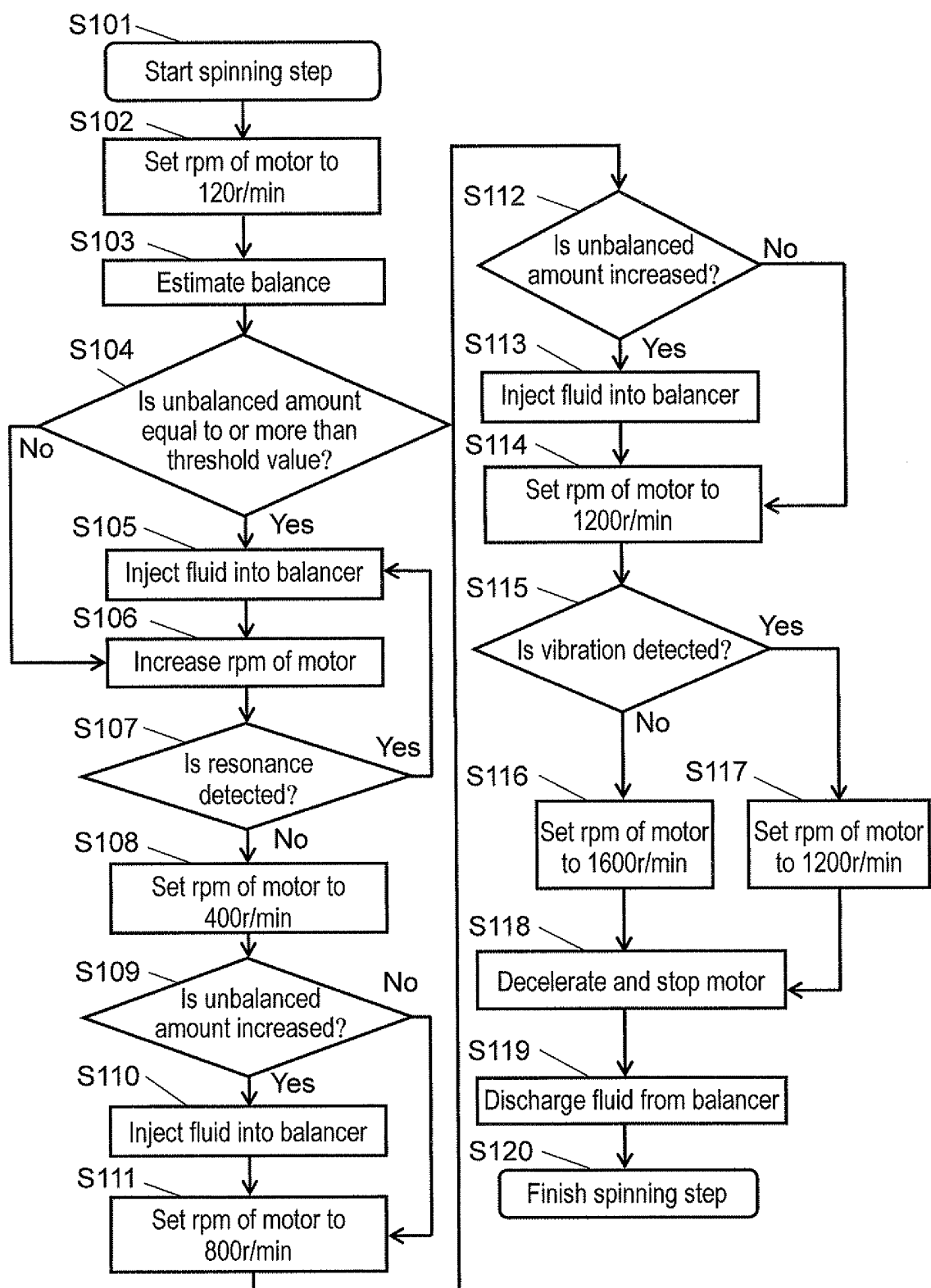


FIG. 3

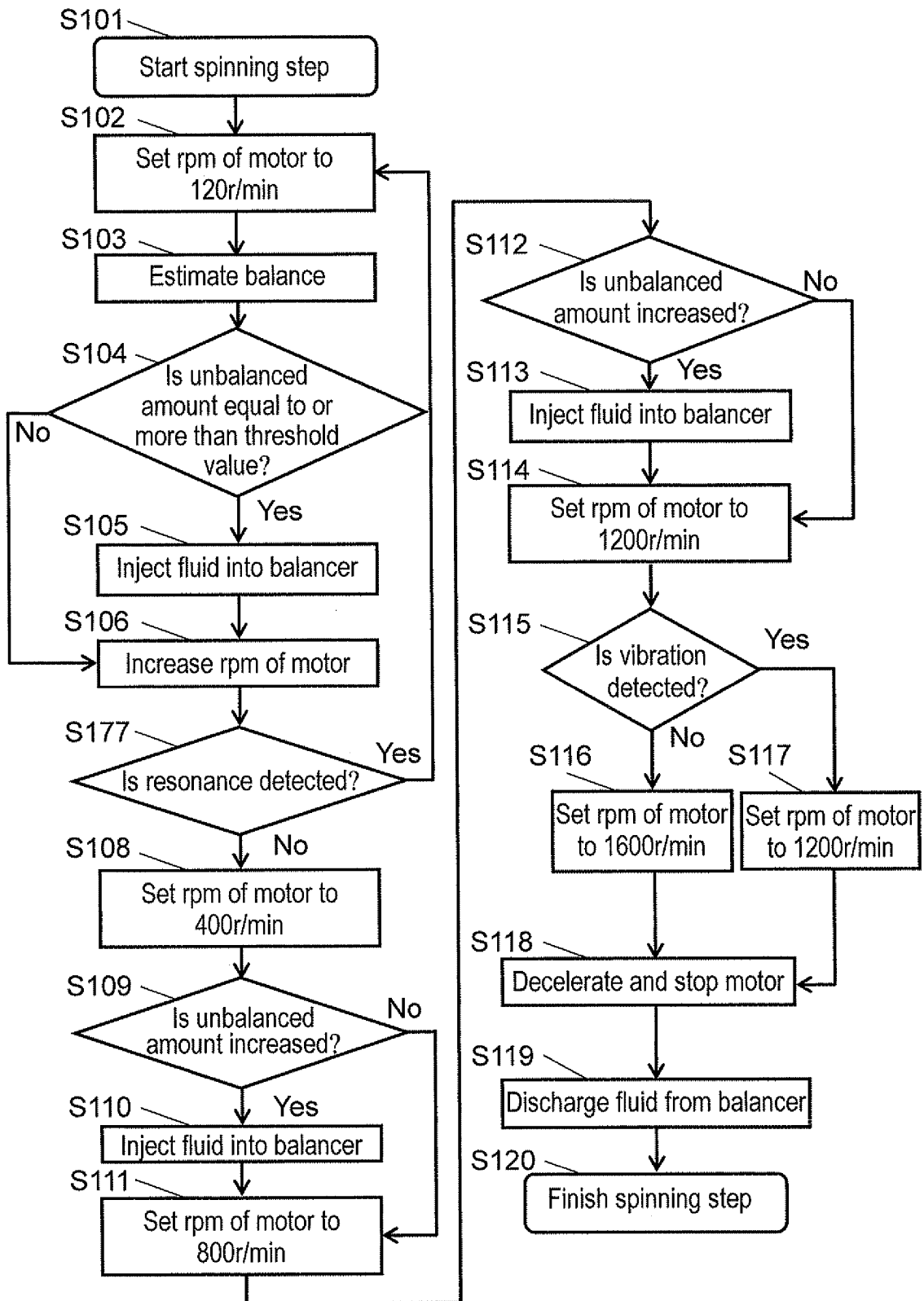


FIG. 4

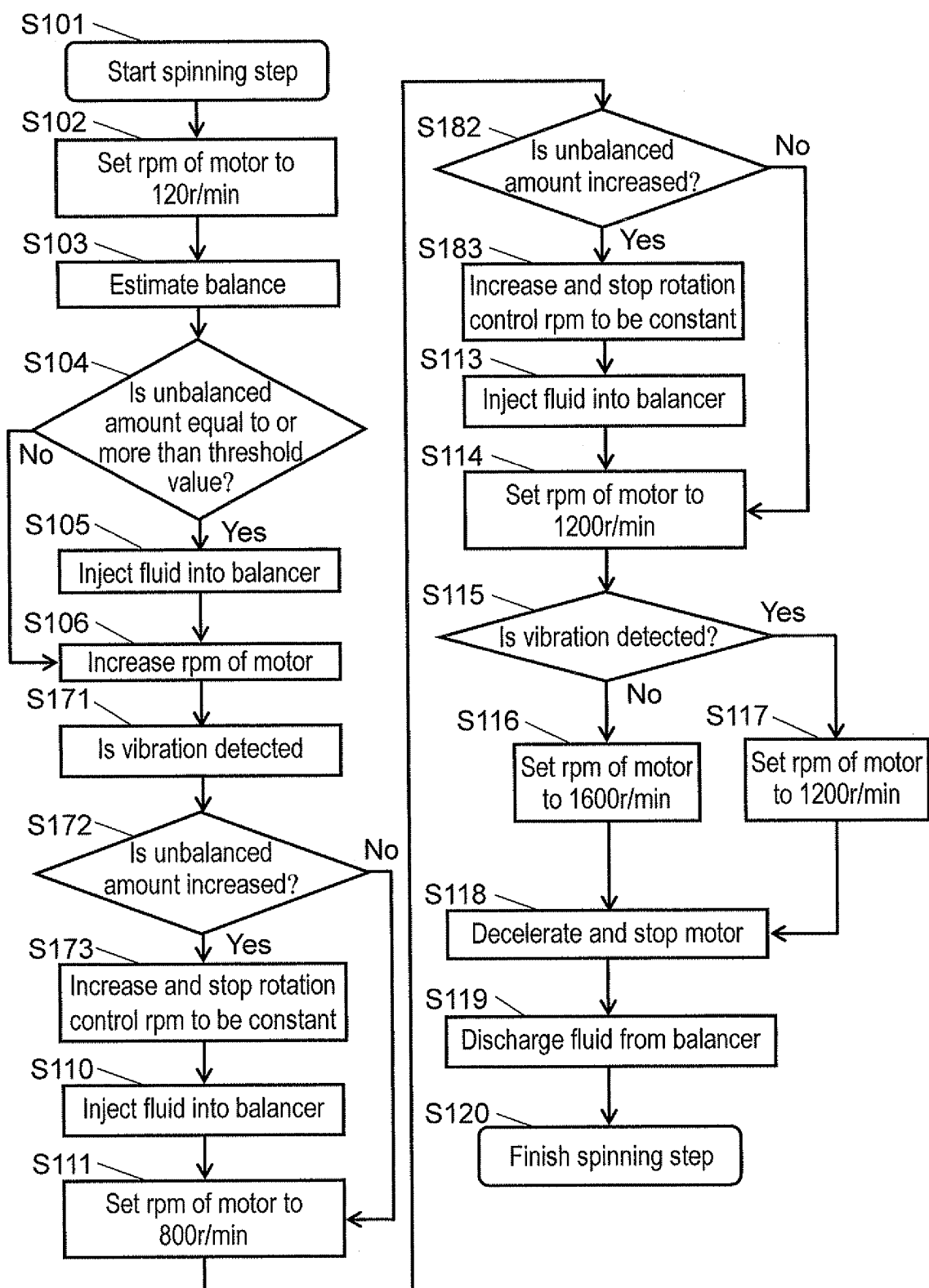


FIG. 5

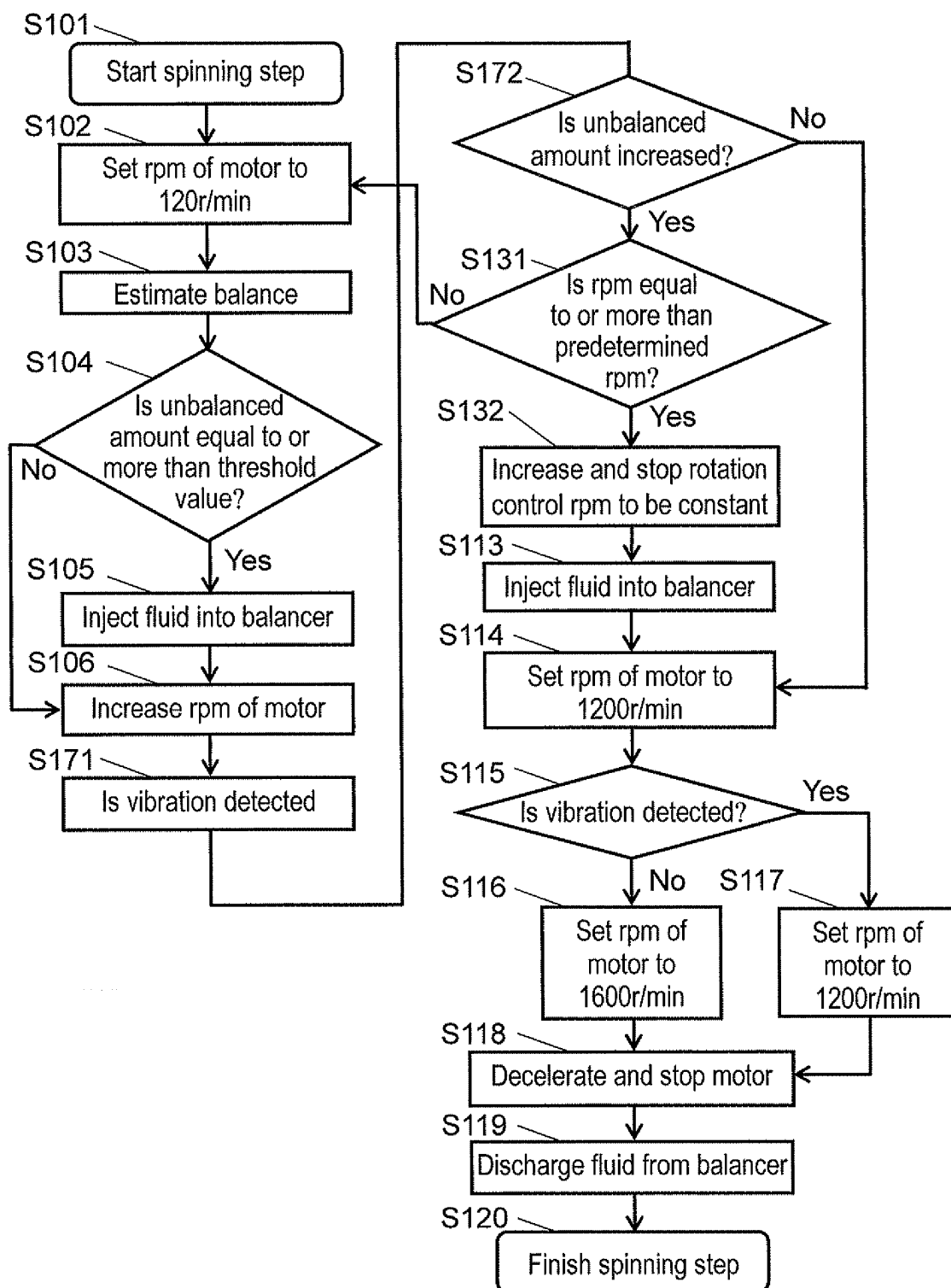


FIG. 6

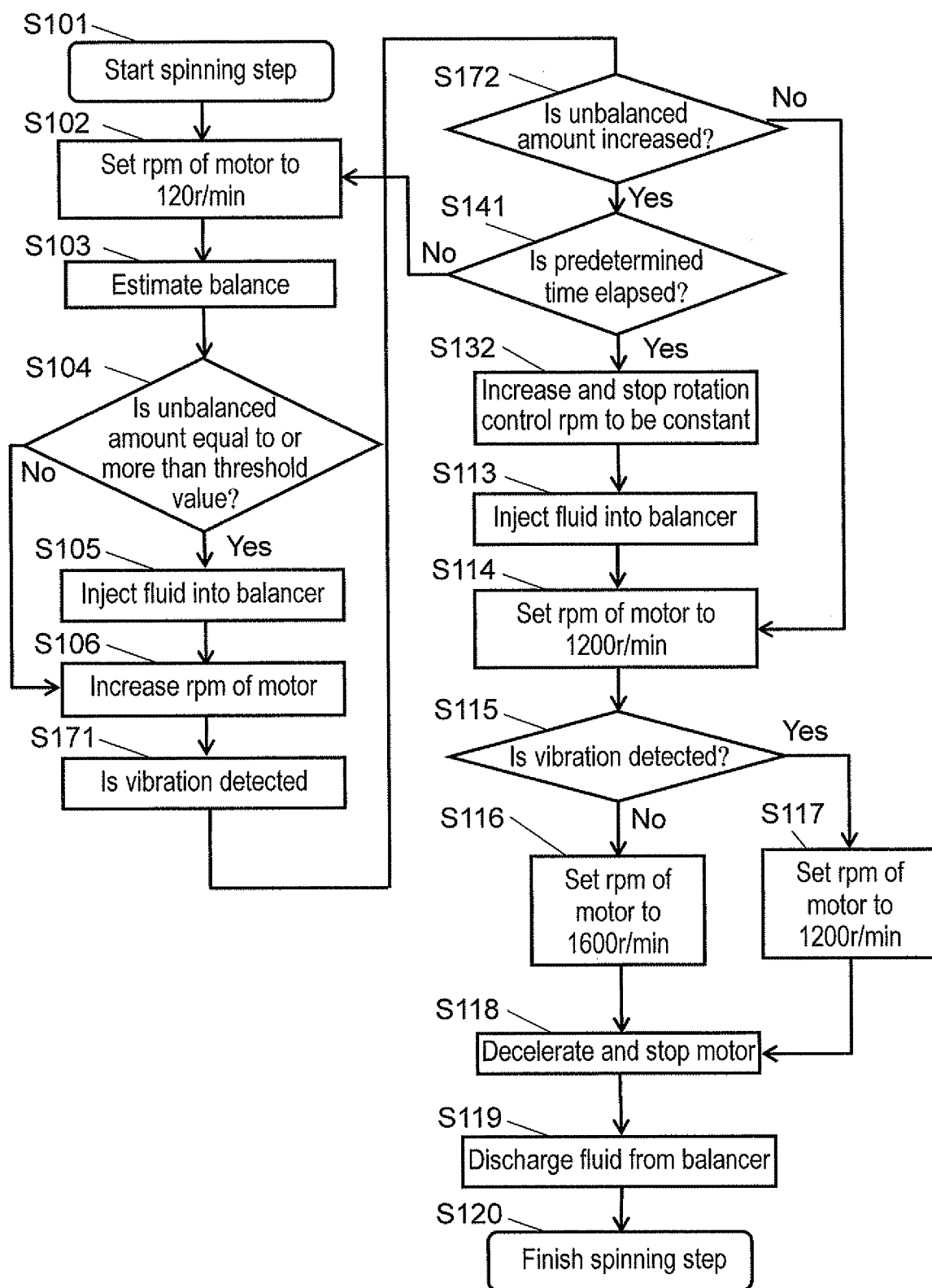


FIG. 7

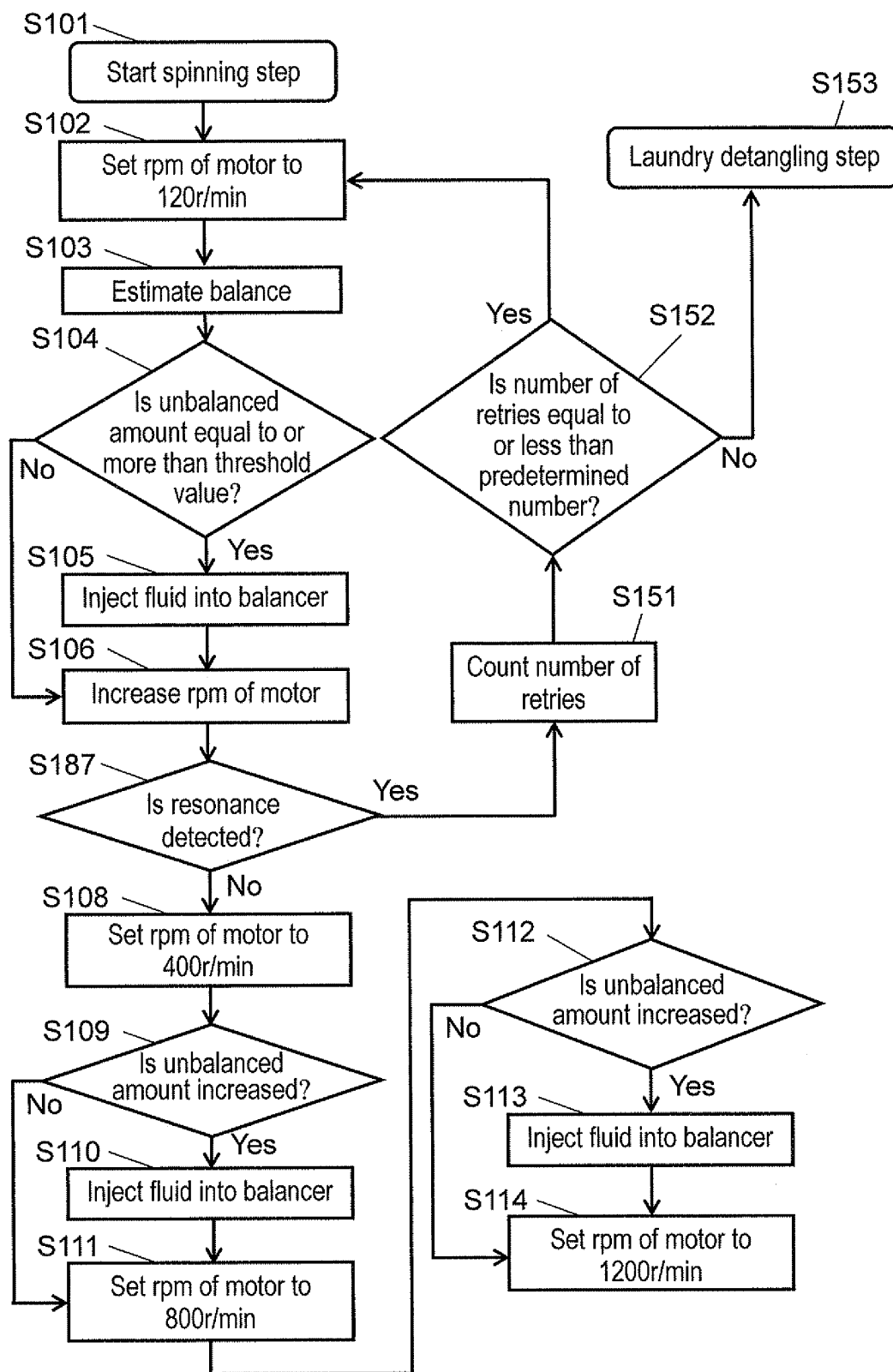
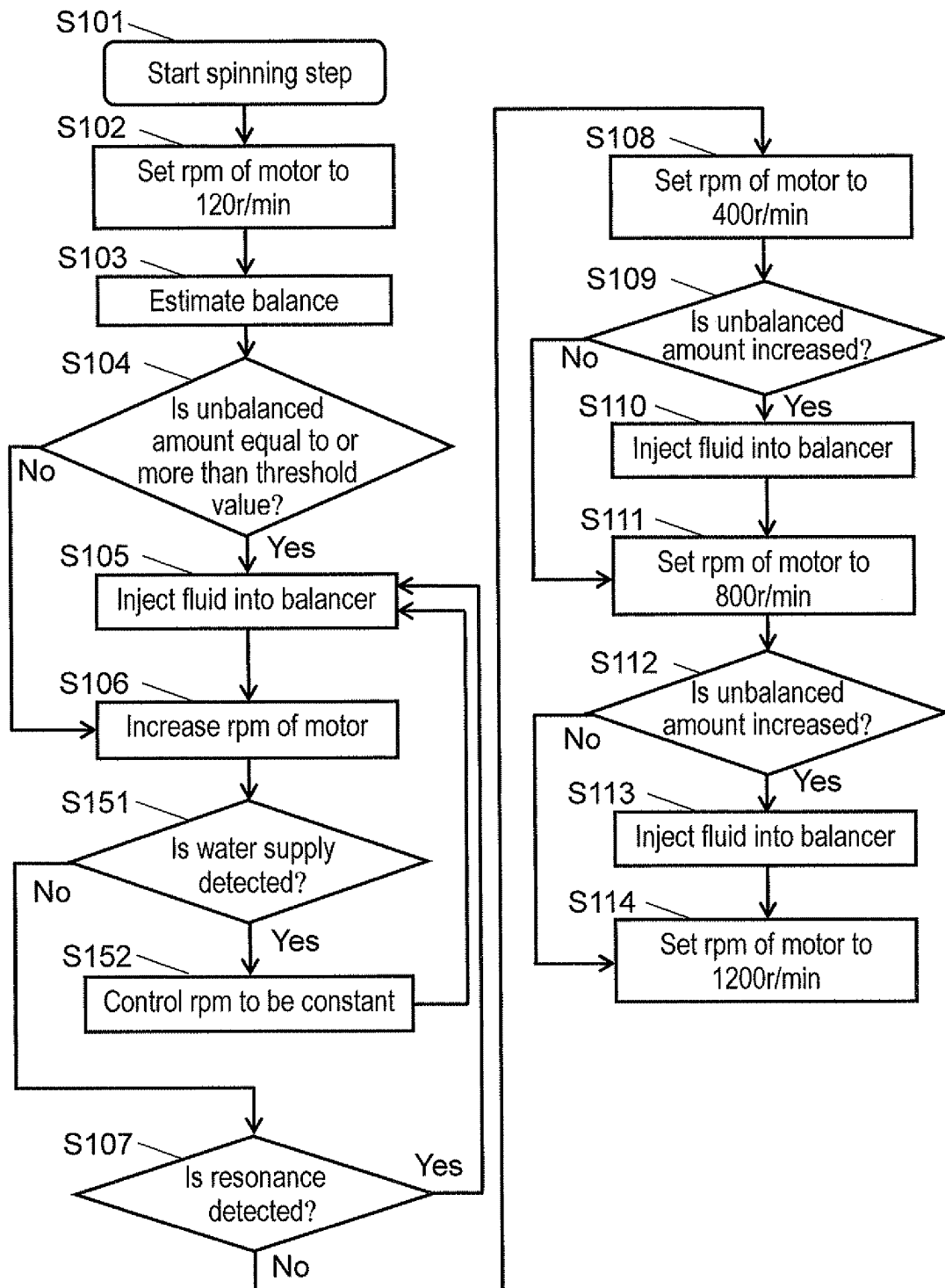


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/001582

A. CLASSIFICATION OF SUBJECT MATTER

D06F33/02 (2006.01) i, D06F37/04 (2006.01) i, D06F37/22 (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)

D06F33/02, D06F37/04, D06F37/22

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 57-84100 A (Mitsubishi Heavy Industries, Ltd.), 26 May 1982 (26.05.1982), entire text; all drawings & GB 2080836 A & GB 2138029 A & GB 2141232 A & DE 3123386 A & DE 3153272 C & IT 1139366 B	1-6
Y	JP 2002-292184 A (Sanyo Electric Co., Ltd.), 08 October 2002 (08.10.2002), entire text; all drawings (Family: none)	1-6

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

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"&" document member of the same patent family

Date of the actual completion of the international search
19 March, 2010 (19.03.10)Date of mailing of the international search report
30 March, 2010 (30.03.10)Name and mailing address of the ISA/
Japanese Patent Office

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