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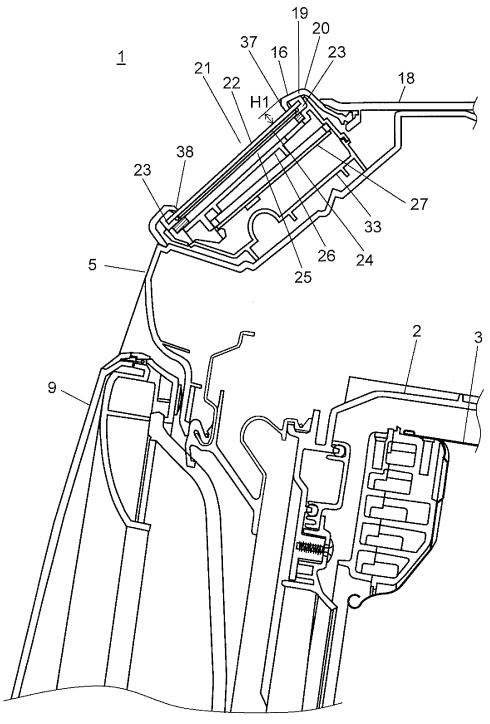
(54) WASHING MACHINE

(57) There is provided a washing machine including rotary drum (3) that is rotatably driven, a washing machine housing that accommodates rotary drum (3), and operation display panel (16) that is arranged on an upper part of the washing machine housing and has opening window (21). In addition, the washing machine includes liquid crystal panel (25) that is attached to a rear surface side of operation display panel (16), transparent glass plate (22) that is attached via elastic body (23) to a rear surface side of a portion where opening window (21) is disposed in operation display panel (16), and transparent electrode (24) that is mounted on a rear surface of transparent glass plate (22).

FIG. 4



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Description

TECHNICAL FIELD

[0001] The present invention relates to a washing machine for performing respective steps including at least washing, rinsing, and spin-drying inside a rotary drum.

BACKGROUND ART

[0002] A washing machine in the related art is configured so that a rotary drum having a bottomed cylinder shape is arranged inside a water tub in a predetermined direction so as to rotatably drive rotary drum. Many through-holes through which water and air are allowed to pass are formed on a peripheral surface of rotary drum.

[0003] A laundry loading-unloading port which can be opened and closed by a door is formed on a front surface side of the water tub. A user loads laundry into rotary drum through the laundry loading-unloading port, and washing machine controls water supply into the water tub, drainage from the water tub, and rotation of rotary drum. In this manner, each step of washing, rinsing, spin-drying, and drying is performed.

[0004] An operation display panel having a light emitting display unit or a pressing operation button unit is arranged on an upper part on a front surface side of a washing machine body. The user selects a desired operation course and starts an operation. Operation display panel is made of a transparent resin, and a front surface thereof is covered with an insert-molded film, thereby forming a colored, printed, and decorated surface. Since light for the selected course is turned on or blinks during the operation, the user can easily recognize an operation condition (for example, refer to PTL 1).

[0005] FIG. 38 is a front view of operation display panel 1050 mounted on a washing machine in the related art.

[0006] FIG. 38 illustrates a state where all display content items are displayed on liquid crystal panel 1051. For example, a case is assumed where the user selects an "urgent" course. At this time, the user presses course button 1052 to turn on the light for only the content items effective in selecting a course on liquid crystal panel 1051. Each time the user presses course button 1052, the set course varies. After the user confirms that the operation course is set to the "urgent" course, the user starts the operation by pressing a "start" button.

[0007] However, according to a configuration of the washing machine in the related art, too many operation buttons such as course button 1052 for setting the operation content items are arrayed side by side on operation display panel 1050. Consequently, the user is less likely to understand which button to select, thereby causing a problem of poor operability.

[0008] In addition, liquid crystal panel 1051 serves only to turn on display light at a predetermined display position. Consequently, as the number of information items to be displayed increases, a size of the display decreases one by one, thereby causing a problem of degraded visibility.

Citation List

Patent Literature

[0009] PTL 1: Japanese Patent Unexamined Publication No. 2005-143793

SUMMARY OF THE INVENTION

[0010] The present invention aims to provide a washing machine having an operation display panel excellent in operability and visibility.

[0011] A washing machine according to the present invention includes a rotary drum that is rotatably driven, a washing machine housing that accommodates the rotary drum, an operation display panel that is arranged on an upper part of the washing machine housing and has an opening window, and a liquid crystal panel that is attached to a rear surface side of the operation display panel. In addition, the washing machine further includes a transparent glass plate that is attached via an elastic body to a rear surface side of a portion where the opening window is disposed in the operation display panel, and a transparent electrode that is mounted on a rear surface of the transparent glass plate.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

FIG. 1 is a view illustrating a cross-sectional configuration of a front-loading-type washing machine according to a first embodiment of the present invention.

FIG. 2 is a front view of an operation display panel of the front-loading-type washing machine according to the first embodiment of the present invention.

FIG. 3 is a perspective view of the front-loading-type washing machine according to the first embodiment of the present invention.

FIG. 4 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel of the front-loading-type washing machine according to the first embodiment of the present invention.

FIG. 5A is a cross-sectional view taken along line 5A-5A in FIG. 2.

FIG. 5B is a cross-sectional view taken along line 5B-5B in FIG. 2.

FIG. 6 is an exploded perspective view of operation display panel of the front-loading-type washing machine according to the first embodiment of the present invention.

FIG. 7 is a view illustrating a cross-sectional configuration of a front-loading-type washing machine according to a second embodiment of the present invention.

FIG. 8 is a front view of an operation display panel of the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 9 is a perspective view of the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 10 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel of the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 11A is a cross-sectional view taken along line 11A-11A in FIG. 8.

FIG. 11B is a cross-sectional view taken along line 11B-11B in FIG. 8.

FIG. 12 is an exploded perspective view of operation display panel of the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 13A is a view illustrating a cross-sectional configuration in the vicinity of an upper side of operation display panel of the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 13B is a view illustrating a cross-sectional configuration in the vicinity of a lower side of operation display panel according to the second embodiment of the present invention.

FIG. 14 is a rear view of operation display panel according to the second embodiment of the present invention.

FIG. 15A is a view illustrating a cross-sectional configuration in the vicinity of an opening of a rear surface cover in the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 15B is a view illustrating a cross-sectional configuration in the vicinity of the opening of the rear surface cover in the front-loading-type washing machine according to the second embodiment of the present invention.

FIG. 16 is a view illustrating a cross-sectional configuration of a front-loading-type washing machine according to a third embodiment of the present invention.

FIG. 17 is a front view of an operation display panel of the front-loading-type washing machine according to the third embodiment of the present invention.

FIG. 18 is a perspective view of the front-loading-type washing machine according to the third embodiment of the present invention.

FIG. 19 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel of the front-loading-type washing machine according to the third embodiment of the present invention.

FIG. 20A is a cross-sectional view taken along line 20A-20A in FIG. 17.

FIG. 20B is a cross-sectional view taken along line 20B-20B in FIG. 17.

FIG. 21 is an exploded perspective view of operation display panel of the front-loading-type washing machine according to the third embodiment of the present invention.

FIG. 22A is a view illustrating a cross-sectional configuration in the vicinity of an upper side of operation display panel of the front-loading-type washing machine according to the third embodiment of the present invention.

FIG. 22B is a view illustrating a cross-sectional configuration in the vicinity of a lower side of operation display panel according to the third embodiment of the present invention.

FIG. 23 is a view illustrating a cross-sectional configuration in the vicinity of an engagement portion of operation display panel according to the third embodiment of the present invention.

FIG. 24 is a view illustrating a cross-sectional configuration of a front-loading-type washing machine according to a fourth embodiment of the present invention.

FIG. 25 is a front view of an operation display panel of the front-loading-type washing machine according to the fourth embodiment of the present invention.

FIG. 26 is a perspective view of the front-loading-type washing machine according to the fourth embodiment of the present invention.

FIG. 27 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel of the front-loading-type washing machine according to the fourth embodiment of the present invention.

FIG. 28A is a cross-sectional view taken along line 28A-28A in FIG. 25.

FIG. 28B is a cross-sectional view taken along line 28B-28B in FIG. 25.
FIG. 29 is an exploded perspective view of operation display panel of the front-loading-type washing machine according to the fourth embodiment of the present invention.
FIG. 30 is a perspective view of an elastic body of the front-loading-type washing machine according to the fourth embodiment of the present invention.
FIG. 31 is a view illustrating a cross-sectional configuration of a front-loading-type washing machine according to a fifth embodiment of the present invention.
FIG. 32 is a front view of an operation display panel of the front-loading-type washing machine according to the fifth embodiment of the present invention.
FIG. 33 is a perspective view of the front-loading-type washing machine according to the fifth embodiment of the present invention.
FIG. 34 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel of the front-loading-type washing machine according to the fifth embodiment of the present invention.
FIG. 35A is a cross-sectional view taken along line 35A-35A in FIG. 32.
FIG. 35B is a cross-sectional view taken along line 35B-35B in FIG. 32.
FIG. 36 is an exploded perspective view of operation display panel of the front-loading-type washing machine according to the fifth embodiment of the present invention.
FIG. 37A is a perspective view of an elastic body of the front-loading-type washing machine according to the fifth embodiment of the present invention.
FIG. 37B is a view illustrating a cross-sectional configuration cross-sectional view taken along line 37B-37B in FIG. 37A.
FIG. 38 is a front view of an operation display panel mounted on a washing machine in the related art.

DESCRIPTION OF EMBODIMENTS

[0013] Hereinafter, embodiments according to the present invention will be described with reference to the drawings. The present invention is not limited to the embodiments.

(FIRST EXEMPLARY EMBODIMENT)

[0014] FIG. 1 is a view illustrating a cross-sectional configuration of front-loading-type washing machine 100 according to a first exemplary embodiment of the present invention.

[0015] As illustrated in FIG. 1, water tub 2 in a suspended state is arranged inside main body 1 which serves as a housing of front-loading-type washing machine 100. Rotary drum 3 formed in a bottomed cylinder shape is rotatably arranged inside water tub 2 in a state where a rotary shaft thereof tilts downward from a front surface side toward a rear surface side.

[0016] Laundry loading-unloading port 4 passing through an opening end of rotary drum 3 is formed on the front surface side of water tub 2. Front frame body 5 configures front surface of the main body 1. Opening 6 is disposed on an upward tilting surface formed on the front surface side of front frame body 5. A user can load laundry into and can unload the laundry from rotary drum 3 through laundry loading-unloading port 4 by opening door 9 which opens and closes opening 6. Door 9 is disposed on the upward tilting surface, thereby enabling the user to carry out laundry loading-unloading work without the user's waist having to be bent. This configuration can improve poor workability of the front-loading-type washing machine of a general type in which a rotary shaft of rotary drum 3 is disposed in a horizontal direction so that laundry is loaded and unloaded through an opening formed in a vertical direction.

[0017] Many through-holes 10 leading into water tub 2 are formed on a peripheral surface of rotary drum 3. Rotary drum 3 is rotatably driven in a forward direction and a rearward direction by motor 11 attached to the rear surface side of water tub 2. In water tub 2, water supply pipeline 12 and drain pipeline 13 are connected to each other by pipes. Water is supplied into and drained from water tub 2 by respectively controlling water supply valve 14 and drain valve 15.

[0018] Operation display panel 16 is arranged on an upper part of front frame body 5. On the lower left side when viewed from the front surface of operation display panel 16, detergent supply case 17 (refer to FIG. 3) is arranged in front frame body 5 in a state where detergent supply case 17 is drawable forward. Prior to an operation, the user supplies detergent to detergent supply case 17, and operates operation display panel 16 when necessary. This enables the user to perform setting of desired operation content items, operation start, and temporary stop, and to recognize a state of the operation in progress.

[0019] The user loads the laundry into rotary drum 3 by opening door 9 to start the operation of front-loading-type washing machine 100. Then, water supply valve 14 is opened, and water is supplied into detergent supply case 17. While the detergent supplied into detergent supply case 17 is caused to flow, water is supplied into water tub 2 so as to reach a predetermined amount via water supply pipeline 12. Then, rotary drum 3 is rotatably driven by motor 11 so as

to start a washing step. In the washing step, an agitating operation of lifting and dropping the laundry in a rotation direction is repeatedly performed by rotating rotary drum 3.

[0020] After a predetermined time for washing elapses, drain valve 15 is opened to discharge soiled washing water through drain pipeline 13. Then, the washing water contained in the laundry is spin-dried by a spin-drying operation for rotating rotary drum 3 at high speed. Thereafter, water is supplied into water tub 2 through water supply pipeline 12 to perform a rinsing step. In this rinsing operation, the agitating operation for the laundry is also repeatedly performed by rotating rotary drum 3 so as to perform rinsing.

[0021] Here, operation display panel 16 will be described in detail.

[0022] FIG. 2 is a front view of operation display panel 16 of front-loading-type washing machine 100 according to the first exemplary embodiment of the present invention. FIG. 3 is a perspective view of front-loading-type washing machine 100. FIG. 4 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel 16 of front-loading-type washing machine 100. FIG. 5A is a cross-sectional view taken along line 5A-5A in FIG. 2. FIG. 5B is a cross-sectional view taken along line 5B-5B in FIG. 2. FIG. 6 is an exploded perspective view of operation display panel 16 of front-loading-type washing machine 100.

[0023] Operation display panel 16 is arranged between the upper part of front frame body 5 and top plate 18. A front surface of transparent resin portion 19 of operation display panel 16 is covered with insert-molded film 20 (polyethylene terephthalate (PET) film), thereby configuring a colored, printed, and decorated surface. Opening window 21 having a substantially rectangular shape is disposed in the center of transparent resin portion 19.

[0024] Opening window 21 is a region where neither transparent resin portion 19 nor film 20 is formed. Transparent glass plate 22 is attached via elastic body 23 to a rear surface side of a portion where opening window 21 is disposed in operation display panel 16. Transparent electrode 24 adheres to a rear surface of transparent glass plate 22. In addition, liquid crystal panel 25 is attached to liquid crystal mounting base 26 on the rear surface side of transparent glass plate 22. Control board unit 27 for controlling transparent electrode 24 and liquid crystal panel 25 is attached to the rear surface of liquid crystal mounting base 26.

[0025] Operation display panel 16 has pressing operation button unit 28 and light emitting display unit 29. Control board unit 32 provided with switch 30 and light emitting element 31 is located inside operation display panel 16, and control board unit 32 is attached to rear surface cover 33.

[0026] Furthermore, operation member 36 having light guide route 34 for guiding light of light emitting element 31 to light emitting display unit 29 and button unit 35 for performing a pressing operation on switch 30 are disposed between operation display panel 16 and rear surface cover 33. Transparent resin portion 19 is not formed on pressing operation button unit 28, and only film 20 is present thereon, thereby enabling switch 30 to be operated using weak operation force. In addition, light emitting display unit 29 is printed by a highly transmissive material. Accordingly, light can be emitted therefrom so that the user can sufficiently recognize even light having low intensity which is emitted from light emitting element 31.

[0027] If the user presses a power-on button (one of buttons in pressing operation button unit 28), for example, a display as illustrated in Fig. 2 is shown on liquid crystal panel 25. The user can look at the display through transparent glass plate 22. Then, for example, if the user's finger touches a front surface of transparent glass plate 22 of a region where a "manual course" is displayed, the display is changed to a display screen for setting the number of or the time for "washing" steps, or the display is changed to a display screen for setting a water level, thereby enabling the user to gradually perform subordinate setting. A method in which the user directly touches the display screen for hierarchical setting is called a touch panel method. Transparent electrode 24 adhering to the rear surface of transparent glass plate 22 detects a change in electrostatic capacitance when a finger touches transparent glass plate 22. In this manner, a finger touched position is specified, thereby enabling display content items to be changed in accordance with the operation of the user.

[0028] In operation display panel 1050 in the related art as illustrated in FIG. 38, a display window in the center serves only to show display content items of liquid crystal panel 1051 through a transparent resin and a film insert-molded on a front surface thereof. Consequently, even a display location is determined. Accordingly, if the content items to be displayed increase, a character to be displayed decreases in size. In addition, too many setting buttons such as course button 1052 are arrayed side by side. Consequently, the user is less likely to understand which button is suitable for pressing, thereby causing a problem of poor operability. In addition, there is a problem of poor visibility, since the character to be displayed decreases in size.

[0029] In contrast, in the present embodiment, as described above, opening window 21 is disposed in operation display panel 16. Then, a configuration adopted in which transparent glass plate 22 having transparent electrode 24 adhering thereto is attached via elastic body 23 to the rear surface side of the portion where opening window 21 is disposed in operation display panel 16. This configuration enables the user to directly touch the display screen for the hierarchical setting. As a result, it is no longer necessary to dispose a fixed operation button at many locations, and thus, it is possible to considerably reduce the number of operation buttons. In addition, since liquid crystal panel 25 sufficiently functions by selectively choosing only the display content items required on each occasion. Accordingly, the display content items

decrease, and thus the character to be displayed can increase in size. Therefore, it is possible to improve operability and visibility.

[0030] Here, a change in electrostatic capacitance is determined by dielectric constant of a finger touched material. As the dielectric constant becomes higher, the change in the electrostatic capacitance becomes greater, and sensitivity becomes higher. In addition, high sensitivity means that a finger pressed position can be recognized accurately and quickly. Furthermore, for example, high sensitivity means that the user is less likely to perform erroneous detection to such an extent as to recognize a water droplet adhering state as a finger touched state, and that the user is less likely to perform the erroneous detection influenced by external noises.

[0031] For example, the dielectric constant of glass is approximately 9, the dielectric constant of acrylonitrile butadiene styrene (ABS) resin or PET resin is approximately 3, and the change in the electrostatic capacitance is inversely proportional to the thickness. Accordingly, for example, if a material of a finger touching portion is configured to be a glass plate, even when the glass plate has thickness three times the thickness as compared to the plate of the ABS resin or the PET resin, the glass plate can have equal sensitivity.

[0032] ABS resin or PET resin is a transparent resin forming material which is generally used as a material for operation display panel, and is used for transparent resin portion in the present embodiment and in the related art. In the related art, a transparent resin having the same thickness as others (approximately 3 mm) and a film (PET film) having a thickness of approximately 0.2 mm are insert-molded on the front surface of a display unit in the center. In contrast, operation display panel 16 according to the present embodiment is configured to have transparent glass plate 22 which has a thickness of approximately 2 mm, which has opening window 21, and in which transparent electrode 24 adheres to the rear surface side of the portion where opening window 21 is disposed in operation display panel 16. This configuration aims to allow at least the sensitivity to become higher.

[0033] For example, even when transparent electrode 24 directly adheres to the rear surface without disposing opening window 21 in operation display panel 16 and by thinning the thickness of transparent resin portion 19, there is a possibility that the sensitivity during the operation can become higher. However, since film 20 (PET film) is insert-molded on the front surface, it is necessary to arrange the thickness of transparent resin portion 19 to be 2.5 mm or thicker in order to prevent warp and deformation after molding while ensuring adhesive performance of film 20. Consequently, it is difficult to slim operation display panel 16 more than before.

[0034] In contrast, in order to obtain the sensitivity to such an extent as to enable the user to comfortably perform the operation during the user's operation, it is necessary to minimize the thickness of transparent resin portion 19 so as to be approximately 1.5 mm. Furthermore, when transparent electrode 24 adheres to operation display panel 16, it is necessary to perform pressurizing and heating using dedicated equipment after the adhering so as not to leave air bubbles therein, or in order to improve adhesive performance. In this case, it is necessary to use huge equipment in order to accept overall operation display panel 16. Consequently, it is not possible to improve productivity. For the above-described reason, the present embodiment does not adopt a configuration in which transparent electrode 24 directly adheres to operation display panel 16.

[0035] In the present embodiment, opening window 21 is disposed in operation display panel 16, and transparent glass plate 22 to which transparent electrode 24 adheres from the rear surface side is attached via elastic body 23 to the rear surface side of the portion where opening window 21 is disposed in operation display panel 16. In this manner, the user looks at the display on liquid crystal panel 25, and touches the front surface of transparent glass plate 22 with the user's finger. Accordingly, the user can set various operation content items when necessary.

[0036] In the present embodiment, in order to prevent transparent glass plate 22 from being damaged due to unexpected external force being applied thereto, the thickness of transparent glass plate 22 is set to approximately 2 mm. As described above, the dielectric constant of the glass is higher than the dielectric constant of ABS resin. Accordingly, even this thickness can sufficiently increase the sensitivity during the operation, and a finger pressed position can be recognized accurately and quickly. In addition, for example, it is possible to realize a configuration in which the user is less likely to perform erroneous detection to such an extent as to recognize a water droplet adhering state as a finger touched state, and in which the user is less likely to perform the erroneous detection influenced by external noises.

[0037] Electronic components such as liquid crystal panel 25 and control board unit 27 are arranged on the rear side of transparent glass plate 22. Accordingly, waterproofing is required therein. Therefore, in the present embodiment, an outer peripheral portion of transparent glass plate 22 having a substantially rectangular shape is covered with elastic body 23 having a frame shape, and transparent glass plate 22 is attached via elastic body 23 to the rear surface side of the portion where opening window 21 having a substantially rectangular shape is disposed in operation display panel 16. Inside upper side 37 of opening window 21 and inside lower side 38, in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 22, transparent glass plate 22 is attached between operation display panel 16 and liquid crystal mounting base 26 via elastic body 23 in a waterproofing manner.

[0038] In addition, inside left side 39 of opening window 21 and inside right side 40, in two directions on the rear surface side and the end surface side of transparent glass plate 22, transparent glass plate 22 is attached between operation display panel 16 and liquid crystal mounting base 26 via elastic body 23 in a waterproofing manner.

[0039] Furthermore, boss 41 is disposed in the vicinity of four corners of opening window 21 on the rear surface of operation display panel 16, and liquid crystal mounting base 26 and rear surface cover 33 are fastened together by using a screw. In a fastening state using the screw, elastic body 23 is pressed by liquid crystal mounting base 26, thereby causing transparent glass plate 22 and operation display panel 16 to closely adhere to each other. This ensures water-proofness of opening window 21. Accordingly, even when the user spills water on opening window 21 by mistake, it is possible to enhance safety without any possibility that the water may cling to the electronic components such as liquid crystal panel 25 and control board unit 27 which are disposed thereinside.

[0040] In the present embodiment, an example has been described in which liquid crystal mounting base 26 and rear surface cover 33 are co-fastened. However, the present invention is not limited to this example. Even when liquid crystal mounting base 26 alone is fastened to operation display panel 16 by using a screw, the same advantageous effect can be obtained.

[0041] In addition, transparent glass plate 22 is attached via elastic body 23 to the rear surface side of the portion where opening window 21 is disposed in operation display panel 16. In this manner, it is possible to prevent transparent glass plate 22 from being damaged due to externally applied impact. For example, when the user drops something on transparent glass plate 22, an impact load is applied to transparent glass plate 22. In addition, an impact force is also similarly applied thereto, when the product is dropped or rolled from a loaded state in the middle of a distribution stage where the packaged product is delivered to a user's home. Operation display panel 16 is made of the resin, thereby absorbing the impact little bit. However, transparent glass plate 22 has hardness which is weak on the impact. Accordingly, elastic body 23 is arranged on the outer periphery of transparent glass plate 22, thereby allowing transparent glass plate 22 to have a soft structure. Therefore, it is possible to prevent damage even when an impact is externally applied thereto.

[0042] As compared to ABS resin, glass has a linear expansion coefficient which is one digit smaller. Depending on places where the product is installed in the user's home, a temperature difference greatly varies in summer or winter. In addition, even in a state where the packaged product is stored at a warehouse, a considerable temperature difference occurs depending on seasons or regional differences. When components having very different linear expansion coefficients are assemble to each other, the components have to employ a structure for absorbing deformation caused by a thermal expansion difference. Otherwise, the components are damaged in some cases.

[0043] Therefore, in the present embodiment, transparent glass plate 22 is attached via elastic body 23 to the rear surface side of the portion where opening window 21 is disposed in operation display panel 16. In this manner, even when a thermal expansion difference causes a dimensional change to occur between transparent glass plate 22 and operation display panel 16 or liquid crystal mounting base 26, the dimensional change is absorbed by elastic body 23. Accordingly, it is possible to prevent the components from being damaged.

[0044] In addition to a region inside opening window 21 by which the user touches transparent glass plate 22 to set operation content items, some pressing operation button units 28 such as a power-on button, a power-off button, and a start button are also arranged in operation display panel 16. The user directly touches transparent glass plate 22 to set the operation content items in accordance with the content items displayed on liquid crystal panel 25. In this manner, it is also possible to remove pressing operation button units 28.

[0045] However, if the fixed button which is always visible from the outside does not remain, the user may wonder what to do when the user makes a mistake in the middle of an operation and wants to return to a prior operation, or when a certain disadvantage occurs during an operation and the user wants to stop the operation immediately. In order to prevent this case, the fixed operation button is configured to remain.

[0046] In addition, in the present embodiment, switch 30 operated by pressing operation button unit 28 and light emitting element 31 emitting light for light emitting display unit 29 are mounted on control board unit 32. Then, control board unit 32 is separated from control board unit 27 which controls transparent electrode 24 and liquid crystal panel 25, control board unit 32 is attached to rear surface cover 33, and control board unit 27 is attached to liquid crystal mounting base 26.

[0047] The reason that control board units 27 and 32 are separated from each other in this way is that a front surface shape of operation display panel 16 is a round shape which moves further rearward as the shape goes from the center position to the end position of the product. Since operation display panel 16 has the round shape, as compared to control board unit 27 placed in the vicinity of the center position, the position of control board unit 32 placed at the right end is moved relatively rearward. Consequently, control board units 27 and 32 are arranged to have steps different from each other, and are less likely to be a single configuration member. Accordingly, for example, if the front surface shape of operation display panel 16 is adapted to be a shape close to a plane, it is possible to adopt a configuration in which control board units 27 and 32 are attached to the rear surface of liquid crystal mounting base 26 by integrally configuring control board units 27 and 32.

[0048] Next, a concavity step difference between transparent resin portion 19 and transparent glass plate 22 which are formed on the respective upper, lower, left, and right sides of opening window 21 having a rectangular shape will be described. As illustrated in FIG. 5A, front surface concavity step difference H2 between operation display panel 16 and transparent glass plate 22 on left side 39 and right side 40 of opening window 21 is smaller than front surface

concavity step difference H1 between operation display panel 16 and transparent glass plate 22 on upper side 37 and lower side 38 of opening window 21 illustrated in FIG. 4. The front surface concavity step differences are obtained by adding the thickness of transparent resin portion 19 covered on transparent glass plate 22 to the thickness of elastic body 23 if elastic body 23 is interposed therebetween.

[0049] As described above, inside left side 39 and inside right side 40 of opening window 21, elastic body 23 is interposed therebetween in two directions on the rear surface side and the end surface side of transparent glass plate 22. However, the front surface side is in direct contact with transparent resin portion 19. Accordingly, front surface concavity step difference H2 is sufficiently obtained when configured to have a thickness of approximately 2.5 mm which enables insert-molding without any problem.

[0050] In contrast, as illustrated in FIG. 4, inside upper side 37 and inside lower side 38 of opening window 21, elastic body 23 is interposed therebetween in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 22. Accordingly, front surface concavity step difference H1 becomes approximately 4.5 mm by adding the thickness of 3 mm in transparent resin portion 19 to the thickness of 1.5 mm in elastic body 23, and thus becomes greater than front surface concavity step difference H2. Then, a difference between front surface concavity step difference H1 and front surface concavity step difference H2 is absorbed by step difference H3 of stepped portion 42 formed on the left side further from left side 39 and step difference H3 of stepped portion 42 formed on the right side further from right side 40.

[0051] Opening window 21 is recessed by one step from the front surface of operation display panel 16, and thus is externally conspicuous. If horizontal width L1 of opening window is too small as compared to entire width L0 of operation display panel 16, the glass formed portion serving as the display unit leaves poor impression, thereby causing a design problem of a spoiled sense of quality. When information is displayed on liquid crystal panel 25 and the user sets the operation content items, or when operation conditions of the product are displayed, light is brightly turned on inside opening window 21. Accordingly, the design problem does not matter. However, when the light is turned off, the recessed region of opening window 21 is likely to be more conspicuous as an external recess.

[0052] If horizontal width L1 of opening window 21 is increased and a ratio of operation display panel 16 to entire width L0 is set to be approximately 40% for example, the recessed region of opening window 21 can raise a sense of presence and can obtain improved design. However, since entire width L0 is approximately 600 mm, it is necessary to set horizontal width L1 of opening window 21 to be approximately 240 mm. Transparent glass plate 22 large enough to that extent is less likely to be attached to operation display panel 16 so as to withstand an impact force while the waterproofness is ensured. In addition, if opening window 21 large enough to that extent is disposed in operation display panel 16 itself, a strength of the component becomes weaker. Consequently, it is difficult to prevent warp and deformation after molding. Furthermore, transparent glass plate 22 and transparent electrode 24 increase in size, thereby increasing the production cost.

[0053] In the present embodiment, front surface concavity step difference H2 between operation display panel 16 and transparent glass plate 22 on left side 39 and right side 40 of opening window 21 is adapted to be smaller than front surface concavity step difference H1 between operation display panel 16 and transparent glass plate 22 on upper side 37 and lower side 38. Then, the difference between front surface concavity step difference H1 and front surface concavity step difference H2 is absorbed by step difference H3 of stepped portion 42 formed on the left side further from left side 39 and step difference H3 of stepped portion 42 formed on the right side further from right side 40. That is, front surface concavity step difference H1 is substantially equal to the sum of front surface concavity step difference H2 and step difference H3. As described above, in addition to horizontal width L1 of opening window 21, horizontal width L2 between stepped portions 42 spreading outward therefrom is provided. In this manner, the recessed region which is externally conspicuous becomes visible more widely.

[0054] Horizontal width L1 of opening window 21 relates to a size of transparent glass plate 22, transparent electrode 24, and liquid crystal panel 25. Specifically, horizontal width L1 is set to be approximately 150 mm so as to have a size large enough to protect these electronic components from externally permeating water, to withstand externally applied impact, and to prevent damage. However, the size is too small as compared to the entire width (L0 = 600 mm) of operation display panel 16, thereby showing an externally humble image. Accordingly, the recessed region of the horizontal width (L2 = 260 mm) between stepped portions 42 is disposed outside opening window 21. That is, according to this configuration, horizontal width L2 of the recessed region can be set to have a size of approximately 40% as compared to entire width L0 of operation display panel 16. Accordingly, the recessed region can be externally recognized, can raise a sense of presence, and can obtain improved design.

[0055] Horizontal width L2 between stepped portions 42 does not affect an internal structure in terms of waterproofness and strength. Accordingly, horizontal width L2 can be freely set. In addition, in order to decrease step difference H2 on left side 39 and right side 40 of opening window 21, the front surface side of transparent glass plate 22 is brought into contact with operation display panel 16. However, a configuration is made so that elastic body 23 is interposed between the rear surface side and the end surface side of transparent glass plate 22, is fastened in boss 41 by using a screw, and is pressed between liquid crystal mounting base 26 and operation display panel 16. This configuration ensures the

waterproofness without causing a possibility that water flowing from the front surface side of transparent glass plate 22 may permeate into opening window 21. In addition, even when an impact is applied from the outside, the impact is absorbed by elastic body 23. Accordingly, it is possible to prevent the components from being damaged.

[0056] In the present embodiment, in order to widely show the external design of the recessed region, inside left side 39 and right side 40 of opening window 21, front surface side of transparent glass plate 22 is brought into contact with operation display panel 16, thereby decreasing step difference H2. This reason is that decreasing step difference H2 increases a sense of integrity between the region of horizontal width L1 and the region of horizontal width L2 so as to widely (horizontal width L2) show the recessed region. The present invention is not limited to this example. If it is not necessary to widely show the recessed region, similar to the inside of upper side 37 and lower side 38 of opening window 21, a configuration in which elastic body 23 is interposed therebetween in three directions of the front surface side, the rear surface side, and the end surface side of transparent glass plate 22 may be applied to left side 39 and right side 40. That is, four sides of opening window 21 are configured to have front surface concavity step difference H1, and a configuration may be made so that stepped portion 42 is not provided.

[0057] As described above, front-loading-type washing machine 100 according to the present embodiment includes rotary drum 3 that is rotatably driven, main body 1 that is the washing machine body for accommodating rotary drum 3, operation display panel 16 that is arranged in the upper part of the washing machine body and has opening window 21, and liquid crystal panel 25 that is attached to the rear surface side of operation display panel 16. In addition, front-loading-type washing machine 100 includes transparent glass plate 22 that is attached via elastic body 23 to the rear surface side of the portion where opening window 21 is disposed in operation display panel 16, and transparent electrode 24 that is mounted on the rear surface of transparent glass plate 22.

[0058] According to this configuration, when the operation content items are to be set, if the user directly touches display on transparent glass plate 22 and selects a selectable course, a subordinate display such as time setting for "washing" for example is further continuously is shown. Accordingly, the user can perform a hierarchical operation in which the user determines the setting by touching the subordinate display. In addition, the operation buttons can be reduced, and the size of the character to be displayed can be increased. Accordingly, it is possible to improve operability and visibility. In addition, transparent glass plate 22 is attached to operation display panel 16 via elastic body 23. Therefore, it is possible to prevent water clinging to transparent glass plate 22 from permeating into the housing.

[0059] In addition, opening window 21 has a substantially rectangular shape, and is configured so that step difference H2 between operation display panel 16 and transparent glass plate 22 which are formed on left side 39 and right side 40 of opening window 21 is smaller than step difference H1 between operation display panel 16 and transparent glass plate 22 which are formed on upper side 37 and lower side 38 of opening window 21.

[0060] This configuration enables transparent glass plate 22 having a display function and an operation function to be shown as a visually larger image. Transparent glass plate 22 is located on the recess side (inner side of the housing) further from opening window 21 side, and is externally conspicuous. Accordingly, if an area occupied by operation display panel 16 of opening window 21 is small, the external design of transparent glass plate 22 may be shown as humble particularly when the light is turned off. However, according to the above-described configuration, transparent glass plate 22 can be shown as a horizontally larger image. Therefore, it is possible to improve the external design.

(SECOND EXEMPLARY EMBODIMENT)

[0061] FIG. 7 is a view illustrating a cross-sectional configuration of front-loading-type washing machine 200 according to a second exemplary embodiment of the present invention.

[0062] As illustrated in FIG. 7, water tub 102 in a suspended state is arranged inside main body 101 which serves as a housing of front-loading-type washing machine 200. Rotary drum 103 formed in a bottomed cylinder shape is rotatably arranged inside water tub 102 in a state where a rotary shaft thereof tilts downward from a front surface side toward a rear surface side.

[0063] Laundry loading-unloading port 104 passing through an opening end of rotary drum 103 is formed on the front surface side of water tub 102. Front frame body 105 configures a front surface of main body 101. Opening 106 is disposed on an upward tilting surface formed on the front surface side of front frame body 105. A user can load laundry into and can unload the laundry from rotary drum 103 through laundry loading-unloading port 104 by opening door 109 which opens and closes opening 106. Door 109 is disposed on the upward tilting surface, thereby enabling the user to carry out laundry loading-unloading work without the user's waist having to be bent. This configuration can improve poor workability of the front-loading-type washing machine of a general type in which the rotary shaft of rotary drum 103 is disposed in a horizontal direction so that laundry is loaded and unloaded through an opening formed in a vertical direction.

[0064] Many through-holes 110 leading into water tub 102 are formed on a peripheral surface of rotary drum 103. Rotary drum 103 is rotatably driven in a forward direction and a rearward direction by motor 111 attached to the rear surface side of water tub 102. In water tub 102, water supply pipeline 112 and drain pipeline 113 are connected to each other by pipes. Water is supplied into and drained from water tub 102 by respectively controlling water supply valve 114

and drain valve 115.

[0065] Operation display panel 116 is arranged on an upper part of front frame body 105. On the lower left side when viewed from the front surface of operation display panel 116, detergent supply case 117 (refer to FIG. 9) is arranged in front frame body 105 in a state where detergent supply case 117 is drawable forward. Prior to an operation, the user supplies detergent to detergent supply case 117, and operates operation display panel 116 when necessary. This enables the user to perform setting of desired operation content items, operation start, and temporary stop, and to recognize a state of the operation in progress.

[0066] The user loads the laundry into rotary drum 103 by opening door 109 to start the operation of front-loading-type washing machine 200. Then, water supply valve 114 is opened, and water is supplied into detergent supply case 117. While the detergent supplied into detergent supply case 117 is caused to flow, water is supplied into water tub 102 so as to reach a predetermined amount via water supply pipeline 112. Then, rotary drum 103 is rotatably driven by motor 111 so as to start a washing step. In the washing step, an agitating operation of lifting and dropping the laundry in a rotation direction is repeatedly performed by rotating rotary drum 103.

[0067] After a predetermined time for washing elapses, drain valve 115 is opened to discharge soiled washing water through drain pipeline 113. Then, the washing water contained in the laundry is spin-dried by a spin-drying operation for rotating rotary drum 103 at high speed. Thereafter, water is supplied into the water tub 102 through water supply pipeline 112 to perform a rinsing step. In this rinsing operation, the agitating operation for the laundry is also repeatedly performed by rotating rotary drum 103 so as to perform rinsing.

[0068] Here, operation display panel 116 will be described in detail.

[0069] FIG. 8 is a front view of operation display panel 116 of front-loading-type washing machine 200 according to the second exemplary embodiment of the present invention. FIG. 9 is a perspective view of front-loading-type washing machine 200. FIG. 10 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel 116 of front-loading-type washing machine 200. FIG. 11A is a cross-sectional view taken along line 11A-11A in FIG. 8. FIG. 11B is a cross-sectional view taken along line 11B-11B in FIG. 8. FIG. 12 is an exploded perspective view of operation display panel 116 of front-loading-type washing machine 200.

[0070] Operation display panel 116 is arranged between the upper part of front frame body 105 and top plate 118. A front surface of transparent resin portion 119 of operation display panel 116 is covered with insert-molded film 120 (polyethylene terephthalate (PET) film), thereby configuring a colored, printed, and decorated surface. Opening window 121 having a substantially rectangular shape is disposed in the center of transparent resin portion 119.

[0071] Opening window 121 is a region where neither transparent resin portion 119 nor film 120 is formed. Transparent glass plate 122 is attached via an elastic body 123 to a rear surface side of a portion where opening window 121 is disposed in operation display panel 116. Transparent electrode 124 adheres to a rear surface of transparent glass plate 122. In addition, liquid crystal panel 125 is mounted on liquid crystal mounting base 126 on the rear surface side of transparent glass plate 122. Control board unit 127 for controlling transparent electrode 124 or liquid crystal panel 125 is attached to the rear surface of liquid crystal mounting base 126.

[0072] Operation display panel 116 has pressing operation button unit 128 and light emitting display unit 129. Control board unit 132 provided with switch 130 and light emitting element 131 is located inside operation display panel 116, and control board unit 132 is attached to rear surface cover 133.

[0073] Furthermore, operation member 136 having light guide route 134 for guiding light of light emitting element 131 to light emitting display unit 129 and button unit 135 for performing a pressing operation on switch 130 are disposed between operation display panel 116 and rear surface cover 133. Transparent resin portion 119 is not formed on pressing operation button unit 128, and only film 120 is present thereon, thereby enabling switch 130 to be operated using weak operation force. In addition, light emitting display unit 129 is printed by a highly transmissive material. Accordingly, light can be emitted therefrom so that the user can sufficiently recognize even light having low intensity which is emitted from light emitting element 131.

[0074] If the user presses a power-on button (one of buttons in pressing operation button unit 128), for example, a display as illustrated in Fig. 8 is shown on liquid crystal panel 125. The user can look at the display through transparent glass plate 122. Then, for example, if the user's finger touches a front surface of transparent glass plate 122 of a region where a "manual course" is displayed, the display is changed to a display screen for setting the number of or the time for "washing" steps, or the display is changed to a display screen for setting a water level, thereby enabling the user to gradually perform subordinate setting. A method in which the user directly touches the display screen for hierarchical setting is called a touch panel method. Transparent electrode 124 adhering to the rear surface of transparent glass plate 122 detects a change in electrostatic capacitance when a finger touches transparent glass plate 122. In this manner, a finger touched position is specified, thereby enabling display content items to be changed in accordance with the operation of the user.

[0075] In operation display panel 1050 in the related art as illustrated in FIG. 38, a display window in the center serves only to show display content items of liquid crystal panel 1051 through the transparent resin and the film insert-molded on the front surface thereof. Consequently, even the display location is determined. Accordingly, if the content items to

be displayed increase, a character to be displayed decreases in size. In addition, too many setting buttons such as course button 1052 are arrayed side by side. Consequently, the user is less likely to understand which button is suitable for pressing, thereby causing a problem of poor operability. In addition, there is a problem of poor visibility, since the character to be displayed decreases in size.

[0076] In contrast, in the present embodiment, as described above, opening window 121 is disposed in operation display panel 116. Then, a configuration adopted in which transparent glass plate 122 having transparent electrode 124 adhering thereto is attached via elastic body 123 to the rear surface side of the portion where opening window 121 is disposed in operation display panel 116. This configuration enables the user to directly touch the display screen for the hierarchical setting. As a result, it is no longer necessary to dispose a fixed operation button at many locations, and thus, it is possible to considerably reduce the number of operation buttons. In addition, since liquid crystal panel 125 sufficiently functions by selectively choosing only the display content items required on each occasion. Accordingly, the display content items decrease, and thus the character to be displayed can increase in size. Therefore, it is possible to improve operability and visibility.

[0077] Here, a change in electrostatic capacitance is determined by dielectric constant of a finger touched material. As the dielectric constant becomes higher, the change in the electrostatic capacitance becomes greater, and sensitivity becomes higher. In addition, high sensitivity means that a finger pressed position can be recognized accurately and quickly. Furthermore, for example, high sensitivity means that the user is less likely to perform erroneous detection to such an extent as to recognize a water droplet adhering state as a finger touched state, and that the user is less likely to perform the erroneous detection influenced by external noises.

[0078] For example, the dielectric constant of glass is approximately 9, the dielectric constant of acrylonitrile butadiene styrene (ABS) resin or PET resin is approximately 3, and the change in the electrostatic capacitance is inversely proportional to the thickness. Accordingly, for example, if a material of a finger touching portion is configured to be a glass plate, even when the glass plate has thickness three times the thickness as compared to the plate of the ABS resin or the PET resin, the glass plate can have equal sensitivity.

[0079] ABS resin or PET resin is a transparent resin forming material which is generally used as a material for operation display panel, and is used for transparent resin portion in the present embodiment and in the related art. In the related art, a transparent resin having the same thickness as others (approximately 3 mm) and a film (PET film) having a thickness of approximately 0.2 mm are insert-molded on a front surface of a display unit in the center. In contrast, operation display panel 116 according to the present embodiment is configured to have transparent glass plate 122 which has a thickness of approximately 2 mm, which has opening window 121, and in which the transparent electrode 124 adheres to the rear surface side of the portion where opening window 121 is disposed in operation display panel 116. This configuration aims to allow at least the sensitivity to become higher.

[0080] For example, even when transparent electrode 124 directly adheres to the rear surface without disposing opening window 121 in operation display panel 116 and by thinning the thickness of transparent resin portion 119, there is a possibility that the sensitivity during the operation can become higher. However, since film 120 (PET film) is insert-molded on the front surface, it is necessary to arrange the thickness of transparent resin portion 119 to be 2.5 mm or thicker in order to prevent warp and deformation after molding while ensuring adhesive performance of film 120. Consequently, it is difficult to slim operation display panel 116 more than before.

[0081] In contrast, in order to obtain the sensitivity to such an extent as to enable the user to comfortably perform the operation during the user's operation, it is necessary to minimize the thickness of transparent resin portion 119 so as to be approximately 1.5 mm. Furthermore, when transparent electrode 124 adheres to operation display panel 116, it is necessary to perform pressurizing and heating using dedicated equipment after the adhering so as not to leave air bubbles therein, or in order to improve adhesive performance. In this case, it is necessary to use huge equipment in order to accept overall operation display panel 116. Consequently, it is not possible to improve productivity. For the above-described reason, the present embodiment does not adopt a configuration in which transparent electrode 124 directly adheres to operation display panel 116.

[0082] In the present embodiment, opening window 121 is disposed in operation display panel 116, and transparent glass plate 122 to which transparent electrode 124 adheres from the rear surface side is attached via elastic body 123 to the rear surface side of the portion where opening window 121 is disposed in operation display panel 116. In this manner, the user looks at the display on liquid crystal panel 125, and touches the front surface of transparent glass plate 122 with the user's finger. Accordingly, the user can set various operation content items when necessary.

[0083] In the present embodiment, in order to prevent transparent glass plate 122 from being damaged due to unexpected external force being applied thereto, the thickness of transparent glass plate 122 is set to approximately 2 mm. As described above, the dielectric constant of the glass is higher than the dielectric constant of ABS resin. Accordingly, even this thickness can sufficiently increase the sensitivity during the operation, and a finger pressed position can be recognized accurately and quickly. In addition, for example, it is possible to realize a configuration in which the user is less likely to perform erroneous detection to such an extent as to recognize a water droplet adhering state as a finger touched state, and in which the user is less likely to perform the erroneous detection influenced by external noises.

[0084] Electronic components such as liquid crystal panel 125 and control board unit 127 are arranged on the rear side of transparent glass plate 122. Accordingly, waterproofing is required therein. Therefore, in the present embodiment, an outer peripheral portion of transparent glass plate 122 having a substantially rectangular shape is covered with elastic body 123 having a frame shape, and transparent glass plate 122 is attached via elastic body 123 to the rear surface side of the portion where opening window 121 having a substantially rectangular shape is disposed in operation display panel 116. Inside upper side 137 of opening window 121 and inside lower side 138, in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 122, transparent glass plate 122 is attached between operation display panel 116 and liquid crystal mounting base 126 via elastic body 123 in a waterproofing manner.

[0085] In addition, inside left side 139 of opening window 121 and inside right side 140, in two directions on the rear surface side and the end surface side of transparent glass plate 122, transparent glass plate 122 is attached between operation display panel 116 and liquid crystal mounting base 126 via elastic body 123 in a waterproofing manner.

[0086] Furthermore, boss 141 is disposed in the vicinity of four corners of opening window 121 on the rear surface of operation display panel 116, and liquid crystal mounting base 126 and rear surface cover 133 are fastened together by using a screw. In a fastening state using the screw, elastic body 123 is pressed by liquid crystal mounting base 126, thereby causing transparent glass plate 122 and operation display panel 116 to closely adhere to each other. This ensures waterproofness of opening window 121. Accordingly, even when the user spills water on opening window 121 by mistake, it is possible to enhance safety without any possibility that the water may cling to the electronic components such as liquid crystal panel 125 and control board unit 127 which are disposed thereinside.

[0087] In the present embodiment, an example has been described in which liquid crystal mounting base 126 and rear surface cover 133 are co-fastened. However, the present invention is not limited to this example. Even when liquid crystal mounting base 126 alone is fastened to operation display panel 116 by using a screw, the same advantageous effect can be obtained.

[0088] In addition, transparent glass plate 122 is attached via elastic body 123 to the rear surface side of the portion where opening window 121 is disposed in operation display panel 116. In this manner, it is possible to prevent transparent glass plate 122 from being damaged due to externally applied impact. For example, when the user drops something on transparent glass plate 122, an impact load is applied to transparent glass plate 122. In addition, an impact force is also similarly applied thereto, when the product is dropped or rolled from a loaded state in the middle of a distribution stage where the packaged product is delivered to a user's home. Operation display panel 116 is made of the resin, thereby absorbing the impact little bit. However, transparent glass plate 122 has hardness which is weak on the impact. Accordingly, elastic body 123 is arranged on the outer periphery of transparent glass plate 122, thereby allowing transparent glass plate 122 to have a soft structure. Therefore, it is possible to prevent damage even when an impact is externally applied thereto.

[0089] As compared to ABS resin, glass has a linear expansion coefficient which is one digit smaller. Depending on places where the product is installed in the user's home, a temperature difference greatly varies in summer or winter. In addition, even in a state where the packaged product is stored at a warehouse, a considerable temperature difference occurs depending on seasons or regional differences. When components having very different linear expansion coefficients are assemble to each other, the components have to employ a structure for absorbing deformation caused by a thermal expansion difference. Otherwise, the components become damaged in some cases.

[0090] Therefore, in the present embodiment, transparent glass plate 122 is attached via elastic body 123 to the rear surface side of the portion where opening window 121 is disposed in operation display panel 116. In this manner, even when a thermal expansion difference causes a dimensional change to occur between transparent glass plate 122 and operation display panel 116 or liquid crystal mounting base 126, the dimensional change is absorbed by elastic body 123. Accordingly, it is possible to prevent the components from being damaged.

[0091] In addition to a region inside opening window 121 by which the user touches transparent glass plate 122 to set operation content items, some pressing operation button units 128 such as a power-on button, a power-off button, and a start button are also arranged in operation display panel 116. The user directly touches transparent glass plate 122 to set the operation content items in accordance with the content items displayed on liquid crystal panel 125. In this manner, it is also possible to remove pressing operation button units 128.

[0092] However, if the fixed button which is always visible from the outside does not remain, the user may wonder what to do when the user makes a mistake in the middle of an operation and wants to return to a prior operation, or when a certain disadvantage occurs during an operation and the user wants to stop the operation immediately. In order to prevent this case, the fixed operation button is configured to remain.

[0093] In addition, in the present embodiment, switch 130 operated by pressing pressing operation button unit 128 and light emitting element 131 emitting light for light emitting display unit 129 are mounted on control board unit 132. Then, control board unit 132 is separated from control board unit 127 which controls transparent electrode 124 and liquid crystal panel 125, control board unit 132 is attached to rear surface cover 133, and control board unit 127 is attached to the rear surface of liquid crystal mounting base 126.

[0094] The reason that control board units 127 and 132 are separated from each other in this way is that a front surface shape of operation display panel 116 is a round shape which moves further rearward as the shape goes from the center position to the end position of the product. Since operation display panel 116 has the round shape, as compared to control board unit 127 placed in the vicinity of the center position, the position of control board unit 132 placed at the right end is moved relatively rearward. Consequently, control board units 127 and 132 are arranged to have steps different from each other, and are less likely to be a single configuration member. Accordingly, for example, if the front surface shape of operation display panel 116 is adapted to be a shape close to a plane, it is possible to adopt a configuration in which control board units 127 and 132 are attached to the rear surface of liquid crystal mounting base 126 by integrally configuring control board units 127 and 132.

[0095] Next, a concavity step difference between transparent resin portion 119 and transparent glass plate 122 which are formed on the respective upper, lower, left, and right sides of opening window 121 having a rectangular shape will be described. As illustrated in FIG. 11A, front surface concavity step difference H2 between operation display panel 116 and transparent glass plate 122 on left side 139 and right side 140 of opening window 121 is smaller than front surface concavity step difference H1 between operation display panel 116 and transparent glass plate 122 on upper side 137 and lower side 138 of opening window 121 illustrated in FIG. 10. The front surface concavity step differences are obtained by adding the thickness of transparent resin portion 119 covered on transparent glass plate 122 to the thickness of elastic body 123 if elastic body 123 is interposed therebetween.

[0096] As described above, inside left side 139 and inside right side 140 of opening window 121, elastic body 123 is interposed therebetween in two directions on the rear surface side and the end surface side of transparent glass plate 122. However, the front surface side is in direct contact with transparent resin portion 119. Accordingly, front surface concavity step difference H2 is sufficiently obtained when configured to have a thickness of approximately 2.5 mm which enables insert-molding without any problem.

[0097] In contrast, as illustrated in FIG. 10, inside upper side 137 and inside lower side 138 of opening window 121, elastic body 123 is interposed therebetween in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 122. Accordingly, front surface concavity step difference H1 becomes approximately 4.5 mm by adding the thickness of 3 mm in transparent resin portion 119 to the thickness of 1.5 mm in elastic body 123, and thus becomes greater than front surface concavity step difference H2. Then, a difference between front surface concavity step difference H1 and front surface concavity step difference H2 is absorbed by step difference H3 of stepped portion 142 formed on the left side further from left side 139 and step difference H3 of stepped portion 142 formed on the right side further from right side 140.

[0098] Opening window 121 is recessed by one step from the front surface of operation display panel 116, and thus is externally conspicuous. If horizontal width L1 of opening window is too small as compared to an entire width L0 of operation display panel 116, the glass formed portion serving as the display unit leaves poor impression, thereby causing a design problem of a spoiled sense of quality. When information is displayed on liquid crystal panel 125 and the user sets the operation content items, or when operation conditions of the product are displayed, light is brightly turned on inside opening window 121. Accordingly, the design problem does not matter. However, when the light is turned off, the recessed region of opening window 121 is likely to be more conspicuous as an external recess.

[0099] If horizontal width L1 of opening window 121 is increased and a ratio of operation display panel 116 to entire width L0 is set to be approximately 40% for example, the recessed region of opening window 121 can raise a sense of presence and can obtain improved design. However, since entire width L0 is approximately 600 mm, it is necessary to set horizontal width L1 of opening window 121 to be approximately 240 mm. Transparent glass plate 122 large enough to that extent is less likely to be attached to operation display panel 116 so as to withstand an impact force while the waterproofness is ensured. In addition, if opening window 121 large enough to that extent is disposed in operation display panel 116 itself, strength of the component becomes weaker. Consequently, it is difficult to prevent warp and deformation after molding. Furthermore, transparent glass plate 122 and transparent electrode 124 increase in size, thereby increasing the production cost.

[0100] In the present embodiment, front surface concavity step difference H2 between operation display panel 116 and transparent glass plate 122 on left side 139 and right side 140 of opening window 121 is adapted to be smaller than the front surface concavity step difference H1 between operation display panel 116 and transparent glass plate 122 on upper side 137 and lower side 138. Then, the difference between front surface concavity step difference H1 and front surface concavity step difference H2 is absorbed by step difference H3 of stepped portion 142 formed on the left side further from left side 139 and step difference H3 of stepped portion 142 formed on the right side further from right side 140. That is, front surface concavity step difference H1 is substantially equal to the sum of front surface concavity step difference H2 and step difference H3. As described above, in addition to horizontal width L1 of opening window 121, horizontal width L2 between stepped portions 142 spreading outward therefrom is provided. In this manner, the recessed region which is externally conspicuous becomes visible more widely.

[0101] Horizontal width L1 of opening window 121 relates to a size of transparent glass plate 122, transparent electrode 124, and liquid crystal panel 125. Specifically, horizontal width L1 is set to be approximately 150 mm so as to have a

size large enough to protect these electronic components from externally permeating water, to withstand externally applied impact, and to prevent damage. However, the size is too small as compared to the entire width (L0 = 600 mm) of operation display panel 116, thereby showing an externally humble image. Accordingly, the recessed region of horizontal width (L2 = 260 mm) between stepped portions 142 is disposed outside opening window 121. That is, according to this configuration, horizontal width L2 of the recessed region can be set to have a size of 40% as compared to entire width L0 of operation display panel 116. Accordingly, the recessed region can be externally recognized, can raise a sense of presence, and can obtain improved design.

[0102] Horizontal width L2 between stepped portions 142 does not affect an internal structure in terms of waterproofness and strength. Accordingly, horizontal width L2 can be freely set. In addition, in order to decrease step difference H2 on left side 139 and right side 140 of opening window 121, the front surface side of transparent glass plate 122 is brought into contact with operation display panel 116. However, a configuration is made so that elastic body 123 is interposed between the rear surface side and the end surface side of transparent glass plate 122, is fastened in boss 141 by using a screw, and is pressed between liquid crystal mounting base 126 and operation display panel 116. This configuration ensures the waterproofness without causing a possibility that water flowing from the front surface side of transparent glass plate 122 may permeate into opening window 121. In addition, even when an impact is applied from the outside, the impact is absorbed by elastic body 123. Accordingly, it is possible to prevent the components from being damaged.

[0103] FIG. 13A is a view illustrating a cross-sectional configuration in the vicinity of upper side 137 of operation display panel 116 of front-loading-type washing machine 200 according to the second exemplary embodiment of the present invention. FIG. 13B is a view illustrating a cross-sectional configuration in the vicinity of lower side 138 of operation display panel 116. FIG. 14 is a rear view of operation display panel 116. FIG. 15A is a view illustrating a cross-sectional configuration in the vicinity of opening 156 of rear surface cover 133 in front-loading-type washing machine 200. FIG. 15B is a view illustrating a cross-sectional configuration in the vicinity of opening 162 of rear surface cover 133 in front-loading-type washing machine 200.

[0104] Transparent glass plate 122 is elastically held between liquid crystal mounting base 126 and operation display panel 116 via elastic body 123. Liquid crystal panel 125 is attached to transparent glass plate 122 side of liquid crystal mounting base 126, and control board unit 127 is attached to the rear surface of liquid crystal mounting base 126. Door 109 and detergent supply case 117 are arranged on the lower side of operation display panel 116. Since the upper side influences the entire height of the product, it is difficult to configure operation display panel 116 to be big. Therefore, the component is arranged in the front and rear surface of liquid crystal mounting base 126. In this manner, it is possible to effectively utilize a space inside operation display panel 116, and it is possible to widely utilize a display range.

[0105] Junction line 150 is disposed on the left side of transparent electrode 124. Junction line 150 is connected to control board unit 127, and has a function of transmitting operation information relating to which location on a display screen a user has touched. In addition, junction line 151 is disposed on the lower side of liquid crystal panel 125. Junction line 151 is connected to control board unit 127, and controls display contents of liquid crystal panel 125. Transparent glass plate 122, elastic body 123, liquid crystal panel 125, liquid crystal mounting base 126, and control board unit 127 are unitized, thereby configuring touch panel unit 152. Touch panel unit 152 alone may be attached to the rear surface of operation display panel 116. In addition, touch panel unit 152 may be attached to rear surface cover 133, and thereafter, may be attached to the rear surface of operation display panel 116 in a state where control board unit 132 or operation member 136 is assembled to operation display unit 153.

[0106] When transparent electrode 124 adheres to transparent glass plate 122, it is necessary to use special manufacturing equipment so that dirt does not cling thereto or bubbles are not generated. In addition, it is also necessary to perform a special performance inspection to check whether a user's finger touched position on transparent glass plate 122 is correctly recognized corresponding to a position of liquid crystal panel 125 and whether the sensitivity is normal. Transparent glass plate 122 is attached to liquid crystal mounting base 126 by an outer periphery thereof being covered with elastic body 123. Therefore, after touch panel unit 152 is assembled, it is possible to prevent the operation from being hindered due to a deviated positional relationship between transparent electrode 124 and liquid crystal panel 125, or to prevent transparent electrode 124 from having a problem of poor appearance caused by dirt clinging thereto.

[0107] In addition, liquid crystal panel 125 is attached to the front surface side of liquid crystal mounting base 126, and control board unit 127 is attached to the rear surface for unitization. In this manner, it is possible to shorten the length of junction lines 150 and 151 which are connected to control board unit 127. As a result, a configuration can be made so that malfunction caused by external noises is less likely to occur. It is possible to prevent the components from being unintentionally caught thereon and damaged during the assembly, thereby improving assembly performance. That is, touch panel unit 152 in a unitized state where the performance or appearance quality is ensured can be assembled to operation display panel 116. Accordingly, the quality can be stabilized and the assembly performance can be improved. In addition, if touch panel unit 152 is manufactured at a factory including inspection and manufacturing equipment required for the unitization, operation display unit 153 which does not require such equipment can be manufactured at a factory which does not include special equipment. In addition, it is also possible to employ a flexible production system in which the assembly work to operation display panel 116 is carried out at another factory.

[0108] As illustrated in FIG. 11B, in the vicinity of opening window 121, liquid crystal mounting base 126 is fastened to boss 141 which is formed on the rear surface of operation display panel 116 by using a screw. In general, since it is necessary to form a space of approximately 15 mm in order to form boss 141, the boss 141 is disposed at four locations on the right and left sides of opening window 121 where the space is available. However, boss 141 is not disposed on the upper and lower sides of opening window 121 so that the vertical width of liquid crystal panel 125 can be utilized to the maximum. Even in this configuration, as described above, transparent glass plate 122 is elastically held between liquid crystal mounting base 126 and operation display panel 116 by the outer periphery being covered with elastic body 123. Accordingly, the sealing performance is maintained, and thus it is possible to prevent water containing detergent from permeating into touch panel unit 152 through opening window 121. In order to ensure the sealing performance, it is effective to directly fasten the vicinity of opening window 121 by using a screw. In addition, rear surface cover 133 and liquid crystal mounting base 126 are co-fastened, thereby allowing the available space and the improved assembly performance.

[0109] As illustrated in FIGS. 13A, 13B, and 14, engagement portions 154 and 155 (first engagement portions) which engage with operation display panel 116 between bosses 141 (between screw fastened portions) are disposed in liquid crystal mounting base 126. As described above, it is difficult to dispose bosses 141 in the vertical direction of opening window 121 where space is not available. Accordingly, if liquid crystal panel 125 becomes horizontally wider, a distance between bosses 141 (between the screw fastened portions) becomes great. Consequently, floating of operation display panel 116 cannot be regulated. Therefore, engagement portion 154 is disposed on the upper side of liquid crystal mounting base 126 and engagement portion 155 is disposed on the lower side between bosses 141, thereby causing respective engagement portions 154 and 155 to engage with operation display panel 116. This regulates the floating between bosses 141, and thus it is possible to ensure the sealing performance over the entire region of opening window 121. Engagement portions 154 and 155 can be formed in a smaller space as compared to bosses 141. Accordingly, it is possible to ensure the sealing performance without sacrificing the vertical width of liquid crystal panel 125. Therefore, it is possible to improve the design and usability.

[0110] As illustrated in FIGS. 14, 15A, and 15B, opening 156 (first opening) is disposed in rear surface cover 133 which covers control board unit 127. Relay connector 157 of control board unit 127 is disposed and lid 158 (first lid) which covers opening 156 is disposed at a position corresponding to opening 156.

[0111] FIG. 14 illustrates a state where lid 158 is undone so that relay connector 157 is visible through opening 156. Relay connector 157 serves to connect control board unit 132 and control board unit 127 to each other. It is not necessary to attach rear surface cover 133 to operation display panel 116 in a state where both of these are connected to each other in advance. It is possible to connect both of these to each other later in the assembled state of operation display unit 153.

[0112] If relay connector 157 is connected before rear surface cover 133 is attached to operation display panel 116, the connection results in blind work in a state where relay lead wire 159 is covered with touch panel unit 152. In addition, it is necessary to loosen relay lead wire 159. Consequently, the assembly performance becomes poor. Moreover, there is a possibility that relay lead wire 159 may be caught thereon inside the unit. However, relay connector 157 is connected through opening 156 after operation display unit 153 is assembled, and lid 158 is lastly put thereon. In this manner, it is no longer necessary to loosen relay lead wire 159 unnecessarily. Therefore, it is possible to prevent relay lead wire 159 from being caught on inside operation display unit 153, thereby enabling the workability to be improved.

[0113] Relay connector 160 is also disposed at a position which is visible through opening 156 of control board unit 127. Accordingly, similar to above-described relay connector 157, after operation display unit 153 is assembled, relay lead wire 161 which is to be connected to a control device (not illustrated) arranged on the main body side can be connected to relay connector 160 through opening 156.

[0114] Relay lead wire 161 can creep around the outside of rear surface cover 133. Accordingly, it is not necessary to carry out the assembly work such as blind work to creep the inside. Therefore, it is possible to prevent relay lead wire 161 from being caught thereon inside operation display unit 153, thereby enabling the workability to be improved.

[0115] In addition, after relay lead wires 159 and 161 are connected to relay connectors 157 and 160, lid 158 is put on opening 156. In this manner, control board units 127 and 132, liquid crystal panel 125, and transparent electrode 124 are covered with rear surface cover 133 and operation display panel 116. Therefore, for example, it is possible to minimize a fitting gap to be approximately 0.5 mm over the entire region. This configuration prevents insects such as cockroaches or dirt from invading the inside of operation display unit 153 after operation display panel 116 is assembled to main body 101. Accordingly, over a long period of time, it is possible to prevent the product from being damaged.

[0116] In addition, as illustrated in FIGS. 14, 15A, and 15B, opening 162 (first opening) is disposed in rear surface cover 133 which covers control board unit 127. Connector 163 of control board unit 127 is disposed and lid 164 (second lid) which covers opening 162 is disposed at a position corresponding to opening 162. FIG. 14 illustrates a state where lid 164 is undone so that connector 163 is visible through opening 162. Connector 163 serves to write a control program, and is used, for example, when the control program is improved after the assembly of the product and the control program is needed to be written on a microcomputer of control board unit 127 at a factory or at a user's home.

[0117] Although a case of writing the control program does not occur so frequently, some cases occur in an initial stage of mass production. As the work for these cases, writing the control program can be performed in such a way that operation display panel 116 is detached from main body 101, lid 164 is undone so that connector 163 is visible through opening 162, and connector 163 is connected thereto. In this case, the user may not touch any electrical connection portion such as other connectors at all, and it is not necessary to detach rear surface cover 133 from operation display panel 116. Accordingly, the work becomes comfortable, and thus it is possible to prevent a secondary accident such as a mistake occurring during re-assembly.

[0118] In addition, opening 162 is covered with lid 164, thereby covering control board units 127 and 132, liquid crystal panel 125, and transparent electrode 124 with rear surface cover 133 and operation display panel 116. Therefore, for example, it is possible to minimize a fitting gap to be approximately 0.5 mm over the entire region. This configuration prevents insects such as cockroaches or dirt from invading the inside of operation display unit 153 after operation display panel 116 is assembled to main body 101. Accordingly, over a long period of time, it is possible to prevent the product from being damaged.

[0119] As described above, front-loading-type washing machine 200 according to the present embodiment includes rotary drum 103 that is rotatably driven, main body 101 that is the washing machine body for accommodating rotary drum 103, operation display panel 116 that is arranged in the upper part of the washing machine body and has opening window 121, and liquid crystal panel 125 that is attached to the rear surface side of operation display panel 116. In addition, front-loading-type washing machine 200 includes transparent glass plate 122 that is attached via elastic body 123 to the rear surface side of the portion where opening window 121 is disposed in operation display panel 116, and transparent electrode 124 that is mounted on the rear surface of transparent glass plate 122.

[0120] According to this configuration, when the operation content items are to be set, if the user directly touches display on transparent glass plate 122 and selects a selectable course, a subordinate display such as time setting for "washing" for example is further continuously shown. Accordingly, the user can perform a hierarchical operation in which the user determines the setting by touching the subordinate display. In addition, the operation buttons can be reduced, and the size of the character to be displayed can be increased. Accordingly, it is possible to improve operability and visibility. In addition, transparent glass plate 122 is attached to operation display panel 116 via elastic body 123. Therefore, it is possible to prevent water clinging to transparent glass plate 122 from permeating into the housing.

[0121] In addition, opening window 121 has a substantially rectangular shape, and is configured so that step difference H2 between operation display panel 116 and transparent glass plate 122 which are formed on left side 139 and right side 140 of opening window 121 is smaller than step difference H1 between operation display panel 116 and transparent glass plate 122 which are formed on upper side 137 and lower side 138 of opening window 121.

[0122] This configuration enables transparent glass plate 122 having a display function and an operation function to be shown as a visually larger image. Transparent glass plate 122 is located on the recess side (inner side of the housing) further from opening window 121 side, and is externally conspicuous. Accordingly, if an area occupied by operation display panel 116 of opening window 121 is small, the external design of transparent glass plate 122 may be shown as humble particularly when the light is turned off. However, according to the above-described configuration, transparent glass plate 122 can be shown as a horizontally larger image. Therefore, it is possible to improve the external design.

[0123] In addition, front-loading-type washing machine 200 according to the present embodiment further includes liquid crystal mounting base 126 to which liquid crystal panel 125 is attached, and control board unit 127 which controls liquid crystal panel 125 and transparent electrode 124. Transparent glass plate 122 is elastically held between liquid crystal mounting base 126 and operation display panel 116 via elastic body 123. Control board unit 127 is attached to the rear surface of liquid crystal mounting base 126.

[0124] As described above, liquid crystal panel 125 is attached to the front side of liquid crystal mounting base 126, and control board unit 127 is attached to the rear side, thereby enabling the space to be saved. Accordingly, the space inside operation display panel 116 can be widened, thereby enabling liquid crystal panel 125 to increase in size so as to widen a display range.

[0125] In addition, transparent glass plate 122, elastic body 123, liquid crystal panel 125, liquid crystal mounting base 126, and control board unit 127 are unitized, thereby configuring touch panel unit 152. Touch panel unit 152 is attached to operation display panel 116 or to rear surface cover 133 which covers control board unit 127.

[0126] According to this configuration, touch panel unit 152 remaining in a unitized state where the performance or appearance quality is ensured can be assembled to operation display panel 116 or rear surface cover 133. Accordingly, the quality can be stabilized, and the assembly performance can be improved. Furthermore, even at a factory which does not include inspection and manufacturing equipment required for the unitization, touch panel unit 152 can be assembled to operation display panel 116. Therefore, it is also possible to employ a flexible production system.

[0127] In addition, in the vicinity of opening window 121, liquid crystal mounting base 126 is fastened to the rear surface of operation display panel 116 by using a screw. According to this configuration, the sealing performance between transparent glass plate 122 and operation display panel 116 can be certainly maintained by elastic body 123, and thus it is possible to prevent water containing detergent from permeating into touch panel unit 152 through opening window 121.

[0128] In addition, liquid crystal mounting base 126 has the engagement portions 154 and 155 (first engagement portions) which engage with operation display panel 116 between the screw fastened portions.

[0129] According to this configuration, liquid crystal panel 125 is horizontally widened. In this manner, even when the screw fastened portions are apart from each other, engagement portions 154 and 155 can regulate the floating of operation display panel 116. Accordingly, elastic body 123 can certainly maintain the sealing performance between transparent glass plate 122 and operation display panel 116 over the entire region of opening window 121. Therefore, it is possible to prevent water containing detergent from permeating into touch panel unit 152 through opening window 121.

[0130] In addition, a configuration is adopted so as to further include opening 156 (first opening) which is disposed in rear surface cover 133, lid 158 (first lid) which covers opening 156, and relay connectors 157 and 160 which are disposed at the position corresponding to opening 156 of control board unit 127.

[0131] According to this configuration, after control board unit 127 or rear surface cover 133 is attached to operation display panel 116, relay connector 157 is connected from control board unit 127, and relay connector 160 is connected from main body 101 side. In this manner, lid 158 may be lastly undone. Accordingly, it is no longer necessary to loosen relay lead wire 159 unnecessarily. Therefore, it is possible to prevent relay lead wire 159 from being caught thereon inside operation display panel 116.

[0132] In addition, a configuration is adopted so as to further include opening 162 (second opening) which is disposed in rear surface cover 133, lid 164 which covers opening 162, and connector 163 for writing a control program which is disposed at the position corresponding to opening 162 of control board unit 127.

[0133] According to this configuration, for example, when the control program is improved and the control program is needed to be written on a microcomputer of control board unit 127, even without detaching rear surface cover 133 from operation display panel 116, the writing can be performed by connecting to connector 163 after lid 164 is undone. Therefore, the work becomes comfortable, and thus it is possible to prevent a secondary accident such as a mistake occurring during re-assembly.

(THIRD EXEMPLARY EMBODIMENT)

[0134] FIG. 16 is a view illustrating a cross-sectional configuration of front-loading-type washing machine 300 according to a third exemplary embodiment of the present invention.

[0135] As illustrated in FIG. 16, water tub 202 in a suspended state is arranged inside main body 201 which serves as a housing of front-loading-type washing machine 300. Rotary drum 203 formed in a bottomed cylinder shape is rotatably arranged inside water tub 202 in a state where a rotary shaft thereof tilts downward from a front surface side toward a rear surface side.

[0136] Laundry loading-unloading port 204 passing through an opening end of rotary drum 203 is formed on the front surface side of water tub 202. Front frame body 205 configures a front surface of main body 201. Opening 206 is disposed on an upward tilting surface formed on the front surface side of front frame body 205. A user can load laundry into and can unload the laundry from rotary drum 203 through laundry loading-unloading port 204 by opening door 209 which opens and closes opening 206. Door 209 is disposed on the upward tilting surface, thereby enabling the user to carry out laundry loading-unloading work without the user's waist having to be bent. This configuration can improve poor workability of the front-loading-type washing machine of a general type in which the rotary shaft of rotary drum 203 is disposed in a horizontal direction so that laundry is loaded and unloaded through an opening formed in a vertical direction.

[0137] Many through-holes 210 leading into water tub 202 are formed on a peripheral surface of rotary drum 203. Rotary drum 203 is rotatably driven in a forward direction and a rearward direction by motor 211 attached to the rear surface side of the water tub 202. In the water tub 202, water supply pipeline 212 and drain pipeline 213 are connected to each other by pipes. Water is supplied into and drained from water tub 202 by respectively controlling water supply valve 214 and drain valve 215.

[0138] Operation display panel 216 is arranged on an upper part of front frame body 205. On the lower left side when viewed from the front surface of operation display panel 216, detergent supply case 217 (refer to FIG. 18) is arranged in front frame body 205 in a state where detergent supply case 217 is drawable forward. Prior to an operation, the user supplies detergent to detergent supply case 217, and operates operation display panel 216 when necessary. This enables the user to perform setting of desired operation content items, operation start, and temporary stop, and to recognize a state of the operation in progress.

[0139] The user loads the laundry into rotary drum 203 by opening door 209 to start the operation of front-loading-type washing machine 300. Then, water supply valve 214 is opened, and water is supplied into detergent supply case 217. While the detergent supplied into detergent supply case 217 is caused to flow, water is supplied into water tub 202 so as to reach a predetermined amount via water supply pipeline 212. Then, rotary drum 203 is rotatably driven by motor 211 so as to start a washing step. In the washing step, an agitating operation of lifting and dropping the laundry in a rotation direction is repeatedly performed by rotating rotary drum 203.

[0140] After a predetermined time for washing elapses, drain valve 215 is opened to discharge soiled washing water

through drain pipeline 213. Then, the washing water contained in the laundry is spin-dried by a spin-drying operation for rotating rotary drum 203 at high speed. Thereafter, water is supplied into water tub 202 through water supply pipeline 212 to perform a rinsing step. In this rinsing operation, the agitating operation for the laundry is also repeatedly performed by rotating rotary drum 203 so as to perform rinsing.

[0141] Here, operation display panel 216 will be described in detail.

[0142] FIG. 17 is a front view of operation display panel 216 of front-loading-type washing machine 300 according to the third exemplary embodiment of the present invention. FIG. 18 is a perspective view of front-loading-type washing machine 300. FIG. 19 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel 216 of front-loading-type washing machine 300. FIG. 20A is a cross-sectional view taken along line 20A-20A in FIG. 17. FIG. 20B is a cross-sectional view taken along line 20B-20B in FIG. 17. FIG. 21 is an exploded perspective view of operation display panel 216 of front-loading-type washing machine 300.

[0143] Operation display panel 216 is arranged between the upper part of front frame body 205 and top plate 218. A front surface of transparent resin portion 219 of operation display panel 216 is covered with insert-molded film 220 (polyethylene terephthalate (PET) film), thereby configuring a colored, printed, and decorated surface. Opening window 221 having a substantially rectangular shape is disposed in the center of transparent resin portion 219.

[0144] Opening window 221 is a region where neither transparent resin portion 219 nor film 220 is formed. Transparent glass plate 222 is attached via elastic body 223 to a rear surface side of a portion where opening window 221 is disposed in operation display panel 216. Transparent electrode 224 adheres to a rear surface of transparent glass plate 222. In addition, liquid crystal panel 225 is mounted on liquid crystal mounting base 226 on the rear surface side of transparent glass plate 222. Control board unit 227 for controlling transparent electrode 224 or liquid crystal panel 225 is mounted on the rear surface of liquid crystal mounting base 226.

[0145] Operation display panel 216 has pressing operation button unit 228 and light emitting display unit 229. Control board unit 232 provided with switch 230 and light emitting element 231 is located inside operation display panel 216, and control board unit 232 is attached to rear surface cover 233.

[0146] Furthermore, operation member 236 having light guide route 234 for guiding light of light emitting element 231 to light emitting display unit 229 and button unit 235 for performing a pressing operation on switch 230 is disposed between operation display panel 216 and rear surface cover 233. Transparent resin portion 219 is not formed on pressing operation button unit 228, and only film 220 is present thereon, thereby enabling switch 230 to be operated using weak operation force. In addition, light emitting display unit 229 is printed by a highly transmissive material. Accordingly, light can be emitted therefrom so that the user can sufficiently recognize even light having low intensity which is emitted from light emitting element 231.

[0147] If the user presses a power-on button (one of buttons in pressing operation button unit 228), for example, a display as illustrated in Fig. 17 is shown on liquid crystal panel 225. The user can look at the display through transparent glass plate 222. Then, for example, if the user's finger touches a front surface of transparent glass plate 222 of a region where a "manual course" is displayed, the display is changed to a display screen for setting the number of or the time for "washing" steps, or the display is changed to a display screen for setting a water level, thereby enabling the user to gradually perform subordinate setting. A method in which the user directly touches the display screen for hierarchical setting is called a touch panel method. Transparent electrode 224 adhering to the rear surface of transparent glass plate 222 detects a change in electrostatic capacitance when a finger touches transparent glass plate 222. In this manner, a finger touched position is specified, thereby enabling display content items to be changed in accordance with the operation of the user.

[0148] In operation display panel 1050 in the related art as illustrated in FIG. 38, a display window in the center serves only to show display content items of liquid crystal panel 1051 through the transparent resin and the film insert-molded on the front surface thereof. Consequently, even the display location is determined. Accordingly, if the content items to be displayed increase, a character to be displayed decreases in size. In addition, too many setting buttons such as course button 1052 are arrayed side by side. Consequently, the user is less likely to understand which button is suitable for pressing, thereby causing a problem of poor operability. In addition, there is a problem of poor visibility, since the character to be displayed decreases in size.

[0149] In contrast, in the present embodiment, as described above, opening window 221 is disposed in operation display panel 216. Then, a configuration adopted in which transparent glass plate 222 having transparent electrode 224 adhering thereto is attached via elastic body 223 to the rear surface side of the portion where opening window 221 is disposed in operation display panel 216. This configuration enables the user to directly touch the display screen for the hierarchical setting. As a result, it is no longer necessary to dispose a fixed operation button at many locations, and thus, it is possible to considerably reduce the number of operation buttons. In addition, since liquid crystal panel 225 sufficiently functions by selectively choosing only the display content items required on each occasion. Accordingly, the display content items decrease, and thus the character to be displayed can increase in size. Therefore, it is possible to improve operability and visibility.

[0150] Here, a change in electrostatic capacitance is determined by dielectric constant of a finger touched material.

As the dielectric constant becomes higher, the change in the electrostatic capacitance becomes greater, and sensitivity becomes higher. In addition, high sensitivity means that a finger pressed position can be recognized accurately and quickly. Furthermore, for example, high sensitivity means that the user is less likely to perform erroneous detection to such an extent as to recognize a water droplet adhering state as a finger touched state, and that the user is less likely to perform the erroneous detection influenced by external noises.

[0151] For example, the dielectric constant of glass is approximately 9, the dielectric constant of acrylonitrile butadiene styrene (ABS) resin or PET resin is approximately 3, and the change in the electrostatic capacitance is inversely proportional to the thickness. Accordingly, for example, if a material of a finger touching portion is configured to be a glass plate, even when the glass plate has thickness three times the thickness as compared to the plate of the ABS resin or the PET resin, the glass plate can have equal sensitivity.

[0152] ABS resin or PET resin is a transparent resin forming material which is generally used as a material for operation display panel, and is used for transparent resin portion in the present embodiment and in the related art. In the related art, a transparent resin having the same thickness as others (approximately 3 mm) and a film (PET film) having a thickness of approximately 0.2 mm are insert-molded on a front surface of a display unit in the center. In contrast, operation display panel 216 according to the present embodiment is configured to have transparent glass plate 222 which has a thickness of approximately 2 mm, which has opening window 221, and in which transparent electrode 224 adheres to the rear surface side of the portion where opening window 221 is disposed in operation display panel 216. This configuration aims to allow at least the sensitivity to become higher.

[0153] For example, even when transparent electrode 224 directly adheres to the rear surface without disposing opening window 221 in operation display panel 216 and by thinning the thickness of transparent resin portion 219, there is a possibility that the sensitivity during the operation can become higher. However, since film 220 (PET film) is insert-molded on the front surface, it is necessary to arrange the thickness of transparent resin portion 219 to be 2.5 mm or thicker in order to prevent warp and deformation after molding while ensuring adhesive performance of film 220. Consequently, it is difficult to slim operation display panel 216 more than before.

[0154] In contrast, in order to obtain the sensitivity to such an extent as to enable the user to comfortably perform the operation during the user's operation, it is necessary to minimize the thickness of transparent resin portion 219 so as to be approximately 1.5 mm. Furthermore, when transparent electrode 224 adheres to operation display panel 216, it is necessary to perform pressurizing and heating using dedicated equipment after the adhering so as not to leave air bubbles therein, or in order to improve adhesive performance. In this case, it is necessary to use huge equipment in order to accept overall operation display panel 216. Consequently, it is not possible to improve productivity. For the above-described reason, the present embodiment does not adopt a configuration in which transparent electrode 224 directly adheres to operation display panel 216.

[0155] In the present embodiment, opening window 221 is disposed in operation display panel 216, and transparent glass plate 222 to which transparent electrode 224 adheres from the rear surface side is attached via elastic body 223 to the rear surface side of the portion where opening window 221 is disposed in operation display panel 216. In this manner, the user looks at the display on liquid crystal panel 225, and touches the front surface of transparent glass plate 222 with the user's finger. Accordingly, the user can set various operation content items when necessary.

[0156] In the present embodiment, in order to prevent transparent glass plate 222 from being damaged due to unexpected external force being applied thereto, the thickness of transparent glass plate 222 is set to approximately 2 mm. As described above, the dielectric constant of the glass is higher than the dielectric constant of ABS resin. Accordingly, even this thickness can sufficiently increase the sensitivity during the operation, and a finger pressed position can be recognized accurately and quickly. In addition, for example, it is possible to realize a configuration in which the user is less likely to perform erroneous detection to such an extent as to recognize a water droplet adhering state as a finger touched state, and in which the user is less likely to perform the erroneous detection influenced by external noises.

[0157] Electronic components such as liquid crystal panel 225 and control board unit 227 are arranged on the rear side of transparent glass plate 222. Accordingly, waterproofing is required therein. Therefore, in the present embodiment, an outer peripheral portion of transparent glass plate 222 having a substantially rectangular shape is covered with elastic body 223 having a frame shape, and transparent glass plate 222 is attached via elastic body 223 to the rear surface side of the portion where opening window 221 having a substantially rectangular shape is disposed in operation display panel 216. Inside upper side 237 of opening window 221 and inside lower side 238, in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 222, transparent glass plate 222 is attached between operation display panel 216 and liquid crystal mounting base 226 via elastic body 223 in a waterproofing manner.

[0158] In addition, inside left side 239 of opening window 221 and inside right side 240, in two directions on the rear surface side and the end surface side of transparent glass plate 222, transparent glass plate 222 is attached between operation display panel 216 and liquid crystal mounting base 226 via elastic body 223 in a waterproofing manner.

[0159] Furthermore, boss 241 is disposed in the vicinity of four corners of opening window 221 on the rear surface of operation display panel 216, and liquid crystal mounting base 226 and rear surface cover 233 are fastened together by

using a screw. In a fastening state using the screw, elastic body 223 is pressed by liquid crystal mounting base 226, thereby causing transparent glass plate 222 and operation display panel 216 to closely adhere to each other. This ensures waterproofness of opening window 221. Accordingly, even when the user spills water on opening window 221 by mistake, it is possible to enhance safety without any possibility that the water may cling to the electronic components such as liquid crystal panel 225 and control board unit 227 which are disposed thereinside.

[0160] In the present embodiment, an example has been described in which liquid crystal mounting base 226 and rear surface cover 233 are co-fastened. However, the present invention is not limited to this example. Even when liquid crystal mounting base 226 alone is fastened to operation display panel 216 by using a screw, the same advantageous effect can be obtained.

[0161] In addition, transparent glass plate 222 is attached via elastic body 223 to the rear surface side of the portion where opening window 221 is disposed in operation display panel 216. In this manner, it is possible to prevent transparent glass plate 222 from being damaged due to externally applied impact. For example, when the user drops something on transparent glass plate 222, an impact load is applied to transparent glass plate 222. In addition, an impact force is also similarly applied thereto, when the product is dropped or rolled from a loaded state in the middle of a distribution stage where the packaged product is delivered to a user's home. Operation display panel 216 is made of the resin, thereby absorbing the impact little bit. However, transparent glass plate 222 has hardness which is weak on the impact. Accordingly, elastic body 223 is arranged on the outer periphery of transparent glass plate 222, thereby allowing transparent glass plate 222 to have a soft structure. Therefore, it is possible to prevent damage even when an impact is externally applied thereto.

[0162] As compared to ABS resin, glass has a linear expansion coefficient which is one digit smaller. Depending on places where the product is installed in the user's home, a temperature difference greatly varies in summer or winter. In addition, even in a state where the packaged product is stored at a warehouse, a considerable temperature difference occurs depending on seasons or regional differences. When components having very different linear expansion coefficients are assemble to each other, the components have to employ a structure for absorbing deformation caused by a thermal expansion difference. Otherwise, the components become damaged in some cases.

[0163] Therefore, in the present embodiment, transparent glass plate 222 is attached via elastic body 223 to the rear surface side of the portion where opening window 221 is disposed in operation display panel 216. In this manner, even when a thermal expansion difference causes a dimensional change to occur between transparent glass plate 222 and operation display panel 216 or liquid crystal mounting base 226, the dimensional change is absorbed by elastic body 223. Accordingly, it is possible to prevent the components from being damaged.

[0164] In addition to a region inside opening window 221 by which the user touches transparent glass plate 222 to set operation content items, some pressing operation button units 228 such as a power-on button, a power-off button, and a start button are also arranged in operation display panel 216. The user directly touches transparent glass plate 222 to set the operation content items in accordance with the content items displayed on liquid crystal panel 225. In this manner, it is also possible to remove pressing operation button units 228.

[0165] However, if the fixed button which is always visible from the outside does not remain, the user may wonder what to do when the user makes a mistake in the middle of an operation and wants to return to a prior operation, or when a certain disadvantage occurs during an operation and the user wants to stop the operation immediately. In order to prevent this case, the fixed operation button is configured to remain.

[0166] In addition, in the present embodiment, switch 230 operated by pressing pressing operation button unit 228 and light emitting element 231 emitting light for light emitting display unit 229 are mounted on control board unit 232. Then, control board unit 232 is separated from control board unit 227 which controls transparent electrode 224 and liquid crystal panel 225, control board unit 232 is attached to rear surface cover 233, and control board unit 227 is attached to the rear surface of liquid crystal mounting base 226.

[0167] The reason that control board units 227 and 232 are separated from each other in this way is that a front surface shape of operation display panel 216 is a round shape which moves further rearward as the shape goes from the center position to the end position of the product. Since operation display panel 216 has the round shape, as compared to control board unit 227 placed in the vicinity of the center position, the position of control board unit 232 placed at the right end is moved relatively rearward. Consequently, control board units 227 and 232 are arranged to have steps different from each other, and are less likely to be a single configuration member. Accordingly, for example, if the front surface shape of operation display panel 216 is adapted to be a shape close to a plane, it is possible to adopt a configuration in which control board units 227 and 232 are attached to the rear surface of liquid crystal mounting base 226 by integrally configuring control board units 227 and 232.

[0168] Next, a concavity step difference between transparent resin portion 219 and transparent glass plate 222 which are formed on the respective upper, lower, left, and right sides of opening window 221 having a rectangular shape will be described. As illustrated in FIG. 20A, front surface concavity step difference H2 between operation display panel 216 and transparent glass plate 222 on left side 239 and right side 240 of opening window 221 is smaller than front surface concavity step difference H1 between operation display panel 216 and transparent glass plate 222 on upper side 237

and lower side 238 of opening window 221 illustrated in FIG. 19. The front surface concavity step differences are obtained by adding the thickness of transparent resin portion 219 covered on transparent glass plate 222 to the thickness of elastic body 223 if elastic body 223 is interposed therebetween.

[0169] As described above, inside left side 239 and inside right side 240 of opening window 221, elastic body 223 is interposed therebetween in two directions on the rear surface side and the end surface side of transparent glass plate 222. However, the front surface side is in direct contact with transparent resin portion 219. Accordingly, front surface concavity step difference H2 is sufficiently obtained when configured to have a thickness of approximately 2.5 mm which enables insert-molding without any problem.

[0170] In contrast, as illustrated in FIG. 19, inside upper side 237 and inside lower side 238 of opening window 221, elastic body 223 is interposed therebetween in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 222. Accordingly, front surface concavity step difference H1 becomes approximately 4.5 mm by adding the thickness of 3 mm in transparent resin portion 219 to the thickness of 1.5 mm in elastic body 223, and thus becomes greater than front surface concavity step difference H2. Then, a difference between front surface concavity step difference H1 and front surface concavity step difference H2 is absorbed by step difference H3 of stepped portion 242 formed on the left side further from left side 239 and step difference H3 of stepped portion 242 formed on the right side further from right side 240.

[0171] Opening window 221 is recessed by one step from the front surface of operation display panel 216, and thus is externally conspicuous. If horizontal width L1 of opening window is too small as compared to entire width L0 of operation display panel 216, the glass formed portion serving as the display unit leaves poor impression, thereby causing a design problem of a spoiled sense of quality. When information is displayed on liquid crystal panel 225 and the user sets the operation content items, or when operation conditions of the product are displayed, light is brightly turned on inside opening window 221. Accordingly, the design problem does not matter. However, when the light is turned off, the recessed region of opening window 221 is likely to be more conspicuous as an external recess.

[0172] If horizontal width L1 of opening window 221 is increased and a ratio of operation display panel 216 to entire width L0 is set to be approximately 40% for example, the recessed region of opening window 221 can raise a sense of presence and can obtain improved design. However, since entire width L0 is approximately 600 mm, it is necessary to set horizontal width L1 of opening window 221 to be approximately 240 mm. Transparent glass plate 222 large enough to that extent is less likely to be attached to operation display panel 216 so as to withstand an impact force while the waterproofness is ensured. In addition, if opening window 221 large enough to that extent is disposed in operation display panel 216 itself, strength of the component becomes weaker. Consequently, it is difficult to prevent warp and deformation after molding. Furthermore, transparent glass plate 222 and transparent electrode 224 increase in size, thereby increasing the production cost.

[0173] In the present embodiment, front surface concavity step difference H2 between operation display panel 216 and transparent glass plate 222 on left side 239 and right side 240 of opening window 221 is adapted to be smaller than front surface concavity step difference H1 between operation display panel 216 and transparent glass plate 222 on upper side 237 and lower side 238. Then, the difference between front surface concavity step difference H1 and front surface concavity step difference H2 is absorbed by step difference H3 of stepped portion 242 formed on the left side further from left side 239 and step difference H3 of stepped portion 242 formed on the right side further from right side 240. That is, front surface concavity step difference H1 is substantially equal to the sum of front surface concavity step difference H2 and step difference H3. As described above, in addition to horizontal width L1 of opening window 221, horizontal width L2 between the stepped portions 242 spreading outward therefrom is provided. In this manner, the recessed region which is externally conspicuous becomes visible more widely.

[0174] Horizontal width L1 of opening window 221 relates to a size of transparent glass plate 222, transparent electrode 224, and liquid crystal panel 225. Specifically, horizontal width L1 is set to be approximately 150 mm so as to have a size large enough to protect these electronic components from externally permeating water, to withstand externally applied impact, and to prevent damage. However, the size is too small as compared to the entire width (L0 = 600 mm) of operation display panel 216, thereby showing an externally humble image. Accordingly, the recessed region of horizontal width (L2 = 260 mm) between stepped portions 242 is disposed outside opening window 221. That is, according to this configuration, horizontal width L2 of the recessed region can be set to have a size of approximately 40% as compared to entire width L0 of operation display panel 216. Accordingly, the recessed region can be externally recognized, can raise a sense of presence, and can obtain improved design.

[0175] Horizontal width L2 between stepped portions 242 does not affect an internal structure in terms of waterproofness and strength. Accordingly, horizontal width L2 can be freely set. In addition, in order to decrease step difference H2 on left side 239 and right side 240 of opening window 221, the front surface side of transparent glass plate 222 is brought into contact with operation display panel 216. However, a configuration is made so that elastic body 223 is interposed between the rear surface side and the end surface side of transparent glass plate 222, is fastened in boss 241 by using a screw, and is pressed between liquid crystal mounting base 226 and operation display panel 216. This configuration ensures the waterproofness without causing a possibility that water flowing from the front surface side of transparent

glass plate 222 may permeate into opening window 221. In addition, even when an impact is applied from the outside, the impact is absorbed by elastic body 223. Accordingly, it is possible to prevent the components from being damaged.

[0176] FIG. 22A is a view illustrating a cross-sectional configuration in the vicinity of upper side 237 of operation display panel 216 of front-loading-type washing machine 300 according to the third exemplary embodiment of the present invention. FIG. 22B is a view illustrating a cross-sectional configuration in the vicinity of lower side 238 of operation display panel 216. FIG. 23 is a view illustrating a cross-sectional configuration in the vicinity of engagement portion 257 of operation display panel 216.

[0177] Transparent glass plate 222 is elastically held between liquid crystal mounting base 226 and operation display panel 216 via elastic body 223. Liquid crystal panel 225 is attached to transparent glass plate 222 side of liquid crystal mounting base 226, and control board unit 227 is attached to the rear surface of liquid crystal mounting base 226. Door 209 and detergent supply case 217 are arranged on the lower side of operation display panel 216. Since the upper side influences the entire height of the product, it is difficult to configure operation display panel 216 to be big. Therefore, the component is arranged in the front and rear surface of liquid crystal mounting base 226. In this manner, it is possible to effectively utilize a space inside operation display panel 116, and it is possible to widely utilize a display range.

[0178] Junction line 250 is disposed on the left side of transparent electrode 224. Junction line 250 is connected to control board unit 227, and has a function of transmitting operation information relating to which location on a display screen a user has touched. In addition, junction line 251 is disposed on the lower side of liquid crystal panel 225. Junction line 251 is connected to control board unit 227, and controls display contents of liquid crystal panel 225. Transparent glass plate 222, elastic body 223, liquid crystal panel 225, liquid crystal mounting base 226, and control board unit 227 are unitized, thereby configuring touch panel unit 252. Touch panel unit 252 alone may be attached to the rear surface of operation display panel 216. In addition, touch panel unit 252 may be attached to rear surface cover 233, and thereafter, may be attached to the rear surface of operation display panel 216 in a state where control board unit 232 or operation member 236 is assembled to operation display unit 253.

[0179] When transparent electrode 224 adheres to transparent glass plate 222, it is necessary to use special manufacturing equipment so that dirt does not cling thereto or bubbles are not generated. In addition, it is also necessary to perform a special performance inspection to check whether a user's finger touched position on transparent glass plate 222 is correctly recognized corresponding to a position of liquid crystal panel 225 and whether the sensitivity is normal. Transparent glass plate 222 is attached to liquid crystal mounting base 226 by an outer periphery thereof being covered with elastic body 223. Therefore, after touch panel unit 252 is assembled, it is possible to prevent the operation from being hindered due to a deviated positional relationship between transparent electrode 224 and liquid crystal panel 225, or to prevent the transparent electrode 224 from having a problem of poor appearance caused by dirt clinging thereto.

[0180] In addition, liquid crystal panel 225 is attached to the front surface side of liquid crystal mounting base 226, and control board unit 227 is attached to the rear surface for unitization. In this manner, it is possible to shorten the length of junction lines 250 and 251 which are connected to control board unit 227. As a result, a configuration can be made so that malfunction caused by external noises is less likely to occur. It is possible to prevent the components from being unintentionally caught thereon and damaged during the assembly, thereby improving assembly performance. That is, touch panel unit 252 in a unitized state where the performance or appearance quality is ensured can be assembled to operation display panel 216. Accordingly, the quality can be stabilized and the assembly performance can be improved. In addition, if the touch panel unit 252 is manufactured at a factory including inspection and manufacturing equipment required for the unitization, operation display unit 253 which does not require such equipment can be manufactured at a factory which does not include special equipment. In addition, it is also possible to employ a flexible production system in which the assembly work to operation display panel 216 is carried out at another factory.

[0181] As illustrated in FIG. 20B, in the vicinity of opening window 221, liquid crystal mounting base 226 is fastened to boss 241 which is formed on the rear surface of operation display panel 216 by using a screw. In general, since it is necessary to form a space of approximately 15 mm in order to form boss 241, boss 241 is disposed at four locations on the right and left sides of opening window 221 where space is available. However, boss 241 is not disposed on the upper and lower sides of opening window 221 so that the vertical width of liquid crystal panel 225 can be utilized to the maximum. Even in this configuration, as described above, transparent glass plate 222 is elastically held between liquid crystal mounting base 226 and operation display panel 216 by the outer periphery being covered with elastic body 223. Accordingly, the sealing performance is maintained, and thus it is possible to prevent water containing detergent from permeating into touch panel unit 252 through opening window 221. In order to ensure the sealing performance, it is effective to directly fasten the vicinity of opening window 221 by using a screw. In addition, rear surface cover 233 and liquid crystal mounting base 226 are co-fastened, thereby allowing the available space and the improved assembly performance.

[0182] As illustrated in FIGS. 22A and 22B, engagement portions 254 and 255 (first engagement portions) which engage with operation display panel 216 between bosses 241 (between screw fastened portions) are disposed in liquid crystal mounting base 226. As described above, it is difficult to dispose bosses 241 in the vertical direction of opening window 221 where space is not available. Accordingly, if liquid crystal panel 225 becomes horizontally wider, a distance

between bosses 241 (between the screw fastened portions) becomes great. Consequently, floating of operation display panel 216 cannot be regulated. Therefore, engagement portion 254 is disposed on the upper side of liquid crystal mounting base 226 and engagement portion 255 is disposed on the lower side between bosses 241, thereby causing respective engagement portions 254 and 255 to engage with operation display panel 216. This regulates the floating between bosses 241, and thus it is possible to ensure the sealing performance over the entire region of opening window 221. Engagement portions 254 and 255 can be formed in a smaller space as compared to bosses 241. Accordingly, it is possible to ensure the sealing performance without sacrificing the vertical width of liquid crystal panel 225. Therefore, it is possible to improve the design and usability.

[0183] As illustrated in FIG. 22B, engagement portion 256 (second engagement portion) which engages with front frame body 205 is disposed in a portion on lower side 238 of liquid crystal mounting base 226, thereby regulating forward floating of operation display panel 216. Liquid crystal mounting base 226 engages with operation display panel 216 by using above-described engagement portion 255. Accordingly, without causing operation display panel 216 to engage with front frame body 205, it is possible to suppress the forward floating of operation display panel 216. In general use, a force causing a product to float forward is not applied to operation display panel 216. However, for example, if the product in a packaged state is dropped or rolled during cargo handling, there is a possibility that a force detaching operation display panel 216 forward may be applied to operation display panel 216. Accordingly, engagement portion 256 of liquid crystal mounting base 226 is configured to engage with front frame body 205. In this manner, it is possible to prevent operation display panel 216 from being detached forward from the product.

[0184] In addition, if operation display panel 216 floats forward from the product, a gap is generated between front frame body 205 and operation display panel 216, thereby causing a problem in that the gap moving when pressed degrades the product, or that water droplets or dust permeating into the product through the gap adversely affects the quality. In the present embodiment, engagement portion 256 of liquid crystal mounting base 226 is configured to engage with front frame body 205. In this manner, it is possible to prevent operation display panel 216 from floating forward from the product.

[0185] In place of the above-described configuration, operation display panel 216 may be configured to directly engage with front frame body 205. However, in this case, there is a problem in that a wide vertical width for liquid crystal panel 225 is not available. Operation display panel 216 is configured to have a convex shape obliquely upward from an outer shape which is formed by top plate 218 and front frame body 205, and a vertical wall is present on the lower side. When the engagement portion is disposed in the lower portion of operation display panel 216, the engagement portion is to be separately disposed so as to be apart from the vertical wall. Otherwise, the vertical wall becomes thicker, and thus sink marks are generated on the surface, thereby causing a problem of poor appearance. Furthermore, the liquid crystal mounting base 226 also has to escape from the engagement portion. Consequently, to that extent, it becomes necessary to decrease the size of liquid crystal panel 225. With regard to these problems, engagement portion 256 of liquid crystal mounting base 226 is configured to engage with front frame body 205. In this manner, without sacrificing the vertical width of liquid crystal panel 225, it is possible to prevent operation display panel 216 from floating or being detached from front frame body 205.

[0186] In addition, as illustrated in FIG. 23, engagement portion 257 (third engagement portion) which engages with front frame body 205 is also disposed in the lower portion of rear surface cover 233, thereby regulating operation display panel 216 so as not to float forward from the product. Rear surface cover 233 is fastened to operation display panel 216. Accordingly, without causing operation display panel 216 to engage with front frame body 205, it is possible to regulate operation display panel 216 so as not to float forward from the product.

[0187] Operation display panel 216 has a long shape which is present up to both ends of the product. However, engagement portion 256 of liquid crystal mounting base 226 can prevent operation display panel 216 from floating or being detached from front frame body 205 in a range where liquid crystal mounting base 226 is present in the center portion, and engagement portion 257 of the rear surface cover 233 can prevent operation display panel 216 from floating or being detached from front frame body 205 in a range where liquid crystal mounting base 226 is not present. Accordingly, it is not necessary to form the engagement portion on the lower side of operation display panel 216. Without sacrificing the vertical width of liquid crystal panel 225 or control board unit 232, it is possible to prevent operation display panel 216 from floating or being detached therefrom.

[0188] As described above, front-loading-type washing machine 300 according to the present embodiment includes rotary drum 203 that is rotatably driven, main body 201 that is the washing machine body for accommodating rotary drum 203, operation display panel 216 that is arranged in the upper part of the washing machine body and has opening window 221, and liquid crystal panel 225 that is attached to the rear surface side of operation display panel 216. In addition, front-loading-type washing machine 300 includes transparent glass plate 222 that is attached via elastic body 223 to the rear surface side of the portion where opening window 221 is disposed in operation display panel 216, and transparent electrode 224 that is mounted on the rear surface of transparent glass plate 222.

[0189] According to this configuration, when the operation content items are to be set, if the user directly touches display on transparent glass plate 222 and selects a selectable course, a subordinate display such as time setting for

"washing" for example is further continuously shown. Accordingly, the user can perform a hierarchical operation in which the user determines the setting by touching the subordinate display. In addition, the operation buttons can be reduced, and the size of the character to be displayed can be increased. Accordingly, it is possible to improve operability and visibility. In addition, transparent glass plate 222 is attached to operation display panel 216 via elastic body 223. Therefore, it is possible to prevent water clinging to transparent glass plate 222 from permeating into the housing.

[0190] In addition, opening window 221 has a substantially rectangular shape, and is configured so that step difference H2 between operation display panel 216 and transparent glass plate 222 which are formed on left side 239 and right side 240 of opening window 221 is smaller than step difference H1 between operation display panel 216 and transparent glass plate 222 which are formed on upper side 237 and lower side 238 of opening window 221.

[0191] This configuration enables transparent glass plate 222 having a display function and an operation function to be shown as a visually larger image. Transparent glass plate 222 is located on the recess side (inner side of the housing) further from opening window 221 side, and is externally conspicuous. Accordingly, if an area occupied by operation display panel 216 of opening window 221 is small, the external design of transparent glass plate 222 may be shown as humble particularly when the light is turned off. However, according to the above-described configuration, transparent glass plate 222 can be shown as a horizontally larger image. Therefore, it is possible to improve the external design.

[0192] In addition, front-loading-type washing machine 300 according to the present embodiment further includes liquid crystal mounting base 226 to which liquid crystal panel 225 is attached, and control board unit 227 which controls liquid crystal panel 225 and transparent electrode 224. Transparent glass plate 222 is elastically held between liquid crystal mounting base 226 and operation display panel 216 via elastic body 223. Control board unit 227 is attached to the rear surface of liquid crystal mounting base 226.

[0193] As described above, liquid crystal panel 225 is attached to the front side of liquid crystal mounting base 226, and control board unit 227 is attached to the rear side, thereby enabling the space to be saved. Accordingly, the space inside operation display panel 216 can be widened, thereby enabling liquid crystal panel 225 to increase in size so as to widen a display range.

[0194] In addition, transparent glass plate 222, elastic body 223, liquid crystal panel 225, liquid crystal mounting base 226, and control board unit 227 are unitized, thereby configuring touch panel unit 252. Touch panel unit 252 is attached to operation display panel 216 or to rear surface cover 233 which covers control board unit 227.

[0195] According to this configuration, touch panel unit 252 remaining in a unitized state where the performance or appearance quality is ensured can be assembled to operation display panel 216 or rear surface cover 233. Accordingly, the quality can be stabilized, and the assembly performance can be improved. Furthermore, even at a factory which does not include inspection and manufacturing equipment required for the unitization, touch panel unit 252 can be assembled to operation display panel 216. Therefore, it is also possible to employ a flexible production system.

[0196] In addition, in the vicinity of opening window 221, liquid crystal mounting base 226 is fastened to the rear surface of operation display panel 216 by using a screw. According to this configuration, the sealing performance between transparent glass plate 222 and operation display panel 216 can be certainly maintained by elastic body 223, and thus it is possible to prevent water containing detergent from permeating into touch panel unit 252 through opening window 221.

[0197] In addition, front frame body 205 arranged on the front surface side of main body 201 serving as the washing machine body is further provided. Liquid crystal mounting base 226 has engagement portions 254 and 255 (first engagement portion) which engage with operation display panel 216, and engagement portion 256 (second engagement portion) which engages with front frame body 205.

[0198] According to this configuration, liquid crystal mounting base 226 is configured to engage with front frame body 205. In this manner, it is no longer necessary to dispose the engagement portion with front frame body 205 in operation display panel 216, thereby enabling liquid crystal panel 225 to increase in size so as to widen a display range.

[0199] In addition, rear surface cover 233 which covers control board unit 227 and is attached to operation display panel 216 is further provided. Rear surface cover 233 has engagement portion 257 (third engagement portion) which engages with front frame body 205.

[0200] According to this configuration, operation display panel 216 can be attached to front frame body 205 even without disposing the engagement portion with front frame body 205 in operation display panel 216. Accordingly, it is possible to prevent dust or water droplets from permeating into operation display panel 216 through the gap generated by floating of operation display panel 216.

(FOURTH EXEMPLARY EMBODIMENT)

[0201] FIG. 24 is a view illustrating a cross-sectional configuration of front-loading-type washing machine 400 according to a fourth exemplary embodiment of the present invention.

[0202] As illustrated in FIG. 24, water tub 302 in a suspended state is arranged inside main body 301 which serves as a housing of front-loading-type washing machine 400. Rotary drum 303 formed in a bottomed cylinder shape is rotatably arranged inside water tub 302 in a state where a rotary shaft thereof tilts downward from a front surface side

toward a rear surface side.

[0203] Laundry loading-unloading port 304 passing through an opening end of rotary drum 303 is formed on the front surface side of water tub 302. Front frame body 305 configures a front surface of main body 301. Opening 306 is disposed on an upward tilting surface formed on the front surface side of front frame body 305. A user can load laundry into and can unload the laundry from rotary drum 303 through laundry loading-unloading port 304 by opening door 309 which opens and closes opening 306. Door 309 is disposed on the upward tilting surface, thereby enabling the user to carry out laundry loading-unloading work without the user's waist having to be bent. This configuration can improve poor workability of the front-loading-type washing machine of a general type in which the rotary shaft of rotary drum 303 is disposed in a horizontal direction so that laundry is loaded and unloaded through an opening formed in a vertical direction.

[0204] Many through-holes 310 leading into water tub 302 are formed on a peripheral surface of rotary drum 303. Rotary drum 303 is rotatably driven in a forward direction and a rearward direction by motor 311 attached to the rear surface side of water tub 302. In water tub 302, water supply pipeline 312 and drain pipeline 313 are connected to each other by pipes. Water is supplied into and drained from water tub 302 by respectively controlling water supply valve 314 and drain valve 315.

[0205] Operation display panel 316 is arranged on an upper part of front frame body 305. On the lower left side when viewed from the front surface of operation display panel 316, detergent supply case 317 (refer to FIG. 26) is arranged in front frame body 305 in a state where detergent supply case 317 is drawable forward. Prior to an operation, the user supplies detergent to detergent supply case 317, and operates operation display panel 316 when necessary. This enables the user to perform setting of desired operation content items, operation start, and temporary stop, and to recognize a state of the operation in progress.

[0206] The user loads the laundry into rotary drum 303 by opening door 309 to start the operation of front-loading-type washing machine 400. Then, water supply valve 314 is opened, and water is supplied into detergent supply case 317. While the detergent supplied into detergent supply case 317 is caused to flow, water is supplied into water tub 302 so as to reach a predetermined amount via water supply pipeline 312. Then, rotary drum 303 is rotatably driven by motor 311 so as to start a washing step. In the washing step, an agitating operation of lifting and dropping the laundry in a rotation direction is repeatedly performed by rotating rotary drum 303.

[0207] After a predetermined time for washing elapses, drain valve 315 is opened to discharge soiled washing water through drain pipeline 313. Then, the washing water contained in the laundry is spin-dried by a spin-drying operation for rotating rotary drum 303 at high speed. Thereafter, water is supplied into the water tub 302 through water supply pipeline 312 to perform a rinsing step. In this rinsing operation, the agitating operation for the laundry is also repeatedly performed by rotating rotary drum 303 so as to perform rinsing.

[0208] Here, operation display panel 316 will be described in detail.

[0209] FIG. 25 is a front view of operation display panel 316 of front-loading-type washing machine 400 according to the fourth exemplary embodiment of the present invention. FIG. 26 is a perspective view of front-loading-type washing machine 400. FIG. 27 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel 316 of front-loading-type washing machine 400. FIG. 28A is a cross-sectional view taken along line 28A-28A in FIG. 25. FIG. 28B is a cross-sectional view taken along line 28B-28B in FIG. 25. FIG. 29 is an exploded perspective view of operation display panel 316 of front-loading-type washing machine 400. In addition, FIG. 30 is a perspective view of an elastic body 323 of front-loading-type washing machine 400.

[0210] Operation display panel 316 is arranged between the upper part of front frame body 305 and top plate 318. A front surface of transparent resin portion 319 of operation display panel 316 is covered with insert-molded film 320 (polyethylene terephthalate (PET) film), thereby configuring a colored, printed, and decorated surface. Opening window 321 having a substantially rectangular shape is disposed in the center of transparent resin portion 319.

[0211] Opening window 321 is a region where neither transparent resin portion 319 nor film 320 is formed. Transparent glass plate 322 is attached via elastic body 323 to a rear surface side of a portion where opening window 321 is disposed in operation display panel 316. Transparent electrode 324 adheres to a rear surface of transparent glass plate 322. In addition, liquid crystal panel 325 is mounted on liquid crystal mounting base 326 on the rear surface side of transparent glass plate 322. Control board unit 327 for controlling transparent electrode 324 or liquid crystal panel 325 is mounted on the rear surface of liquid crystal mounting base 326.

[0212] Operation display panel 316 has pressing operation button unit 328 and light emitting display unit 329. Control board unit 332 provided with switch 330 and light emitting element 331 is located inside operation display panel 316, and control board unit 332 is attached to rear surface cover 333.

[0213] Furthermore, operation member 336 having light guide route 334 for guiding light of light emitting element 331 to light emitting display unit 329 and button unit 335 for performing a pressing operation on switch 330 are disposed between operation display panel 316 and rear surface cover 333. Transparent resin portion 319 is not formed on pressing operation button unit 328, and only film 320 is present thereon, thereby enabling switch 330 to be operated using weak operation force. In addition, light emitting display unit 329 is printed by a highly transmissive material. Accordingly, light can be emitted therefrom so that the user can sufficiently recognize even light having low intensity which is emitted from

the light emitting element 331.

[0214] If the user presses a power-on button (one of buttons in pressing operation button unit 328), for example, a display as illustrated in Fig. 25 is shown on liquid crystal panel 325. The user can look at the display through transparent glass plate 322. Then, for example, if the user's finger touches a front surface of transparent glass plate 322 of a region where a "manual course" is displayed, the display is changed to a display screen for setting the number of or the time for "washing" steps, or the display is changed to a display screen for setting a water level, thereby enabling the user to gradually perform subordinate setting. A method in which the user directly touches the display screen for hierarchical setting is called a touch panel method. Transparent electrode 324 adhering to the rear surface of transparent glass plate 322 detects a change in electrostatic capacitance when a finger touches transparent glass plate 322. In this manner, a finger touched position is specified, thereby enabling display content items to be changed in accordance with the operation of the user.

[0215] In operation display panel 1050 in the related art as illustrated in FIG. 38, a display window in the center serves only to show display content items of liquid crystal panel 1051 through the transparent resin and the film insert-molded on the front surface thereof. Consequently, even the display location is determined. Accordingly, if the content items to be displayed increase, a character to be displayed decreases in size. In addition, too many setting buttons such as course button 1052 are arrayed side by side. Consequently, the user is less likely to understand which button is suitable for pressing, thereby causing a problem of poor operability. In addition, there is a problem of poor visibility, since the character to be displayed decreases in size.

[0216] In contrast, in the present embodiment, as described above, opening window 321 is disposed in operation display panel 316. Then, a configuration adopted in which transparent glass plate 322 having transparent electrode 324 adhering thereto is attached via elastic body 323 to the rear surface side of the portion where opening window 321 is disposed in operation display panel 316. This configuration enables the user to directly touch the display screen for the hierarchical setting. As a result, it is no longer necessary to dispose a fixed operation button at many locations, and thus, it is possible to considerably reduce the number of operation buttons. In addition, since liquid crystal panel 325 sufficiently functions by selectively choosing only the display content items required on each occasion. Accordingly, the display content items decrease, and thus the character to be displayed can increase in size. Therefore, it is possible to improve operability and visibility.

[0217] Electronic components such as liquid crystal panel 325 and control board unit 327 are arranged on the rear side of transparent glass plate 322. Accordingly, waterproofing is required therein. Therefore, in the present embodiment, an outer peripheral portion of transparent glass plate 322 having a substantially rectangular shape is covered with elastic body 323 having a frame shape, and transparent glass plate 322 is attached via elastic body 323 to the rear surface side of the portion where opening window 321 having a substantially rectangular shape is disposed in operation display panel 316. Inside upper side 337 of opening window 321 and inside lower side 338, in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 322, transparent glass plate 322 is attached between operation display panel 316 and liquid crystal mounting base 326 via elastic body 323 in a waterproofing manner.

[0218] In addition, inside left side 339 of opening window 321 and inside right side 340, in two directions on the rear surface side and the end surface side of transparent glass plate 322, transparent glass plate 322 is attached between operation display panel 316 and liquid crystal mounting base 326 via elastic body 323 in a waterproofing manner. On left side 339 and right side 340, the front surface side of transparent glass plate 322 is not covered with elastic body 323. However, in the right and left outer side portions of transparent glass plate 322, elastic body 323 is configured to be pressed against operation display panel 316. Accordingly, the waterproofness is ensured.

[0219] According to this configuration, while the waterproofness is ensured between transparent glass plate 322 and operation display panel 316, it is possible to decrease a step difference of left side 339 and right side 340 of opening window 321 with respect to transparent glass plate 322. Decreasing the step difference provides merits in that the design comes to have a visually refreshing appearance and the viewing angle is broadened. The present embodiment adopts a configuration in which the front surface portion on left side 339 and right side 340 of transparent glass plate 322 is not covered with elastic body 323. However, even if upper side 337 and lower side 338 are similarly configured, the same advantageous effect can be obtained. A configuration may be sufficiently adopted if elastic body 323 does not cover the front surface portion of at least one end surface among four end surfaces which are formed between transparent glass plate 322 and opening window 321.

[0220] Furthermore, boss 341 is disposed in the vicinity of four corners of opening window 321 on the rear surface of operation display panel 316, and liquid crystal mounting base 326 and rear surface cover 333 are fastened together by using a screw. In a fastening state using the screw, elastic body 323 is pressed by liquid crystal mounting base 326, thereby causing transparent glass plate 322 and operation display panel 316 to closely adhere to each other. This ensures waterproofness of opening window 321. Accordingly, even when the user spills water on opening window 321 by mistake, it is possible to enhance safety without any possibility that the water may cling to the electronic components such as liquid crystal panel 325 and control board unit 327 which are disposed thereinside.

[0221] In the present embodiment, an example has been described in which liquid crystal mounting base 326 and rear surface cover 333 are co-fastened. However, the present invention is not limited to this example. Even when liquid crystal mounting base 326 alone is fastened to operation display panel 316 by using a screw, the same advantageous effect can be obtained.

[0222] As illustrated in FIGS. 28A, 28B, and 30, on the lower side of elastic body 323, opening 323a is disposed at a position corresponding to the end surface of transparent glass plate 322. Then, groove 323b is disposed on at least any outer side of the right and left sides of elastic body 323.

[0223] In this manner, even if a seal of opening window 321 is broken due to damaged elastic body 323 or a defective component such as operation display panel 316 in a short shot state, water permeating through the lower side of opening 323a passes through opening 323a disposed on the lower side of elastic body 323, and falls out downward. Accordingly, there is no possibility that the water may reach transparent electrode 324 on the rear surface of transparent glass plate 322. On the other hand, a configuration is made so that water permeating through the right and left sides of elastic body 323 passes through groove 323b disposed in elastic body 323, and falls out downward. Accordingly, there is no possibility that the water may reach a charging unit such as control board unit 332. This configuration can ensure the safety.

[0224] In addition, vertical wall 316a is disposed on at least any one side of the upper and lower sides of operation display panel 316 (refer to FIG. 27). Vertical wall 316a is configured to cover the end surface of elastic body 323. This prevents the water from splashing onto the end surface of elastic body 323, even when the water splashes through the periphery of operation display panel 316. Therefore, it is possible to prevent occurrence of a disadvantage in which the water permeates into operation display panel 316 through the gap of elastic body 323 and splashes onto the charging unit.

[0225] In addition, transparent glass plate 322 is attached via elastic body 323 to the rear surface side of the portion where opening window 321 is disposed in operation display panel 316. In this manner, it is possible to prevent transparent glass plate 322 from being damaged due to externally applied impact. For example, when a user drops something on transparent glass plate 322, an impact load is applied to transparent glass plate 322. In addition, an impact force is also similarly applied thereto, when the product is dropped or rolled from a loaded state in the middle of a distribution stage where the packaged product is delivered to a user's home. Operation display panel 316 is made of the resin, thereby absorbing the impact little bit. However, transparent glass plate 322 has hardness which is weak on the impact. Accordingly, elastic body 323 is arranged on the outer periphery of transparent glass plate 322, thereby allowing transparent glass plate 322 to have a soft structure. Therefore, it is possible to prevent damage even when an impact is externally applied thereto.

[0226] As compared to ABS resin, glass has a linear expansion coefficient which is one digit smaller. Depending on places where the product is installed in the user's home, a temperature difference greatly varies in summer or winter. In addition, even in a state where the packaged product is stored at a warehouse, a considerable temperature difference occurs depending on seasons or regional differences. When components having very different linear expansion coefficients are assemble to each other, the components have to employ a structure for absorbing deformation caused by a thermal expansion difference. Otherwise, the components become damaged in some cases.

[0227] Therefore, in the present embodiment, transparent glass plate 322 is attached via elastic body 323 to the rear surface side of the portion where opening window 321 is disposed in operation display panel 316. In this manner, even when a thermal expansion difference causes a dimensional change to occur between transparent glass plate 322 and operation display panel 316 or liquid crystal mounting base 326, the dimensional change is absorbed by elastic body 323. Accordingly, it is possible to prevent the components from being damaged.

[0228] According to the above-described configuration, while the waterproofness is ensured around operation display panel 316, it is possible to provide front-loading-type washing machine 400 which is excellent in operability, visibility, and external design.

[0229] As described above, front-loading-type washing machine 400 according to the present embodiment includes rotary drum 303 that is rotatably driven, main body 301 that is the washing machine body for accommodating rotary drum 303, operation display panel 316 that is arranged in the upper part of the washing machine body and has opening window 321, and liquid crystal panel 325 that is attached to the rear surface side of operation display panel 316. In addition, front-loading-type washing machine 400 includes transparent glass plate 322 that is attached via elastic body 323 to the rear surface side of the portion where opening window 321 is disposed in operation display panel 316, and transparent electrode 324 that is mounted on the rear surface of transparent glass plate 322.

[0230] According to this configuration, when the operation content items are to be set, if the user directly touches display on transparent glass plate 322 and selects a selectable course, a subordinate display such as time setting for "washing" for example is further continuously shown. Accordingly, the user can perform a hierarchical operation in which the user determines the setting by touching the subordinate display. In addition, the operation buttons can be reduced, and the size of the character to be displayed can be increased. Accordingly, it is possible to improve operability and visibility. In addition, transparent glass plate 322 is attached to operation display panel 316 via elastic body 323. Therefore, it is possible to prevent water clinging to transparent glass plate 322 from permeating into the housing.

[0231] In addition, opening window 321 has a substantially rectangular shape, and is configured so that step difference

H2 between operation display panel 316 and transparent glass plate 322 which are formed on left side 339 and right side 340 of opening window 321 is smaller than step difference H1 between operation display panel 316 and transparent glass plate 322 which are formed on upper side 337 and lower side 338 of opening window 321.

[0232] This configuration enables transparent glass plate 322 having a display function and an operation function to be shown as a visually larger image. Transparent glass plate 322 is located on the recess side (inner side of the housing) further from opening window 321 side, and is externally conspicuous. Accordingly, if an area occupied by operation display panel 316 of opening window 321 is small, the external design of transparent glass plate 322 may be shown as humble particularly when the light is turned off. However, according to the above-described configuration, transparent glass plate 322 can be shown as a horizontally larger image. Therefore, it is possible to improve the external design.

[0233] In addition, front-loading-type washing machine 400 according to the present embodiment further includes liquid crystal mounting base 326 to which liquid crystal panel 325 is attached, and control board unit 327 which controls liquid crystal panel 325 and transparent electrode 324. Transparent glass plate 322 is elastically held between liquid crystal mounting base 326 and operation display panel 316 via elastic body 323. Control board unit 327 is attached to the rear surface of liquid crystal mounting base 326.

[0234] As described above, liquid crystal panel 325 is attached to the front side of liquid crystal mounting base 326, and control board unit 327 is attached to the rear side, thereby enabling the space to be saved. Accordingly, the space inside operation display panel 316 can be widened, thereby enabling liquid crystal panel 325 to increase in size so as to widen a display range.

[0235] In addition, elastic body 323 is configured so as not to cover the front surface portion of at least one end surface among four end surfaces which are formed between transparent glass plate 322 and opening window 321.

[0236] According to this configuration, while the sealing performance is ensured between transparent glass plate 322 and opening window 321, it is possible to decrease the step difference of opening window 321 with respect to transparent glass plate 322. Accordingly, it is possible to realize operation display panel 316 which has excellent waterproofness and design.

[0237] In addition, opening 323a is disposed at the position corresponding to the end surface of transparent glass plate 322, which is on the lower side of elastic body 323.

[0238] According to this configuration, even if a seal below opening window 321 is broken due to damaged elastic body 323 or a defective component such as operation display panel 316 in a short shot state, permeating water passes through opening 323a disposed on the lower side of elastic body 323 and falls out downward. In this way, a configuration is made so that the water does not reach transparent electrode 324 on the rear surface of transparent glass plate 322. Accordingly, it is possible to prevent the water from splashing onto the charging unit, thereby enabling the safety to be ensured.

[0239] In addition, a configuration is made so that groove 323b is disposed on at least any outer side of the right and left sides of elastic body 323.

[0240] According to this configuration, even when the seal on any one side of the right and left sides of opening window 321 becomes broken, permeating water passes through groove 323b disposed in elastic body 323, and falls out downward. Accordingly, it is possible to prevent the water from splashing onto the charging unit, thereby enabling the safety to be ensured.

[0241] In addition, vertical wall 316a is disposed on at least any one side of the upper and lower sides of operation display panel 316. Vertical wall 316a is configured to cover the end surface of elastic body 323.

[0242] According to this configuration, even when water is poured around operation display panel 316, vertical wall 316a disposed on at least any one side of the upper and lower sides of operation display panel 316 prevents the water from splashing onto the end surface of elastic body 323. Accordingly, it is possible to avoid a disadvantage in which the water permeates into operation display panel 316 through the gap of elastic body 323 and splashes onto the charging unit.

(FIFTH EXEMPLARY EMBODIMENT)

[0243] FIG. 31 is a view illustrating a cross-sectional configuration of front-loading-type washing machine 500 according to a fifth exemplary embodiment of the present invention.

[0244] As illustrated in FIG. 31, water tub 402 in a suspended state is arranged inside main body 401 which serves as a housing of front-loading-type washing machine 500. Rotary drum 403 formed in a bottomed cylinder shape is rotatably arranged inside water tub 402 in a state where a rotary shaft thereof tilts downward from a front surface side toward a rear surface side.

[0245] Laundry loading-unloading port 404 passing through an opening end of rotary drum 403 is formed on the front surface side of water tub 402. Front frame body 405 configures a front surface of main body 401. Opening 406 is disposed on an upward tilting surface formed on the front surface side of front frame body 405. A user can load laundry into and can unload the laundry from rotary drum 403 through laundry loading-unloading port 404 by opening door 409 which opens and closes opening 406. Door 409 is disposed on the upward tilting surface, thereby enabling the user to carry

out laundry loading-unloading work without the user's waist having to be bent. This configuration can improve poor workability of the front-loading-type washing machine of a general type in which the rotary shaft of rotary drum 403 is disposed in a horizontal direction so that laundry is loaded and unloaded through an opening formed in a vertical direction.

[0246] Many through-holes 410 leading into water tub 402 are formed on a peripheral surface of rotary drum 403. Rotary drum 403 is rotatably driven in a forward direction and a rearward direction by motor 411 attached to the rear surface side of water tub 402. In water tub 402, water supply pipeline 412 and drain pipeline 413 are connected to each other by pipes. Water is supplied into and drained from water tub 402 by respectively controlling water supply valve 414 and drain valve 415.

[0247] An operation display panel 416 is arranged on an upper part of front frame body 405. On the lower left side when viewed from the front surface of operation display panel 416, detergent supply case 417 (refer to FIG. 33) is arranged in front frame body 405 in a state where detergent supply case 417 is drawable forward. Prior to an operation, the user supplies detergent to detergent supply case 417, and operates operation display panel 416 when necessary. This enables the user to perform setting of desired operation content items, operation start, and temporary stop, and to recognize a state of the operation in progress.

[0248] The user loads the laundry into rotary drum 403 by opening door 409 to start the operation of front-loading-type washing machine 500. Then, water supply valve 414 is opened, and water is supplied into detergent supply case 417. While the detergent supplied into detergent supply case 417 is caused to flow, water is supplied into water tub 402 so as to reach a predetermined amount via water supply pipeline 412. Then, rotary drum 403 is rotatably driven by motor 411 so as to start a washing step. In the washing step, an agitating operation of lifting and dropping the laundry in a rotation direction is repeatedly performed by rotating rotary drum 403.

[0249] After a predetermined time for washing elapses, drain valve 415 is opened to discharge soiled washing water through drain pipeline 413. Then, the washing water contained in the laundry is spin-dried by a spin-drying operation for rotating rotary drum 403 at high speed. Thereafter, water is supplied into water tub 402 through the water supply pipeline 412 to perform a rinsing step. In this rinsing operation, the agitating operation for the laundry is also repeatedly performed by rotating rotary drum 403 so as to perform rinsing.

[0250] Here, operation display panel 416 will be described in detail.

[0251] FIG. 32 is a front view of operation display panel 416 of front-loading-type washing machine 500 according to the fifth exemplary embodiment of the present invention. FIG. 33 is a perspective view of front-loading-type washing machine 500. FIG. 34 is a view illustrating a cross-sectional configuration in the vicinity of operation display panel 416 of front-loading-type washing machine 500. FIG. 35A is a cross-sectional view taken along line 35A-35A in FIG. 32. FIG. 35B is a cross-sectional view taken along line 35B-35B in FIG. 32. FIG. 36 is an exploded perspective view of operation display panel 416 of front-loading-type washing machine 500. In addition, FIG. 37A is a perspective view of elastic body 423 of front-loading-type washing machine 500. FIG. 37B is a view illustrating a cross-sectional configuration taken along line 37B-37B in FIG. 37A.

[0252] Operation display panel 416 is arranged between the upper part of front frame body 405 and top plate 418. A front surface of transparent resin portion 419 of operation display panel 416 is covered with insert-molded film 420 (polyethylene terephthalate (PET) film), thereby configuring a colored, printed, and decorated surface. Opening window 421 having a substantially rectangular shape is disposed in the center of transparent resin portion 419.

[0253] Opening window 421 is a region where neither transparent resin portion 419 nor film 420 is formed. Transparent glass plate 422 is attached via elastic body 423 to a rear surface side of a portion where opening window 421 is disposed in operation display panel 416. Transparent electrode 424 adheres to a rear surface of transparent glass plate 422. In addition, liquid crystal panel 425 is mounted on liquid crystal mounting base 426 on the rear surface side of transparent glass plate 422. Control board unit 427 for controlling transparent electrode 424 or liquid crystal panel 425 is mounted on the rear surface of liquid crystal mounting base 426.

[0254] Operation display panel 416 has pressing operation button unit 428 and light emitting display unit 429. Control board unit 432 provided with switch 430 and light emitting element 431 is located inside operation display panel 416, and control board unit 432 is attached to rear surface cover 433.

[0255] Furthermore, operation member 436 having light guide route 434 for guiding light of light emitting element 431 to light emitting display unit 429 and button unit 435 for performing a pressing operation on switch 430 are disposed between operation display panel 416 and rear surface cover 433. Transparent resin portion 419 is not formed on pressing operation button unit 428, and only film 420 is present thereon, thereby enabling switch 430 to be operated using weak operation force. In addition, light emitting display unit 429 is printed by a highly transmissive material. Accordingly, light can be emitted therefrom so that the user can sufficiently recognize even light having low intensity which is emitted from the light emitting element 431.

[0256] If the user presses a power-on button (one of buttons in pressing operation button unit 428), for example, a display as illustrated in Fig. 32 is shown on liquid crystal panel 425. The user can look at the display through transparent glass plate 422. Then, for example, if the user's finger touches a front surface of transparent glass plate 422 of a region where a "manual course" is displayed, the display is changed to a display screen for setting the number of or the time

for "washing" steps, or the display is changed to a display screen for setting a water level, thereby enabling the user to gradually perform subordinate setting. A method in which the user directly touches the display screen for hierarchical setting is called a touch panel method. Transparent electrode 424 adhering to the rear surface of transparent glass plate 422 detects a change in electrostatic capacitance when a finger touches transparent glass plate 422. In this manner, a finger touched position is specified, thereby enabling display content items to be changed in accordance with the operation of the user.

[0257] In operation display panel 1050 in the related art as illustrated in FIG. 38, a display window in the center serves only to show display content items of liquid crystal panel 1051 through the transparent resin and the film insert-molded on the front surface thereof. Consequently, even the display location is determined. Accordingly, if the content items to be displayed increase, a character to be displayed decreases in size. In addition, too many setting buttons such as course button 1052 are arrayed side by side. Consequently, the user is less likely to understand which button is suitable for pressing, thereby causing a problem of poor operability. In addition, there is a problem of poor visibility, since the character to be displayed decreases in size.

[0258] In contrast, in the present embodiment, as described above, opening window 421 is disposed in operation display panel 416. Then, a configuration adopted in which transparent glass plate 422 having transparent electrode 424 adhering thereto is attached via elastic body 423 to the rear surface side of the portion where opening window 421 is disposed in operation display panel 416. This configuration enables the user to directly touch the display screen for the hierarchical setting. As a result, it is no longer necessary to dispose a fixed operation button at many locations, and thus, it is possible to considerably reduce the number of operation buttons. In addition, since liquid crystal panel 425 sufficiently functions by selectively choosing only the display content items required on each occasion. Accordingly, the display content items decrease, and thus the character to be displayed can increase in size. Therefore, it is possible to improve operability and visibility.

[0259] Electronic components such as liquid crystal panel 425 and control board unit 427 are arranged on the rear side of transparent glass plate 422. Accordingly, waterproofing is required therein. Therefore, in the present embodiment, an outer peripheral portion of transparent glass plate 422 having a substantially rectangular shape is covered with elastic body 423 having a frame shape, and transparent glass plate 422 is attached via elastic body 423 to the rear surface side of the portion where opening window 421 having a substantially rectangular shape is disposed in operation display panel 416. Inside upper side 437 of opening window 421 and inside lower side 438, in three directions on the front surface side, the rear surface side, and the end surface side of transparent glass plate 422, transparent glass plate 422 is attached between operation display panel 416 and liquid crystal mounting base 426 via elastic body 423 in a waterproofing manner.

[0260] In addition, inside left side 439 of opening window 421 and inside right side 440, in two directions on the rear surface side and the end surface side of transparent glass plate 422, transparent glass plate 422 is attached between operation display panel 416 and liquid crystal mounting base 426 via elastic body 423 in a waterproofing manner.

[0261] In elastic body 423, engagement pawl 423c is disposed at each one location in four corners, and engagement hook 423d is disposed at each one location on the right and left. In addition, in liquid crystal mounting base 426, engagement hole 426c is disposed at each one location in four corners, and engagement pawl 426d is disposed at each one location on the right and left. Engagement pawl 423c and engagement hole 426c engage with each other, and engagement hook 423d and engagement pawl 426d engage with each other. Engagement pawl 423c and engagement hole 426c or engagement hook 423d and engagement pawl 426d configure a fourth engagement portion.

[0262] This configures elastic body 423 fitted to transparent glass plate 422 and liquid crystal mounting base 426 in a unitized state. This enables elastic body 423 and liquid crystal mounting base 426 to be unitized without using a separate component such as a screw. Accordingly, it is possible to reduce the number of components and costs.

[0263] Furthermore, when assembly work is carried out, it is possible to avoid occurrence of an assembly work-related disadvantage in which elastic body 423 having transparent glass plate 422 fitted thereto detaches and drops down from liquid crystal mounting base 426.

[0264] In addition, notch 426e is disposed at a position corresponding to a side surface of elastic body 423 on an outer wall of liquid crystal mounting base 426. In this manner, a portion of elastic body 423 which is crushed between operation display panel 416 and liquid crystal mounting base 426 escapes to a portion of notch 426e disposed in liquid crystal mounting base 426, when operation display panel 416 is assembled thereto. In this manner, it is possible to avoid an inferior assembly performance in which the assembly work cannot be carried out due to strong repulsion of elastic body 423. In addition to this avoidance, operation display panel 416 is prevented from floating due to the repulsion of elastic body 423.

[0265] Furthermore, boss 441 is disposed in the vicinity of four corners of opening window 421 on the rear surface of operation display panel 416, and liquid crystal mounting base 426 and rear surface cover 433 are fastened together by using a screw. In the fastened state using the screw, elastic body 423 is pressed by liquid crystal mounting base 426, and transparent glass plate 422 and operation display panel 416 closely adhere to each other. This can ensure the waterproofness of opening window 421. Accordingly, even when the user spills water on opening window 421 by mistake,

it is possible to enhance safety without any possibility that the water may cling to the electronic components such as liquid crystal panel 425 and control board unit 427 which are disposed thereinside.

[0266] In the present embodiment, an example has been described in which liquid crystal mounting base 426 and rear surface cover 433 are co-fastened. However, the present invention is not limited to this example. Even when liquid crystal mounting base 426 alone is fastened to operation display panel 416 by using a screw, the same advantageous effect can be obtained.

[0267] In addition, vertical wall 416a is disposed on at least any one side of the upper and lower sides of operation display panel 416 (refer to FIG. 34). Vertical wall 416a is configured to cover the end surface of a fourth engagement portion (at least one of engagement pawl 423c and engagement hook 423d) of elastic body 423. Accordingly, vertical wall 416a prevents the water from splashing onto the engagement portion of elastic body 423, even when the water splashes through the periphery of operation display panel 416. Therefore, occurrence of a disadvantage is prevented in which the water permeates into operation display panel 416 through the gap of the engagement portion in elastic body 423 and splashes onto the charging unit.

[0268] In addition, transparent glass plate 422 is attached via elastic body 423 to the rear surface side of the portion where opening window 421 is disposed in operation display panel 416. In this manner, it is possible to prevent transparent glass plate 422 from being damaged due to externally applied impact. For example, when a user drops something on transparent glass plate 422, an impact load is applied to transparent glass plate 422. In addition, an impact force is also similarly applied thereto, when the product is dropped or rolled from a loaded state in the middle of a distribution stage where the packaged product is delivered to a user's home. Operation display panel 416 is made of the resin, thereby absorbing the impact little bit. However, transparent glass plate 422 has hardness which is weak on the impact. Accordingly, elastic body 423 is arranged on the outer periphery of transparent glass plate 422, thereby allowing transparent glass plate 422 to have a soft structure. Therefore, it is possible to prevent damage even when an impact is externally applied thereto.

[0269] As compared to ABS resin, glass has a linear expansion coefficient which is one digit smaller. Depending on places where the product is installed in the user's home, a temperature difference greatly varies in summer or winter. In addition, even in a state where the packaged product is stored at a warehouse, a considerable temperature difference occurs depending on seasons or regional differences. When components having very different linear expansion coefficients are assemble to each other, the components have to employ a structure for absorbing deformation caused by a thermal expansion difference. Otherwise, the components become damaged in some cases.

[0270] Therefore, in the present embodiment, transparent glass plate 422 is attached via elastic body 423 to the rear surface side of the portion where opening window 421 is disposed in operation display panel 416. In this manner, even when a thermal expansion difference causes a dimensional change to occur between transparent glass plate 422 and operation display panel 416 or liquid crystal mounting base 426, the dimensional change is absorbed by elastic body 423. Accordingly, it is possible to prevent the components from being damaged.

[0271] According to the above-described configuration, while the waterproofness is ensured around operation display panel 416, it is possible to provide front-loading-type washing machine 500 which is excellent in cost and assembly performance.

[0272] As described above, front-loading-type washing machine 500 according to the present embodiment includes rotary drum 403 that is rotatably driven, main body 401 that is the washing machine body for accommodating rotary drum 403, operation display panel 416 that is arranged in the upper part of the washing machine body and has opening window 421, and liquid crystal panel 425 that is attached to the rear surface side of operation display panel 416. In addition, front-loading-type washing machine 500 includes transparent glass plate 422 that is attached via elastic body 423 to the rear surface side of the portion where opening window 421 is disposed in operation display panel 416, and transparent electrode 424 that is mounted on the rear surface of transparent glass plate 422.

[0273] According to this configuration, when the operation content items are to be set, if the user directly touches display on transparent glass plate 422 and selects a selectable course, a subordinate display such as time setting for "washing" for example is further continuously shown. Accordingly, the user can perform a hierarchical operation in which the user determines the setting by touching the subordinate display. In addition, the operation buttons can be reduced, and the size of the character to be displayed can be increased. Accordingly, it is possible to improve operability and visibility. In addition, transparent glass plate 422 is attached to operation display panel 416 via elastic body 423. Therefore, it is possible to prevent water clinging to transparent glass plate 422 from permeating into the housing.

[0274] In addition, opening window 421 has a substantially rectangular shape, and is configured so that step difference H2 between operation display panel 416 and transparent glass plate 422 which are formed on left side 439 and right side 440 of opening window 421 is smaller than step difference H1 between operation display panel 416 and transparent glass plate 422 which are formed on upper side 437 and lower side 438 of opening window 421.

[0275] This configuration enables transparent glass plate 422 having a display function and an operation function to be shown as a visually larger image. Transparent glass plate 422 is located on the recess side (inner side of the housing) further from opening window 421 side, and is externally conspicuous. Accordingly, if an area occupied by operation

display panel 416 of opening window 421 is small, the external design of transparent glass plate 422 may be shown as humble particularly when the light is turned off. However, according to the above-described configuration, transparent glass plate 422 can be shown as a horizontally larger image. Therefore, it is possible to improve the external design.

[0276] In addition, front-loading-type washing machine 500 according to the present embodiment further includes liquid crystal mounting base 426 to which liquid crystal panel 425 is attached, and control board unit 427 which controls liquid crystal panel 425 and transparent electrode 424. Transparent glass plate 422 is elastically held between liquid crystal mounting base 426 and operation display panel 416 via elastic body 423. Control board unit 427 is attached to the rear surface of liquid crystal mounting base 426.

[0277] As described above, liquid crystal panel 425 is attached to the front side of liquid crystal mounting base 426, and control board unit 427 is attached to the rear side, thereby enabling the space to be saved. Accordingly, the space inside operation display panel 416 can be widened, thereby enabling liquid crystal panel 425 to increase in size so as to widen a display range.

[0278] In addition, elastic body 423 has the fourth engagement portion (at least one of engagement pawl 423c, engagement hole 426c, engagement hook 423d, and engagement pawl 426d) which engages with liquid crystal mounting base 426.

[0279] According to this configuration, elastic body 423 and liquid crystal mounting base 426 can be configured to engage with each other. Accordingly, it is possible to unitize elastic body 423 and liquid crystal mounting base 426 without using a separate component such as a screw, and it is possible to reduce the number of components and costs. Furthermore, when assembly work is carried out, it is also possible to solve an assembly-related problem such as a case where a component around elastic body 423 detaches and drops down.

[0280] In addition, notch 426e is disposed at the position corresponding to the side surface of elastic body 423 in liquid crystal mounting base 426.

[0281] According to this configuration, a portion of elastic body 423 which is crushed between operation display panel 416 and liquid crystal mounting base 426 can escape to a portion of notch 426e disposed in liquid crystal mounting base 426, when operation display panel 416 is assembled thereto. In this manner, it is possible to solve the assembly-related problem in which the assembly work cannot be carried out due to strong repulsion of elastic body 423. In addition, it is possible to prevent operation display panel 416 from floating due to the repulsion of elastic body 423.

[0282] Vertical wall 416a is disposed on at least one side of the upper and lower sides of operation display panel 416, and vertical wall 416a is configured to cover the fourth engagement portion of elastic body 423.

[0283] According to this configuration, even when water is poured around operation display panel 416, vertical wall 416a disposed on at least any one side of the upper and lower sides of operation display panel 416 can prevent the water from splashing onto the fourth engagement portion of elastic body 423. Accordingly, it is possible to avoid occurrence of a disadvantage in which the water permeates into operation display panel 416 through the gap of the fourth engagement portion of elastic body 423 and splashes onto the charging unit.

[0284] In the above-described respective embodiments, front-loading-type washing machines 100, 200, 300, 400, and 500 in which rotary drums 3, 103, 203, 303, and 403 formed in the bottomed cylinder shape are rotatably arranged in the state where the rotary shaft tilts downward from the front surface side toward the rear surface side have been described as examples. However, the washing machine according to the present invention is not limited to these examples, and can also be applied to a washing machine whose rotary shaft of a rotary drum is horizontal, or a washing machine whose rotary shaft of a rotary drum is vertical (so-called a top-loading-type washing machine).

INDUSTRIAL APPLICABILITY

[0285] As described above, according to the present invention, it is possible to achieve a special advantageous effect in that the present invention can provide a washing machine which has an operation display panel and is excellent in operability and visibility. Accordingly, the present invention is useful for a washing machine which performs each step of washing, rinsing, spin-drying, and drying inside a rotary drum.

REFERENCE MARKS IN THE DRAWINGS

1, 101, 201, 301, 401	main body
2, 102, 202, 302, 402	water tub
3, 103, 203, 303, 403	rotary drum
4, 104, 204, 304, 404	laundry loading-unloading port
5, 105, 205, 305, 405	front frame body
6, 106, 206, 306, 406	opening
9, 109, 209, 309, 409	door
10, 110, 210, 310, 410	through-hole

(continued)

12, 112, 212, 312, 412	water supply pipeline
13, 113, 213, 313, 413	drain pipeline
14, 114, 214, 314, 414	water supply valve
15, 115, 215, 315, 415	drain valve
16, 116, 216, 316, 416, 1050	operation display panel
17, 117, 217, 317, 417	detergent supply case
18, 118, 218, 318, 418	top plate
19, 119, 219, 319, 419	transparent resin portion
20, 120, 220, 320, 420	film
21, 121, 221, 321, 421	opening window
22, 122, 222, 322, 422	transparent glass plate
23, 123, 223, 323, 423	elastic body
24, 124, 224, 324, 424	transparent electrode
25, 125, 225, 325, 425, 1051	liquid crystal panel
26, 126, 226, 326, 426	liquid crystal mounting base
27, 32, 127, 132, 227, 232, 327, 332, 427, 432	control board unit
28, 128, 228, 328, 428	pressing operation button unit
29, 129, 229, 329, 429	light emitting display unit
30, 130, 230, 330, 430	switch
31, 131, 231, 331, 431	light emitting element
33, 133, 233, 333, 433	rear surface cover
34, 134, 234, 334, 434	light guide route
35, 135, 235, 335, 435	button unit
36, 136, 236, 336, 436	operation member
37, 137, 237, 337, 437	upper side
38, 138, 238, 338, 438	lower side
39, 139, 239, 339, 439	left side
40, 140, 240, 340, 440	right side
41, 141, 241, 341, 441	boss
42, 142, 242	stepped portion
100, 200, 300, 400, 500	front-loading-type washing machine
150, 151, 250, 251	junction line
152, 252	touch panel unit
153, 253	operation display unit
154, 155, 254, 255, 256, 257	engagement portion
156, 162	opening
157, 160	relay connector
158, 164	lid
159, 161	relay lead wire
163	connector
316a, 416a	vertical wall
323a	opening
323b	groove
423c, 426d	engagement pawl
423d	engagement hook
426c	engagement hole
1052	course button

Claims

1. A washing machine comprising:

   a rotary drum that is rotatably driven;
   a washing machine housing that accommodates the rotary drum;
   an operation display panel that is arranged on an upper part of the washing machine housing and has an opening window;
   a liquid crystal panel that is attached to a rear surface side of the operation display panel;
   a transparent glass plate that is attached via an elastic body to a rear surface side of a portion where the opening window is disposed in the operation display panel; and
   a transparent electrode that is attached to a rear surface of the transparent glass plate.

2. The washing machine of claim 1,
   wherein the opening window has a substantially rectangular shape, and
   wherein a step difference (H2) between the operation display panel and the transparent glass plate which are formed on a left side and a right side of opening window is configured to be smaller than a step difference (H1) between the operation display panel and the transparent glass plate which are formed on an upper side and a right side of the opening window.

3. The washing machine of claim 1 or 2, further comprising:

   a liquid crystal mounting base to which the liquid crystal panel is attached; and
   a control board unit that controls the liquid crystal panel and the transparent electrode,
   wherein the transparent glass plate is elastically held between the liquid crystal mounting base and the operation display panel via the elastic body,and
   wherein the control board unit is attached to a rear surface of the liquid crystal mounting base.

4. The washing machine of claim 3,
   wherein the transparent glass plate, the elastic body, the liquid crystal panel, the liquid crystal mounting base, and the control board unit are unitized so as to configure a touch panel unit, and
   wherein the touch panel unit is attached to the operation display panel or a rear surface cover which covers the control board unit.

5. The washing machine of claim 3 or 4,
   wherein the liquid crystal mounting base is fastened to a rear surface of the operation display panel by using a screw, in the vicinity of the opening window.

6. The washing machine of claim 5,
   wherein the liquid crystal mounting base has a first engagement portion which engages with the operation display panel, between fastened portions using the screw.

7. The washing machine of any one of claims 4 to 6, further comprising:

   a first opening that is disposed in the rear surface cover;
   a first lid that covers the first opening; and
   a relay connector that is disposed at a position corresponding to the first opening of the control board unit.

8. The washing machine of any one of claims 4 to 7, further comprising:

   a second opening that is disposed in the rear surface cover;
   a second lid that covers the second opening; and
   a connector for writing a control program which is disposed at a position corresponding to the second opening of the control board unit.

9. The washing machine of any one of claims 3 to 5, further comprising:

   a front frame body that is arranged on a front surface side of the washing machine housing,

wherein the liquid crystal mounting base has a first engagement portion which engages with the operation display panel, and a second engagement portion which engages with front frame body.

10. The washing machine of claim 9, further comprising:

a rear surface cover that covers the control board unit and is attached to the operation display panel,
wherein the rear surface cover has a third engagement portion which engages with the front frame body.

11. The washing machine of any one of claims 1 to 3,
wherein the elastic body is configured so as not to cover a front surface portion of at least one end surface among four end surfaces which are formed between the transparent glass plate and the opening window.

12. The washing machine of claim 11,
wherein an opening is disposed at a position corresponding to an end surface of the transparent glass plate, which is a lower side of elastic body.

13. The washing machine of claim 11 or 12,
wherein a groove is disposed on at least any outer side of right and left sides of the elastic body.

14. The washing machine of any one of claims 11 to 13,
wherein a vertical wall is disposed on at least any one side of upper and lower sides of the operation display panel, and
wherein the vertical wall covers an end surface of the elastic body.

15. The washing machine of any one of claims 1 to 3,
wherein the elastic body has a fourth engagement portion which engages with the liquid crystal mounting base.

16. The washing machine of claim 15,
wherein a notch of the liquid crystal mounting base is disposed at a position corresponding to a side surface of the elastic body.

17. The washing machine of claim 15 or 16,
wherein a vertical wall is disposed on at least one side of upper and lower sides of the operation display panel, and
wherein the vertical wall covers the fourth engagement portion of the elastic body.

FIG. 1

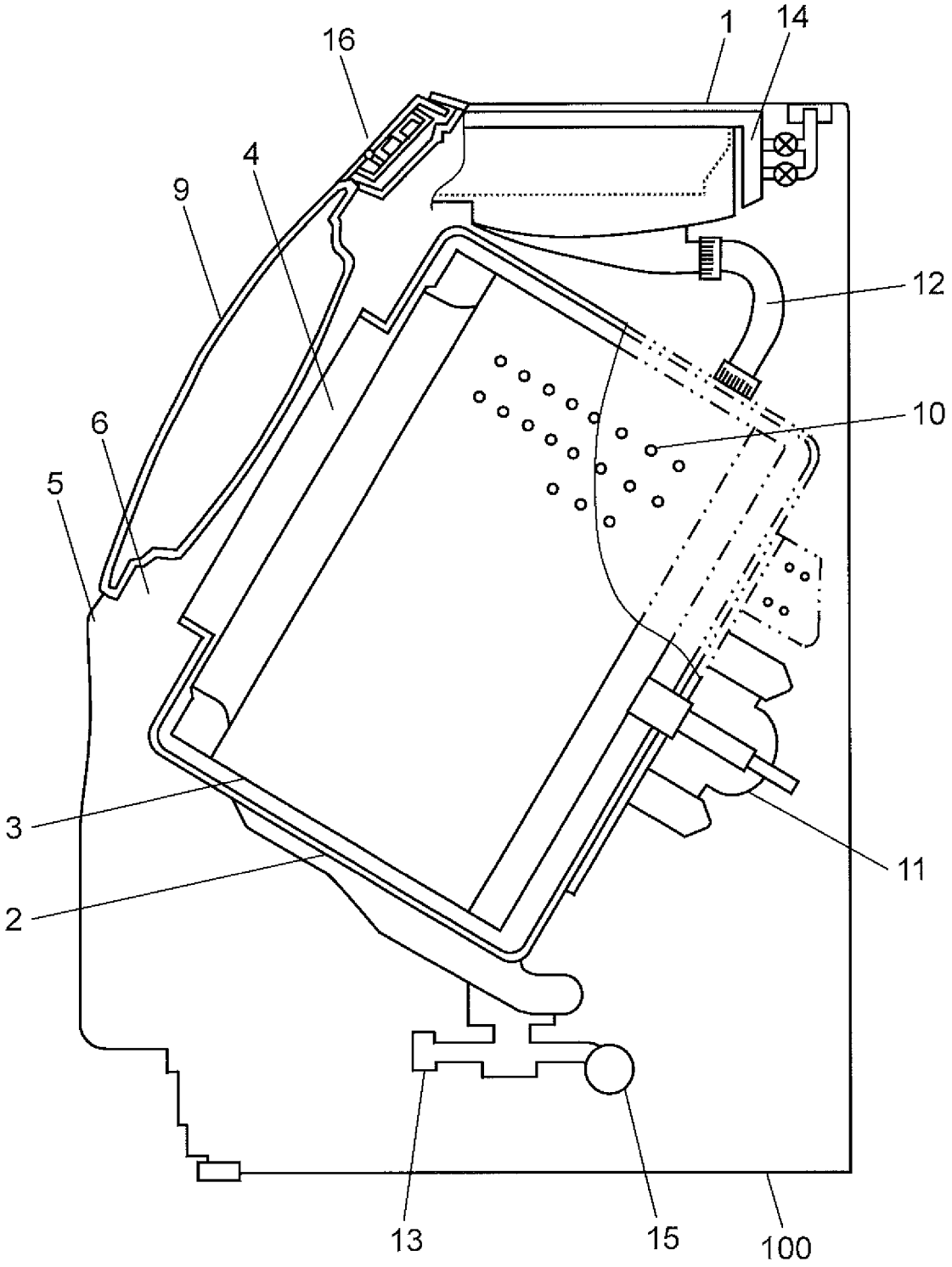

FIG. 2

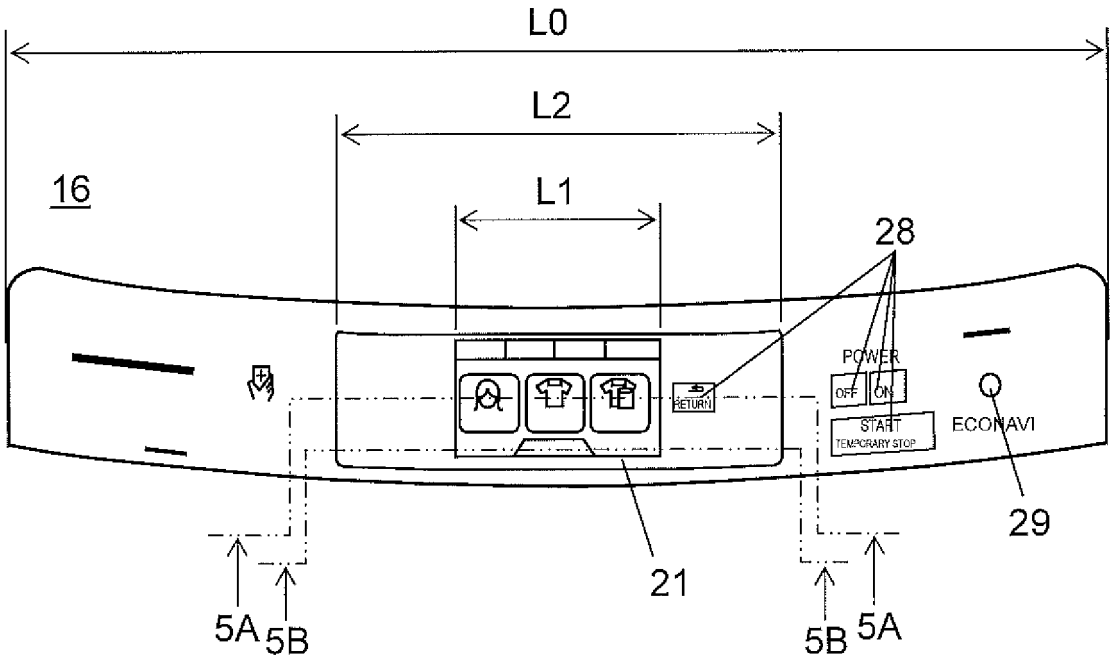
L0
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FIG. 3

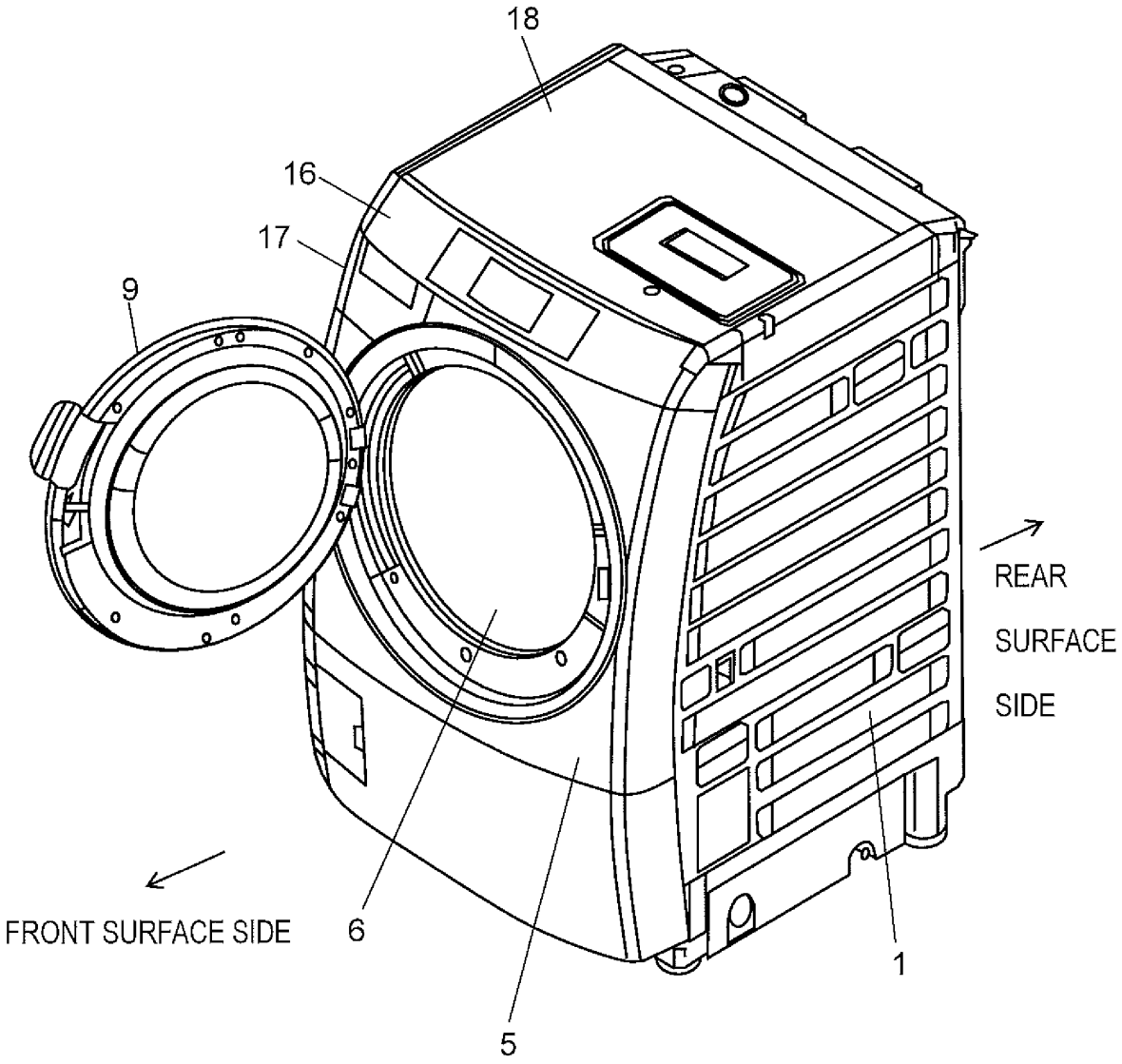

FIG. 4

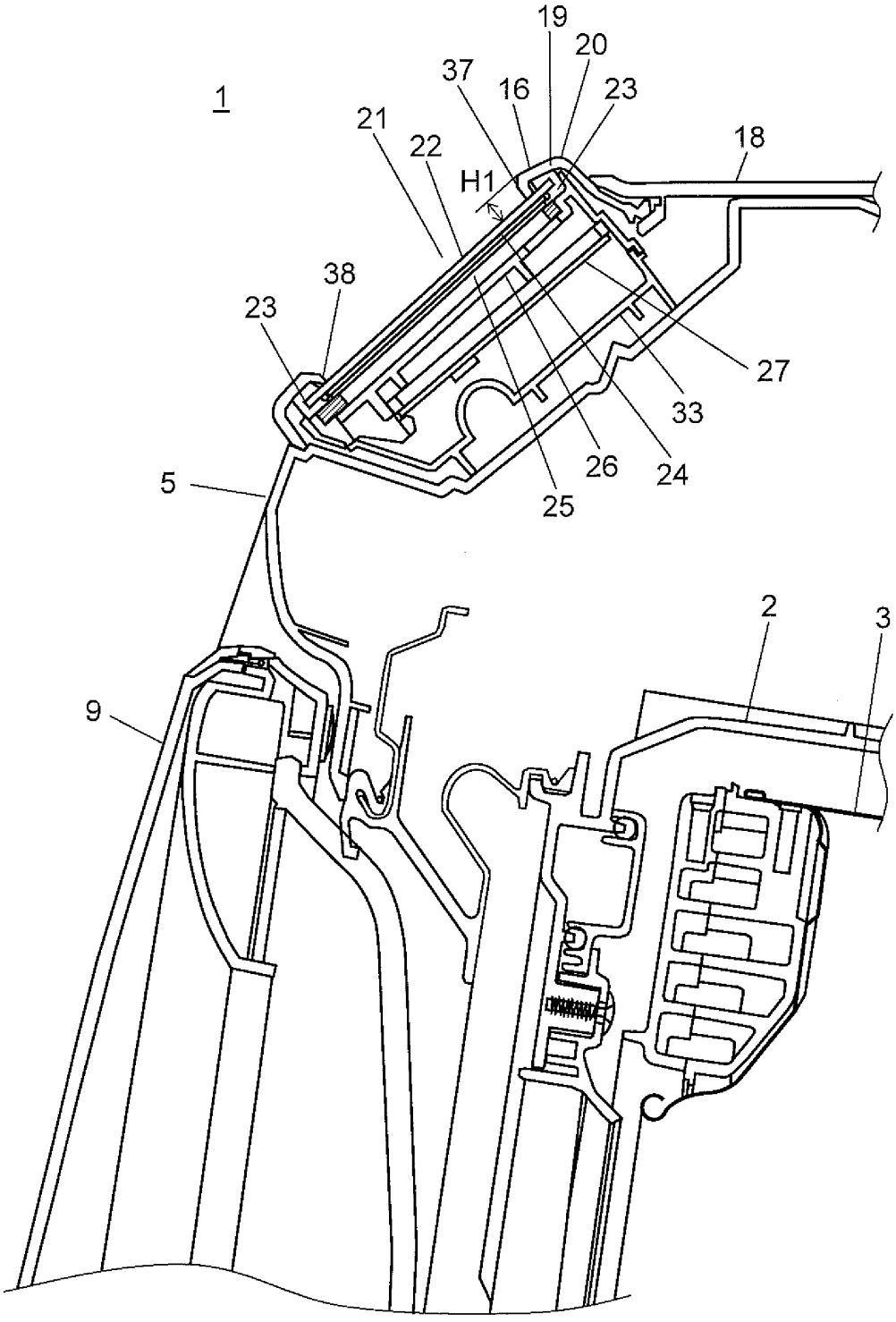

FIG. 5A

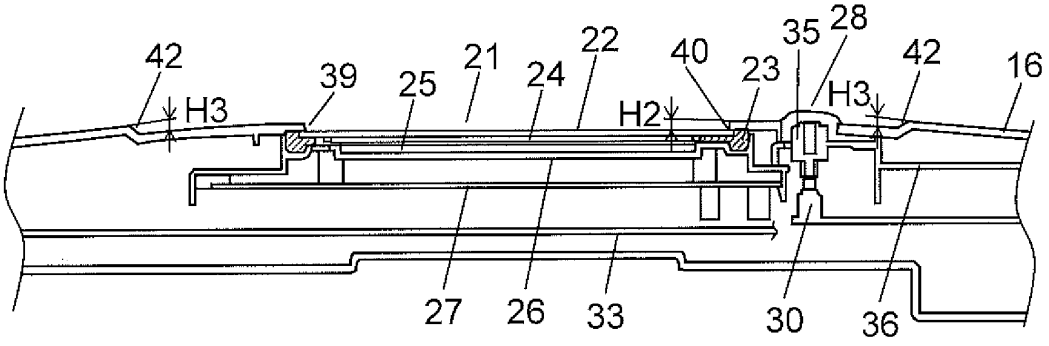

FIG. 5B

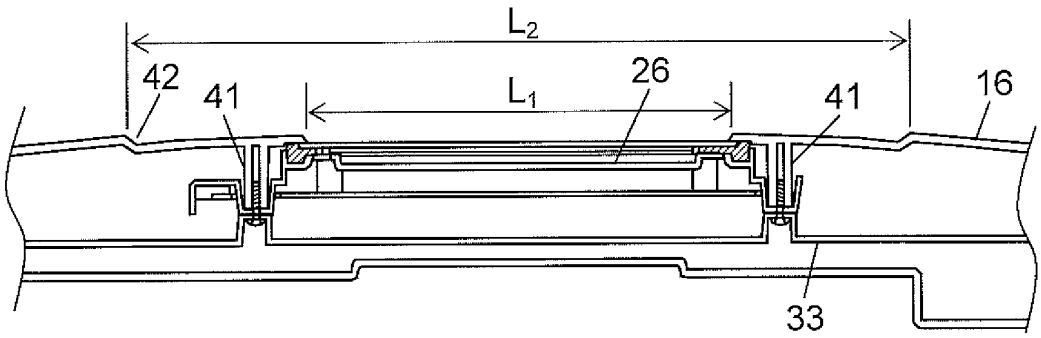

FIG. 6

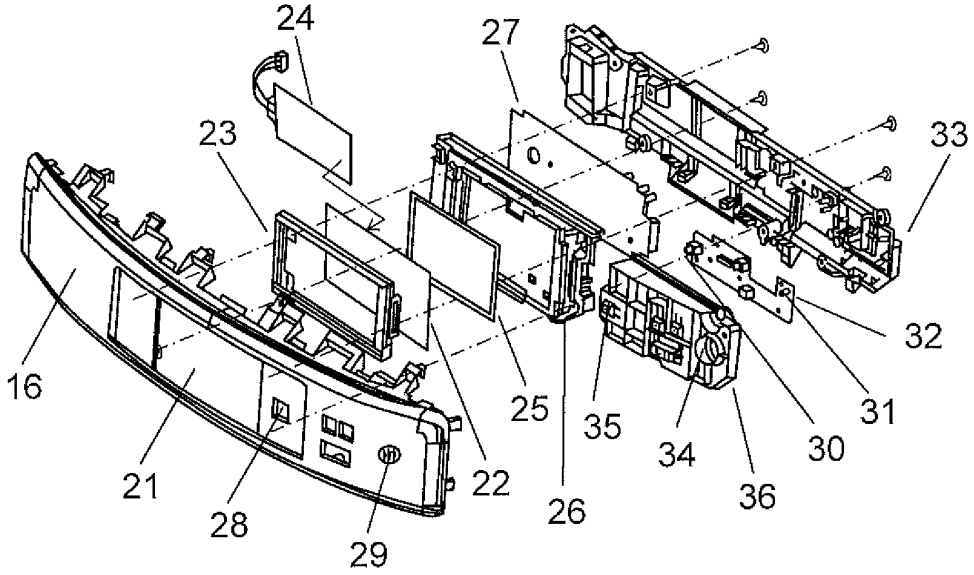

FIG. 7

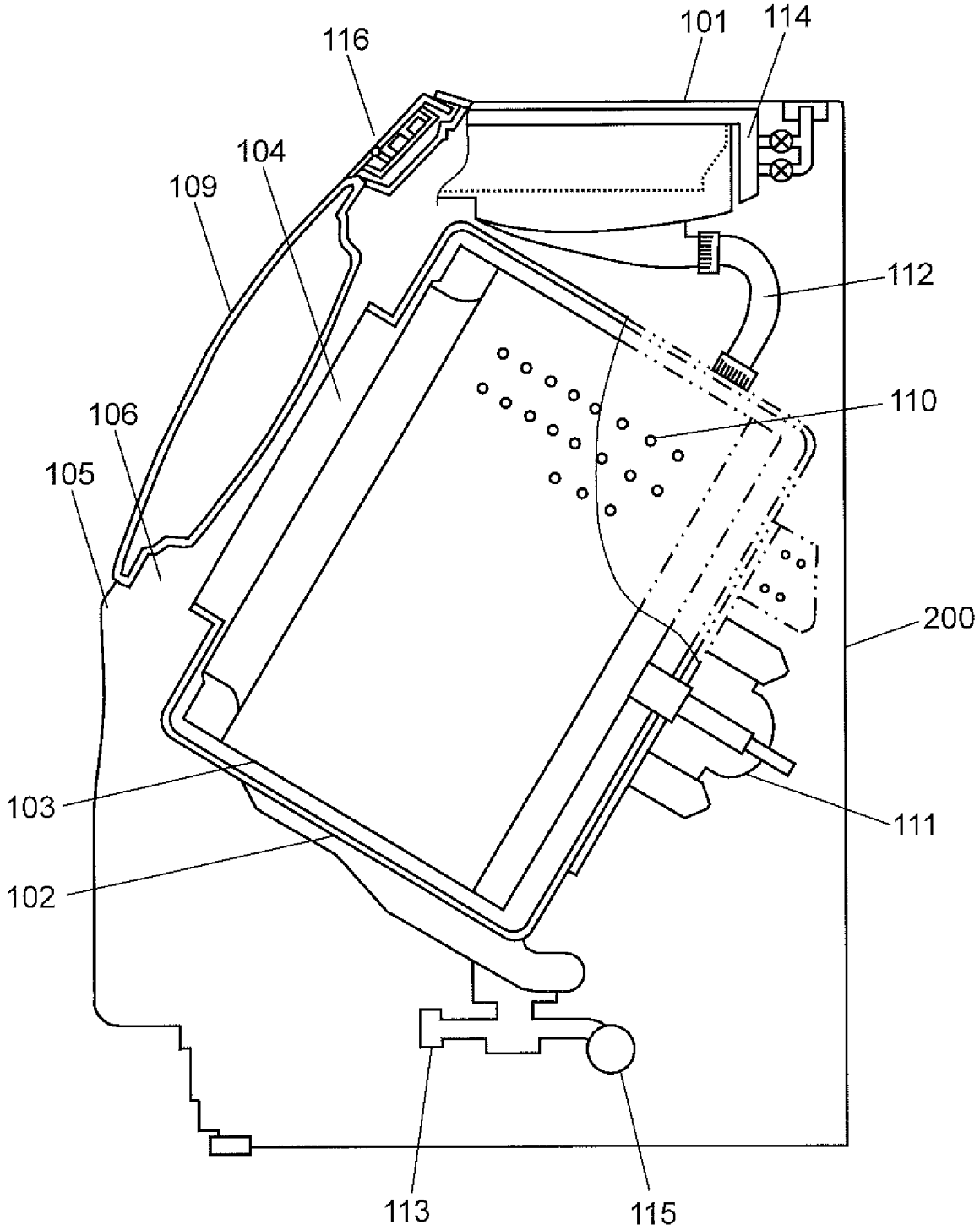

FIG. 8

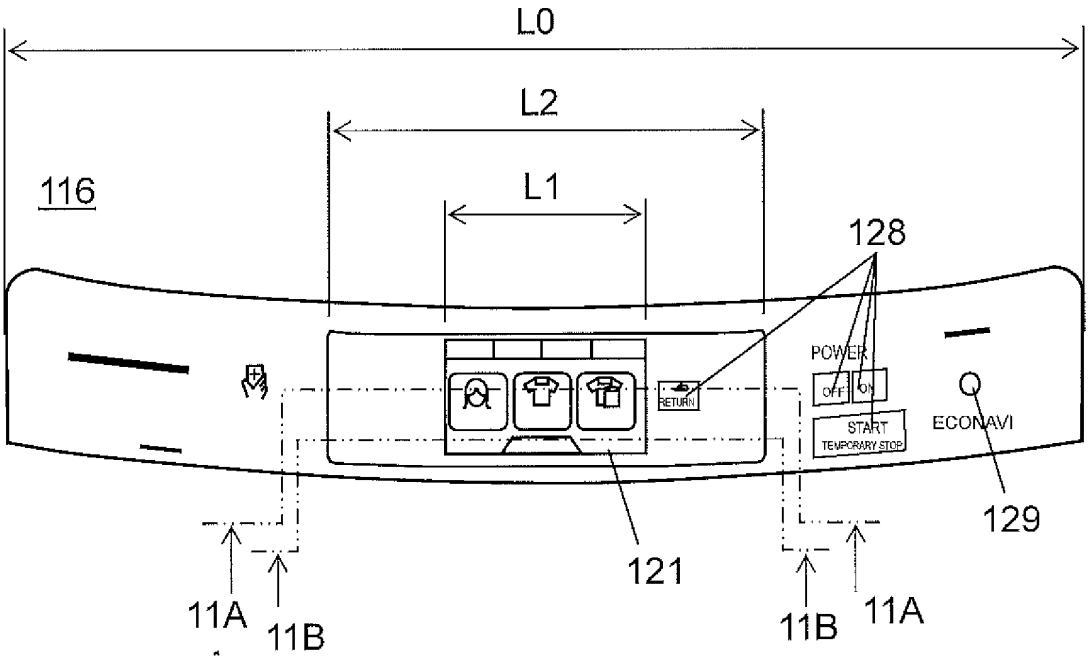
L0
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FIG. 9

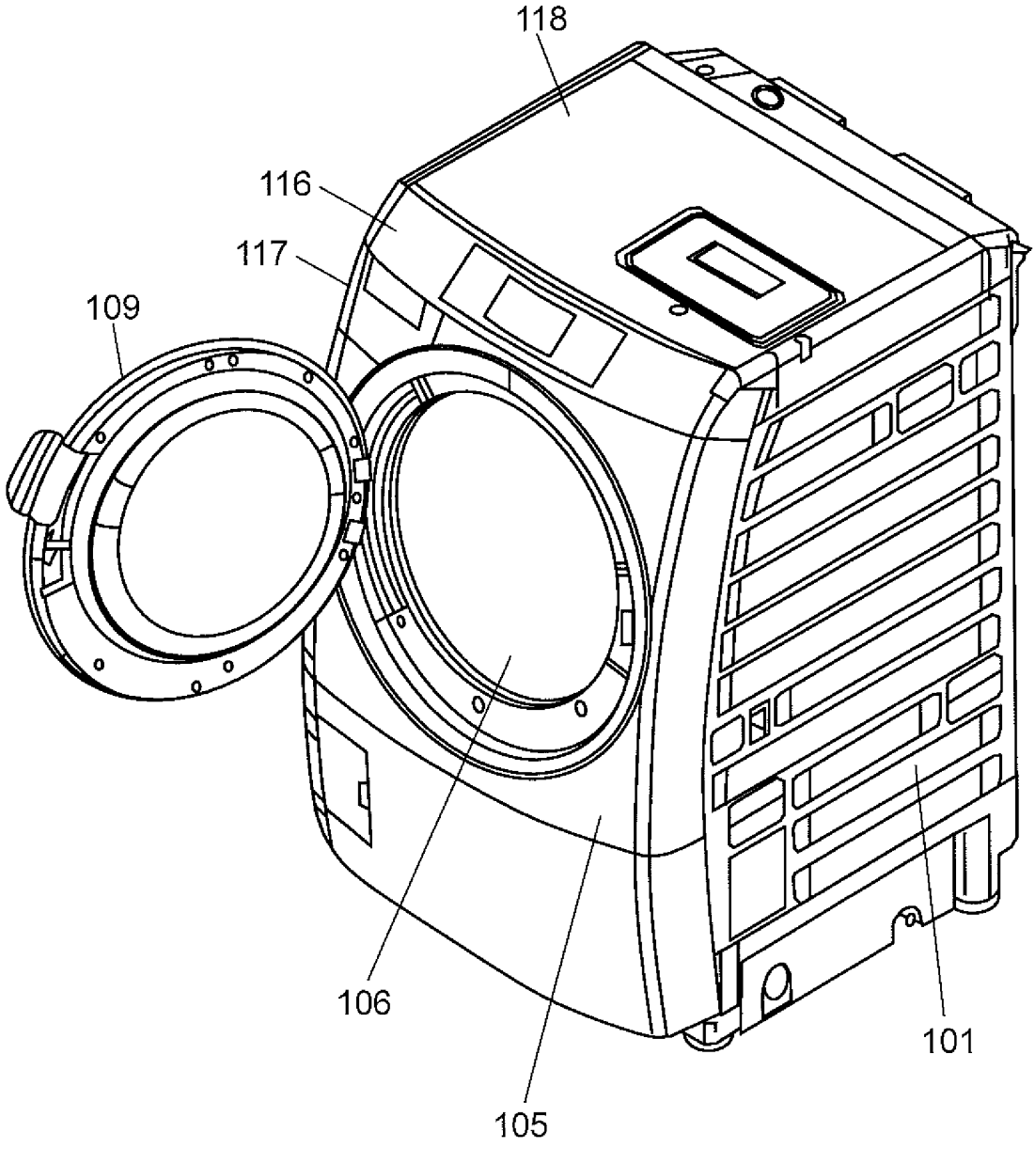

FIG. 10

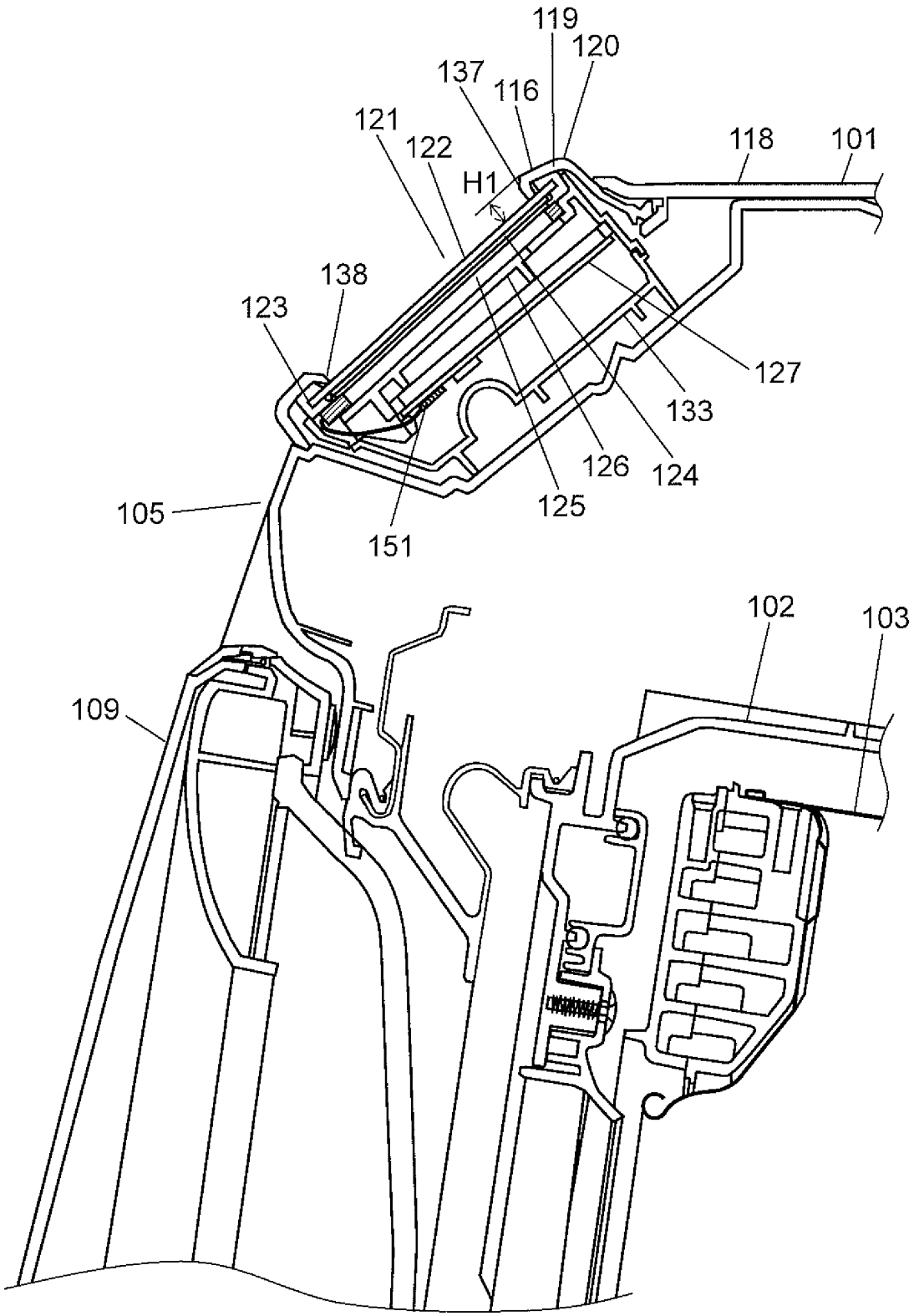
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FIG. 11A

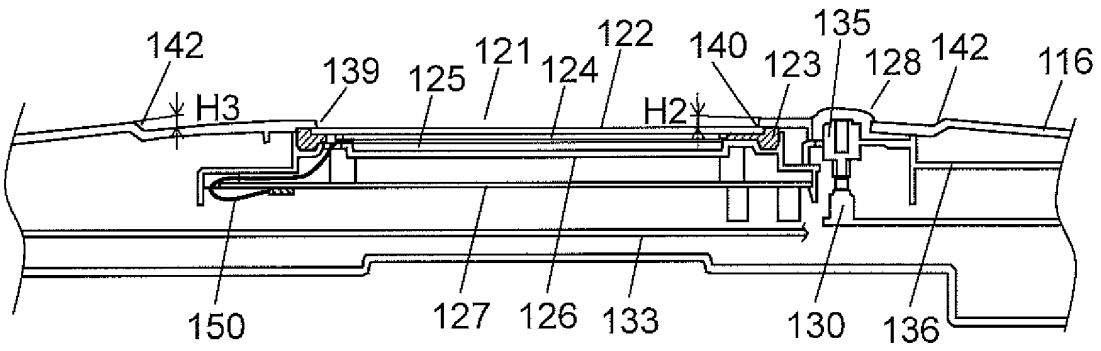

FIG. 11B

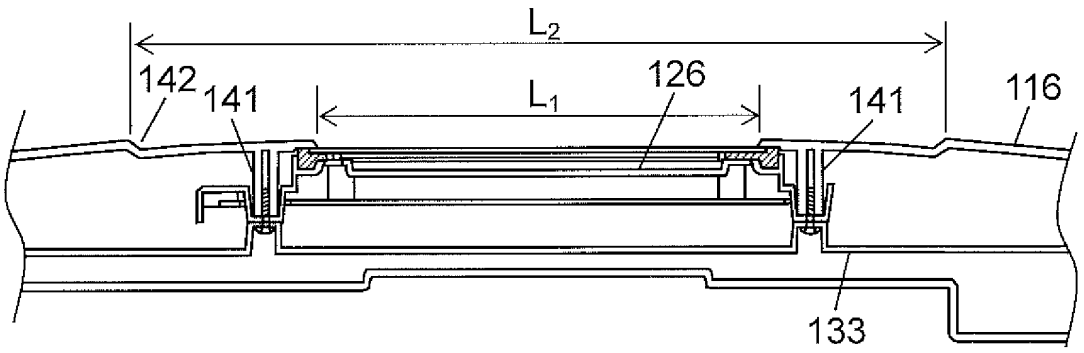

FIG. 12

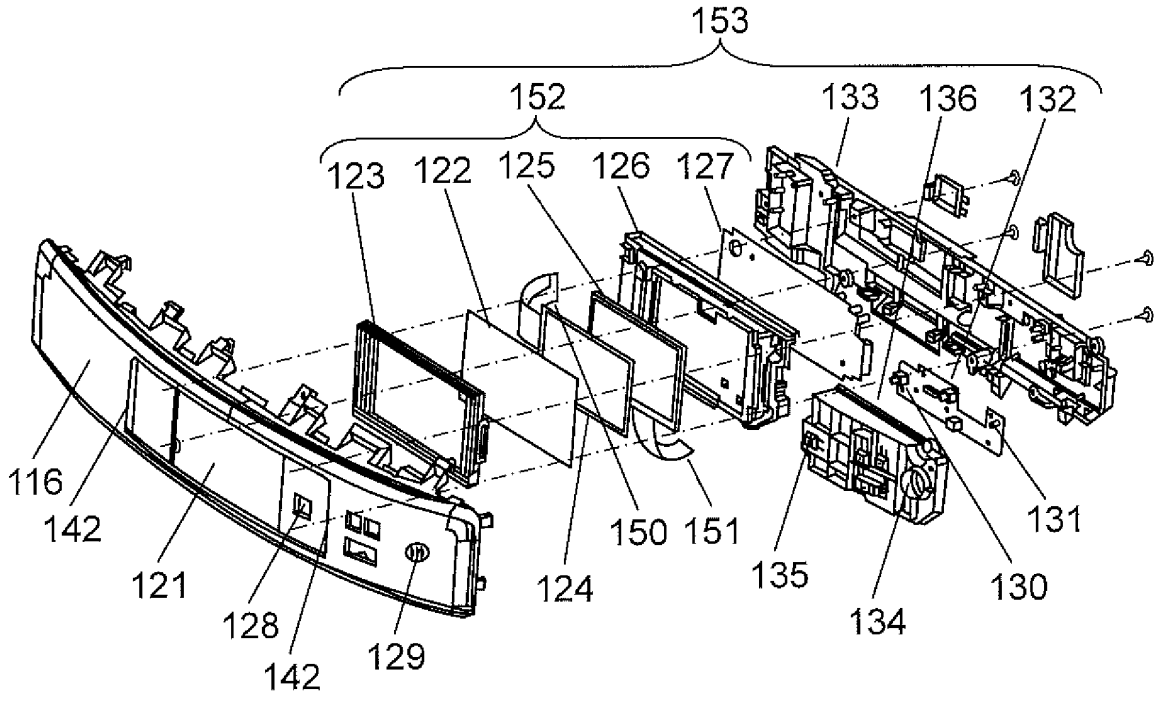
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FIG. 13A

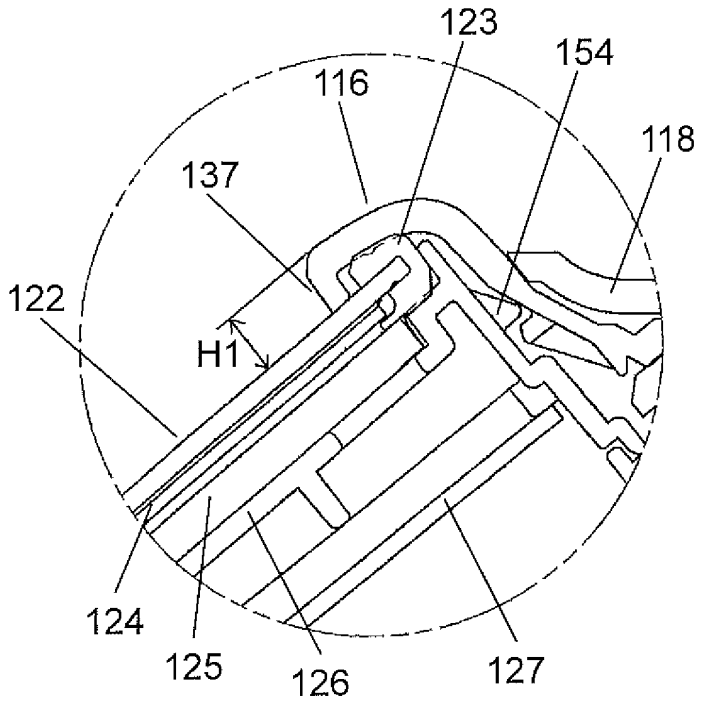

FIG. 13B

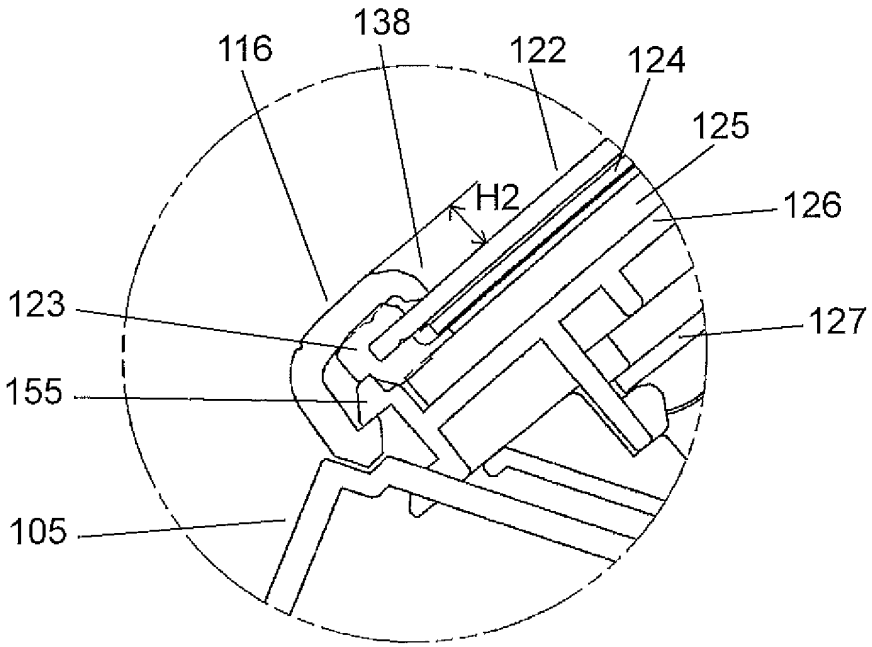

FIG. 14

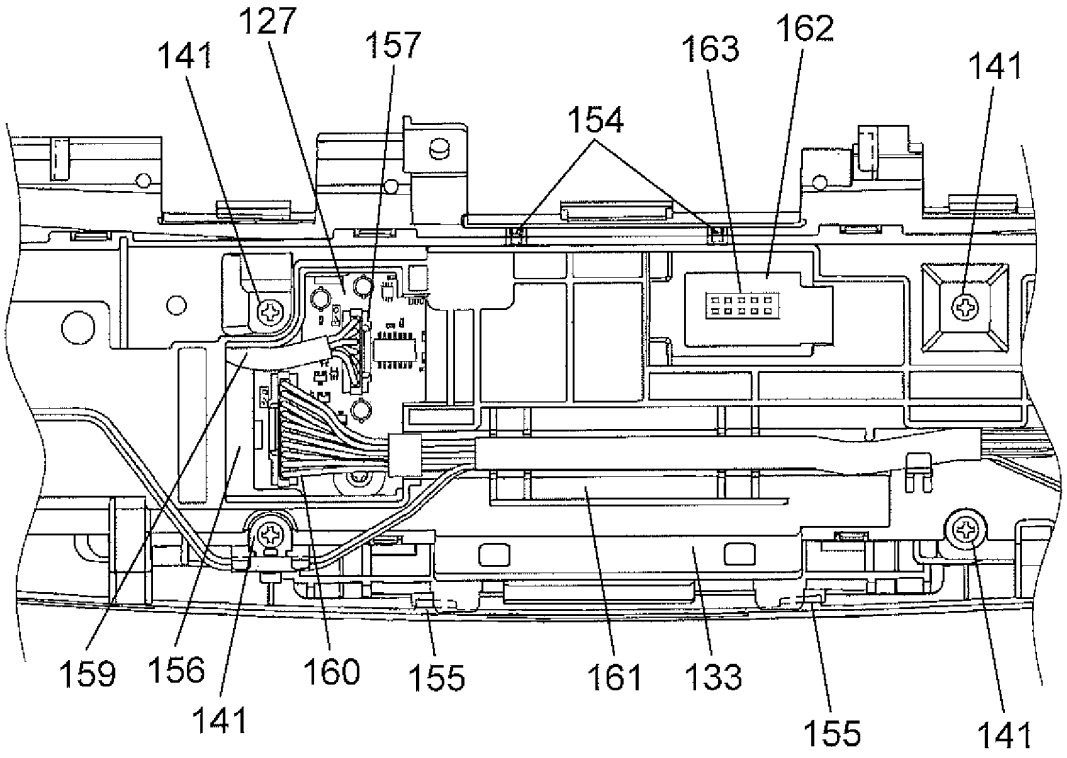

FIG. 15A

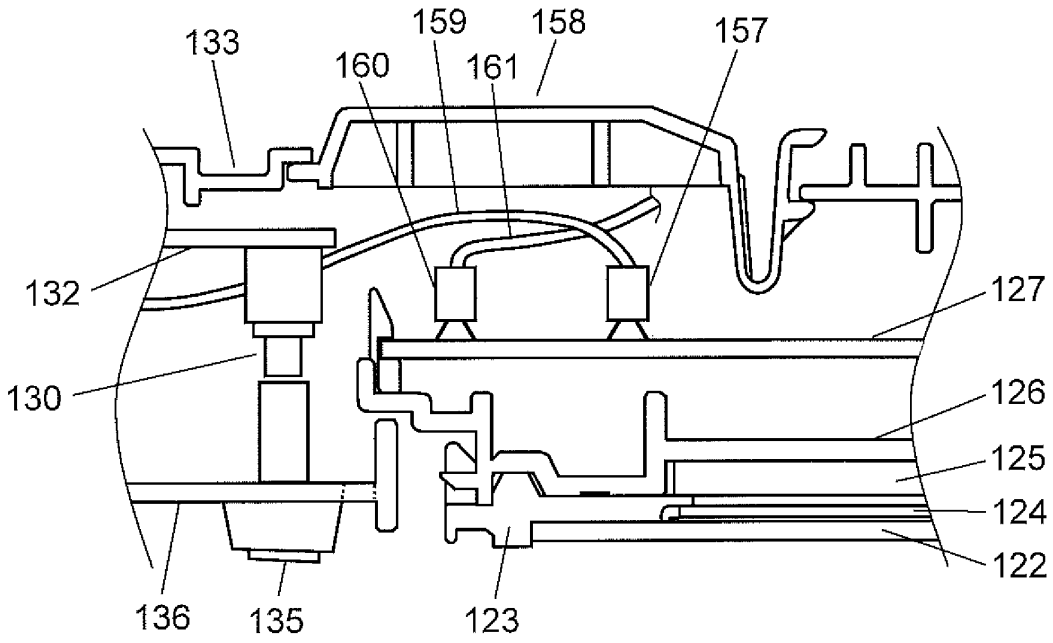

FIG. 15B

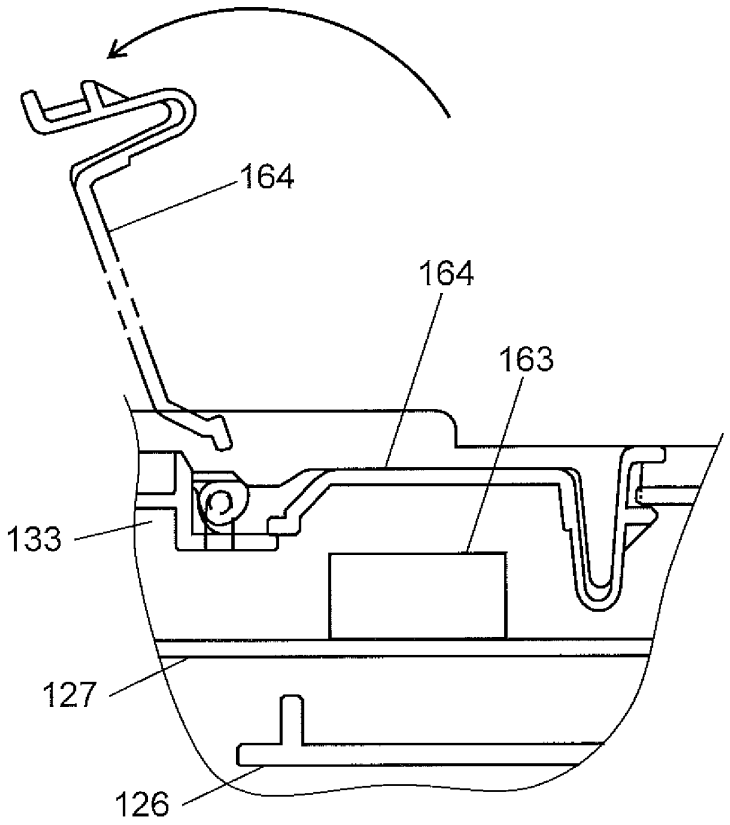

FIG. 16

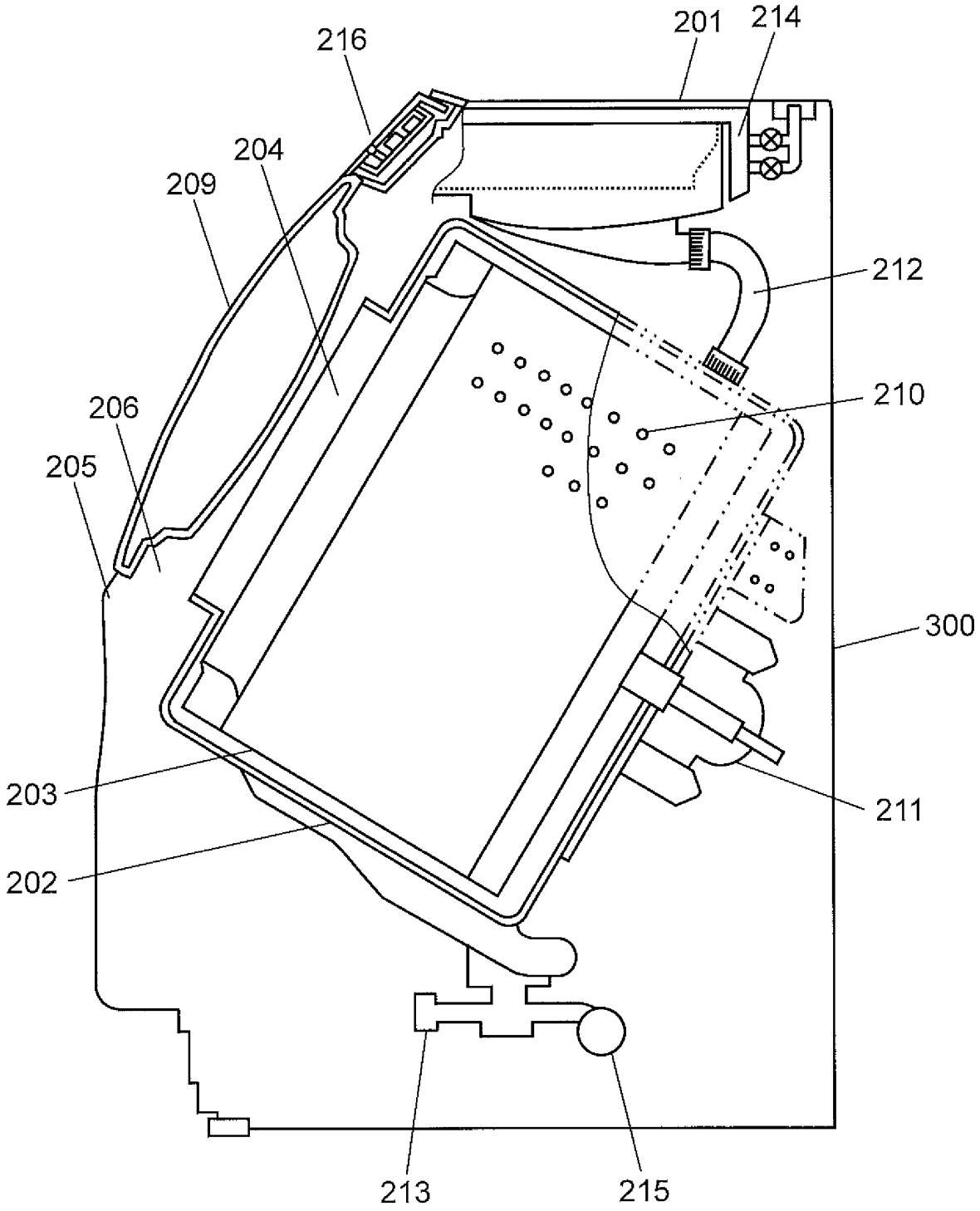

FIG. 17

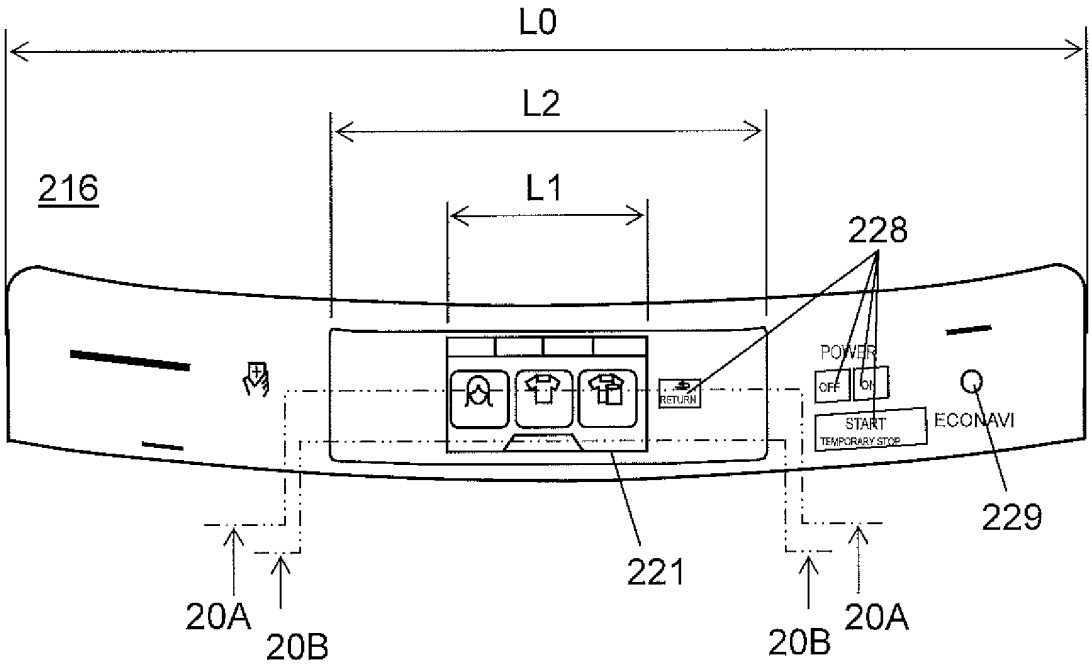
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FIG. 18

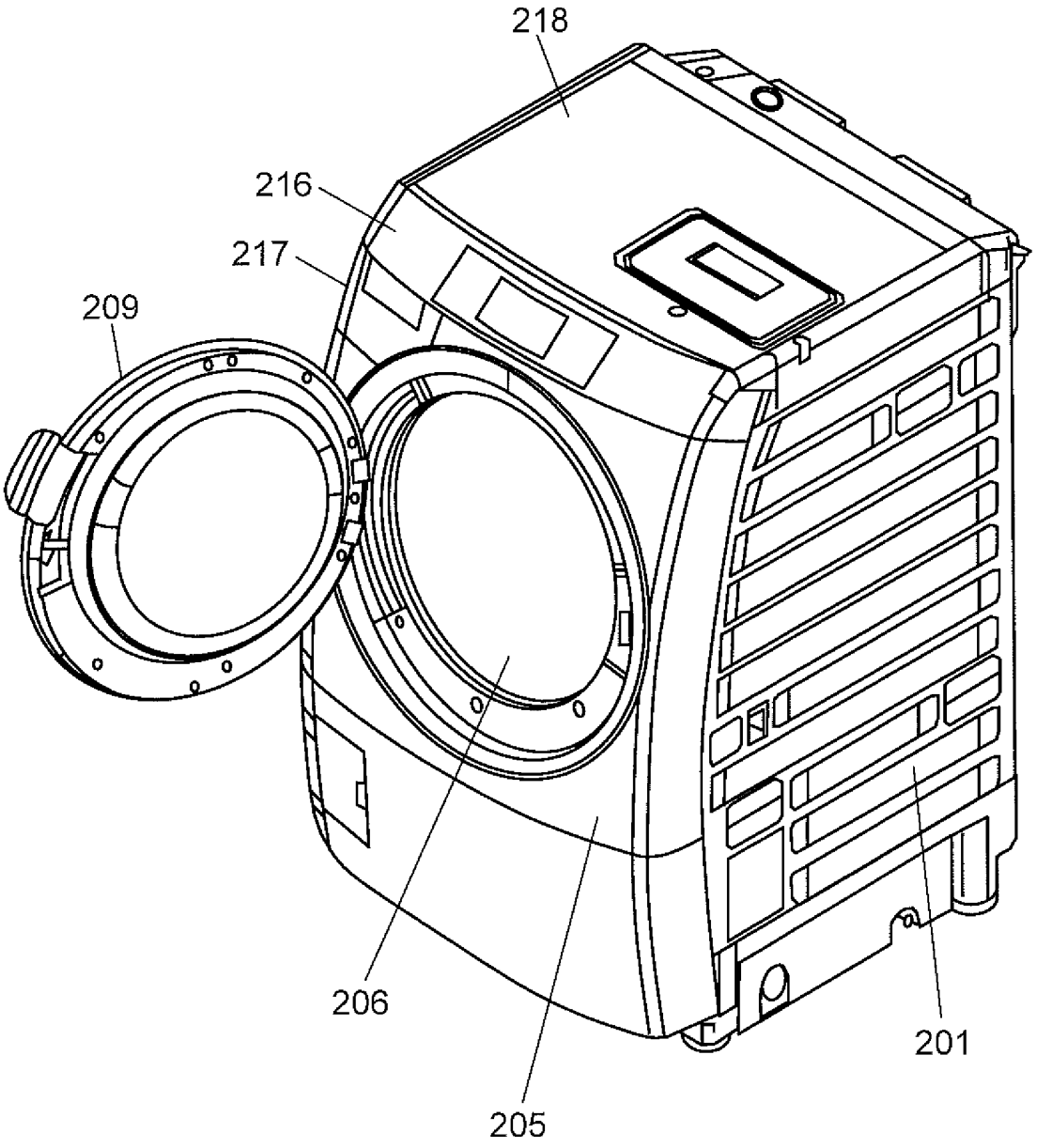

FIG. 19

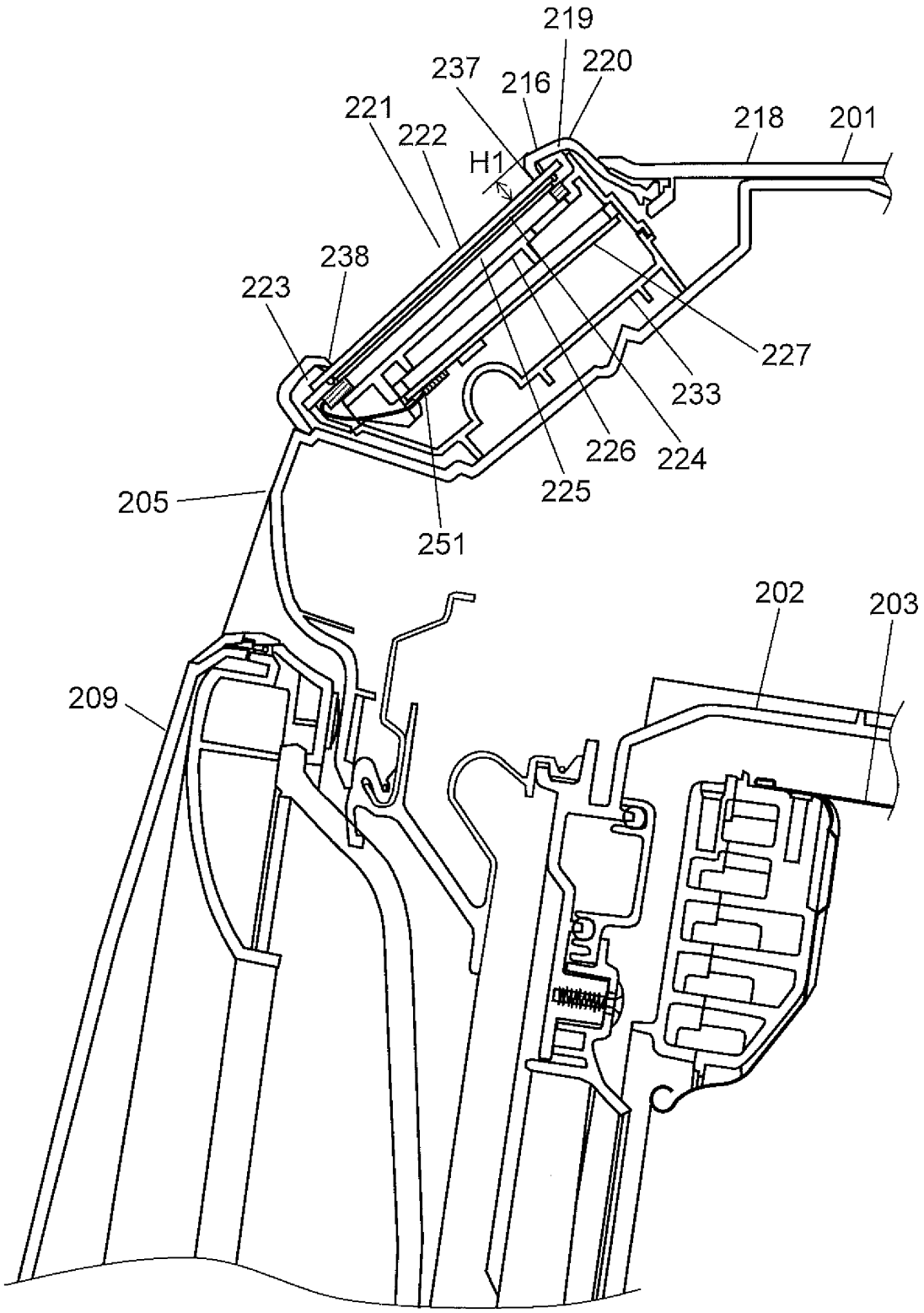
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FIG. 20A

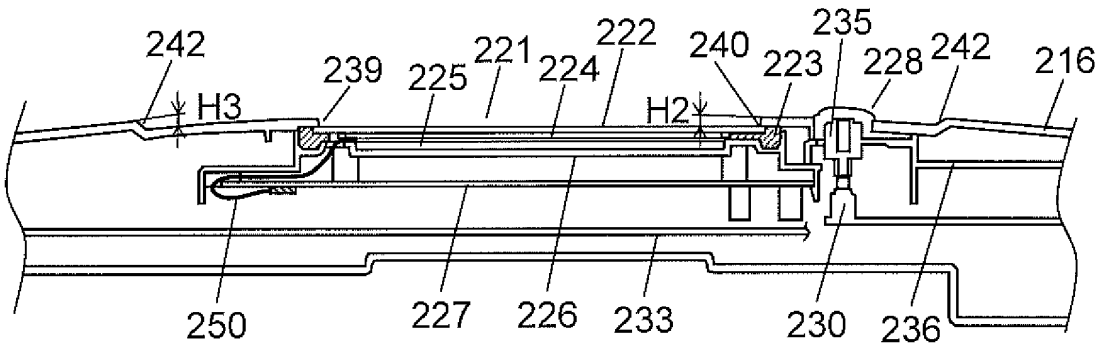

FIG. 20B

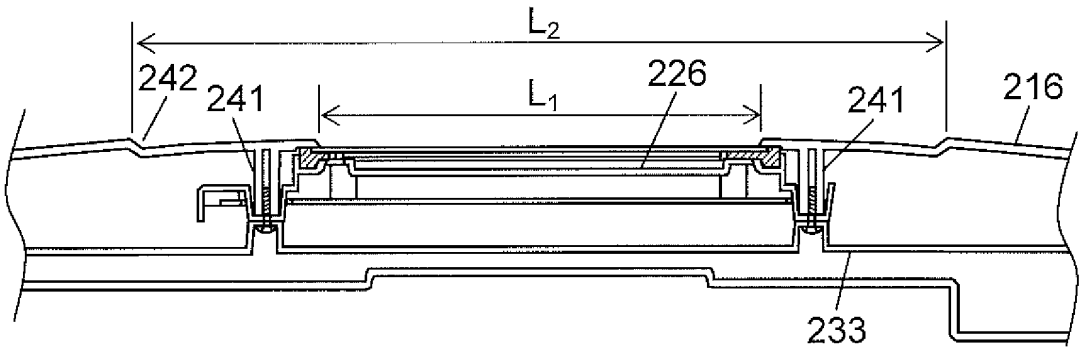

FIG. 21

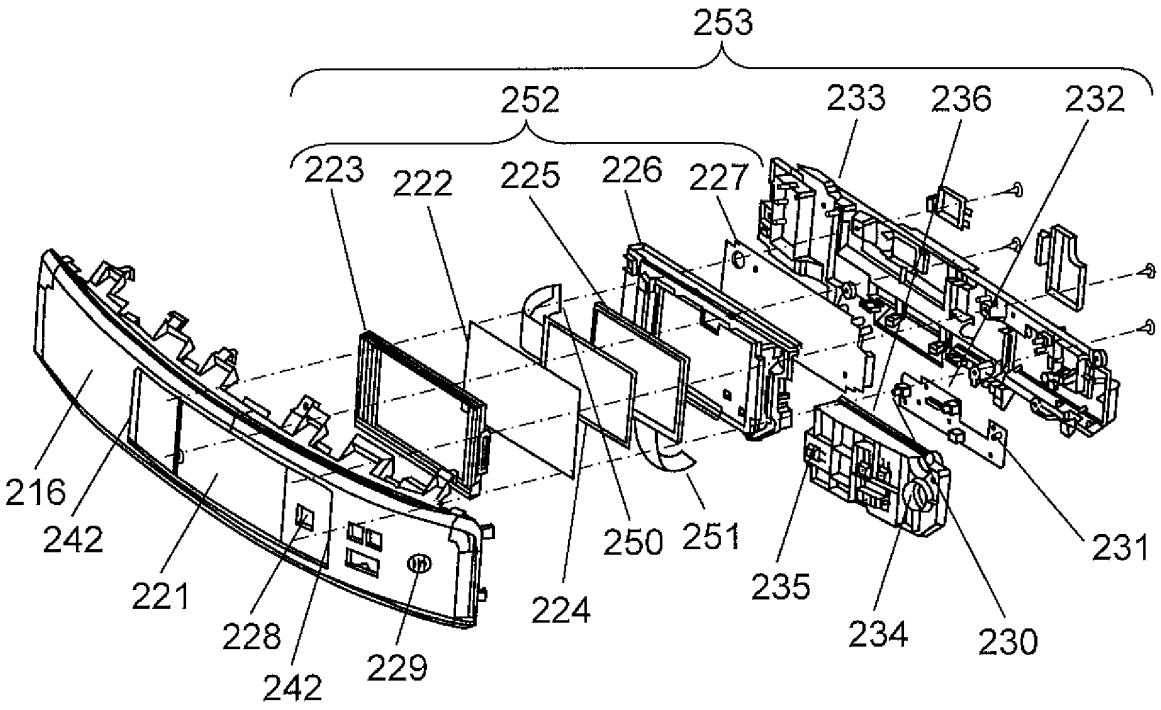
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FIG. 22A

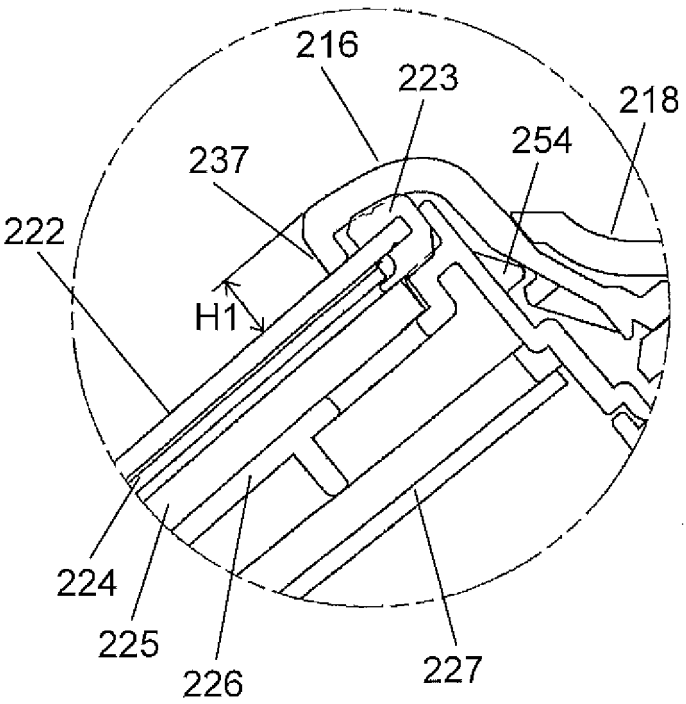

FIG. 22B

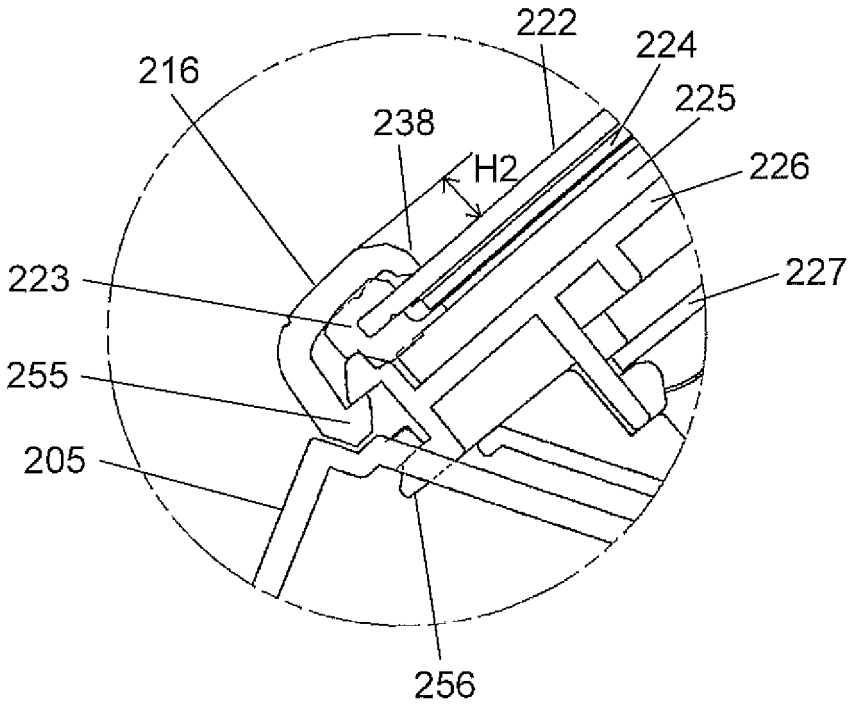

FIG. 23

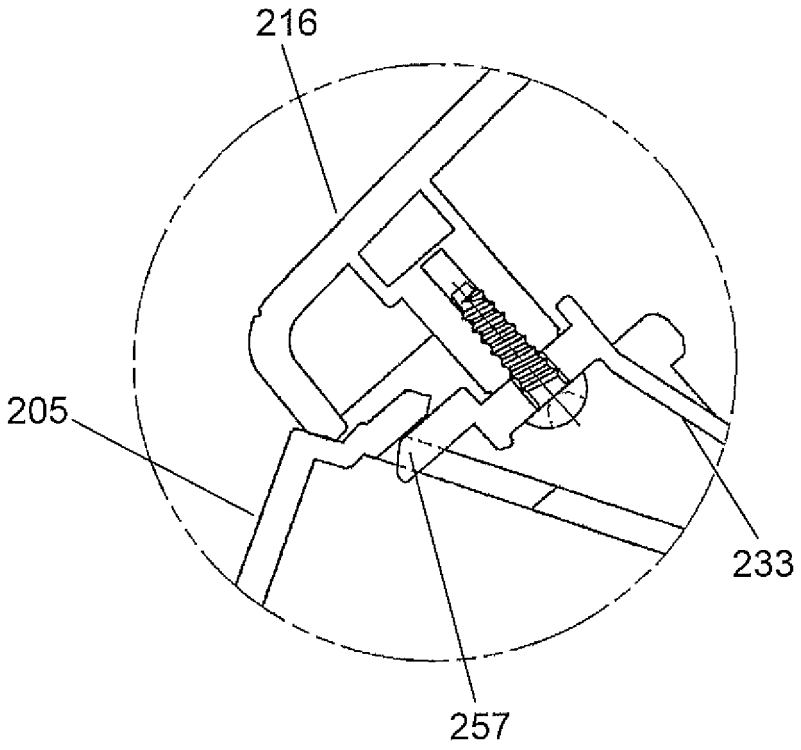

FIG. 24

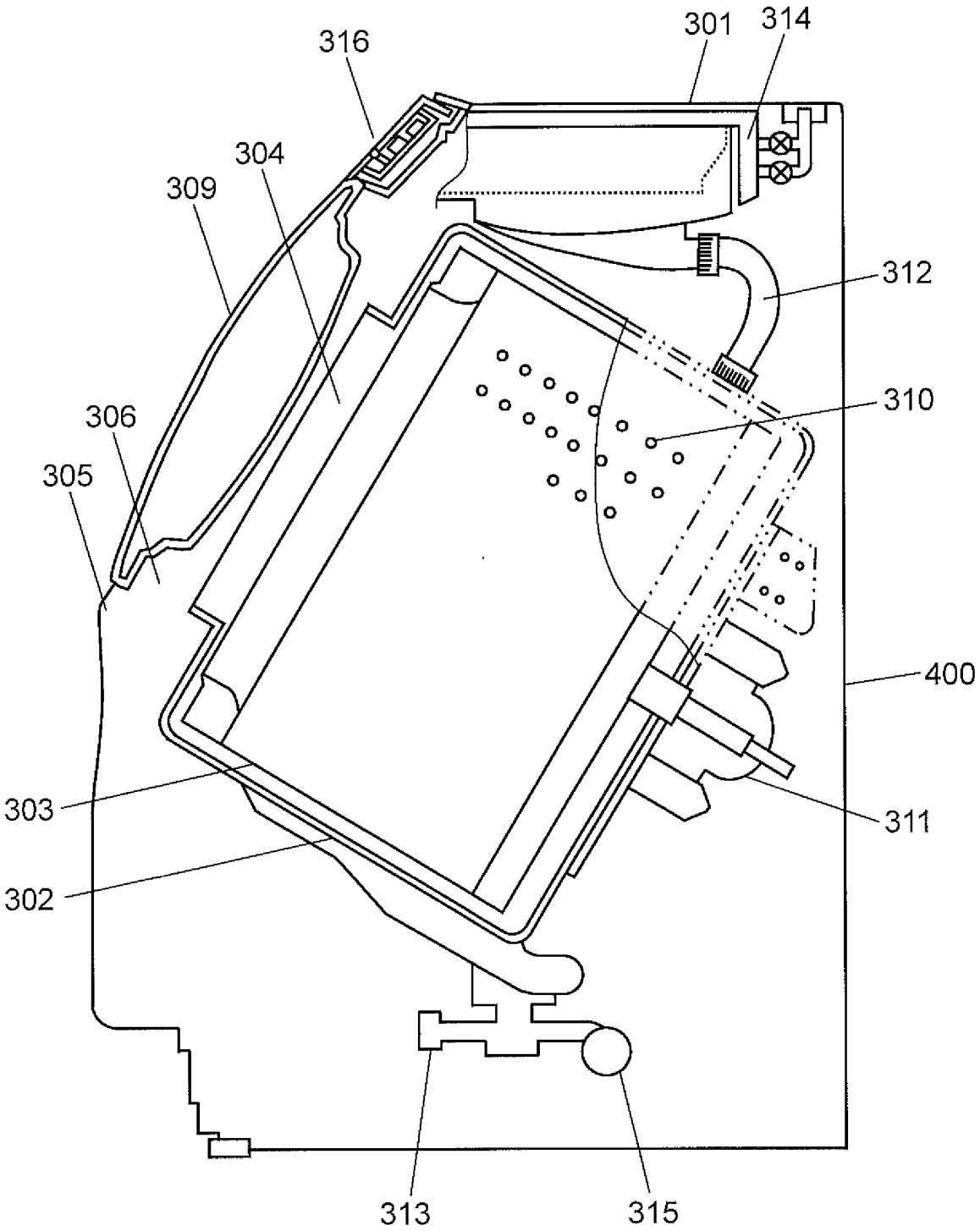

FIG. 25

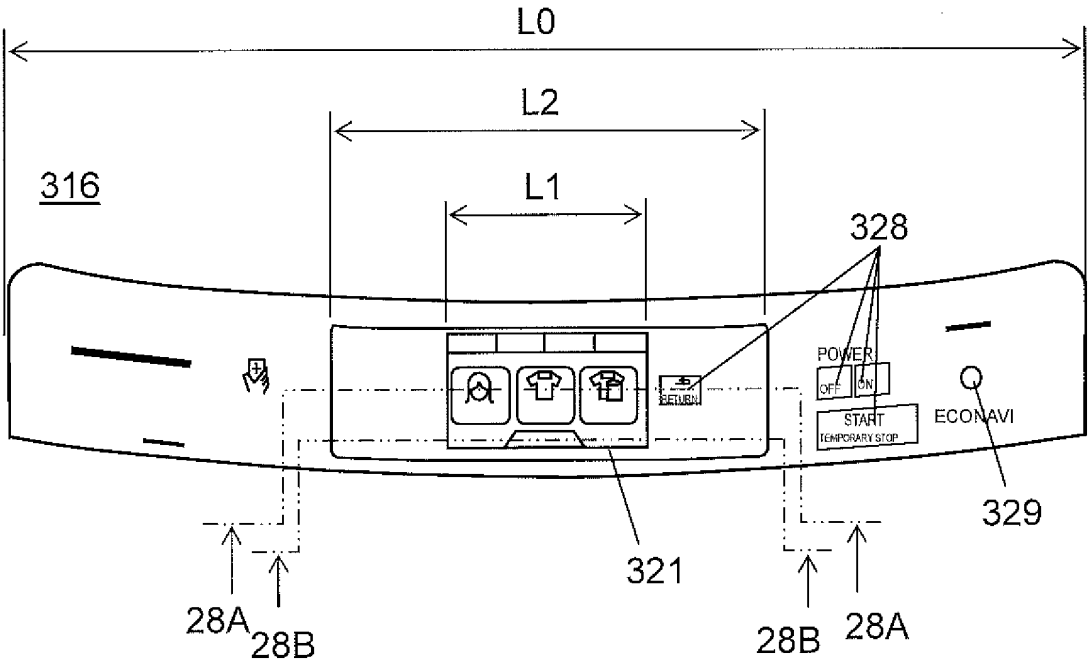
L0
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FIG. 26

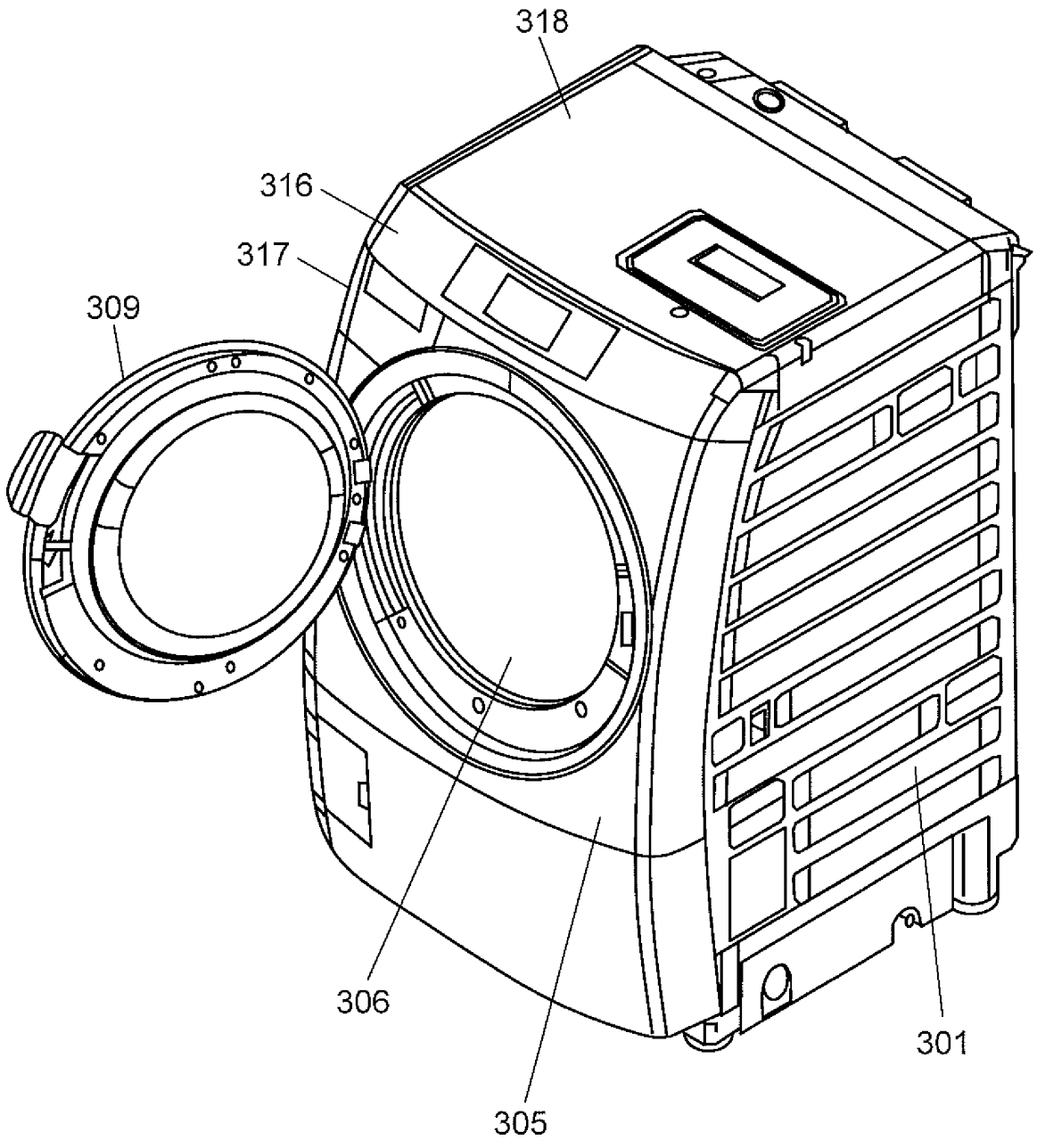

FIG. 27

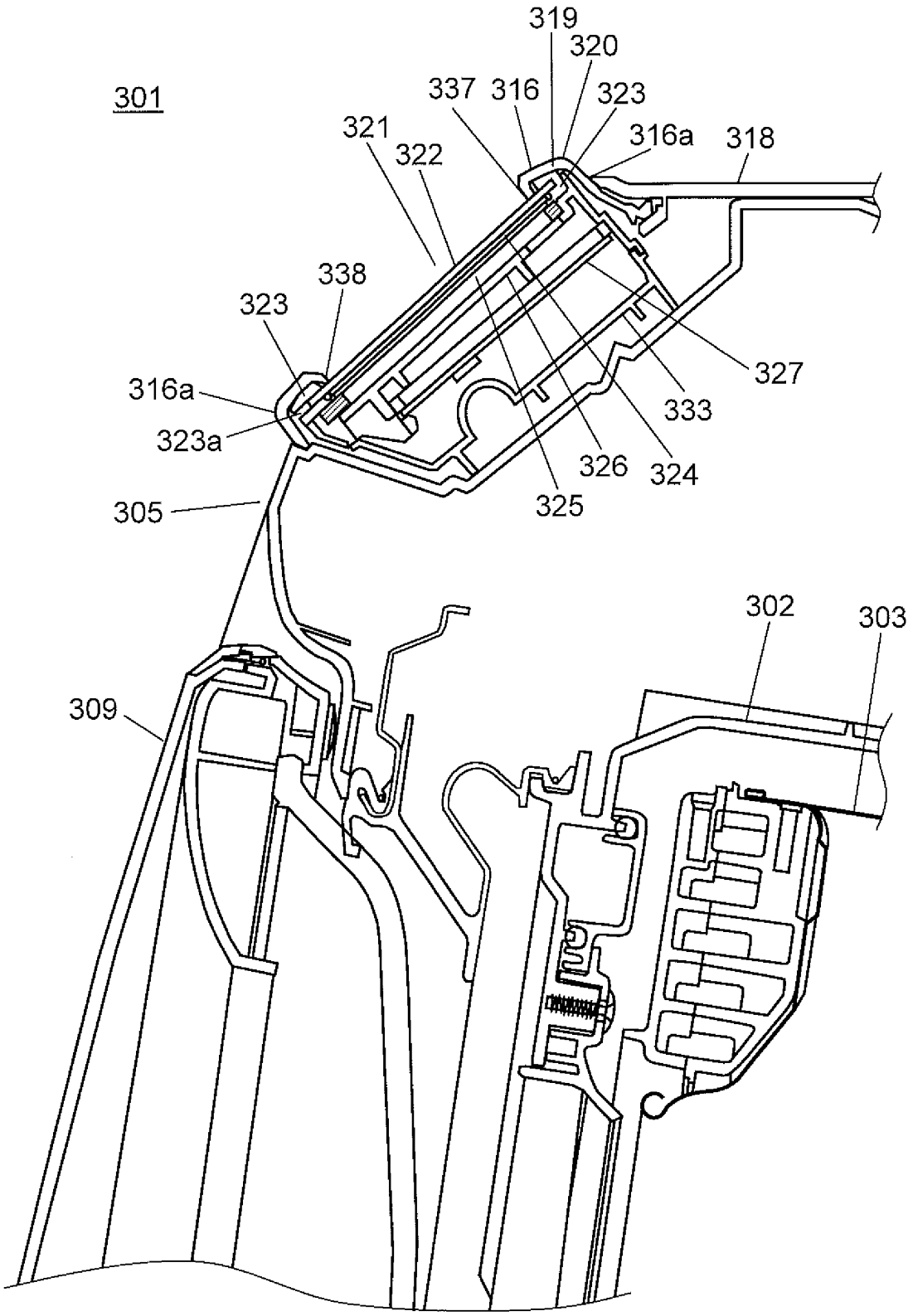
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FIG. 28A

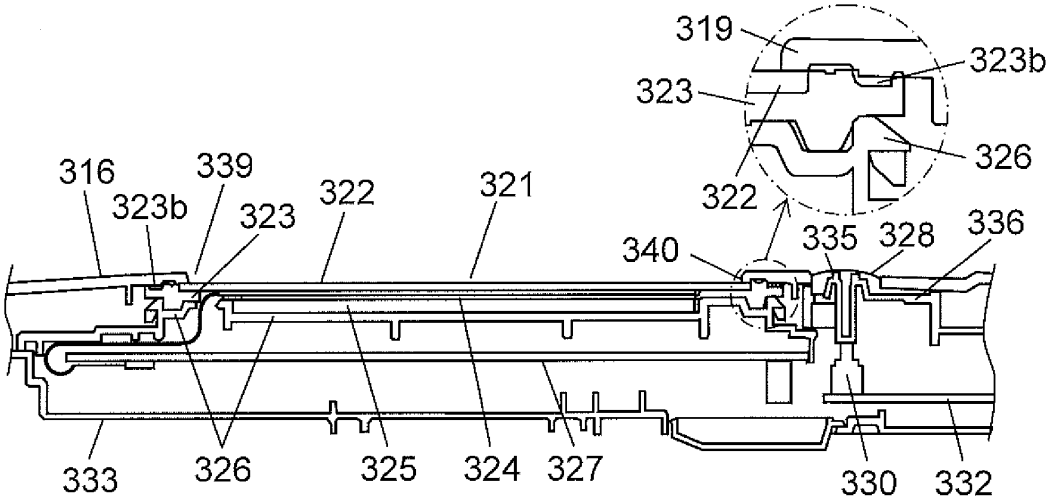

FIG. 28B

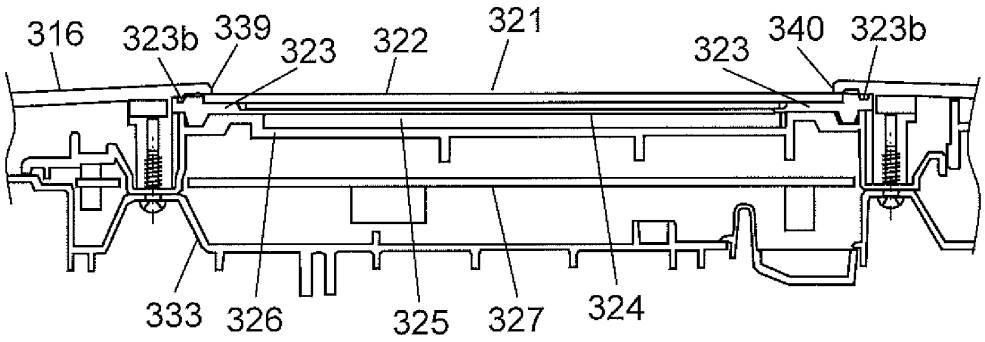

FIG. 29

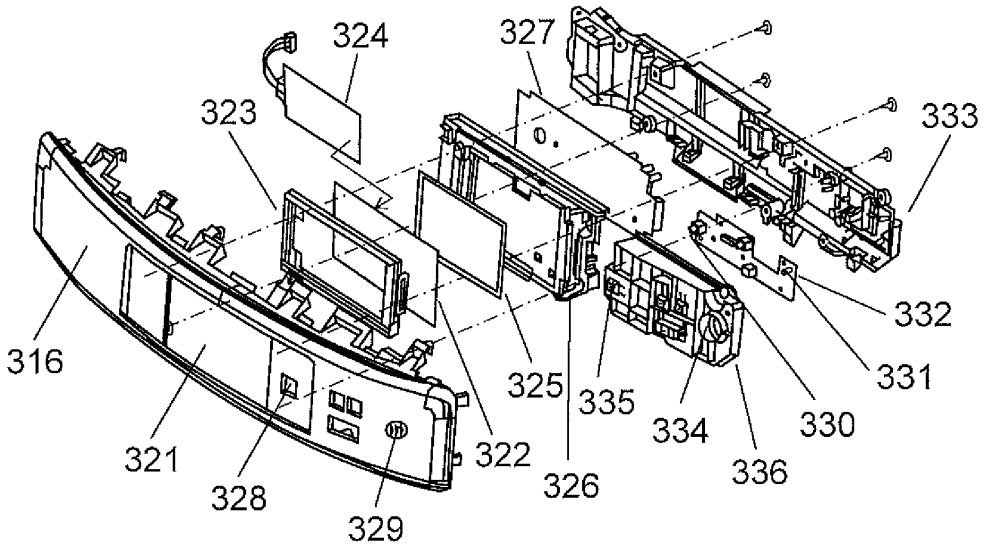

FIG. 30

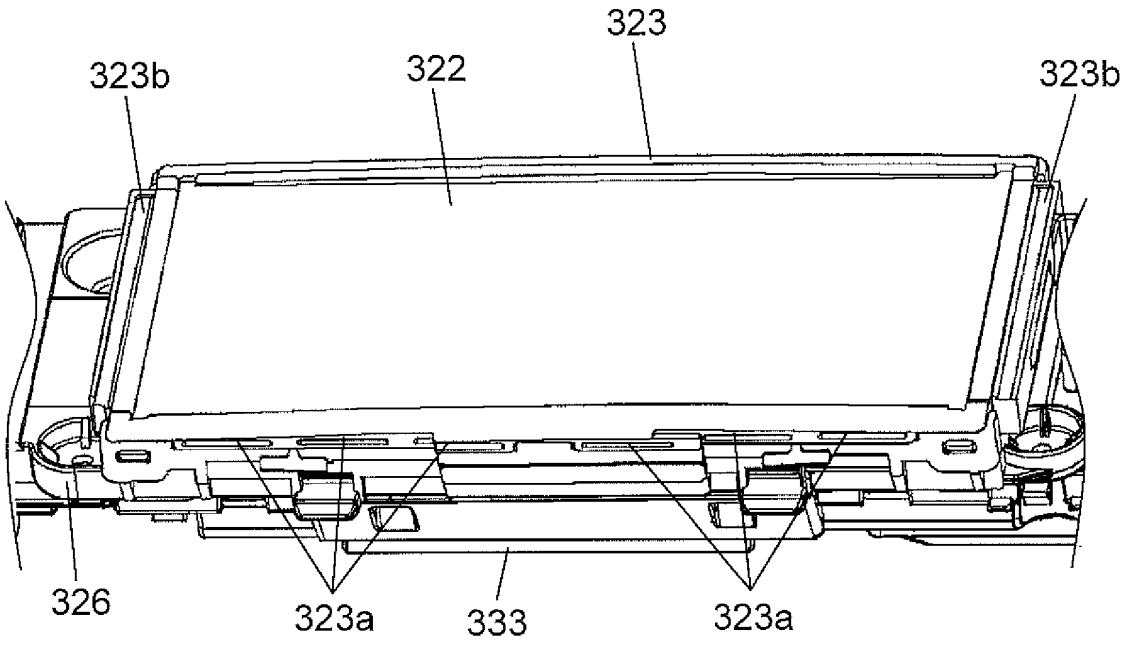

FIG. 31

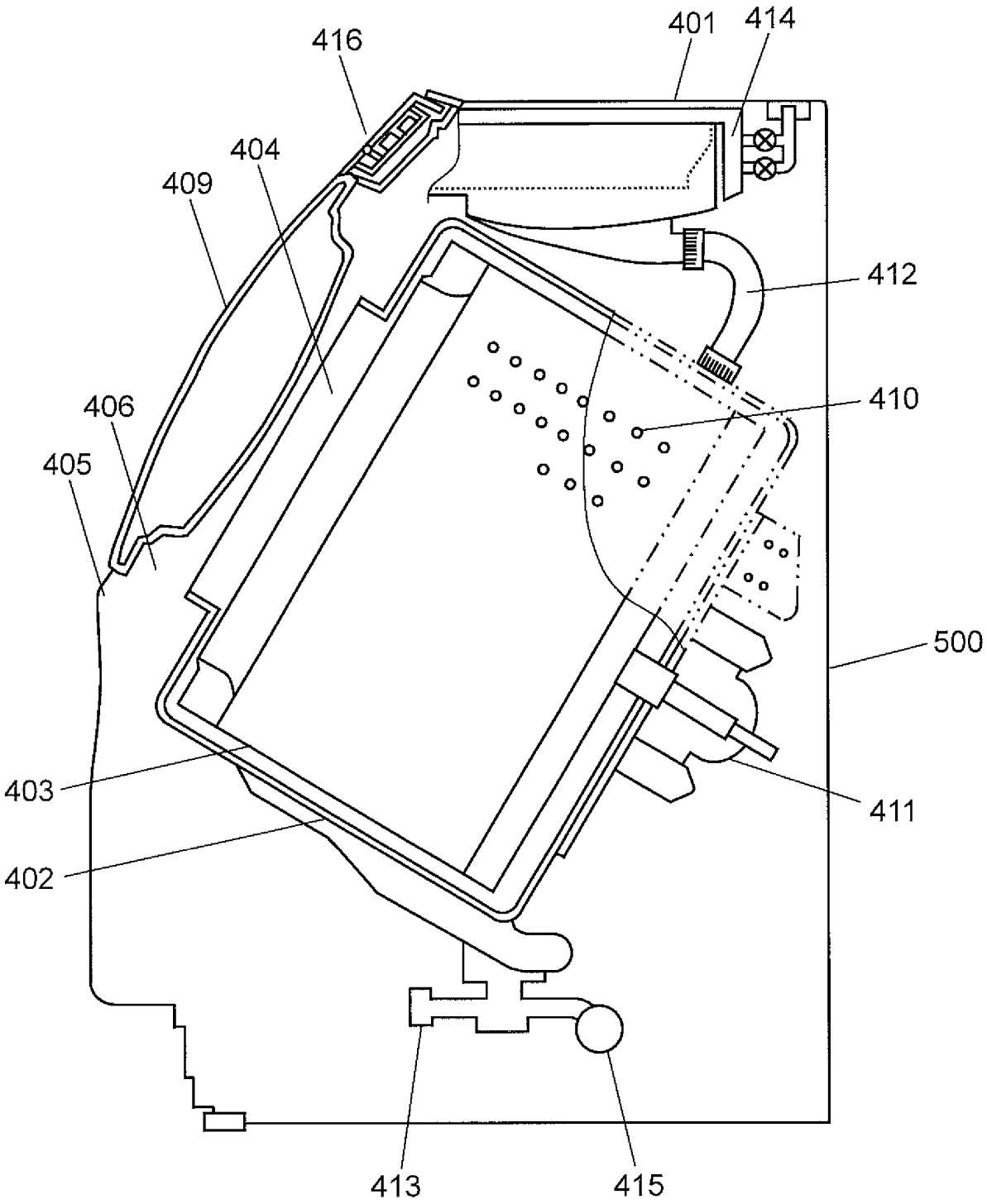

FIG. 32

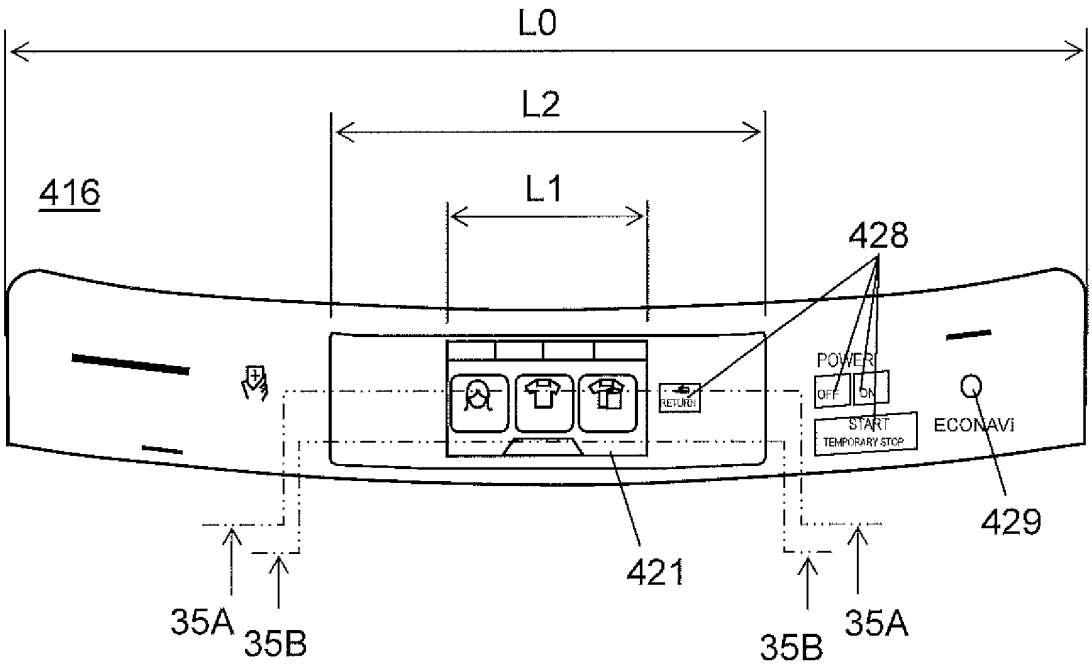
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FIG. 33

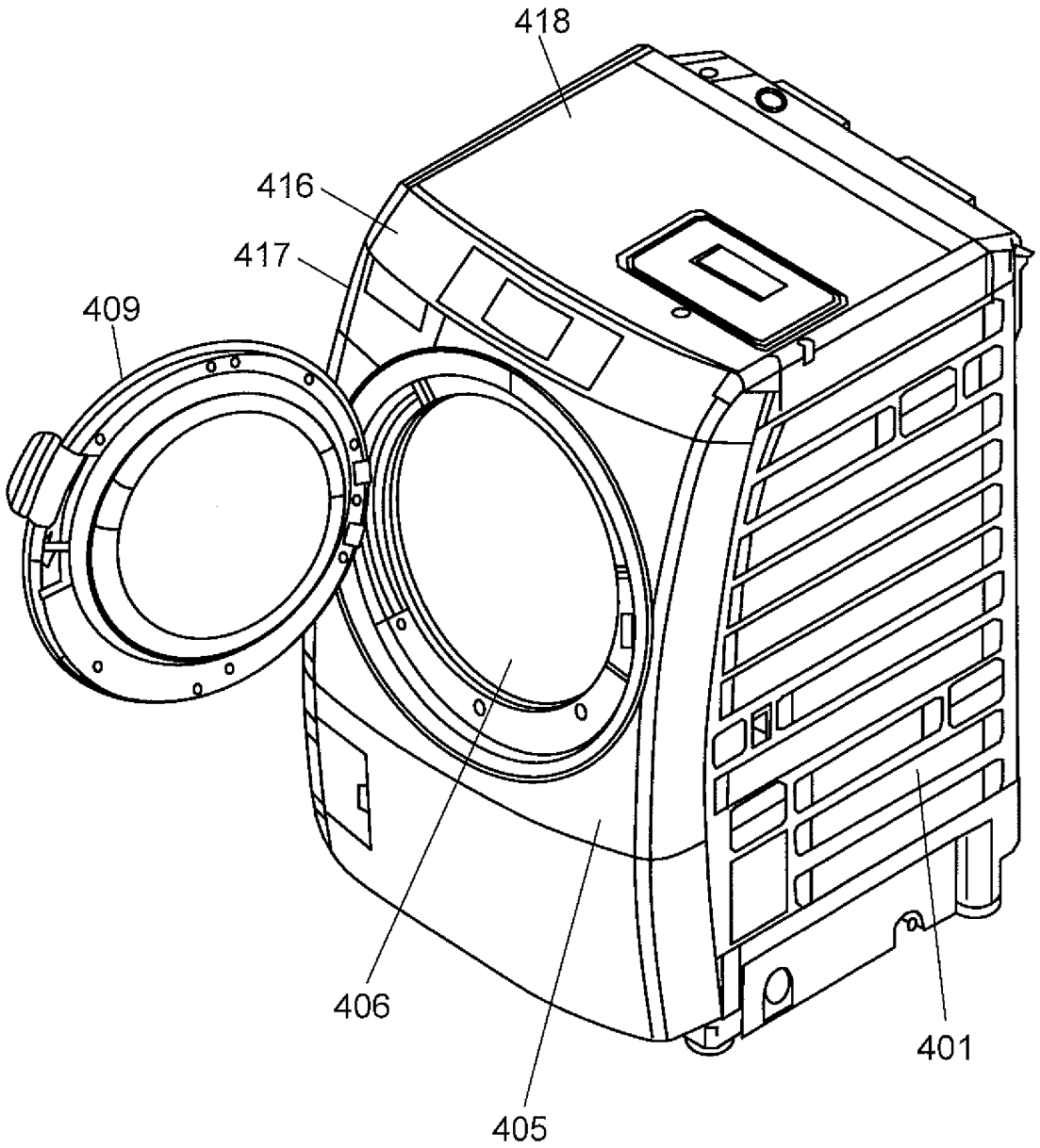

FIG. 34

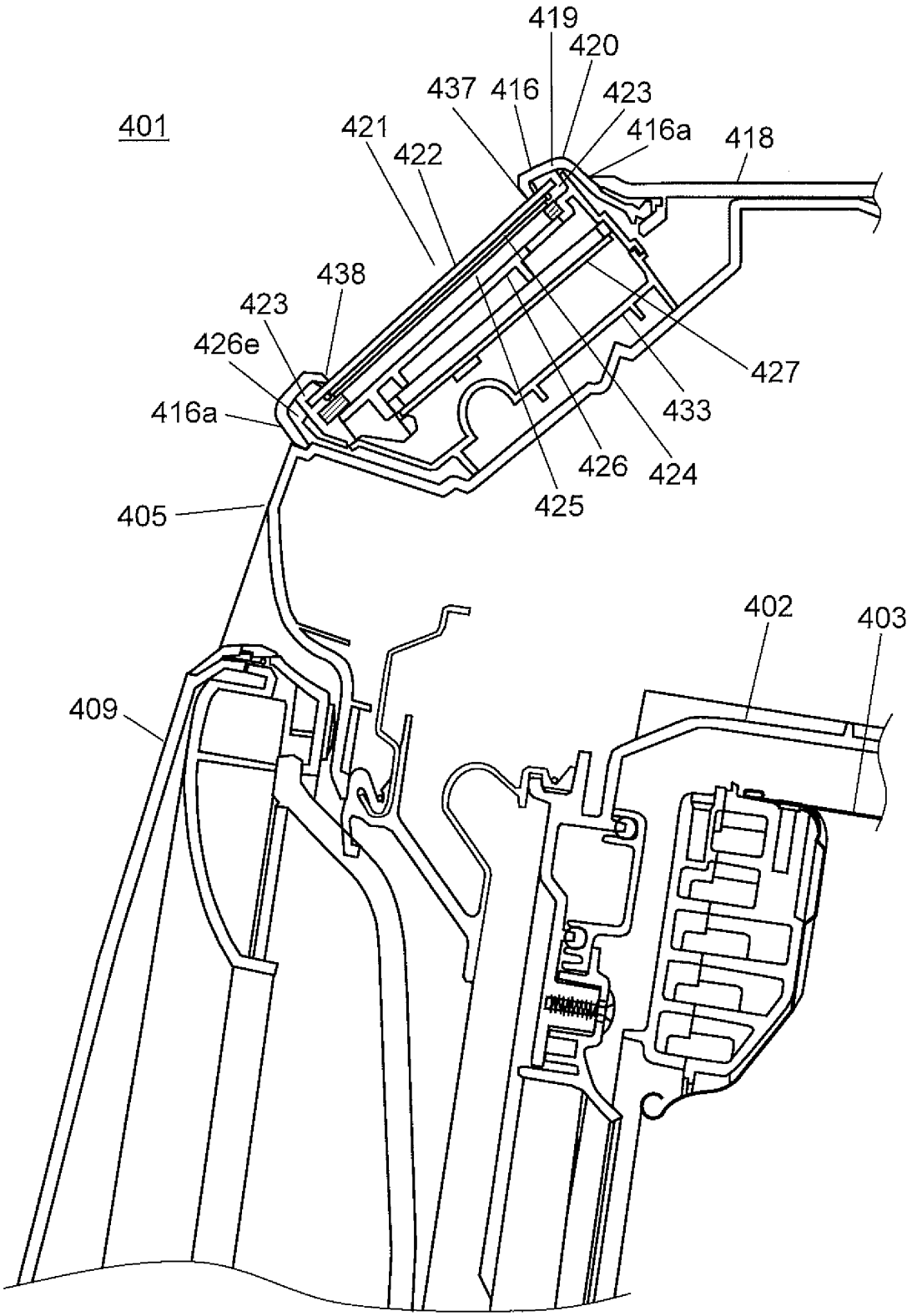
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FIG. 35A

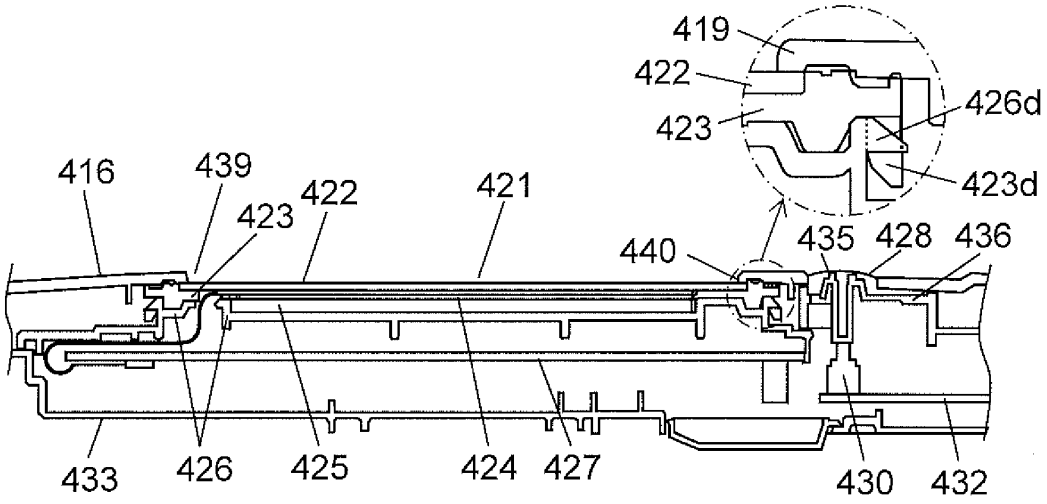


FIG. 35B

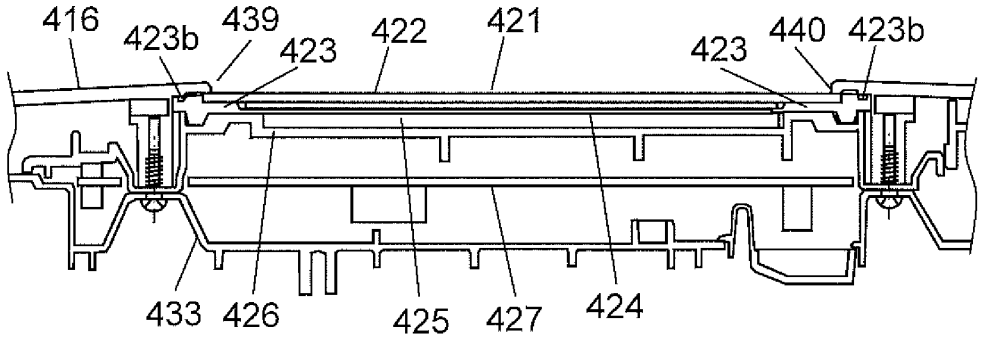


FIG. 36

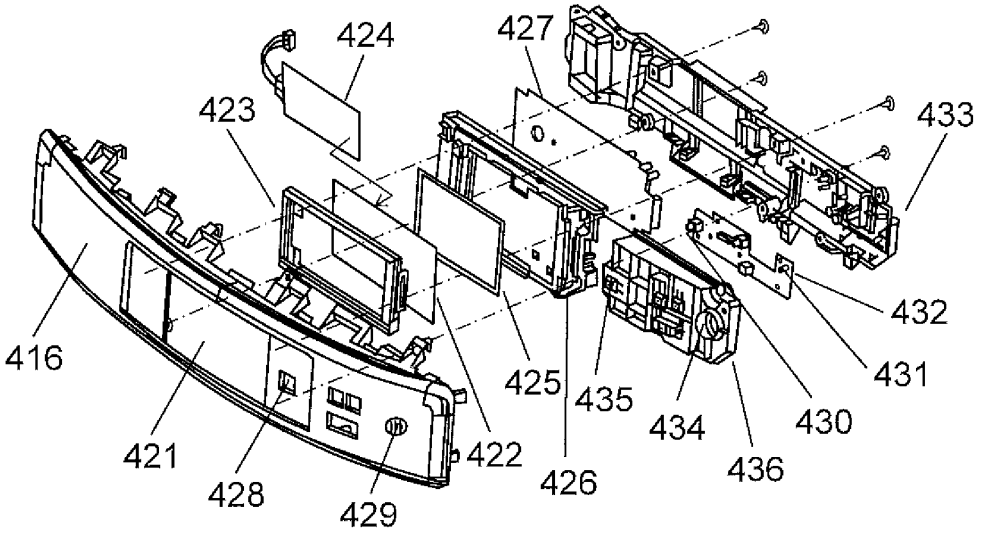


FIG. 37A

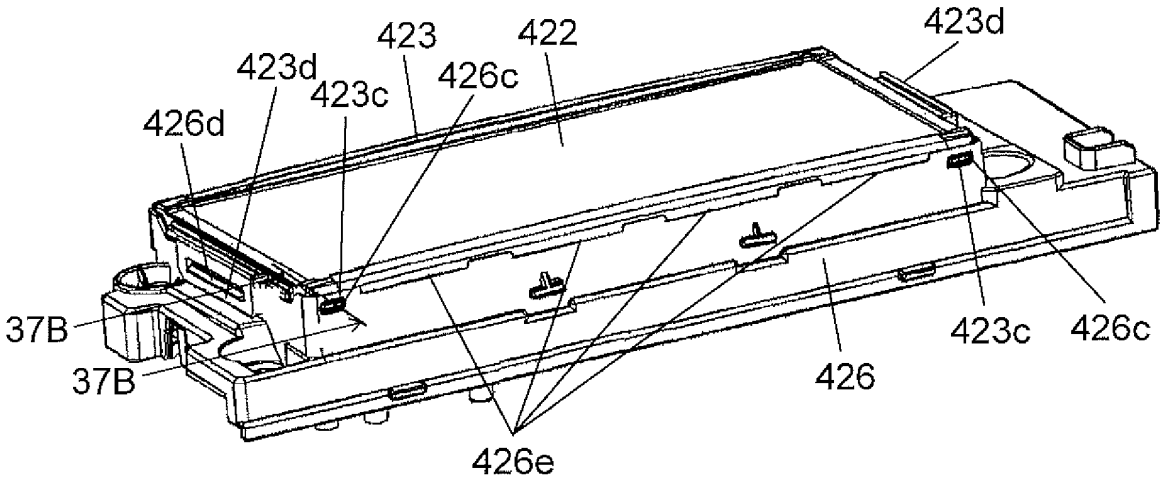


FIG. 37B

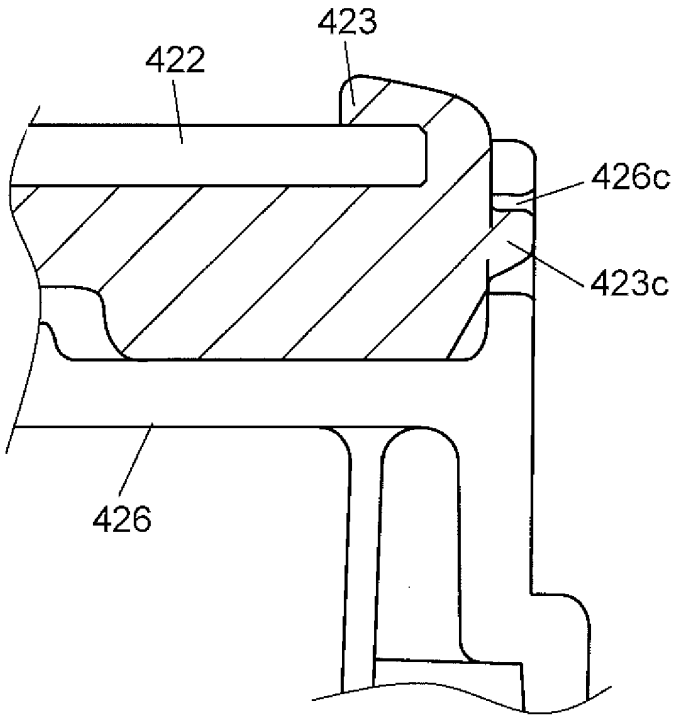
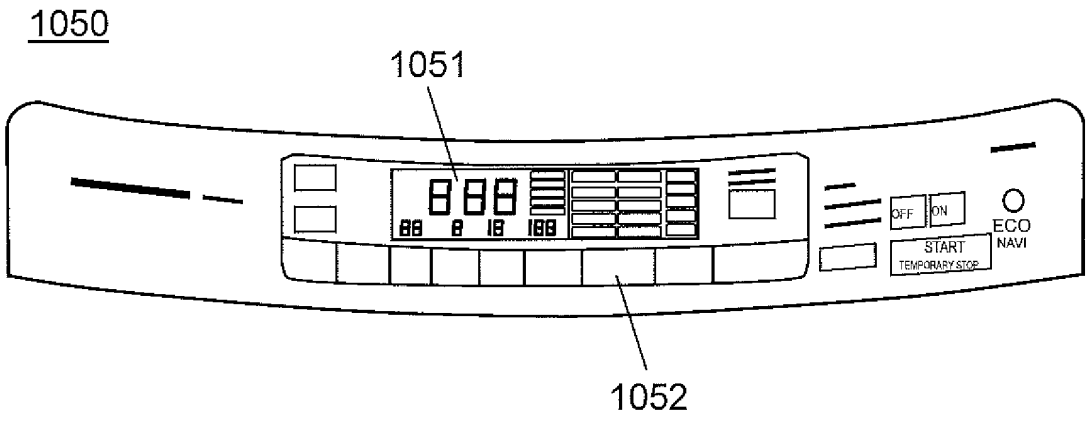


FIG. 38



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/005372

A. CLASSIFICATION OF SUBJECT MATTER
D06F39/00(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)
D06F39/00

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 1996-2013
Kokai Jitsuyo Shinan Koho 1971-2013 Toroku Jitsuyo Shinan Koho 1994-2013

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 A	JP 2002-253892 A (Hitachi, Ltd.), 10 September 2002 (10.09.2002), paragraphs [0006] to [0015]; fig. 1 to 6 & US 2002/0116959 A1 & KR 10-2002-0070039 A & CN 1373249 A	1-6,9-11, 14-17 7-8,12-13
Y A	JP 3-252692 A (Hitachi, Ltd.), 11 November 1991 (11.11.1991), page 9, lower left column, line 19 to lower right column, line 8; page 12, upper left column, line 6 to lower left column, line 16; fig. 3 to 4, 14 & US 5243453 A & CA 2037222 A	1-6,9-11, 14-17 7-8,12-13

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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28 November, 2013 (28.11.13)	10 December, 2013 (10.12.13)
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-141278 A (Toshiba Corp., Toshiba AVE Co., Ltd.), 04 June 1996 (04.06.1996), paragraph [0068]; fig. 9 & US 5694793 A & KR 10-0225279 B & CN 1133919 A	2-6,9-11, 14-17
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A	JP 3-243987 A (Hitachi, Ltd.), 30 October 1991 (30.10.1991), entire text; all drawings (Family: none)	1-17
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A	JP 8-318087 A (Toshiba Corp., Toshiba AVE Co., Ltd.), 03 December 1996 (03.12.1996), entire text; fig. 5 (Family: none)	1-17
A	JP 9-117587 A (Toshiba Corp., Toshiba AVE Co., Ltd.), 06 May 1997 (06.05.1997), entire text; fig. 5 (Family: none)	1-17

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- JP 2005143793 A **[0009]**