US00RE48487E

(19) **United States**
(12) **Reissued Patent**
Lee et al.

(10) **Patent Number: US RE48,487 E**
(45) **Date of Reissued Patent: Mar. 30, 2021**

(54) WASHING MACHINE

(71) Applicant: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(72) Inventors: **Do Yun Lee**, Yongin-si (KR); **Sang Wook Kim**, Suwon-si (KR)

(73) Assignee: **Samsung Electronics Co., Ltd.**, Suwon-si (KR)

(21) Appl. No.: **16/192,555**

(22) Filed: **Nov. 15, 2018**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **9,725,841**
Issued: **Aug. 8, 2017**
Appl. No.: **14/959,583**
Filed: **Dec. 4, 2015**

(30) **Foreign Application Priority Data**

Dec. 4, 2014 (KR) 10-2014-0173203

(51) **Int. Cl.**
D06F 39/14 (2006.01)
D06F 37/42 (2006.01)

(52) **U.S. Cl.**
CPC ***D06F 39/14*** (2013.01); ***D06F 37/42*** (2013.01)

(58) **Field of Classification Search**
CPC D06F 37/42; D06F 39/14; D06F 37/28; E05B 65/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,363,755	B1 *	4/2002	Hapke	D06F 37/42 210/146
7,251,961	B2 *	8/2007	Hapke	D06F 39/14 68/12.26
9,725,841	B2	8/2017	Lee et al.	
2012/0312594	A1 *	12/2012	Hapke	D06F 37/42 174/668
2015/0008808	A1 *	1/2015	Kim	D06F 39/14 312/228
2015/0069889	A1 *	3/2015	Kim	D06F 39/14 312/228.1
2015/0240527	A1 *	8/2015	Osvatic	D06F 37/42 292/144
2016/0230326	A1 *	8/2016	Han	D06F 39/14
2016/0251793	A1 *	9/2016	Finney	D06F 37/28

FOREIGN PATENT DOCUMENTS

KR	10-2011-0013149	A	2/2011
KR	10-2012-0056702	A	6/2012
KR	10-2014-0173203	A	6/2016

OTHER PUBLICATIONS

Notice of Preliminary Rejection dated Nov. 20, 2020 in connection with Korean Application No. 10-2014-0173203, 13 pages.

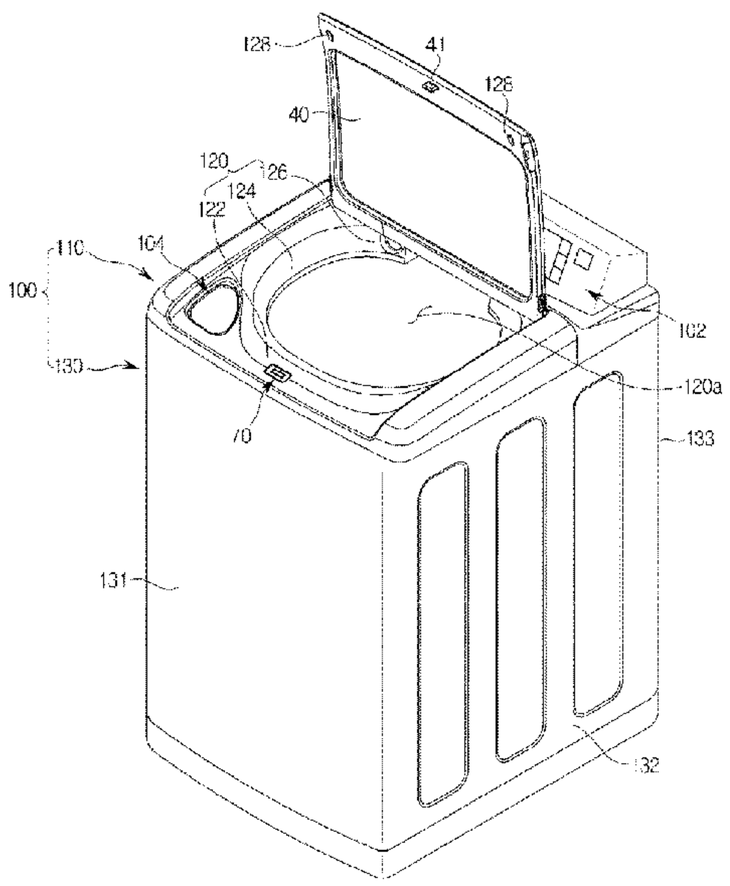
* cited by examiner

Primary Examiner — Terrence R Till

(57) **ABSTRACT**

A washing machine including a cabinet with an opening, a door that opens and closes to uncover and cover the opening, respectively, and a door locking device that selectively restrains a motion of the door when the door is closed. This configuration may be used to prevent the door from opening when, for example, the washing machine is in operation. In addition, a structure of a front portion of the opening may facilitate loading and unloading of laundry.

33 Claims, 15 Drawing Sheets



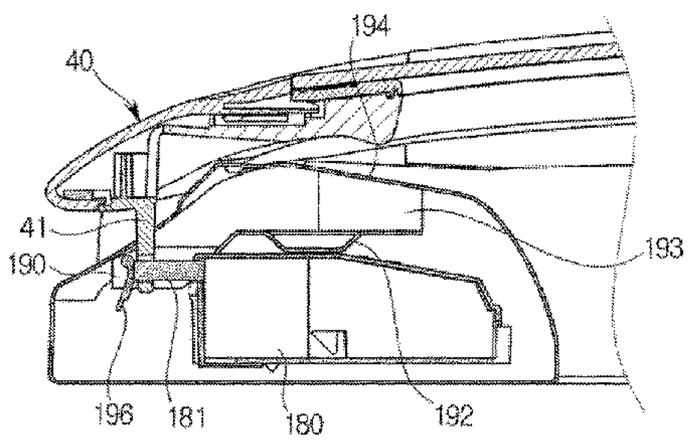


FIG. 1

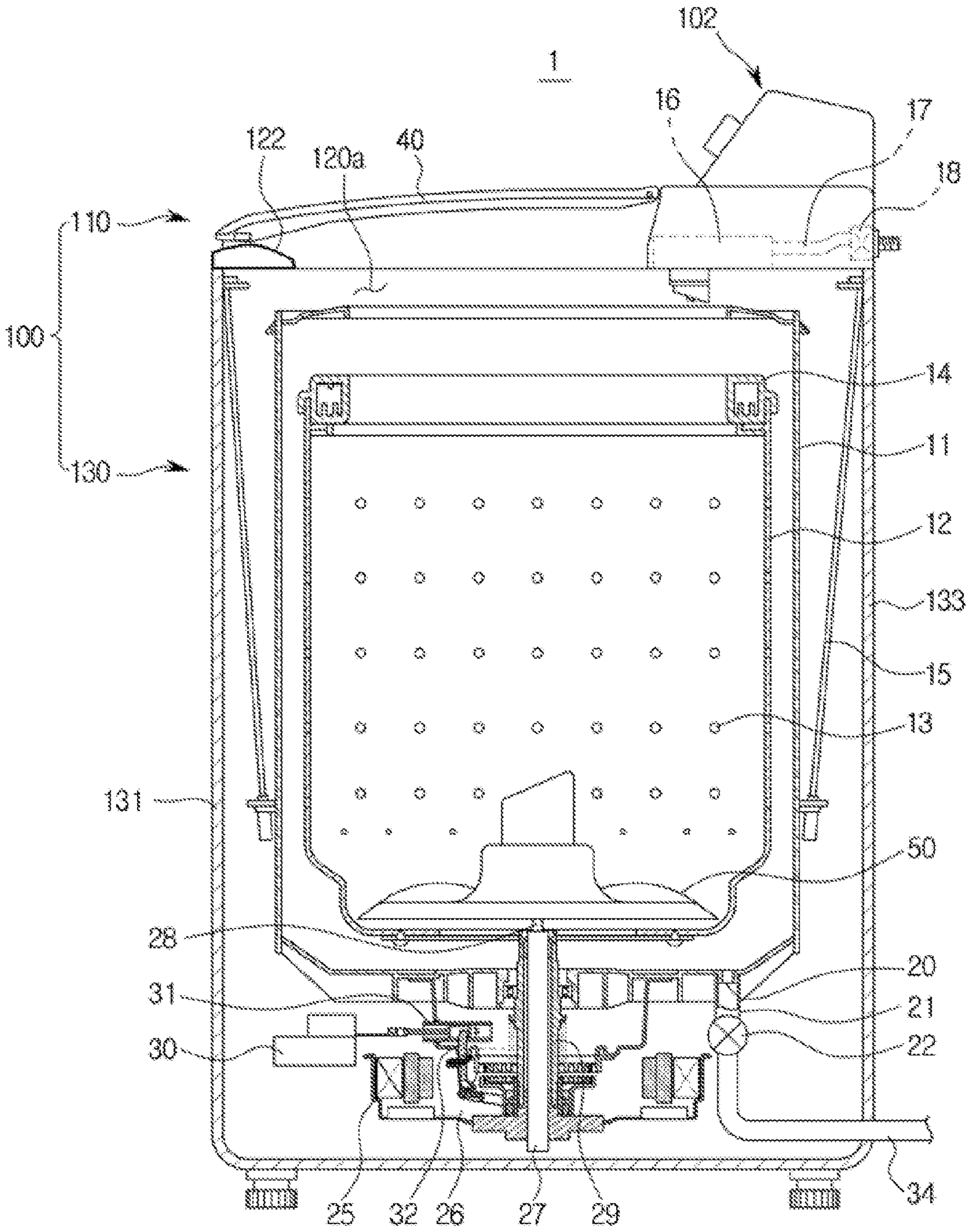

102
1
16
17
122
120a
40
18
110
100
14
11
130
12
133
15
131
13
50
28
20
31
21
30
22
34
25
32
26
27
29

FIG. 2

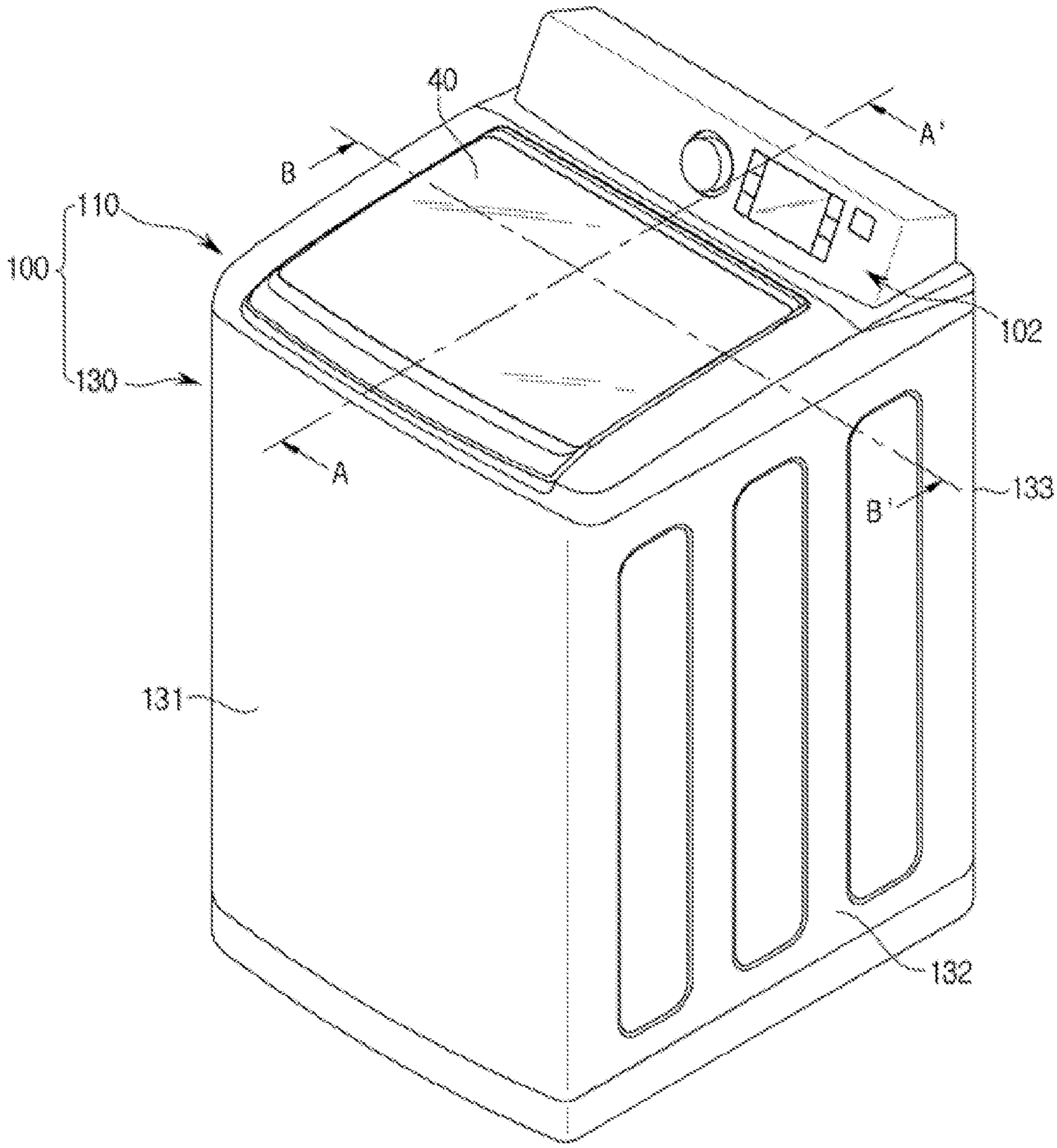


FIG. 3

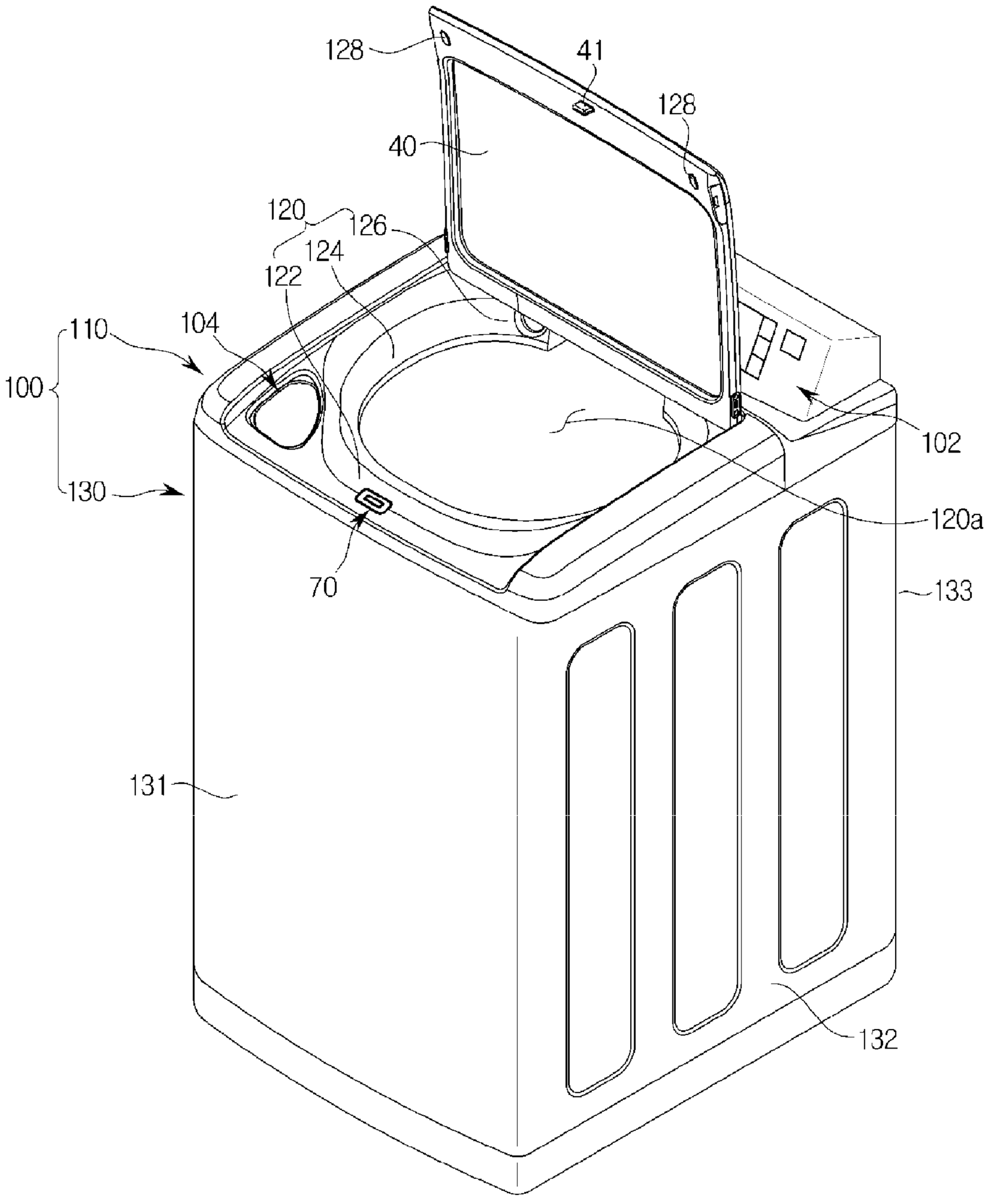

128
41
128
40
120
126
124
122
110
104
100
130
102
120a
70
133
131
132

FIG. 4

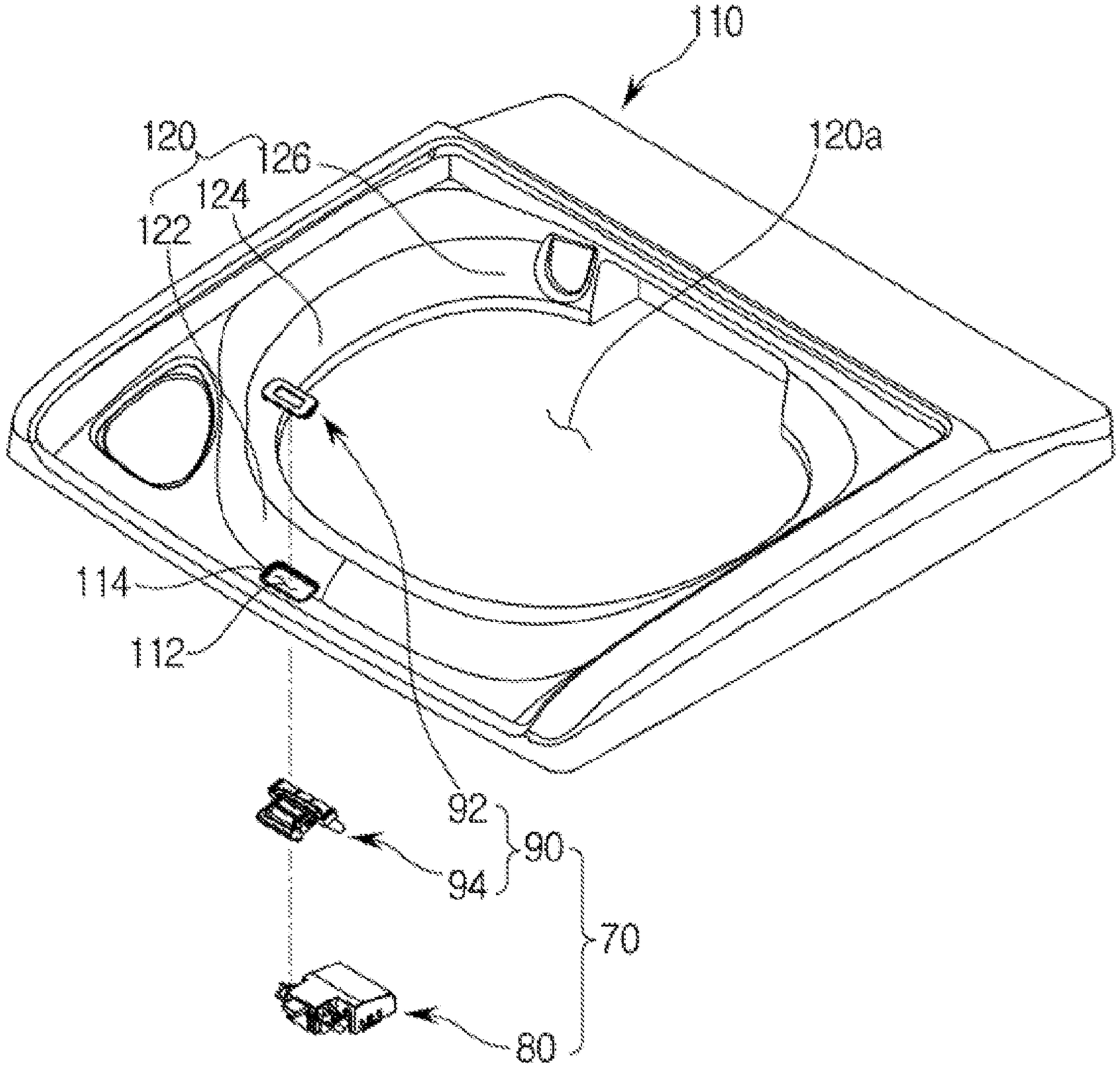


FIG. 5

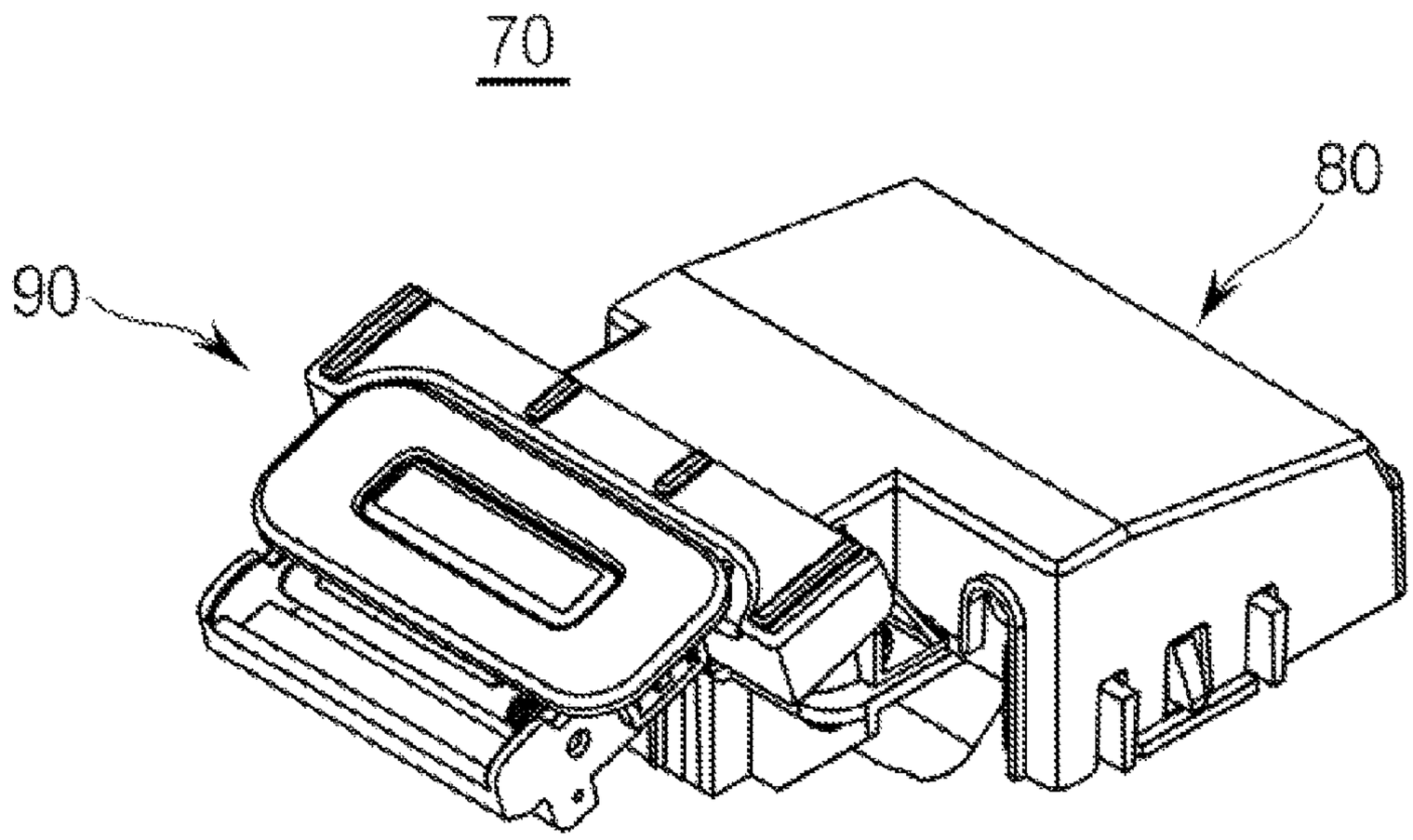


FIG. 6

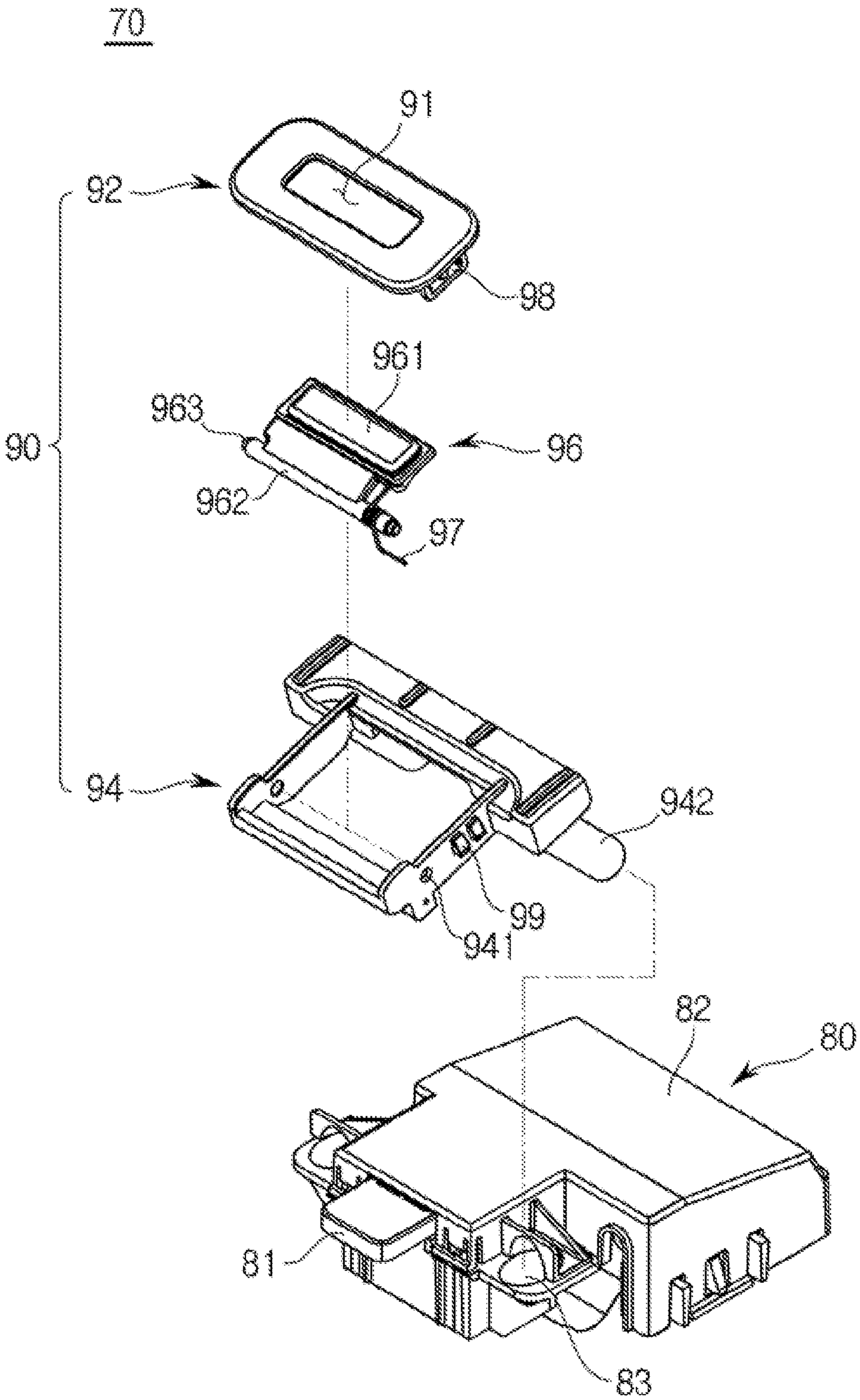


FIG. 7

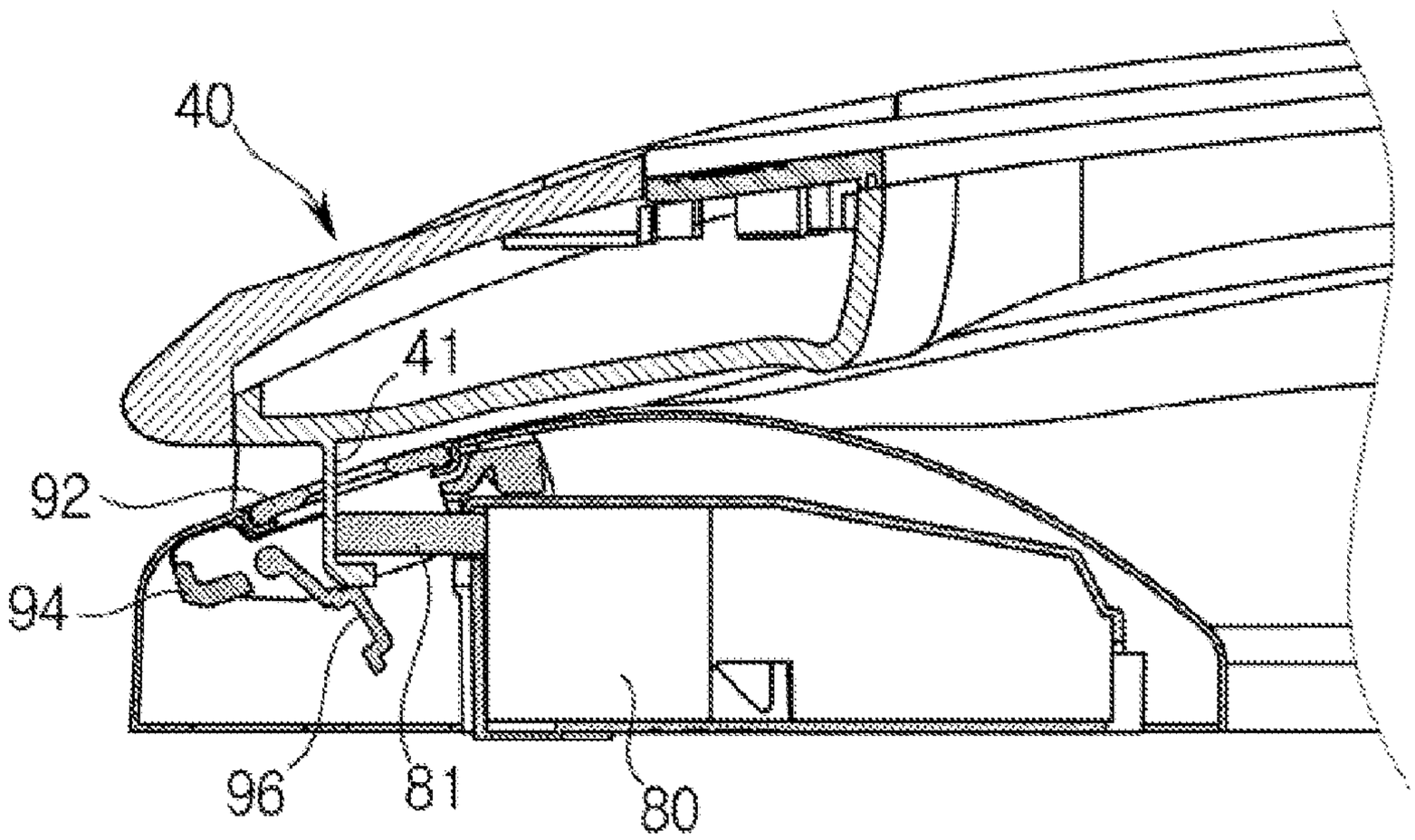


FIG. 8

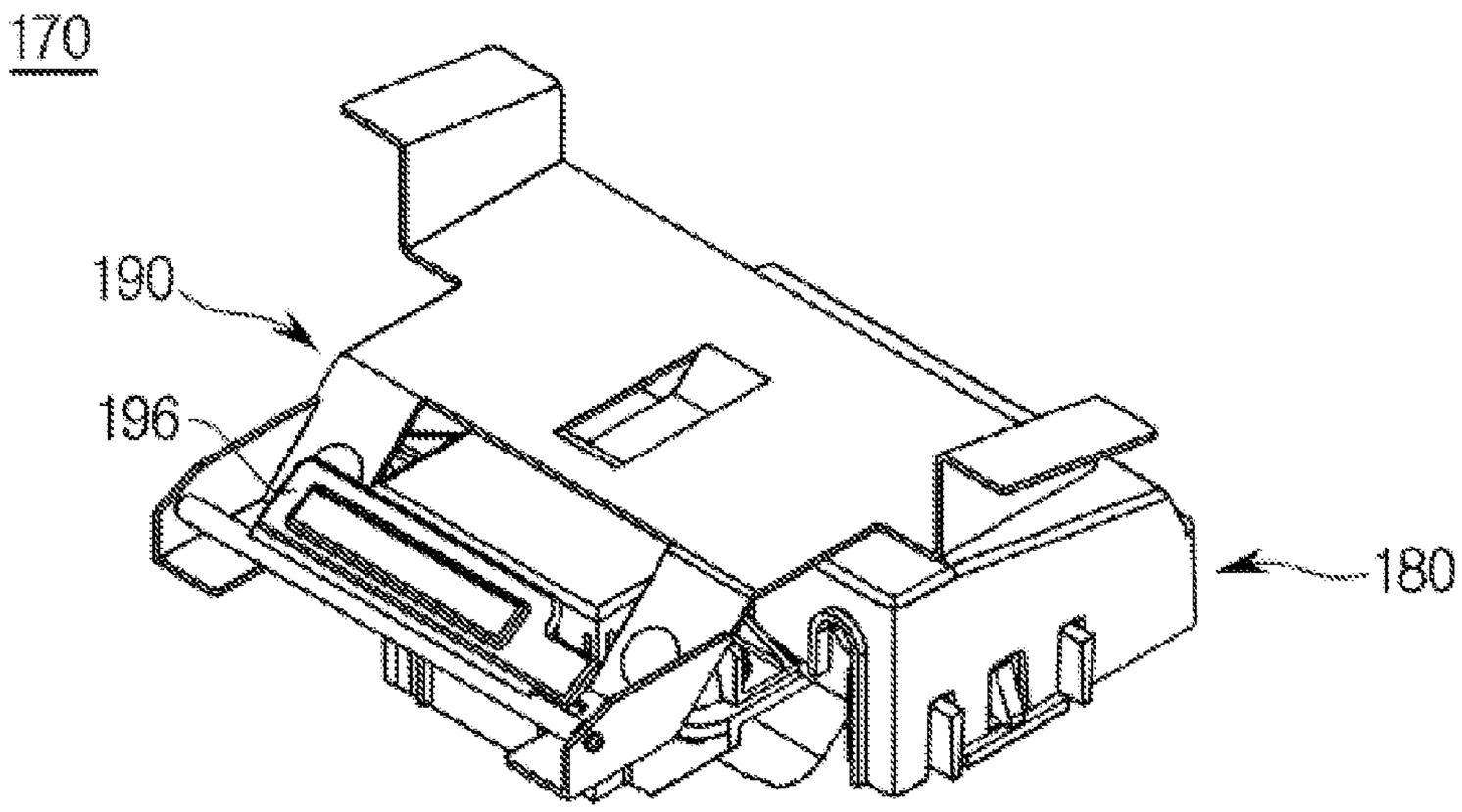


FIG. 9

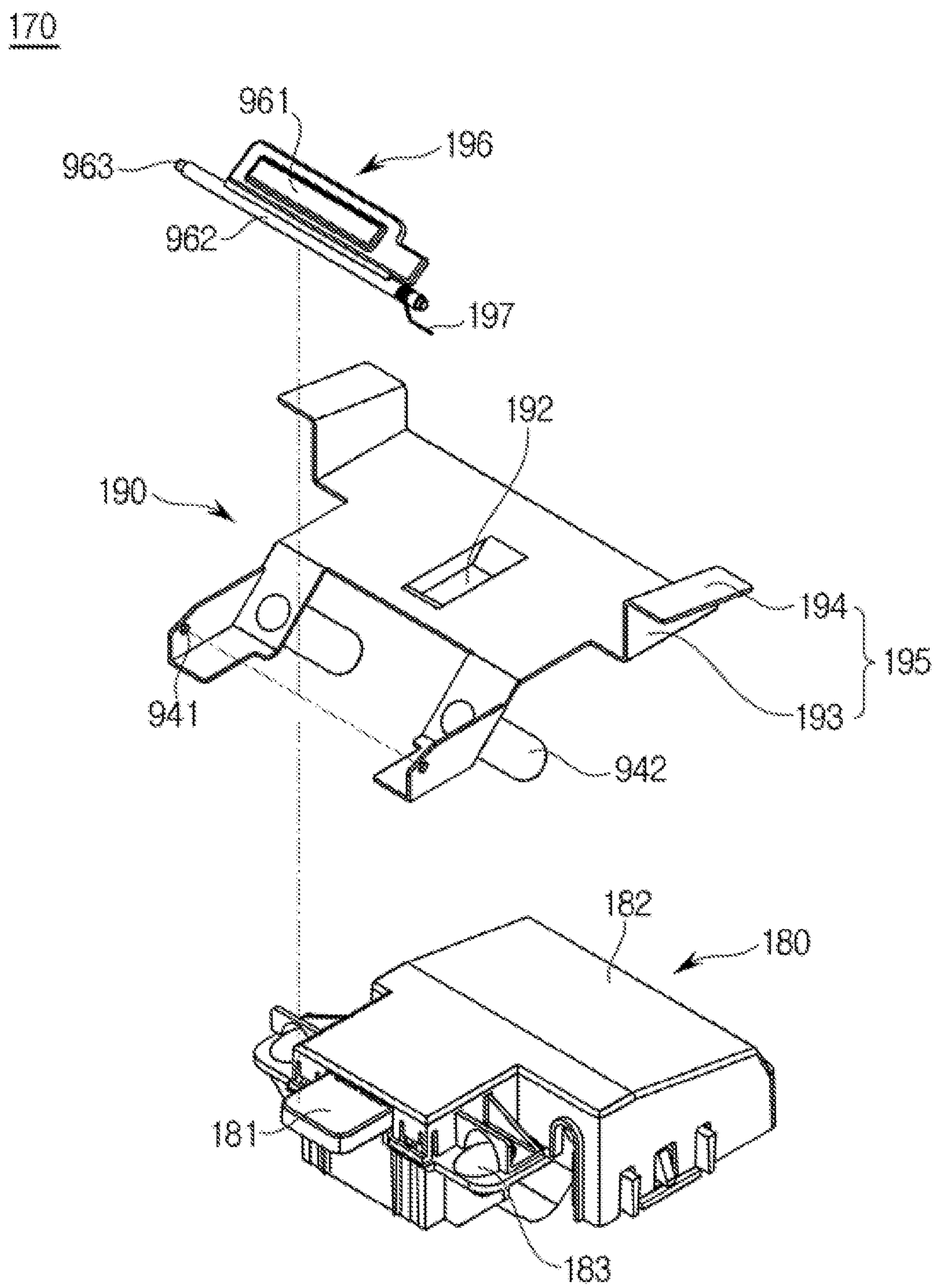

170
961
196
963
962
197
192
190
194
195
193
941
942
182
180
181
183

FIG. 10

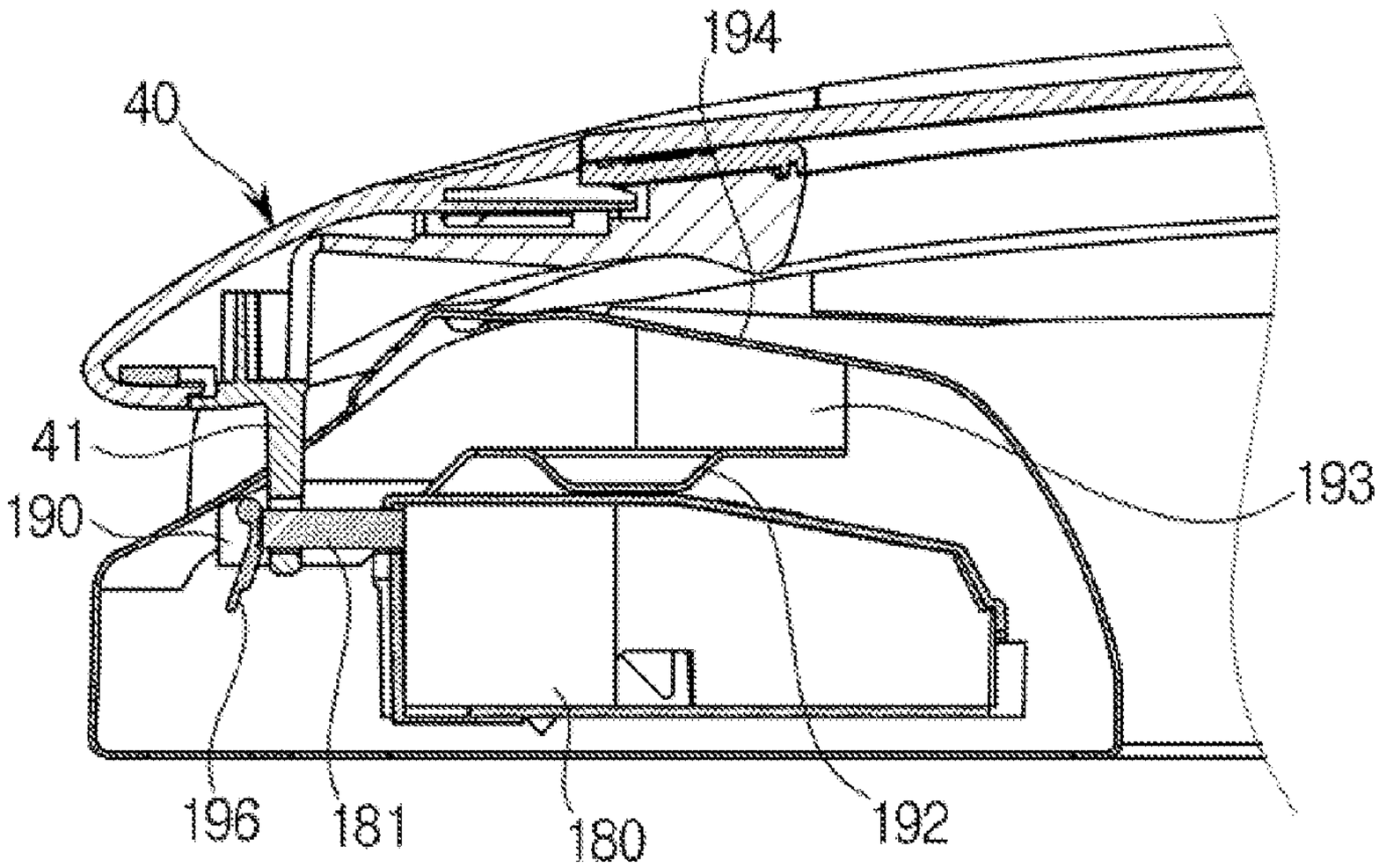


FIG. 11

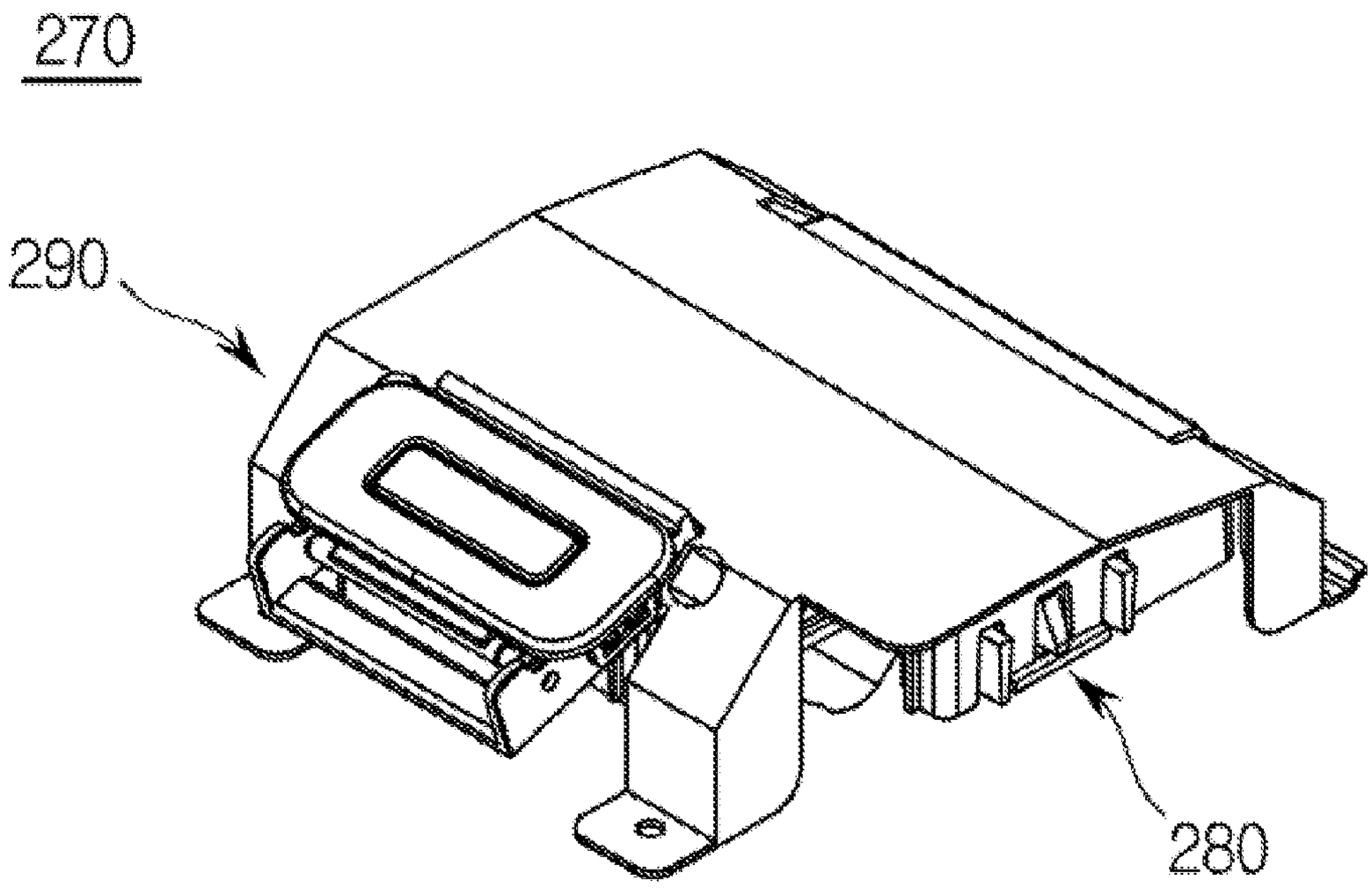


FIG. 12

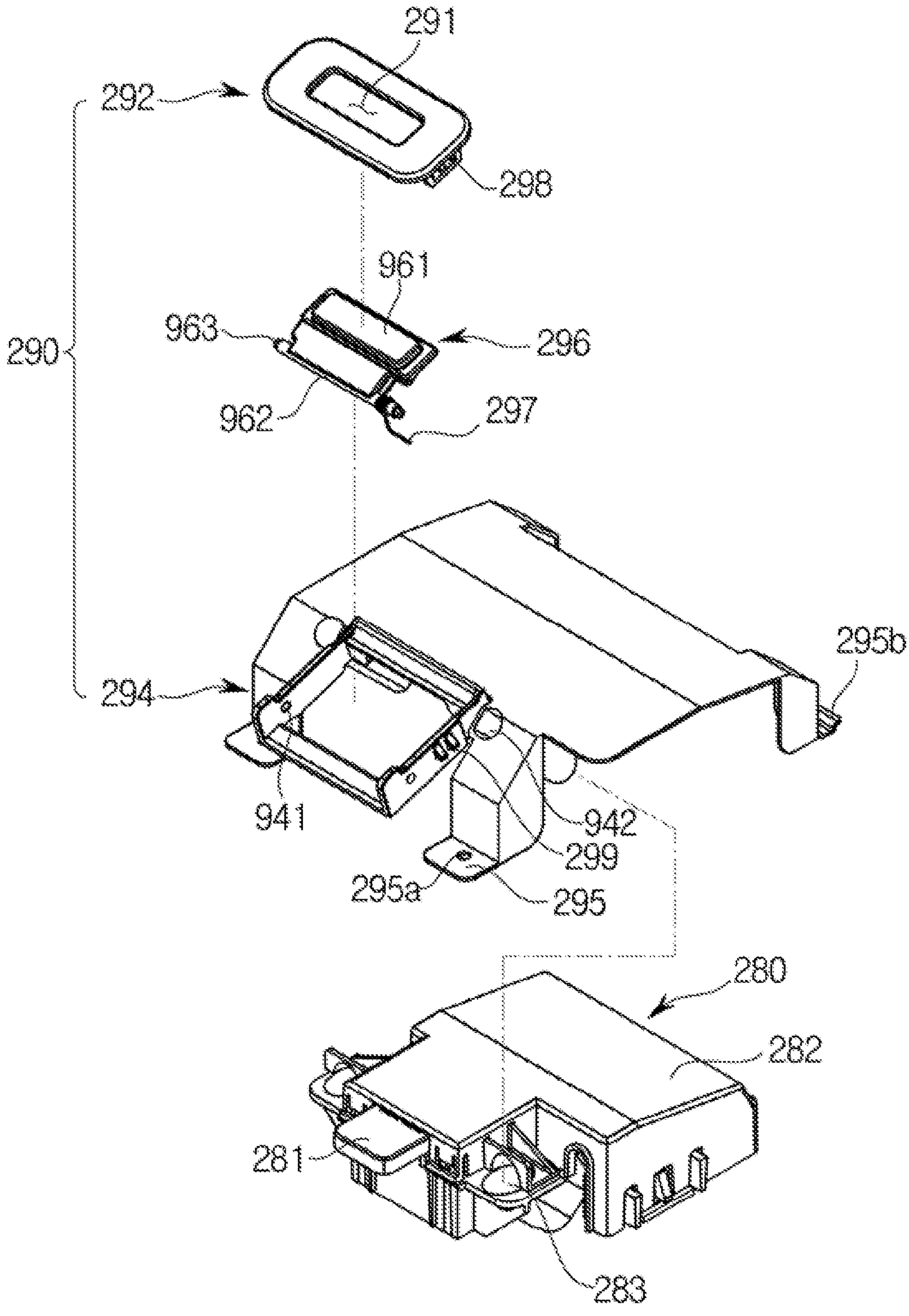

291
292
298
961
963
296
290
962
297
295b
294
941
942
299
295a
295
280
282
281
283

FIG. 13

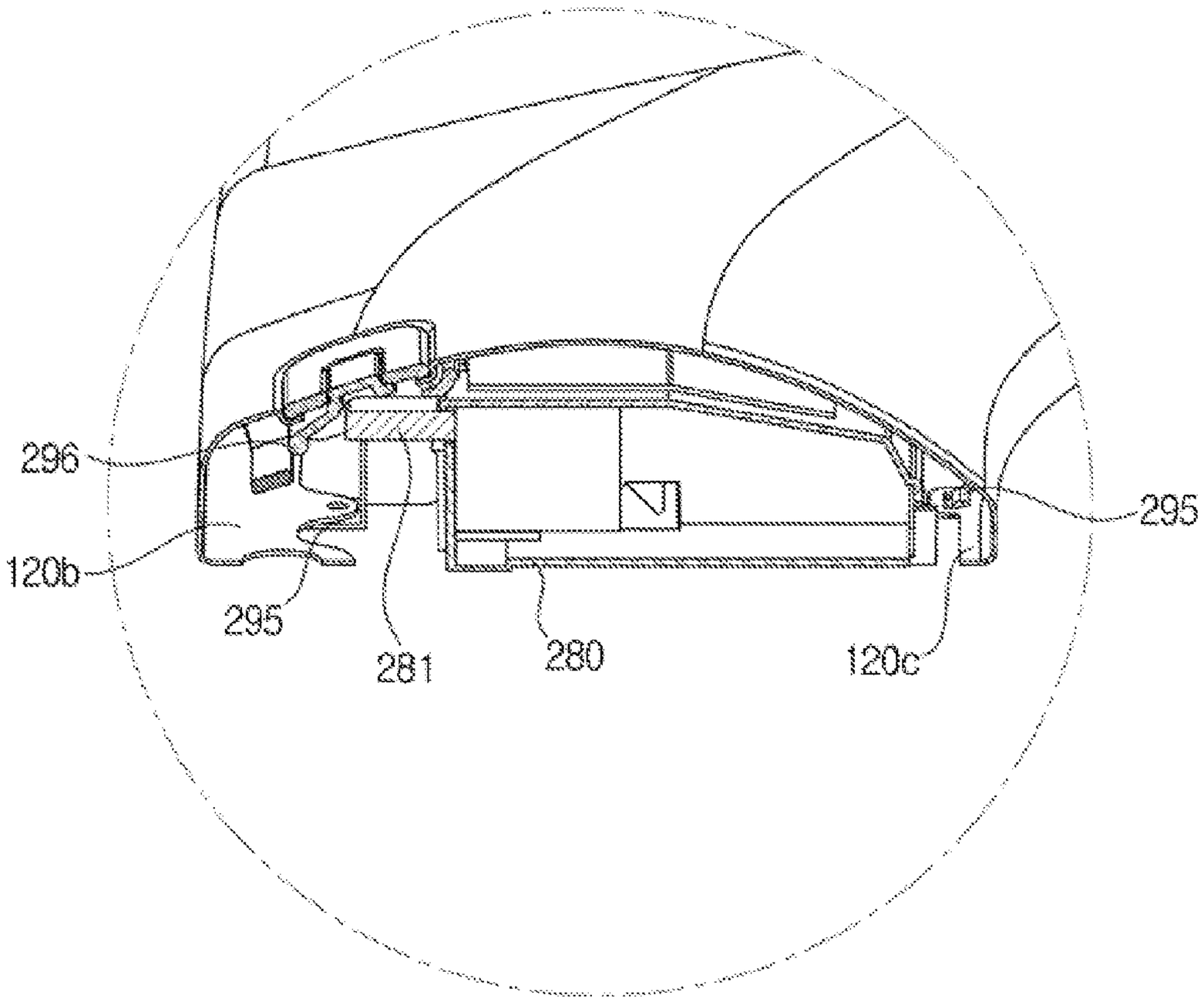


FIG. 14

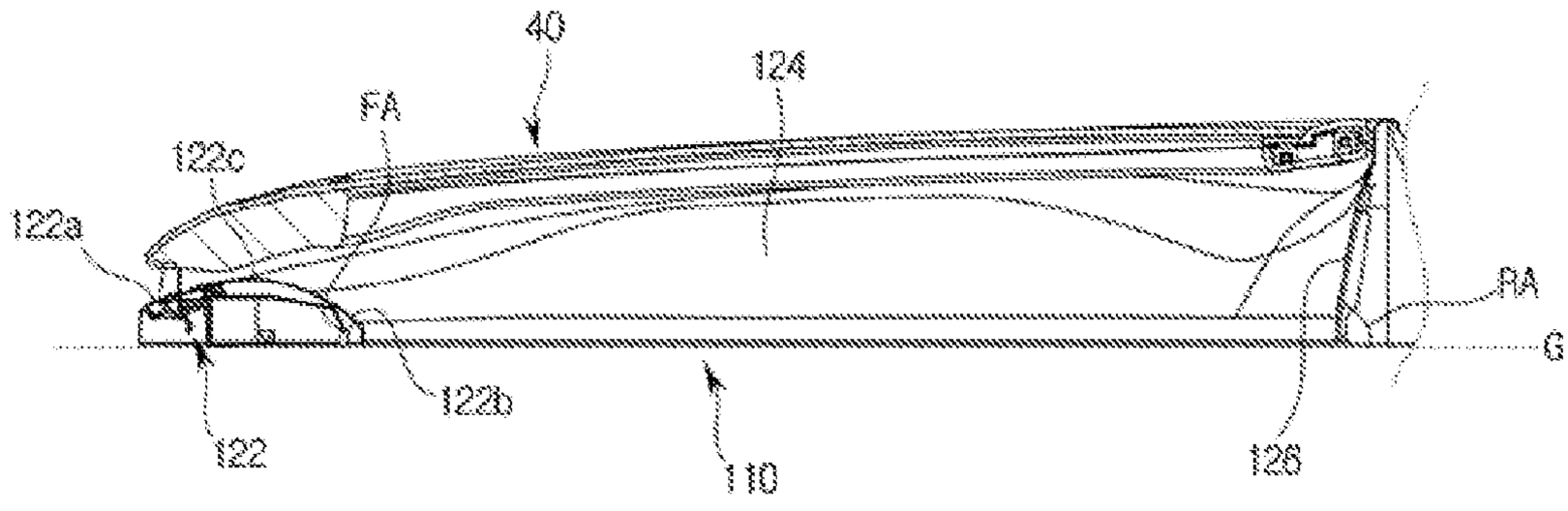
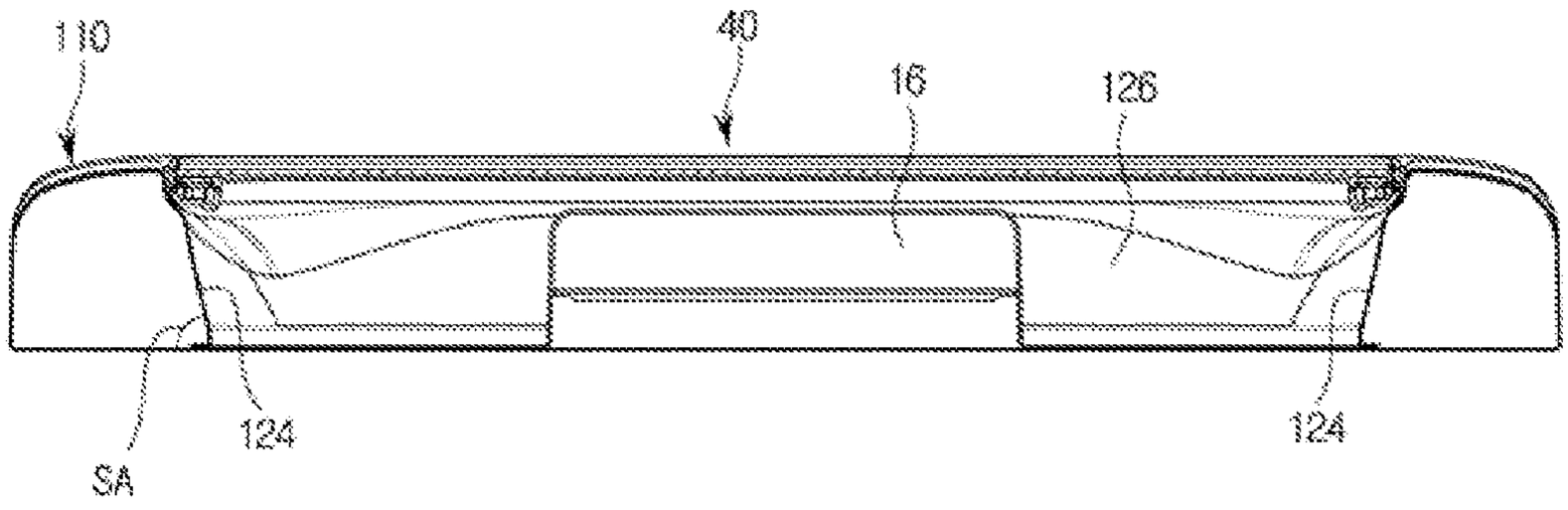


FIG. 15



WASHING MACHINE

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

[RELATED APPLICATION(S)] *CROSS-REFERENCE TO RELATED APPLICATIONS*

This application *is a reissue of U.S. application Ser. No. 14/959,583, filed Dec. 4, 2015, now U.S. Pat. No. 9,725,841, which* claims [the benefit of] *priority to* Korean Patent Application No. 10-2014-0173203, filed on Dec. 4, 2014 in the Korean Intellectual Property Office, the [disclosure] *disclosures* of which [is] *are* incorporated herein by reference.

BACKGROUND

The present disclosure relates to a washing machine, and more particularly, to a washing machine with a door locking device.

Generally, a washing machine is an apparatus that uses water and detergent to wash laundry, and includes a cabinet, a fixed tub in which wash water is stored, and a rotating tub rotatably provided in the fixed tub.

An opening is formed at the washing machine for loading and unloading laundry, and the opening is covered or uncovered with a door. A locking device may be provided to prevent the door from opening during, for example, washing operation.

However, when the locking device of the door is disposed at a front surface of the door, a cabinet corresponding thereto has a protruding structure, which interferes with a user when the user bends down to load or unload laundry.

Since a door locking device may restrain a door from outside the washing machine cabinet, a part of the door locking device installed in the cabinet to be coupled to a locking part of the door had to protrude to the outside via a through-hole in the cabinet. Hence, it may have been difficult not to be able to form a flat opening flange to receive the door on an upper surface of the cabinet. Furthermore, when the door locking device is disposed at a center of a front portion of the opening flange, the door locking device that may protrude past an abutting surface may bother a user when the user bends over to load or unload laundry, or otherwise access the washing machine tub.

SUMMARY

An aspect of the present disclosure provides a washing machine with an improved structure of a door locking device. In addition, a washing machine with an improved structure of an upper frame of a cabinet is provided to facilitate an approach to an inner portion of the washing machine to, for example, load or unload laundry.

According to an aspect of the present disclosure, a washing machine includes a cabinet, an upper frame at an upper portion of the cabinet and having an opening and an opening flange formed around the opening. A door is rotatably disposed at the upper frame to open and close, where a closed door covers the opening and an opened door uncovers the opening. A locking member is provided at the door

where the locking member is configured to be inserted into the upper frame when the door is closed. A door locking device may be supported by the upper frame and configured to selectively restrain the locking member in the upper frame when the door is closed.

The locking member may be provided at a center portion of a front portion of the door, and the door locking device may be at a corresponding center portion of a front portion of the upper frame.

The opening flange may include a through-hole and a mounting part around the through-hole. The door locking device may comprise a locking switch configured to restrain the locking member and a mounting unit where a first side is coupled to the mounting part and a second side is coupled to the locking switch.

The mounting unit may include an upper unit above the mounting part and have an accommodation hole configured to correspond to the through-hole, where the accommodation hole may be capable of receiving the locking member. The mounting unit may also include a lower unit below the mounting part.

The upper unit and the lower unit may be configured to be coupled to the opening flange with the mounting part in between, and the locking switch may be coupled to the lower unit and mounted on a lower portion of the opening flange by coupling between the upper unit and the lower unit.

One of the upper unit and the lower unit may include a locking protrusion, and the other of the upper unit and the lower unit may include a coupling hole that couples to the locking protrusion.

The mounting unit may include a flip cover that uncovers and covers the accommodation hole.

The mounting unit may include a closing member configured to force the flip cover upward to cover the accommodation hole, where the flip cover is configured to be pushed open by the locking member as the door is closed.

In an embodiment of the present disclosure, the flip cover and the closing member may be a part of the lower unit.

In an embodiment of the present disclosure, the upper unit and the lower unit may be coupled to the opening flange while having the mounting part therebetween, the locking switch may be coupled to the lower unit, the lower unit may include a coupling flange to be coupled to the upper frame, and the coupling flange may be fixed in the upper frame by screw coupling and a hook structure to mount the locking switch on the lower portion of the opening flange.

The locking switch may include a sliding member configured to be selectively inserted into the locking member, and the sliding member may slide in the upper frame.

In an embodiment of the present disclosure, the mounting unit may include a coupling flange for coupling to the upper frame, and the coupling flange may be welded to an inside of the upper frame.

In an embodiment of the present disclosure, the opening flange may include a front flange in front of the opening, a pair of side flanges formed at sides of the opening and facing each other, and a rear flange provided at a rear of the opening facing the front flange, and connected to the pair of side flanges, and the door locking device at a center portion of the front flange.

The front flange may include a front inclined surface that is inclined down toward the front of the upper frame, a rear inclined surface that is inclined down toward the opening, and a door seating part between the front inclined surface and the rear inclined surface where a forward portion of the door may be seated on the door seating frame when the door is closed.

An angle between the front inclined surface and a reference ground surface may be smaller than an angle between the side flanges and the reference ground surface.

The front inclined surface, the rear inclined surface, and the door seating part may be formed as one curved surface.

The opening flange may be formed to be gradually sloped downward from the rear toward the front.

At the opening flange, a height from a reference ground surface to an upper portion of the front flange may be less than a height from the reference ground surface to upper portions of the side flanges.

According to an aspect of the present disclosure, a washing machine includes a cabinet, an upper frame at an upper portion of the cabinet having an opening and an opening flange formed around the opening, and a door rotatably disposed at the upper frame to open and close, where a closed door covers the opening and an opened door uncovers the opening. The door may have a locking member that may be inserted into the upper frame when the door is closed, and a door locking device supported by the upper frame, and configured to selectively restrain the locking member in the upper frame when the door is closed. The door locking device may include a locking switch configured to restrain the locking member, an upper unit above the opening flange and having an accommodation hole capable of accommodating the locking member, and a lower unit below the opening flange having one side coupled to the upper unit and the other side coupled to the locking switch.

One of the upper unit and the lower unit may include a locking protrusion, and the other of the upper unit and the lower unit may include a coupling hole that couples to the locking protrusion.

The locking switch may include a sliding member that may be selectively inserted into the locking member, and the sliding member may slide in the upper frame.

The upper unit may include a flip cover that may be configured to cover and uncover the accommodation hole.

The upper unit may include a closing member configured to force the flip cover upward to cover the accommodation hole, where the flip cover is configured to be pushed open by the locking member as the door is closed.

BRIEF DESCRIPTION OF THE DRAWINGS

These and/or other aspects of the disclosure will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. **1** is a cross-sectional view of a washing machine according to an embodiment of the present disclosure;

FIG. **2** is a perspective view of the washing machine according to an embodiment of the present disclosure;

FIG. **3** is a perspective view in which a door of the washing machine is opened according to an embodiment of the present disclosure;

FIG. **4** is an exploded perspective view of a upper frame and a door locking device of the washing machine according to an embodiment of the present disclosure;

FIG. **5** is a perspective view of the door locking device of the washing machine according to an embodiment of the present disclosure;

FIG. **6** is an exploded perspective view of the door locking device of the washing machine according to an embodiment of the present disclosure;

FIG. **7** is a partially enlarged view of a cross-sectional view of a mounting part of an upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to an embodiment of the present disclosure;

FIG. **8** is a perspective view of a door locking device of a washing machine according to an embodiment of the present disclosure;

FIG. **9** is an exploded perspective view of the door locking device of the washing machine according to an embodiment of the present disclosure;

FIG. **10** is a partially enlarged view of a cross-sectional view of a mounting part of a upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to an embodiment of the present disclosure;

FIG. **11** is a perspective view of a door locking device of a washing machine according to an embodiment of the present disclosure;

FIG. **12** is an exploded perspective view of the door locking device of the washing machine according to an embodiment of the present disclosure;

FIG. **13** is a partially enlarged view of a cross-sectional view of a mounting part of an upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to an embodiment of the present disclosure;

FIG. **14** is a cross-sectional view of the upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to an embodiment of the present disclosure; and

FIG. **15** is a cross-sectional view of the upper frame of the washing machine along the line B-B' illustrated in FIG. **2** according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

Hereinafter, embodiments according to the present disclosure will be described in detail with reference to the accompanying drawings.

FIG. **1** is a cross-sectional view illustrating a washing machine according to an embodiment of the present disclosure, and FIG. **2** is a perspective view illustrating the washing machine according to an embodiment of the present disclosure.

As illustrated in FIG. **1**, a washing machine **1** includes a cabinet **100** that forms an exterior, a fixed tub **11** disposed in the cabinet **100** and in which wash water is stored, a rotating tub **12** rotatably disposed in the fixed tub **11**, and a pulsator **50** disposed in the rotating tub **12** to generate a water flow.

An opening **120**a is formed at an upper portion of the cabinet **100** to be able to insert laundry in the rotating tub **12**. The opening **120**a may be covered and uncovered by a door **40** installed at the upper portion of the cabinet **100**.

The cabinet **100** may include an upper frame **110** and a lower frame **130**. The lower frame **130** may include a front frame **131** provided at a front surface thereof, a pair of side frames **132** provided at side surfaces thereof to face each other and coupled to the front frame **131**, and a rear frame **133** connected to the side frames **132**, and provided to face the front frame **131**. The upper frame **110** may be provided above the lower frame **130**, and include the opening **120**a.

The fixed tub **11** may be supported by a suspension system **15** in the cabinet **100**.

A water supply pipe **17** for supplying wash water to the fixed tub **11** is installed above the fixed tub **11**. One side of the water supply pipe **17** is connected to an external water supply source, and the other side of the water supply pipe **17** is connected to a detergent supply device **16**. Water supplied through the water supply pipe **17** passes through the detergent supply device **16** and is supplied to an inner portion of

the fixed tub **11** together with a detergent. A water supply valve **18** is installed at the water supply pipe **17** to control a supply of water.

An auxiliary detergent supply device **104** (FIG. **3**) may be provided at the upper frame **110**. A liquid detergent, bleaching agent, fabric conditioner, etc. may be stored in the auxiliary detergent supply device **104**, and introduced into the rotating tub **12** to assist in the washing.

The rotating tub **12** is provided in a shape of a cylinder with an open upper portion, and a plurality of dehydration holes **13** are formed at a side surface thereof. A balancer **14** may be mounted at an upper portion of the rotating tub **12** to enable the rotating tub **12** to stably rotate when rotating at a high speed.

A motor **25** that generates a driving force for rotating the rotating tub **12** and the pulsator **50**, and a power switching device **26** that transfers the driving force from the motor **25** to the rotating tub **12** and/or the pulsator **50** are installed outside and below the fixed tub **11**.

A hollow dehydration shaft **29** may be coupled to the rotating tub **12**, and a washing shaft **27** installed at a hollow portion of the hollow dehydration shaft **29** may be coupled to the pulsator **50** through a washing shaft coupling part **28**. The motor **25** may transfer the driving force to the rotating tub **12** and/or the pulsator **50** in accordance with actions of the power switching device **26**.

The power switching device **26** may include an actuator **30** that generates a driving force for switching power, a rod part **31** that moves linearly in accordance with motion of the actuator **30**, and a clutch part **32** connected to the rod part **31** to rotate in accordance with motion of the rod part **31**.

A drain hole **20** is formed at a floor of the fixed tub **11** to discharge the wash water stored in the fixed tub **11**, and a first drain pipe **21** is connected to the drain hole **20**. A drain valve **22** that regulates drainage may be installed at the first drain pipe **21**. An outlet of the drain valve **22** may be connected to a second drain pipe **34** for discharging the wash water to the outside.

FIG. **3** is a perspective view in which a door of the washing machine is opened according to an embodiment of the present disclosure, and FIG. **4** is an exploded perspective view of an upper frame and a door locking device of the washing machine according to an embodiment of the present disclosure.

The washing machine **1** may include the door **40** at the upper frame **110**, which is an upper portion of the cabinet **100**, and the door may open and close to uncover and cover the opening **120**a, respectively. The washing machine may include a door locking device **70** that is capable of selectively restraining the door **40** when the door **40** has closed the opening **120**a.

The door **40** may include a locking member **41** to enable the door locking device **70** to restrain the door **40**, and the locking member **41** may be inserted into the cabinet **100** when the door **40** is closed. Specifically, the locking member **41** may be inserted into the upper frame **110**.

A shape of the locking member **41** is not limited, and the locking member **41** may be formed in various shapes such as a shape of a hook, ring, etc.

The door locking device **70** may be disposed in the cabinet **100** to correspond to a position of the locking member **41** provided at the door **40**. Specifically, the door locking device may be disposed to be supported at the upper frame **110** of the cabinet **100**. In an embodiment of the present disclosure, the locking member **41** may be disposed at a center portion of a front portion of the door **40**, and the door locking device **70** may correspond thereto and be disposed at a center portion of a front portion of the upper frame **110**.

As the door locking device **70** restrains the door **40**, the door **40** may be prevented from being lifted from the opening **120**a, and become capable of stably covering the opening **120**a. As illustrated in FIG. **3**, the upper frame **110** may include an opening flange **120** formed around the opening **120**a. The opening flange **120** of the upper frame **110** may include a through-hole **112** (FIG. **4**) into which the door locking device **70** is inserted, and a mounting part **114** around the through-hole **112**. The door locking device **70** that restrains the door **40** when the door **40** has closed to cover the opening **120**a is mounted on the mounting part **114** to correspond to the position of the locking member **41** of the door, i.e. a position of the through-hole **112**. The mounting part **114** may not protrude past the opening flange **120**, and an upper surface of the opening flange **120** may be formed flat. In a washing machine according to various embodiments of the present disclosure, since the locking member **41** of the door **40** is inserted into the upper frame **110**, and the door locking device **70** enables restraining the locking member **41** at an inner portion of the upper frame **110**, i.e. a lower portion of the opening flange **120**, a front portion of the opening flange **120** may be flat. In addition, since there is no protruding part from the front portion of the opening flange **120**, the opening **120**a may be made wider. Accordingly, loading and unloading laundry may be made easier.

A shape of the front portion of the opening flange **120** is not limited, and may be any shape as long as the shape enables the door **40** to close to cover the opening **120**a. In an embodiment of the present disclosure, the shape of the front portion of the opening flange **120** and the shape of the front portion of the door **40** are formed flat, such that the front portion of the door **40** fits the front portion of the opening flange **120** when the door **40** is closed.

FIG. **5** is a perspective view of the door locking device of the washing machine according to an embodiment of the present disclosure, FIG. **6** is an exploded perspective view of the door locking device of the washing machine according to an embodiment of the present disclosure, and FIG. **7** is a partially enlarged view of a cross-sectional view of a mounting part of an upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to an embodiment of the present disclosure.

The door locking device **70** may include a locking switch **80** that restrains the locking member **41**, and a mounting unit **90** for mounting the locking switch **80** on the upper frame **110**. One side of the mounting unit **90** may be coupled to the mounting part **114**, and the other side thereof may be coupled to the locking switch **80**.

As illustrated in FIG. **6**, the mounting unit **90** may include an upper unit **92** disposed above the mounting part **114**, and a lower unit **94** disposed below the mounting part **114**.

The upper unit **92** and the lower unit **94** may be coupled to the opening flange **120** with the mounting part **114** in between. The locking switch **80** coupled to the lower unit **94** may be mounted on a lower portion of the opening flange **120** by coupling between the upper unit **92** and the lower unit **94**.

To couple the upper unit **92** and the lower unit **94**, one of the upper unit **92** and the lower unit **94** may include a locking protrusion **99**, and the other one may include a coupling hole **98** that couples to the locking protrusion **99**.

Accordingly, the upper unit **92** and the lower unit **94** may be coupled to each other by snap fitting the locking protrusion **99** and the coupling hole **98**.

The lower unit **94** may include a locking switch coupling part **942** capable of being coupled to the locking switch **80**, and the locking switch **80** may include a mounting unit coupling part **83** to which the locking switch coupling part **942** may be coupled.

A screw hole (not shown) may be formed at one end of the locking switch coupling part **942**, and the locking switch coupling part **942** may be coupled to the locking switch **80** by a screw after being inserted into the mounting unit coupling part **83**.

The locking switch **80** may include a sliding member **81** capable of restraining the locking member **41** of the door **40**, and a locking switch main body **82**.

The sliding member **81** may latch the door **40** when the door **40** has closed to cover the opening **120**a. Specifically, when the door **40** is closed, the sliding member **81** slides forward into the locking member **41** provided at the door **40**, thereby preventing the door **40** from opening.

When a washing operation of the washing machine starts after the door **40** is closed, the sliding member **81** slides forward to restrain the locking member **41** of the door **40**, thereby preventing the door **40** from being opened during operation of the washing machine. A door open/close detection sensor (not shown) may be disposed together, such that the sliding member moves in accordance with a door open/close detection signal.

Even though a shape of the sliding member **81** is not limited, the sliding member **81** may have upper and lower surfaces that are wider than side surfaces in various embodiments of the present disclosure.

The upper unit **92** of the mounting unit **90** may have an accommodation hole **91** that corresponds to the through-hole **112** and is capable of accommodating the locking member **41**.

Since the accommodation hole **91** is disposed to accommodate the locking member **41** of the door, the accommodation hole **91** may guide the door **40** to be seated correctly when the door **40** is closed to cover the opening **120**a.

The lower unit **94** may include a flip cover **96** capable of opening and closing the accommodation hole **91**. The flip cover **96** may include a cover part **961** that closes the accommodation hole **91**, a hinge shaft **962**, a hinge coupling protrusion **963**, and a closing member **97**.

The hinge coupling protrusion **963** is inserted into a hinge coupling hole **941** of the lower unit **94**, such that the cover part **961** rotates by the hinge shaft **962**. The closing member **97** forces the cover part **961** upward when the door **40** is open to prevent, for example, debris from falling through the accommodation hole **91**. When the door **40** is closed, the cover part **961** is pushed open by the locking member **41**.

Various embodiments of the present disclosure may include a door open/close detection sensor (not shown) that detects rotation of a rotary shaft of the door **40**. The open/close detection sensor may be any sensor appropriate for such purposes.

The door open/close detection sensor is a sensor that may detect when the door **40** does not properly cover the opening **120**a. The open/close detection sensor may be any sensor appropriate for such purposes.

As the door open/close detection sensor is disposed, when the opening **120**a is not properly covered by the door **40**, the door open/close detection sensor may be able to notify a control unit (not shown) such that the cover part **961** may not open and/or the sliding member **81** may be prevented from latching the door **40**, and washing operation may not be allowed to take place. Additionally, an alarm may be generated. The control unit may be any processing unit appropriate for such purposes.

In an embodiment of the present disclosure, the flip cover **96** may be opened and closed in accordance with a signal from the door open/close detection sensor. The open/close detection sensor may be any sensor appropriate for such purposes.

FIG. **8** is a perspective view of a door locking device of a washing machine according to another embodiment of the present disclosure. FIG. **9** is an exploded perspective view of the door locking device of the washing machine according to another embodiment of the present disclosure, and FIG. **10** is a partially enlarged view of a cross-sectional view of a mounting part of a upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to another embodiment of the present disclosure.

A door locking device **170** may include a locking switch **180** that restrains the locking member **41**, and a mounting unit **190** for mounting the locking switch **180** on the upper frame **110**. One side of the mounting unit **190** may be coupled to the mounting part **114**, and the other side thereof may be coupled to the locking switch **180**.

The mounting unit **190** may include a coupling flange **195** to couple the door locking device **170** to the upper frame **110**. Specifically, the coupling flange **195** may be formed of a vertical surface **193** and a horizontal surface **194**, and the horizontal surface **194** may be, for example, welded to a bottom surface of the opening flange to couple the door locking device **170** to the upper frame **110**.

The locking switch **180** that couples to the mounting unit **190** may be mounted, for example, on the lower portion of the opening flange **120** by coupling between the mounting unit **190** and the opening flange **120**.

The mounting unit **190** may include the locking switch coupling part **942** capable of being coupled to the locking switch **180**, and the locking switch **180** may include a mounting unit coupling part **183** to which the locking switch coupling part **942** may be coupled.

A screw hole (not shown) may be formed at one end of the locking switch coupling part **942**, and the locking switch coupling part **942** may be coupled to the locking switch **180** by a screw after being inserted into the mounting unit coupling part **183**.

The locking switch **180** may include a sliding member **181** capable of restraining the locking member **41** of the door **40**, and a locking switch main body **182**.

The locking switch main body **182** may contact a seating part **192** provided at the mounting unit **190**.

The sliding member **181** may latch the door **40** when the door **40** has closed the opening **120**a. Specifically, the sliding member **181** may slide forward into the upper frame **110** to latch the locking member **41** provided at the door **40**, thereby restraining the door **40** from opening.

When a washing operation starts after the door **40** is closed, the sliding member **181** slides forward to restrain the locking member **41** of the door **40**, thereby preventing the door **40** from being opened during operation of the washing machine. The door open/close detection sensor (not shown) may be disposed together, such that the sliding member moves in accordance with a door open/close detection signal.

Even though a shape of the sliding member **181** is not limited, the sliding member **181** may be provided to have upper and lower surfaces wider than side surfaces in an embodiment of the present disclosure.

The mounting unit **190** may include a flip cover **196** capable of covering and uncovering the through-hole **112**.

In a present embodiment of the present disclosure, since the through-hole **112** is disposed to correspond to the locking member **41** of the door **40**, the through-hole **112** may guide the door **40** to be seated accurately when the door **40** is closed to cover the opening **120**a.

The flip cover **196** may include the cover part **961** that closes the through-hole **112**, the hinge shaft **962**, the hinge coupling protrusion **963**, and a closing member **197**.

The hinge coupling protrusion **963** is inserted into the hinge coupling hole **941** of the mounting unit **190** such that the cover part **961** rotates on the hinge shaft **962**. The closing member **197** forces the cover part **961** upward to prevent, for example, debris from falling through the accommodation hole **91**. When the door **40** is closed, the cover part **961** is pushed open by the locking member **41**.

In various embodiments of the present disclosure, the flip cover **196** may be able to be opened and closed in accordance with a signal from the door open/close detection sensor. The open/close detection sensor may be any sensor appropriate for such purposes.

FIG. **11** is a perspective view of a door locking device of a washing machine according to still another embodiment of the present disclosure. FIG. **12** is an exploded perspective view of the door locking device of the washing machine according to still another embodiment of the present disclosure, and FIG. **13** is a partially enlarged view of a cross-sectional view of a mounting part of an upper frame of the washing machine along the line A-A' illustrated in FIG. **2** according to still another embodiment of the present disclosure.

A door locking device **270** may include a locking switch **280** that restrains the locking member **41**, and a mounting unit **290** for mounting the locking switch **280** on the upper frame **110**. One side of the mounting unit **290** may be coupled to the mounting part **114**, and the other side thereof may be coupled to the locking switch **280**.

As illustrated in FIG. **12**, the mounting unit **290** may include an upper unit **292** disposed above the mounting part **114**, and a lower unit **294** disposed below the mounting part **114**.

The upper unit **292** and the lower unit **294** may be coupled to the opening flange **120** while having the mounting part **114** therebetween.

To couple the upper unit **292** and the lower unit **294**, one of the upper unit **292** and the lower unit **294** may include a locking protrusion **299**, and the other one may include a coupling hole **298** that couples to the locking protrusion **299**. By snap fitting the locking protrusion **299** and the coupling hole **298**, the upper unit **292** and the lower unit **294** may be coupled to each other.

The lower unit **294** may include the locking switch coupling part **942** capable of being coupled to the locking switch **280**, and the locking switch **280** may include a mounting unit coupling part **283** to which the locking switch coupling part **942** may be coupled.

A screw hole (not shown) may be formed at one end of the locking switch coupling part **942**, and the locking switch coupling part **942** may be coupled to the locking switch **280** by a screw after being inserted into the mounting unit coupling part **283**.

The lower unit **294** may include at least one coupling flange **295** to couple the door locking device **270** to the upper frame **110**. Specifically, a coupling hole **295**a is formed at one of either the front or rear of coupling flange **295** to be coupled to a screw coupling flange **120**b of the upper frame **110** by a screw, and a bent part **295**b is formed at the other of the front or rear of the coupling flange **295** to be coupled to a hook coupling flange **120**c of the upper frame **110**.

In each of the parts, the coupling flange **295** and the upper frame **110** may use, for example, screw coupling or a hook structure to fix the lower unit **294** to the upper frame **110**.

The locking switch **280** that couples to the lower unit **294** may be mounted on the inner portion of the upper frame **110** by coupling the lower unit **294** and the upper frame **110**.

The mounting unit **290** may include the locking switch coupling part **942** capable of being coupled to the locking switch **280**, and the locking switch **280** may include the mounting unit coupling part **283** to which the locking switch coupling part **942** may be coupled.

A screw hole (not shown) may be formed at one end of the locking switch coupling part **942**, and the locking switch coupling part **942** may be coupled to the locking switch **280** by a screw after being inserted into the mounting unit coupling part **283**.

The locking switch **280** may include a sliding member **281** capable of restraining the locking member **41** of the door **40**, and a locking switch main body **282**.

The sliding member **281** may restrain the door **40** by a sliding motion when the door **40** has closed to cover the opening **120**a. Specifically, the sliding member **281** slides forward in the upper frame **110** to latch the locking member **41** of the door **40**, thereby restraining the door **40** from opening.

When the door **40** is closed, the sliding member **281** slides forward to restrain the locking member **41** of the door **40**, thereby preventing the door **40** from being opened during operation of the washing machine. The door open/close detection sensor (not shown) may be disposed together, such that the sliding member moves in accordance with a door open/close detection signal.

Even though a shape of the sliding member **281** is not limited, the sliding member **281** may be provided to have upper and lower surfaces wider than side surfaces in an embodiment of the present disclosure.

The upper unit **292** of the mounting unit **290** may have an accommodation hole **291** that corresponds to the through-hole **112** and is capable of accommodating the locking member **41**.

Since the accommodation hole **291** is disposed to correspond to the locking member **41** of the door, the accommodation hole **291** may guide the door **40** to be seated accurately when the door **40** is closed to cover the opening **120**a.

The lower unit **294** may include a flip cover **296** capable of opening and closing the accommodation hole **291**. The flip cover **296** may include the cover part **961** that covers the accommodation hole **291**, the hinge shaft **962**, the hinge coupling protrusion **963**, and a closing member **297**.

The hinge coupling protrusion **963** is inserted into the hinge coupling hole **941** of the lower unit **294** such that the cover part **961** rotates by the hinge shaft **962**. The closing member **297** forces the cover part **961** upward when the door **40** is open to prevent, for example, debris from falling through the accommodation hole **91**. When the door **40** is closed, the cover part **961** is pushed open by the locking member **41**.

In an embodiment of the present disclosure, the flip cover **296** may be opened and closed in accordance with a signal from a door open/close detection sensor. The open/close detection sensor may be any sensor appropriate for such purposes.

FIG. **14** is a cross-sectional view taken along the line A-A' in FIG. **2**, and FIG. **15** is a cross-sectional view taken along the line B-B' in FIG. **2**.

As discussed with respect to at least FIGS. **1-3**, the upper frame **110** may be provided above the lower frame **130**, and provided to include the opening **120**a. The upper frame **110** includes the opening **120**a formed therein, and the opening flange **120** provided to be tilted toward the opening **120**a.

As discussed with respect to at least FIGS. **2-4**, the opening flange **120** includes a front flange **122** provided at the front with respect to the opening **120**a, a pair of side flanges **124** formed at sides with respect to the opening **120**a and provided to face each other, and a rear flange **126** provided at the rear with respect to the opening **120**a, provided at the other side of the front flange **122**, and connected to the pair of side flanges **124**.

The front flange **122**, the side flanges **124**, and the rear flange **126** are formed to surround the opening **120**a. As mentioned above, the front flange **122** may be provided to be convenient for a user of the washing machine to load and unload laundry, or otherwise access the tub.

In other words, the locking switches **80**, **180**, and **280** of the door locking devices **70**, **170**, and **270** that restrain the door **40** are disposed in the upper frame **110**, such that the sliding members **81**, **181**, and **281** slide forward into the upper frame **110**, and a button unit **102** (FIGS. **1-3**) by which a control signal is input to the washing machine is disposed at the back of the upper frame **110**. Accordingly, a structure of the front flange **122** provided at the front portion of the opening **120**a may be simplified.

In various embodiments of the present disclosure, the sliding members **81**, **181**, and **281** are disposed to slide in the upper frame **110**, such that the height of the front flange **122** may be lowered.

The front flange **122** may be provided at the front portion of the opening **120**a and formed as a convex curved surface in an upward direction. In other words, the front flange **122** may be formed as a curved surface because various embodiments of the disclosure enable a configuration of the front flange **122** where the sliding members **81**, **181**, and **281** are allowed to slide in the upper frame **110**.

Accordingly, the front flange **122** may have a gentle slope forward that may allow a user to easily load and unload laundry from the rotating tub **12**, or otherwise access the rotating tub **12**.

The front flange **122** may include a front inclined surface **122**a in the front of the washing machine, a rear inclined surface **122**b that faces the opening **120**a, and a door seating part **122**c that is formed between the front inclined surface **122**a and the rear inclined surface **122**b. The door seating part **122**c may be formed to have a bottom portion of the door **40** come in contact therewith when the door **40** is closed. Although a bottom portion of the door **40** is provided to be seated on the door seating part **122**c in an embodiment of the present disclosure, embodiments are not limited thereto, and a bottom portion of the door **40** may be seated on the front inclined surface **122**a or the rear inclined surface **122**b.

The front inclined surface **122**a, the rear inclined surface **122**b, and the door seating part **122**c may be formed as one curved surface. As the front flange **122** is formed with one curved surface in front and rear directions, it may be easy for the user to bend his or her body and approach the inner portion of the rotating tub **12**.

When an angle between the side flanges **124** and a reference ground surface G is called a side angle SA, and an angle between the rear flange **126** and the reference ground surface G is called a rear angle RA, an angle between the front inclined surface **122**a and the reference ground surface G may be a front angle FA that may be less than the side angle SA or the rear angle RA. That is, the front angle FA may be smaller than the side angle SA or the rear angle RA. In other words, the opening flange **120** may be provided to have a slope from the side or rear of the opening **120**a toward the front along a circumferential direction of the opening **120**a. The reference ground surface G represents a virtual surface that is a reference for measuring the angles SA, FA, and RA.

The door seating part **122**c is disposed at a portion in which the front inclined surface **122**a and the rear inclined surface **122**b meet in the front flange **122**. The door seating part **122**c is disposed at the other side of a rotating part of the door **40**, such that the other side may be seated thereon. When the door **40** closes the opening **120**a and one side of the door **40** seats on the door seating part **122**c, the door locking devices **70**, **170**, and **270** are provided to restrain the door **40**.

At least one seating pad **128** (FIG. **3**) may be provided at the door **40** to prevent a noise or impact from being generated when the door **40** is closed.

The upper portion of the opening flange **120** may be formed to gradually slope down from the rear toward the front. That is, the front flange **122** is formed to be lower from the reference ground surface G than the side flanges **124** or the rear flange **126**, such that the front flange **122** may enable the user to easily load or unload the laundry, or otherwise access the washing machine.

That is, when a height up to an upper portion of the front flange **122** with respect to the reference ground surface G of the upper frame **110** is h1, h1 may be formed lower than h2, which is a height from the reference ground surface G up to upper portions at any point of the side flanges **124**. The reference ground surface G represents a virtual surface that becomes a reference of h1 and h2 at a lower portion of the upper frame **110**. The height of h1 is not limited.

In various embodiments of the present disclosure, a locking device of a door is improved, thereby preventing opening of the door during times when the door should not be open.

In addition, a structure of an upper frame of a cabinet is improved, thereby facilitating loading and unloading laundry, and otherwise accessing an inner portion of the washing machine.

Hereinbefore, specific embodiments have been illustrated and described. However, the present disclosure is not limited to the embodiments mentioned above, and those of ordinary skill in the art to which the present disclosure pertains will be able to modify and practice the embodiments in various ways without departing from the gist of the technical spirit of the present disclosure defined in the claims below.

What is claimed:

1. A washing machine comprising:

a cabinet;

an upper frame disposed at an upper portion of the cabinet, and including an opening and an opening flange formed around the opening, wherein the opening flange comprises a through-hole and a mounting part around the through-hole;

a door rotatably disposed at the upper frame to open and close, wherein **[**a closed**]** *the* door **[**covers**]** *is configured to cover* the opening *when in a closed position* and **[**an opened door uncovers**]** *to uncover* the opening *when in an opened position*;

a locking member provided at the door, wherein the locking member is configured to be inserted into the upper frame when the door is closed; and

a door locking device disposed to be supported by the upper frame, and configured to selectively restrain the locking member in the upper frame when the door is closed, wherein the door locking device comprises a locking switch configured to restrain the locking member, and a mounting unit in which a first side is coupled to the mounting part, and a second side is coupled to the locking switch.

2. The washing machine according to claim **1**, wherein:

the locking member is provided at a center portion of a front portion of the door; and

the door locking device is disposed at a corresponding center portion of a front portion of the upper frame.

3. The washing machine according to claim **1**, wherein the mounting unit comprises:

an upper unit disposed above the mounting part and having an accommodation hole configured to correspond to the through-hole, wherein the accommodation hole is capable of receiving the locking member; and

a lower unit disposed below the mounting part.

4. The washing machine according to claim **3**, wherein:

the upper unit and the lower unit are configured to be coupled to the opening flange with the mounting part therebetween; and

the locking switch is coupled to the lower unit and mounted on a lower portion of the opening flange by coupling between the upper unit and the lower unit.

5. The washing machine according to claim **3**, wherein a first one of the upper unit and the lower unit comprises a locking protrusion, and a second one of the upper unit and the lower unit comprises a coupling hole that couples to the locking protrusion.

6. The washing machine according to claim **3**, wherein the mounting unit comprises a flip cover configured to cover and uncover the accommodation hole.

7. The washing machine according to claim **6**, wherein the mounting unit comprises a closing member configured to force the flip cover upward to cover the accommodation hole, wherein the flip cover is configured to be pushed open by the locking member as the door is closed.

8. The washing machine according to claim **7**, wherein the lower unit comprises the flip cover and the closing member.

9. The washing machine according to claim **3**, wherein:

the upper unit and the lower unit are coupled to the opening flange while having the mounting part therebetween;

the locking switch is coupled to the lower unit;

the lower unit comprises a coupling flange to be coupled to the upper frame; and

the coupling flange is fixed in the upper frame by screw coupling or a hook structure to mount the locking switch on a lower portion of the opening flange.

10. The washing machine according to claim **1**, wherein the locking switch comprises a sliding member that is configured to be selectively inserted into the locking member, wherein the sliding member slides in the upper frame.

11. The washing machine according to claim **1**, wherein the mounting unit comprises a coupling flange configured to be coupled to the upper frame.

12. The washing machine according to claim **11**, wherein the coupling flange is welded to the upper frame.

13. The washing machine according to claim **1**, wherein the opening flange comprises:

a front flange disposed in front of the opening;

side flanges formed at both sides of the opening, and provided to face each other; and

a rear flange provided at a rear of the opening, facing the front flange, and connected to the side flanges, and

the door locking device is disposed at a center portion of the front flange.

14. The washing machine according to claim **13**, wherein the front flange comprises:

a front inclined surface inclined downward toward a front of the upper frame;

a rear inclined surface inclined downward toward the opening; and

a door seating part formed between the front inclined surface and the rear inclined surface, wherein a forward portion of the door is seated on a door seating frame when the door is closed.

15. The washing machine according to claim **14**, wherein an angle between the front inclined surface and a reference ground surface is smaller than an angle between the side flanges and the reference ground surface.

16. The washing machine according to claim **14**, wherein the front inclined surface, the rear inclined surface, and the door seating part are formed as one curved surface.

17. The washing machine according to claim **13**, wherein the opening flange is formed to be gradually sloped downward from a rear of the opening flange toward a front of the opening flange.

18. The washing machine according to claim **13**, wherein a height from a reference ground surface to an upper portion of the front flange is less than a height from the reference ground surface to upper portions of the side flanges.

19. A washing machine comprising:

a cabinet;

an upper frame disposed at an upper portion of the cabinet, and including an opening and an opening flange formed around the opening;

a door rotatably disposed at the upper frame to open and close, wherein **[**a closed**]** *the* door **[**covers**]** *is configured to cover* the opening *when in a closed position* and **[**an opened door uncovers**]** *to uncover* the opening *when in an opened position*;

a locking member provided at the door, wherein the locking member is configured to be inserted into the upper frame when the door is closed; and

a door locking device disposed to be supported by the upper frame, and configured to selectively restrain the locking member in the upper frame when the door is closed,

wherein the door locking device comprises:

a locking switch configured to restrain the locking member;

an upper unit disposed above the opening flange and having an accommodation hole configured to be capable of accommodating the locking member; and

a lower unit disposed below the opening flange, and having a first side of the lower unit coupled to the upper unit and a second side of the lower unit coupled to the locking switch.

20. The washing machine according to claim **19**, wherein a first one of the upper unit and the lower unit comprises a locking protrusion, and a second one of the upper unit and the lower unit comprises a coupling hole that couples to the locking protrusion.

21. The washing machine according to claim **19**, wherein the locking switch comprises a sliding member that is configured to be selectively inserted into the locking member.

22. The washing machine according to claim 19, wherein the upper unit comprises a flip cover configured to cover and uncover the accommodation hole.

23. The washing machine according to claim 22, wherein the upper unit comprises a closing member configured to force the flip cover upward to cover the accommodation hole, wherein the flip cover is configured to be pushed open by the locking member as the door is closed.

24. A washing machine comprising:

a cabinet;

an upper frame disposed at an upper portion of the cabinet, the upper frame comprising:

an opening to load laundry therethrough,

a detergent supply inlet to supply detergent, a bleaching agent, or a fabric conditioner therethrough, and a locking hole;

a door configured to close the opening, the door including a locking member configured to be inserted through the locking hole; and

a door locking device disposed at the upper frame and configured to restrain the door from being opened when locked, the door locking device comprising:

a first mounting unit disposed on a portion of the upper frame defining the locking hole;

a second mounting unit coupled to the first mounting unit such that the portion of the upper frame is disposed between the first mounting unit and the second mounting unit and

a locking switch coupled to the second mounting unit and including a sliding member configured to restrain the locking member of the door.

25. The washing machine according to claim 24, wherein the second mounting unit comprises a locking switch coupling part configured to be inserted to a mounting unit coupling part disposed at the locking switch.

26. The washing machine according to claim 24, further comprising a door close detection sensor configured to detect the door being closed.

27. The washing machine according to claim 26, wherein the sliding member is configured to be movable to restrain the locking member when an operation of the washing machine starts.

28. The washing machine according to claim 24, wherein the locking member comprises a pocket configured to accommodate an end of the sliding member.

29. The washing machine according to claim 24, wherein the first mounting unit comprises a locking protrusion configured to be inserted to a coupling hole disposed at the second mounting unit.

30. The washing machine according to claim 24, further comprising a flip cover configured to cover the hole of the first mounting unit.

31. The washing machine according to claim 30, wherein the flip cover is configured to be pushed open by the locking member when the door is closed.

32. The washing machine according to claim 24, wherein the door locking device is configured to lock the door when the door is closed based on insertion of a portion of the sliding member of the locking switch into a portion of the locking member that is inserted through the locking hole of the upper frame.

33. The washing machine according to claim 24, wherein the locking member is configured to be inserted through the locking hole of the upper frame when the door is closed.

* * * * *