

DRUM TYPE WASHING MACHINE

Field of the Invention

5 The present invention relates to a drum type washing machine; and more particularly, to a door of the drum type washing machine configured to prevent laundry from inadvertently straying out of a housing of the washing machine.

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Background of the Invention

Conventionally, a door is installed at a housing of a drum type washing machine to prevent laundry, detergent, and
15 the like from inadvertently straying out of the housing (see, for example, Japanese Patent Laid-open Application No. 2004-8683).

Fig. 6 provides a cross sectional view of major components of a door of a conventional drum type washing
20 machine. As shown in the figure, housing 101 of the washing machine has rotary drum 102 and water tub 103 therein. Rotary drum 102 accommodates laundry therein and is rotatably installed in water tub 103. Also, opening 104 through which laundry is loaded into or unloaded from the
25 washing machine is provided at a front surface of housing 101, and door 105 is installed at a front portion of housing

101 to open or close opening 104 by means of rotational shaft portion 106 and joint member 107.

Door 105 has door main body 108 formed of polypropylene and provided with an opening at its approximately central portion; door rear plate 109 formed of polypropylene and also provided with an opening at its approximately central portion; and transparent window 110 formed of glass and provided at the openings of door main body 108 and door rear plate 109. Transparent window 110 is interposed between door main body 108 and door rear plate 109 to be jointly supported by them. Due to the presence of transparent window 110, laundry loaded into rotary drum 102 can be prevented from inadvertently straying out of rotary drum 102. Meanwhile, the opening of door main body 108 is almost entirely closed with door cover 111, wherein door cover 111 is formed of transparent ABS (Acrylonitrile Butadiene Styrene). Thus, the movement of the laundry in rotary drum 102 can be viewed from outside through door cover 111 and transparent window 110.

Further, door main body 108 interposes and supports glass-made transparent window 110 together with door rear plate 109, and door main body 108 is formed of polypropylene as described above. The door main body 108 thus formed, however, would have an uneven surface and a poor gloss, and hence a coating is provided on the surface to improve its appearance.

Door main body 108 and door cover 111 are provided with hook receiving portions 108a and hooks 111a, respectively. By engaging hook receiving portions 108a with hooks 111a, door cover 111 is fixed to door main body 108.
5 Also, joint member 107 is secured to fastening boss 108b by using screw 112.

Below, an operation of the drum type washing machine having the above-described configuration will be explained. After loading laundry into rotary drum 102 and adding water and detergent thereto, rotary drum 102 is rotated by a motor
10 (not shown). At this time, detergent dispersed by the rotation of the laundry clings to transparent window 110, and the detergent clinging to transparent window 110 may adhere to door main body 108 and door rear plate 109 as well
15 when loading/unloading of laundry is performed. Thus, to prevent door main body 108 and door rear plate 109 from being damaged by detergent or other chemicals, they are made of such a resin material as polypropylene having high resistance to chemicals.

20 Moreover, since loads of door main body 108 and transparent window 110 of a certain weight are concentrated on fastening boss 108b for tightly holding joint member 107 in place, fastening boss 108b is formed to have a large diameter in order not to be damaged and broken. Further, to
25 prevent door cover 111 from vibrating and making noises during a wash and a water-extraction cycle, hook receiving

portions 108a and hooks 111a are insertion fitted to each other so that a stress is applied thereto all the time. Also, to prevent weighty transparent window 110 from vibrating and making noises during the wash and the water-extraction cycle, the spacing between door main body 108 and door rear plate 109 is set to be smaller than the thickness of an attachment portion of transparent window 110. Accordingly, since a stress is always imposed on door rear plate 109 and detergent easily clings thereto, door rear plate 109 is made of polypropylene having elasticity and high resistance to chemicals.

However, with regard to the conventional drum type washing machine as described above, since door main body 108 is made of polypropylene having high resistance to chemicals and great mechanical strength, a poor appearance may be caused by an uneven surface formed at a surface opposite to fastening boss 108b, poor gloss of polypropylene itself or a surface scratching. Although, for example, the surface of door main body 108 is coated to ameliorate the poor appearance, it is difficult to obtain a chemical change on the surface of door main body 108 and a desired coating adhesiveness. To improve the coating adhesiveness, it is necessary to damage the surface of door main body 108 by using a chemical or the like, and to cause the damage, door main body 108 needs to be formed of a material having a low resistance to chemicals. However, if resistance to

chemicals is low, door main body 108 may be easily damaged by detergent and so forth. Thus, it has been difficult to select an optimum material for door main body 108.

Further, given that a stress is imposed on door main
5 body 108 in the configuration where door cover 111 is fixed
to door main body 108 by engaging hook receiving portions
108a with hooks 111a, if door main body 108 is formed of the
material having the low resistance to chemicals, it may
easily be damaged by creep. Likewise, to prevent a damage
10 of fastening boss 108b which receives the loads of door main
body 108 and transparent window 110, the material for
forming door main body 108 also needs to have a certain
level of mechanical strength. However, it has been
difficult to find a material that satisfies all of those
15 properties including high resistance to chemicals, high
coating adhesiveness, high resistance to creep and high
mechanical strength.

Also, door cover 111 is configured to be transparent
to enable the observation of laundry movement in the rotary
20 drum from outside. However, if door cover 111 is
transparent, hooks 111a are directly viewed from the front
of door cover 111, hindering improvement of the washing
machine appearance. Further, given that almost entire body
of door cover 111 is exposed to outside and that if it is
25 made of a recyclable material to keep up with the recent
trend of recycling, requiring its material constituents to

be inscribed thereon, it would spoil the appearance thereof.

Further, since transparent window 110 is interposed between door rear plate 109 and door main body 108 to be jointly supported by them, the spacing between door main
5 body 108 and door rear plate 109 should be smaller than the thickness of the attachment portion of transparent window 110 at the periphery thereof to increase interference, thereby allowing a secure installation of transparent window 110. However, as interference increases, it is likely that
10 a gap is formed between the peripheries of door main body 108 and door rear plate 109, thus hampering the appearance. In addition, if the gap exists, foreign materials such as detergent and water would easily enter the inside of door 105, causing degradation or rust generation of internal
15 components of the door. Moreover, if the interference is great, the stress imposed on door main body 108 and door rear plate 109 gets greater as well. Therefore, it has been difficult to select an optimum material for fabricating the door of the washing machine which will satisfy the
20 requirements stated hereinabove.

Summary of the Invention

It is, therefore, an object of the present invention
25 to provide a drum type washing machine having a simple door structure featuring a high resistance to chemicals and a

great mechanical strength, while improving the appearance of the washing machine.

In accordance with the present invention, there is provided a drum type washing machine including: a rotary
5 drum for containing laundry therein, the rotary drum being driven to rotate; a water tub accommodating the rotary drum therein; a washing machine housing, accommodating the water tub therein, provided with an opening for loading the laundry into the rotary drum; and a door pivotally supported
10 on the washing machine housing and adapted to open and close the opening, wherein the door has a door main body provided with a first opening at an approximately central portion thereof, the first opening extending from the outside of the washing machine housing toward the inside of the rotary
15 drum; a door rear plate provided with a second opening at an approximately central portion thereof, the second opening extending from the outside of the washing machine housing toward the inside of the rotary drum, the shape of the second opening being substantially identical to that of the
20 first opening and the shape of the periphery of the door rear plate being substantially identical to that of the door main body; a veneer provided with a third opening at an approximately central portion thereof, the third opening extending from the outside of the washing machine housing
25 toward the inside of the rotary drum, the shape of the periphery of the veneer being substantially identical to

that of the door main body; a door cover covering the first and the third opening; and a transparent window provided at a rotary drum side of the first opening of the door main body, wherein a circumferential portion of the transparent window is interposed between an inner peripheral portion of the door main body around the first opening and an inner peripheral portion of the door rear plate around the second opening; and a circumferential portion of the door cover is interposed between the inner peripheral portion of the door main body around the first opening and an inner peripheral portion of the veneer around the third opening.

Brief Description of the Drawings

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

Fig. 1 sets forth a perspective view showing an external configuration of a drum type washing machine in accordance with a first preferred embodiment of the present invention;

Fig. 2 provides a cross sectional view illustrating major components near a door of the drum type washing machine in Fig. 1;

Fig. 3 presents a cross sectional view illustrating

major components of the door of the drum type washing machine in Fig. 1;

Fig. 4 offers a cross sectional view illustrating major components near a door of a drum type washing machine in accordance with a second preferred embodiment of the present invention;

Fig. 5 depicts a cross sectional view illustrating major components of the door of the washing machine in Fig. 1; and

Fig. 6 shows a cross sectional view illustrating major components of a conventional drum type washing machine.

Detailed Description of the Preferred Embodiments

Hereinafter, preferred embodiments of the present invention will be described with reference to the accompanying drawings. It is to be noted that the present invention is not limited thereto.

(First preferred embodiment)

Fig. 1 is a perspective view showing an external configuration of a drum type washing machine in accordance with a first preferred embodiment of the present invention; Fig. 2 sets forth a cross sectional view showing major components near a door of the washing machine; and Fig. 3 presents a cross sectional view showing major components of

the door.

As shown in Fig. 1, washing machine housing 1 has upwardly inclined surface 1a formed at an upper front surface portion thereof, and circular opening 2 through which laundry is to be loaded into or unloaded from washing machine housing 1 is provided at inclined surface 1a. Further, door 3 covering opening 2 is installed at inclined surface 1a of washing machine housing 1.

Referring to Fig. 2, water tub 4 for collecting wash water therein is installed in washing machine housing 1 such that it can rock back and forth. Also, rotary drum 5 for accommodating laundry therein is rotatably installed in water tub 4. Rotary drum 5 is driven to rotate by a motor (not shown), whereby the laundry in rotary drum 5 gets also rotated and is therefore washed.

Door 3 is connected to flat portion 7a of joint member 7 which is pivotally supported on rotation shaft 6 disposed at washing machine housing 1, so that door 3 is allowed to swing to open and close opening 2. Door 3 has door main body 8 made of polypropylene; door rear plate 9 made of polypropylene having a high resistance to chemicals; transparent window 10 made of glass; door cover 11 made of transparent ABS (Acrylonitrile Butadiene Styrene); and veneer 12 made of ABS having a resistance to chemicals.

Door main body 8 is of an approximately ring shape, and first opening 8b is provided at an approximately central

portion of door main body 8 by providing inner wall 8a configured to be in an upright position, protruding toward the inside of rotary drum 5 from the outside of washing machine housing 1. Also, door rear plate 9 is of an approximately ring shape as well and is disposed inside door main body 8. Second opening 9a conforming to first opening 8b is provided at an approximately central portion of door rear plate 9, and door rear plate 9 also has outer wall 9b at its circumferential periphery, which is in an upright position protruding toward the outside of washing machine housing 1 from the inside of rotary drum 5.

Transparent window 10 made of glass or the like is installed at first and second opening 8b and 9a. Transparent window 10 has an approximately concave shape, and, particularly, it is concaved toward rotary drum 5. Further, flange 10a protruding in a radial direction of transparent window 10 is formed at the peripheral end portion of transparent window 10 along the entire circumference thereof. Flange 10a is interposed between and supported by a leading end of inner wall 8a of door main body 8 and an inner peripheral surface of door rear plate 9. Boss 8d having hole portion 8c at its leading end portion is installed at the inner surface of door main body 8 in an upright position. Further, door rear plate 9 is provided with through hole 9c at a position corresponding to boss 8d. Door main body 8 and door rear plate 9 are connected to each

other by fastening screw 13 into hole portion 8c of boss 8d via through hole 9c while flange 10a of transparent window 10 is interposed therebetween and is supported thereby. Also, large circular hole 8i is formed on the outer surface of door main body 8 at a position corresponding to boss 8d.

Inner peripheral stepped portion 8e is formed on a basal side of inner wall 8a of door main body 8 facing the outside of washing machine housing 1, wherein inner peripheral stepped portion 8e is stepped down toward the outer surface of washing machine housing 1. Door cover flange 11a is formed on the outer periphery of door cover 11 to be lower than the surface of door cover 11, and door cover flange 11a is accommodated in inner peripheral stepped portion 8e. Veneer 12 is provided with third opening 12a substantially conforming to first opening 8b of door main body 8 is attached at door main body 8's side facing the outside of washing machine housing 1. While door cover flange 11a is received in inner peripheral stepped portion 8e, the inner surface of the inner periphery of third opening 12a of veneer 12 encloses door cover flange 11a from outside, thereby interposing and supporting door cover 11.

Referring to Fig. 3, veneer 12 has outer peripheral wall 12b protruding toward door rear plate 9, outer peripheral wall 12b being formed on the outer periphery of veneer 12. Further, outer peripheral stepped portion 9d provided with a downward step to correspond to outer

peripheral wall 12b of veneer 12 is formed on a leading end portion of outer wall 9b of door rear plate 9. Outer peripheral wall 12b is provided with hitching hooks 12c inwardly formed at plural locations on its inner surface. Also, outer peripheral stepped portion 9d is provided with engagement recesses 9e formed on its outer surface to correspond to hitching hooks 12c. By fitting hitching hooks 12c in engagement recesses 9e, veneer 12 is allowed to be fixed on the surface of door main body 8. For example, twelve pairs of hitching hooks 12c and engagement recesses 9e are provided at a pitch of 30 degrees.

Boss 8g is formed on door main body 8's inner surface corresponding to flat portion 7a of joint member 7 such that it stands upright. Boss 8g has hole portion 8f at its leading end. Door rear plate 9 has attachment portion 9f provided with a step downward to correspond to flat portion 7a of joint member 7. Further, through holes 7b and 9g are formed at flat portion 7a of joint member 7 and attachment portion 9f of door rear plate 9, respectively, to correspond to hole portion 8f of boss 8g. Regarding door main body 8, door rear plate 9 and flat portion 7a of joint member 7, door 3 and joint member 7 are connected and fixed to each other by fastening screw 14 into hole portion 8f of boss 8g via through holes 7b and 9g. Further, large circular hole 8h is formed on the outer surface of door main body 8 at a position corresponding to boss 8g.

Moreover, recess 1b is formed in inclined surface 1a of washing machine housing 1 such that door 3 is received in recess 1b. Formed at recess 1b's lower surface 1c serving as a bottom thereof are opening 2 and slit hole 1d through which joint member 7 is to be inserted.

Further, to keep up with the recent trend for recycling, materials used in forming the washing machine are inscribed on door cover flange 11a. When door 3 is assembled, door cover flange 11a is covered by veneer 12 and cannot be viewed from outside.

As for bosses 8d, for example, six bosses are arranged along the entire circumference of door main body 8 at a regular interval at locations not interfering with hitching hooks 12c and engagement recesses 9e.

Further, spacing g1 between the leading end of inner wall 8a of door main body 8 and the inner surface of the inner periphery of second opening 9a is set to be smaller than thickness g2 of flange 10a of transparent window 10, thereby increasing the interference. For example, by setting spacing g1 as 5 mm and thickness g2 as 5.5 mm, interference is set to be 0.5 mm. By configuring so, transparent window 10 can be prevented from vibrating.

In accordance with the first preferred embodiment of the present invention configured as described above, veneer 12 is not required to support weighty components, meaning that when selecting a material for veneer 12, creep strength

and mechanical strength need not be considered, making it possible to use, as a material for veneer, a material, e.g., ABS, of high coating adhesiveness, good surface finishing or a material of high coating adhesiveness strength, and so forth. Therefore, a selection of an appropriate material for the veneer gets easier, which ultimately contributes to the improvement of the appearance of the washing machine

Further, since transparent door cover 11 is interposed between door main body 8 and veneer 12, high resistance to creep is not required. Thus, it gets easier to select an optimum material for door cover 11, capable of improving its appearance. In addition, since it is not necessary to provide hitching hooks 12c and the like at transparent door cover 11, the appearance viewed from the front of door cover 11 can be improved. Also, though the name of materials are inscribed on the peripheral portion of door cover 11, they can be hidden from view, for the periphery of door cover 11 is hidden by veneer 12.

Also, since the surface of door main body 8 is not viewed from outside by being hidden by veneer 12, the possibility of its surface becoming uneven need not be considered when forming it. Thus, the material for door main body 8 can be selected only focusing on resistance to chemicals, resistance to creep and mechanical strength.

Further, although transparent window 10 gets firmly fixed by increasing interference during installation thereof,

door main body 8 and door rear plate 9 may suffer from elastic deformation. However, even in such a case, it is extremely difficult for a gap to form between veneer 12 and the leading end of outer wall 9b of door rear plate 9 because hitching hooks 12c provided on the outer periphery of veneer 12 are locked in engagement recesses 9e of door rear plate 9. Therefore, there is no likelihood that the appearance of the washing machine may get detrimentally affected. Moreover, since foreign substance such as detergent and water is prevented from entering the inside of door 3, degradation of internal components of the door or rust on its metal components can be prevented.

Also, due to the configuration of the drum type washing machine in which detergent dispenser 15 is disposed above door 3, it is easy for detergent to get spattered on door 3. However, by providing door main body 8 and door rear plate 9 made of, e.g., polypropylene having high resistance to chemicals, high resistance to creep and high mechanical strength, and veneer 12 formed of a material having aesthetic appearance, it is possible to obtain a drum type washing machine having a aesthetic appearance,

(Second preferred embodiment)

Fig. 4 is a cross sectional view showing major components near a door of a drum type washing machine in accordance with a second preferred embodiment of the present

invention; and Fig. 5 sets forth a cross sectional view showing major components of the door. Here, parts identical to those described in the first preferred embodiment will be assigned same reference numerals, and description thereof will be omitted.

In Figs. 4 and 5, outer peripheral wall 12d is formed at the circumferential periphery of veneer 12. Hitching hooks 12e are installed at plural locations on the inner surface of outer peripheral wall 12d. By engaging hitching hooks 12e on the backside of outer peripheral portion 8j of door main body 8, veneer 12 gets fixed to the surface of door main body 8. For example, twelve pairs of hitching hooks 12e are provided at a pitch of 30 degrees.

Outer wall 9h of door rear plate 9 is provided with outer peripheral stepped portion 9i at its inner side, wherein outer peripheral stepped portion 9i is provided with a step to correspond to outer peripheral wall 12d of veneer 12. In this configuration, outer peripheral wall 9j of outer peripheral stepped portion 9i encloses outer peripheral wall 12d of veneer 12 from outside thereof. Further, the leading end of outer peripheral wall 9j is configured to contact outer peripheral wall 12d of veneer 12 and the backside of outer periphery 12f.

When manufacturing the drum type washing machine having the above configuration, door main body 8, door cover 11 and veneer 12 are first assembled as a single unit by

fitting door cover flange 11a in inner peripheral stepped portion 8e of door main body 8; attaching veneer 12 thereto from the surface side of door main body 8; and engaging hitching hooks 12e on the inner surface of outer peripheral wall 12d with the backside of outer peripheral portion 8j of door main body 8. Then, flange 10a of transparent window 10 is placed on the leading end portion of inner wall 8a of door main body 8, which is assembled with door cover 11 and veneer 12 as a single unit, and by fastening screw 13 into door rear plate 9, transparent window 10 is attached to the assembly of door main body 8, door cover 11 and veneer 12.

As described, since door main body 8, door cover 11 and veneer 12 can be assembled as a single unit to serve as door 3 jointly, productivity can be improved.

Furthermore, since outer peripheral wall 9j of outer peripheral stepped portion 9i is configured to enclose outer peripheral wall 12b of veneer 12, disengagement of hitching hooks 12e from the backside of outer peripheral portion 8j of door main body 8 can be suppressed, thus improving product quality.

Moreover, since the leading end of outer peripheral wall 9j is configured to contact outer peripheral wall 12d and outer periphery 12f of veneer 12, the leading end of outer peripheral wall 9j gets hidden by the outer periphery of veneer 12 and thus cannot be viewed from the outside of washing machine housing 1. Therefore, the appearance of

door 3 can be improved.

In addition, although door main body 8, door rear plate 9, transparent window 10, door cover 11 and veneer 12 have ring or disk shapes in the first and the second preferred embodiment, they can have polygonal (e.g., rectangular) shapes.

The drum type washing machine in accordance with the present invention as described above employs a door structure featuring high resistance to chemicals and high mechanical strength without detrimentally affecting the appearance of the washing machine, while it is capable of improving the appearance of the washing machine. Therefore, the present invention can be applied to various devices which require an aesthetic door having high resistance to chemicals and high strength.

While the invention has been shown and described with respect to the preferred embodiments, 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 drum type washing machine comprising:

5 a rotary drum for containing laundry therein, the rotary drum being driven to rotate;

a water tub accommodating the rotary drum therein;

a washing machine housing, accommodating the water tub therein, provided with an opening for loading the laundry into the rotary drum; and

10 a door pivotally supported on the washing machine housing and adapted to open and close the opening,

wherein the door includes:

15 a door main body provided with a first opening at an approximately central portion thereof, the first opening extending from the outside of the washing machine housing toward the inside of the rotary drum;

20 a door rear plate provided with a second opening at an approximately central portion thereof, the second opening extending from the outside of the washing machine housing toward the inside of the rotary drum, the shape of the second opening being substantially identical to that of the first opening and the shape of the periphery of the door rear plate being substantially identical to that of the door main body;

25 a veneer provided with a third opening at an

approximately central portion thereof, the third opening extending from the outside of the washing machine housing toward the inside of the rotary drum, the shape of the periphery of the veneer being substantially identical to that of the door main body;

5 a door cover covering the first and the third opening; and

a transparent window provided at a rotary drum side of the first opening of the door main body,

10 wherein a circumferential portion of the transparent window is interposed between an inner peripheral portion of the door main body around the first opening and an inner peripheral portion of the door rear plate around the second opening; and a
15 circumferential portion of the door cover is interposed between the inner peripheral portion of the door main body around the first opening and an inner peripheral portion of the veneer around the third opening.

20 2. The washing machine of claim 1, wherein the transparent window is formed of glass.

3. The washing machine of claim 1 or 2, wherein one or
25 more backwardly protruding hitching hooks are provided at an outer peripheral portion of the veneer, and the hitching

hooks are engaged with one or more engagement recesses provided on an outer peripheral portion of the door rear plate.

- 5 4. The washing machine of claim 1 or 2, wherein one or more backwardly protruding hitching hooks are provided at an outer peripheral portion of the veneer, and the hitching hooks are engaged with a backside of an outer peripheral portion of the door main body.

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5. The washing machine of claim 4, wherein a rear surface of the outer peripheral portion of the veneer is covered by an outer peripheral portion of the door rear plate, while the hitching hooks are engaged with the backside of the
- 15 outer periphery of the door main body.