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WASHING MACHINE

Field of the Invention

5 The present invention relates to a washing machine for performing washing, rinsing and water-extracting processes by controlling water supply and drain in a water tub, which accommodates therein a washing and water-extracting tub and is disposed inside a housing, and by controlling the
10 rotation of the washing and water-extracting tub.

Background of the Invention

15 For example, with regard to a drum type washing machine having a washing and water-extracting tub horizontally disposed therein, an opening through which laundry is loaded into or unloaded from the washing and water-extracting tub is formed at the front portion of the washing machine's housing, and is opened or closed by a door.
20 The door is opened by pressing a push button and is locked while the washing machine is running, to thereby prevent user's hand from getting caught in the washing and water-extracting tub which is rotating and to avoid wash water or laundry from dispersing out of the tub.

25 For opening and closing of the door as in this case, an opening and closing control mechanism, which combines



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mechanical and electrical control features, is provided, and the door's opening and closing is controlled in accordance with the operational status of the drum type washing machine, namely, running or idling status. Since it is required that
5 the door be controlled in relation to control operations for running the washing machine, some of the approaches concerning the door operation have been providing a delay period until the washing and water-extracting tub comes to a complete stop or a mechanism for releasing the door locking
10 in accordance with the operational status of the washing machine.

For example, the following approach has been known that once the door is closed, the door hook would engage such that a sliding member would be moved, thereby
15 activating a switching mechanism, which then triggers a driving unit by transmitting electric current. By the operation of driving unit, the door hook would not disengage while a safeguarding mechanism would keep the sliding member locked in position. By such configuration, the door is
20 locked securely and the time it takes prior to running of the washing machine can be shortened, so that the timing when the door can be opened once the operation is completed becomes earlier (see Japanese Patent Laid-Open Application No. 1998-272293).

25 Since, however, the conventional door opening and closing mechanism involves a great deal of electric

operations so that the entire construction becomes complicated, there has been a reliability issue based on a concern that a washing machine, which works with water, would break or malfunction. Thus, there has been a need to
5 simplify the construction of the door opening and closing mechanism, which is capable of more secure opening and closing operation, for use in a washing machine without breaking down resulting from user's improper control.

10 Summary of the Invention

It is, therefore, an object of the present invention to provide a washing machine having a door opening and closing mechanism capable of controlling opening and closing
15 of the door in accordance with an operational status of the washing machine and also capable of preventing malfunctioning resulting from user's improper control.

20 In accordance with the present invention, there is provided a washing machine including a water tub disposed in a housing and a washing and water-extracting tub for accommodating laundry therein, the washing and water-

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extracting tub being installed in the water tub to be driven to rotate and the washing machine performing washing, rinsing and water-extracting processes by controlling supply and drain of water in the water tub and
5 by controlling rotation of the washing and water-extracting tub, the washing machine comprising:

a door for opening and closing an opening installed at a front portion of the housing to load and unload the laundry into or from the washing and water-extracting tub;

10 a door opening button for opening the door;

a locking member for locking the door in a closed state;

a first bias member for biasing the locking member in a locking direction;

15 a door opening and closing control member having a pivot axis and being rotatable around the pivot axis by a pressure applied on the door opening button;

a second bias member, one end thereof being coupled to the door opening and closing control member and the other end thereof being coupled to the locking member; and

a locking mechanism for locking a movement of the
5 locking member,

wherein pressing of the door opening button while the locking member is not locked by the locking mechanism leads to rotation of the door opening and closing control member but does not deform the second bias member, so that the
10 locking member releases the door from a locked state against the first bias member, whereas pressing of the door opening button while the locking member is locked by the locking mechanism leads to rotation of the door opening and closing control member and deforms the second bias member.

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Further, it is preferable to arrange that between the button and the opening and closing member, a third bias member is disposed to bias the door opening button to be pushed upwardly. Also, the door opening button is
20 configured such that a stroke resulting from pressing the

button would be longer than or equal to a predetermined distance so that a pressure would reach the door opening and closing control member, thereby providing an appropriate sensation of pressure to the door opening

button. Further, a noise generated from subtle vibration of the door opening button due to vibrations while the washing machine is operating can be eliminated.

5 Brief Description of the Drawings

10 The above and other objects and features of the present invention will become apparent from the following description of the preferred embodiment of the present invention given in conjunction with the accompanying drawings, in which:

Fig. 1 shows an exterior view of the configuration of a drum type washing machine's main components in accordance with a preferred embodiment of the present invention;

15 Fig. 2 shows a cross sectional view of the drum type washing machine's door opening and closing mechanism in accordance with the preferred embodiment of the present invention;

20 Fig. 3 shows a float view of a door opening and closing mechanism for use in the washing machine in accordance with the preferred embodiment of the present invention;

Fig. 4 shows a horizontal partial cross sectional view of a door opening button;

25 Fig. 5 shows a vertical partial cross sectional view of the door opening button;

Fig. 6 shows a float view of a locking mechanism;

Fig. 7 shows a partial float view illustrating a door opening and closing control member when it is locked in a door opened state; and

5 Fig. 8 shows a partial cross sectional view illustrating the configuration when a door is locked in a closed state.

Detailed Description of the Preferred Embodiments

10 Hereinafter, a preferred embodiment of the present invention will be described in detail with reference to a drum type washing machine having a washing and water-extracting tub slantingly disposed therein. Fig. 1 shows an exterior view of drum type washing machine 1 in accordance with a preferred embodiment of the present invention. In the upper front portion of housing 2, inclined surface 2a is formed and circular door 8 is disposed for opening and closing circular opening 12 formed at inclined surface 2a. 15 As shown in Fig. 2, disposed in housing 2 is water tub unit 10 having therein cylindrical water tub 3 with a base, in which cylindrical washing and water-extracting tub 5 with a base, which is rotated by driving motor 4, is disposed. 20 Water tub unit 10 is installed in housing 2 via a suspension system (not shown) such that the direction R of the rotating shaft of washing and water-extracting tub 5 is declined 25

toward the rear portion of housing 2 at a specific angle θ with respect to the horizontal direction H. Since by slantingly disposing water tub unit 10 in housing 2, opening 11 of water tub 3 and opening 13 of washing and water-extracting tub 5 are oriented to face inclined surface 2a. Thus, by opening door 8 disposed at inclined surface 2a, it is possible to load and unload laundry into and from washing and water-extracting tub 5. Since door 8 is disposed at inclined surface 2a, user needs to bend his/her waist only slightly to load or unload laundry into or from washing and water-extracting tub 5. Further, since it is no longer necessary to have too much clearance space in front of washing machine 1, installation of drum type washing machine 1 in a small space such as a bathroom becomes possible, and using washing machine 1 becomes more convenient.

Further, since the central portion of door 8 is formed of a transparent material, it is possible to observe the operational state during washing, rinsing and water-extracting processes without user having to bend down.

Door 8 can be opened by pressing door opening button 56 installed at inclined surface 2a. When operation of the washing machine is started after loading laundry into washing and water-extracting tub 5 and closing door 8, door 8 becomes locked in a closed state depending on which process is in progress, e.g., during a water-extracting process and washing and rinsing process with a high water

level. An opening and closing mechanism and a locking mechanism of door 8 in connection with door opening button 56 will now be described hereinafter.

Referring to Fig. 3, there is shown inclined surface 2a with its casing removed. As shown therein, door opening button 56 and locking device 59 are engaged to each other via connection spring (second bias member) 69 formed of a tensile spring. Formed at locking device 59 is latch hole 91 into which protruding latch 90 (see Fig. 1) is inserted when door 8 is closed, wherein the latch is disposed on an inner side of door 8. Latch hole 91 and door opening button 56 are exposed on inclined surface 2a.

As shown in Figs. 4 and 5, door opening button 56 is installed to pivot about rotational shaft 56a within a given rotational range. Under normal condition, compression spring (third bias member) 92 installed in door opening button 56 is pushed upward to its resting position by a spring bias from contacting with door opening and closing control member 93 coupled to connection spring 69. Therefore, when a pressure is applied, compression spring 92 is compressed and pressing protrusion 94 installed in parallel with compression spring 92 contacts door opening and closing control member 93 to turn door opening and closing control member 93 about rotational shaft 93a. As a result, a tensile force is applied to connection spring 69 of which one end is engaged to door opening and closing

control member 93. The displacement resistance of connection spring 69 is such that it is considerably greater than the displacement strength of compression spring 92 and locking spring (first bias member) 112, both of which are
5 formed of compression springs. Therefore, connection spring 69 is not displaced (or displaced minimally) by the tensile force generated by opening door 8.

As shown in Fig. 6, if connection spring 69 is pulled without displacement by turning of door opening and closing
10 control member 93, tensile pin 111 which is engaged with connection spring 69 at the other end from door opening and closing control member 93, would move against the bias of locking spring 112 to turn locking plate (locking member) 113 about supporting shaft 114. Consequently, as shown in
15 Fig. 8, protrusion 113a of locking plate 113 inserted in lock hole 90a of latch 90 which is inserted in latch hole 91 is retrieved to come out from lock hole 90a, whereby door 8 is opened by the bias of a spring (not shown). When the pressure on door opening button 56 is released, locking
20 plate 113 would turn by the bias of locking spring 112, thereby returning protrusion 113a back into latch hole 91 and retreating tensile pin 111. As a result, door opening and closing control member 93 which is pulled by connection spring 69 would turn and pressing protrusion 94 would push
25 door opening button 56 upward, so that door opening button 56 returns to its initial position by the bias of

compression spring 92.

When door 8 is closed, the sloped section at the end of protrusion 113a is pushed by the end of latch 90 inserted into latch hole 91, whereby locking plate 113 is turned
5 against the bias of locking spring 112. Since after latch 90 is completely inserted into latch hole 91, protrusion 113a is then ready to get into lock hole 90a, and locking plate 113 which is urged by the bias of locking spring 112 turns, to thereby make protrusion 113a of locking plate 113
10 get into lock hole 90a of latch 90. As a result, door 8 becomes locked in a closed state.

Once an operation of drum type washing machine 1, for example, washing or rinsing, is started, the water level in washing and water-extracting tub 5 is detected by a water
15 level detector (not shown) for detecting the water level in washing and water-extracting tub 5. If the water is at a level high enough to cause water dispersion when door 8 is opened, solenoid (locking mechanism) 115, installed in locking device 59, is turned on and off once in sequence by
20 a controller (not shown). As shown in Fig. 7, lock plate (locking mechanism) 116 is temporarily retreated and then is advanced by biasing of lock spring (locking mechanism) 117 when solenoid 115 is turned off at which state lock
25 protrusion 116a at the end of lock plate 116 is brought into contact with a lateral side of locking plate 113, thereby preventing the turning of locking plate 113. In such a

locked state, door 8 cannot be opened by pressing door opening button 56. Further, once the water-extracting process is started, door 8 is also locked closed. Therefore, it is possible to eliminate the risk of getting user's hand caught in washing and water-extracting tub 5 spinning at a high speed during, for example, the water-extracting process. Further, the problem of water dispersion as a result of opening door 8 can be avoided.

Further, when door 8 is opened by pressing door opening button 56 while drum type washing machine 1 is running under certain conditions, for example, if washing or rinsing is in progress at a water level without possible water dispersion, micro switch (lock-release status detector) 118 is activated by the rotation of locking plate 113 to detect the open status of door 8, and the output based on the detected status is transmitted to the controller of drum type washing machine 1, so that washing and water-extracting tub 5 is controlled to come to a stop.

In the above configuration, when door opening button 56 is not pressed, door opening and closing control member 93 is biased by locking spring 112 via connection spring 69, and door opening button 56 is biased to its upper limit position by compression spring 92, so that its vibration and resulting noise can be prevented and an appropriate sensation of pressure is provided in door opening button 56. Further, noise generated from subtle vibrations of door

opening button 56 or door opening and closing control member 93 caused by the vibration of drum type washing machine 1 can also be eliminated while the washing machine is running.

Further, the tensile displacement strength of connection spring 69 is considerably greater than the compression displacement strength of compression spring 92 and locking spring 112. Therefore, connection spring 69 only slightly deformed (stretched) due to the pull exerted by turning of door opening and closing control member 93 when door opening button 56 is pressed. Accordingly, the tensile force is transmitted to tensile pin 111 thereby compressing locking spring 112, while transmitting the tensile force of connection spring 69 to locking plate 113 as well. Therefore, a major portion of stroke that has been applied to press door opening button 56 is effectively transmitted to locking plate 113.

Further, for example, during the water-extracting process, when door opening button 56 is pressed to forcibly open door 8 in a locked state, i.e., at the state where locking plate 113 is locked by lock plate 116, connection spring 69 receives and absorbs most of the considerable tensile force and gets displaced (deformed) while preventing the excessive force from being transmitted to locking plate 113 in the locked state and door opening and closing control member 93. Accordingly, as connection spring 69 having a strong displacement resistance is forcibly displaced, user

who presses door opening button 56 would perceive the sensation of improperly controlling door opening button 56, thereby preventing damaging of door opening and closing control member 93 and locking plate 113 due to application of excessive pressure.

Although the preferred embodiment has been described with reference to drum type washing machine 1 configured to slantingly dispose washing and water-extracting tub 5 in housing 2 with door 8 installed on inclined surface 2a of housing 2, the above-described opening and closing mechanism of door 8 can also be applied to a conventional type washing machine having a horizontal washing and water-extracting tub wherein a door is installed at the vertical face of a housing.

Further, the opening and closing mechanism of door 8 can also be applied to a drum type washing and drying machine having added a drying function to drum type washing machine 1 in accordance with the preferred embodiment of the present invention, wherein during the drying process, door 8 can be opened to take out laundry. In order to enable opening of door 8 during the drying process, it is controlled such that locking of locking plate 113 by solenoid 115 does not take place. Further, when door 8 is opened, the rotation of washing and water-extracting tub 5 is controlled to come to a stop by detecting the open status of door 8 by means of micro switch 118, to thereby prevent

door 8 from being opened while washing and water-extracting tub 5 is rotating.

In addition, the above-described door opening and closing mechanism can also be applied to an automatic washing machine or a washing and drying machine, both of which have a pulsator in the lower portion of their washing and water-extracting tub and a door disposed at the top surface.

In accordance with the present invention described heretofore, the door is locked or unlocked depending on the operational state of the washing machine. Further, it is also possible to regulate the operation of the washing machine based on the open or closed status of the door. The present invention is enabled to eliminate the problem of user's hand from getting caught in the washing machine while it is running, and to avoid water or laundry from dispersing out of the washing and water-extracting tub while it is rotating.

Further, since a pressure applied on the door opening button is transmitted to a locking member via the second bias member having a strong displacement resistance, its operation movement is smoothly transmitted to the locking member without displacing the second bias member when the door is opened; and excessively applied pressure on the door opening button is absorbed by the second bias member when the locking member is in a locked state.

While the invention has been shown and described with respect to the preferred embodiment, it will be understood by those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the following claims.

What is claimed is:

1. A washing machine including a water tub disposed in a housing and a washing and water-extracting tub for
5 accommodating laundry therein, the washing and water-extracting tub being installed in the water tub to be driven to rotate and the washing machine performing washing, rinsing and water-extracting processes by controlling supply and drain of water in the water tub and
10 by controlling rotation of the washing and water-extracting tub, the washing machine comprising:

a door for opening and closing an opening installed at a front portion of the housing to load and unload the laundry into or from the washing and water-extracting tub;

15 a door opening button for opening the door;

a locking member for locking the door in a closed state;

a first bias member for biasing the locking member in a locking direction;

20 a door opening and closing control member having a pivot axis and being rotatable around the pivot axis by a pressure applied on the door opening button;

a second bias member, one end thereof being coupled to the door opening and closing control member and the other end thereof being coupled to the locking member; and

a locking mechanism for locking a movement of the
5 locking member,

wherein pressing of the door opening button while the locking member is not locked by the locking mechanism leads to rotation of the door opening and closing control member but does not deform the second bias member, so that the
10 locking member releases the door from a locked state against the first bias member, whereas pressing of the door opening button while the locking member is locked by the locking mechanism leads to rotation of the door opening and closing control member and deforms the second bias member.

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2. The washing machine of claim 1, wherein a third bias member is disposed between the door opening button and the door opening and closing control member, wherein the third bias member serves to bias the door opening button to be
20 pushed upwardly.