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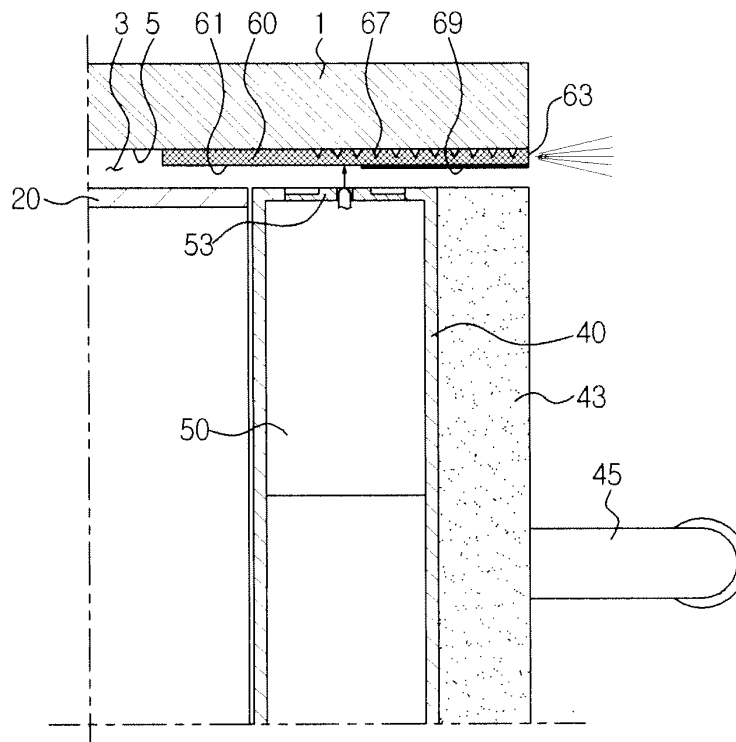
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(54) **Built-in dishwasher**

(57) A built-in dishwasher (10) to be received in a receiving space (3) of an external structure (1). The built-in dishwasher includes a protective panel (60) made of a transparent resin, the protective panel being mounted

at a ceiling of the receiving space. The protective panel prevents deformation of the external structure due to steam and also, enables easy observation of an operating state of the dishwasher.

FIG. 4



## Description

### BACKGROUND

#### 1. Field

**[0001]** Embodiments relate to a built-in dishwasher to enable easy observation of an operating state thereof.

#### 2. Description of the Related Art

**[0002]** Generally, a dishwasher is an appliance to enable sanitary and efficient washing of dishes and has dish washing and drying functions.

**[0003]** A dishwasher is mainly installed in a built-in manner along with kitchen components, such as a sink, etc. To improve the aesthetics of a built-in dishwasher, a front surface of the built-in dishwasher is covered with a panel having the same texture and color as those of kitchen components.

**[0004]** The built-in dishwasher, however, makes observation of an operating state (e.g., washing/rinsing/completion) of the dishwasher difficult and therefore, has been developed to have a configuration for easy observation of the operating state.

### SUMMARY

**[0005]** Therefore, it is an aspect to provide a built-in dishwasher, which enables easy observation of an operating state thereof.

**[0006]** Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the invention.

**[0007]** In accordance with one aspect, a built-in dishwasher configured to be inserted into a receiving space of an external structure through an opening of the receiving space, includes a case, a wash tub placed in the case, a door to open or close the wash tub, an operation indicator to indicate an operating state of the dishwasher, and a protective panel provided at a ceiling of the receiving space facing the operation indicator and serving to prevent steam, discharged from the wash tub upon opening of the door, from contacting the external structure, wherein the protective panel is made of a light transmitting material to transmit light, emitted from the operation indicator, in a forward direction of the door.

**[0008]** The protective panel may be made of any one of glass and transparent resin.

**[0009]** The protective panel may have a length corresponding to a width of the receiving space and may be located adjacent to the opening of the receiving space to face an upper surface of the door.

**[0010]** At least one diffuser pattern may be integrally formed at a portion of the protective panel facing the operation indicator and may serve to diffuse the light emitted from the operation indicator.

**[0011]** The diffuser pattern may take the form of a V-shaped recess indented inward from an upper surface of the protective panel.

**[0012]** The at least one diffuser pattern may include a plurality of diffuser patterns spaced apart from one another in a front-and-rear direction of the protective panel.

**[0013]** The plurality of diffuser patterns may be equidistantly arranged.

**[0014]** A distance between the plurality of diffuser patterns may be reduced away from the operation indicator.

**[0015]** In accordance with another aspect, a built-in dishwasher configured to be inserted into a receiving space of an external structure through an opening of the receiving space, includes an operation indicator provided at an upper surface of a door that opens or closes a wash tub, and a protective panel having a length corresponding to a width of the receiving space and mounted at a ceiling of the receiving space adjacent to the opening of the receiving space, the protective panel serving to prevent deformation of the external structure due to steam discharged upon opening of the door, wherein the protective panel is made of a light transmitting resin and includes an incidence surface facing the operation indicator and an emission surface facing a forward direction of the door, and at least one diffuser pattern is integrally formed at a portion of an upper surface of the protective panel facing the operation indicator and serves to reflect light introduced through the incidence surface to enable emission of the light through the emission surface.

**[0016]** An ornamental panel having the same texture and color as the external structure may be provided at a front surface of the door.

**[0017]** The at least one diffuser pattern may take the form of a V-shaped recess indented inward from the upper surface of the protective panel, and may include a plurality of diffuser patterns spaced apart from one another in a front-and-rear direction of the protective panel.

**[0018]** The diffuser patterns may be elongated in a width direction of the protective panel.

**[0019]** A distance between the plurality of diffuser patterns may be reduced toward the emission surface.

**[0020]** A reflective sheet may be provided at a portion of the incidence surface and may serve to prevent the light from leaking through the incidence surface, rather than being directed to the emission surface.

**[0021]** In accordance with a further aspect, a built-in dishwasher configured to be inserted into a receiving space of an external structure through an opening of the receiving space, includes an operation indicator to emit light according to an operating state of the dishwasher, and a light guide plate having a length corresponding to a width of the receiving space and mounted at a ceiling of the receiving surface, the light guide plate including an incidence surface facing the operation indicator and an emission surface toward the opening of the receiving space, wherein at least one diffuser pattern is indented in the light guide plate at a position facing the operation indicator and serves to diffuse light introduced into the

light guide plate through the incidence surface.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0022]** These and/or other aspects 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 perspective view illustrating a schematic configuration of a dishwasher according to an embodiment;

FIG. 2 is a sectional view illustrating the interior of the dishwasher according to the embodiment;

FIG. 3 is a perspective view illustrating a protective panel according to the embodiment;

FIG. 4 is a sectional view illustrating a part of the dishwasher received in a receiving space according to the embodiment;

FIG. 5A is a sectional view taken along the line 1-1 of FIG. 3;

FIG. 5B is a sectional view taken along the line 1-1 of FIG. 3, illustrating another embodiment; and

FIG. 6 is a view illustrating another embodiment of a diffuser pattern formed at the protective panel.

## DETAILED DESCRIPTION

**[0023]** Reference will now be made in detail to a built-in dishwasher according to embodiments, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout.

**[0024]** FIG. 1 is a perspective view illustrating a schematic configuration of a dishwasher according to an embodiment.

**[0025]** As illustrated in FIG. 1, the dishwasher 10 of the present embodiment may be a built-in dishwasher configured to be inserted into an external structure 1. Here, the external structure 1 may be, e.g., a sink or wall.

**[0026]** To receive the dishwasher 10, the external structure 1 may have a receiving space 3, a front side of which is open.

**[0027]** The dishwasher 10 may basically include a case 20 defining an outer appearance of the dishwasher 10, a door 40 pivotally rotatably coupled to a front side of the case 20, and a control panel 50 mounted on an upper surface 41 of the door 40.

**[0028]** When the built-in dishwasher 10 is installed in the external structure 1, the entire dishwasher 10 is received in the receiving space 3 of the external structure 1 to prevent exposure of the outer appearance thereof.

**[0029]** In addition, to achieve harmony between the door 40 and the external structure 1, an ornamental panel 43 having the same texture and color as those of the external structure 1 may be attached to a front surface of the door 40. The ornamental panel 43 may be provided with a grip 45 for user grip upon opening/closing of the door 40 and thus, may be opened or closed along with the door 40.

**[0030]** FIG. 2 is a sectional view illustrating the interior of the dishwasher according to the embodiment.

**[0031]** As illustrated in FIG. 2, the dishwasher 10 may further include a wash tub 21 placed in the case 20 to provide a washing space, and a sump 22 provided beneath the wash tub 21 to store wash water therein.

**[0032]** The wash tub 21 may contain at least one dish basket 26 in which dishes are received. The dish basket 26 may be supported on a rail 27 in a sliding movable manner.

**[0033]** The wash tub 21 may further contain at least one injection nozzle 28 to inject wash water toward the dishes received in the dish basket 26.

**[0034]** In addition, a water feeder 29 may be provided at a sidewall of the wash tub 21, to supply wash water into the wash tub 21, and a heater 30 may be provided at the bottom of the wash tub 21 to heat wash water.

**[0035]** The sump 22 may be located at the bottom center of the wash tub 21 to collect wash water and pump the collected wash water. To this end, the sump 22 may include a washing pump 23 to pump wash water at a high pressure and a pump motor 24 to drive the washing pump 23.

**[0036]** The washing pump 23 may pump wash water up to the injection nozzle 28 through a first feed pipe 31 and a second feed pipe 32.

**[0037]** The sump 22 may further include a turbidity sensor 25 to detect the pollution level of wash water. A controller (not shown) of the dishwasher 10 may control the implementation number of a washing or rinsing operation based on the pollution level of wash water detected by the turbidity sensor 25. For example, the controller may increase the number of a washing or rinsing operation if the pollution level is high, and may decrease the number of a washing or rinsing operation if the pollution level is low.

**[0038]** A drain pump 33 and a drain pipe 34 may be coupled to the sump 22 to discharge polluted wash water out of the dishwasher 10.

**[0039]** The door 40 coupled to the case 20 may be pivotally rotatable about a hinge shaft 42 provided at a lower end of the case 20, to open or close a front side of the wash tub 21.

**[0040]** The control panel 50 mounted on the upper surface 41 of the door 40 may be used to display and control operation of the dishwasher 10. Although not shown, a circulation duct may be inserted in an interior space of the door 40.

**[0041]** The control panel 50, as illustrated in FIG. 1, may include, e.g., a display part 51 including a touch

panel, etc., to input an operation mode and washing course of the dishwasher 10, an operation indicator 53 to indicate a current operating state of the dishwasher 10, and a Printed Circuit Board (PCB) connected to these components.

**[0042]** The display part 51 and the operation indicator 53 are arranged on the upper surface 41 of the door 40. The display part 51 is provided with operating buttons, such as a button to select a washing, rinsing or drying course, a power on/off button, etc., to allow a user to operate the dishwasher 10.

**[0043]** The operation indicator 53 includes light emitting elements, such as Light Emitting Diodes (LEDs), etc. During operation of the dishwasher 10, the operation indicator 53 emits light to allow the user to observe a current operating state of the dishwasher 10.

**[0044]** The above-described dishwasher 10, as illustrated in FIG. 1, is received in the receiving space 3 of the external structure 1 so as not to be exposed to the outside. Thus, it may be difficult to observe the light emitted from the operation indicator 53 arranged on the upper surface 41 of the door 40 from the outside.

**[0045]** Further, if the door 40 is opened or closed after operation of the dishwasher 10, high-temperature steam within the wash tub 21 may be discharged directly to the external structure 1. This may cause deformation of the external structure 1.

**[0046]** In particular, if the external structure 1 is made of wood, deformation of the external structure 1 may be accelerated.

**[0047]** To prevent deformation of the external structure 1, in the present embodiment, a protective panel 60 may be provided at a ceiling of the receiving space 3 in which the dishwasher 10 is received, to prevent steam discharged upon opening/closing of the door 40 from directly contacting the external structure 1.

**[0048]** FIG. 3 is a perspective view illustrating the protective panel according to the embodiment, and FIG. 4 is a sectional view illustrating a part of the dishwasher received in the receiving space.

**[0049]** Also, FIG. 5A is a sectional view taken along the line 1-1 of FIG. 3, and FIG. 5B is a sectional view taken along the line I-I of FIG. 3, illustrating another embodiment of the present invention.

**[0050]** Referring to FIGS. 3 and 4, the protective panel 60 may have a rectangular shape and may have a predetermined thickness and a length corresponding to a width W of the receiving space 3 (see FIG. 1).

**[0051]** The protective panel 60 may also have a predetermined front-and-rear length F, which is determined to prevent steam discharged upon opening/closing of the door 40 from directly contacting the ceiling 5 of the external structure 1.

**[0052]** The protective panel 60 may be made of a transparent material, such as glass, acrylic-based resin or the like. The protective panel 60 may be attached to the ceiling 5 at a position adjacent to the open front side of the receiving space 3, such that one surface, i.e. a front sur-

face of the protective panel 60 is exposed to the outside.

**[0053]** In this case, a lower surface of the protective panel 60 facing the upper surface 41 of the door 40 may serve as an incidence surface 61, into which the light emitted from the operation indicator 53 is introduced. The front surface of the protective panel 60, exposed through the open front side of the receiving space 3, may serve as an emission surface 63 from which the light introduced through the incidence surface 61 is emitted.

**[0054]** Specifically, the protective panel 60 may be a light guide plate made of a light transmitting material, which serves to transmit the light emitted from the operation indicator 53 in a forward direction of the door 40.

**[0055]** In this way, the transparent protective panel 60 may function not only to prevent deformation of the external structure 1 due to steam discharged from the dishwasher 10, but also to transmit the light, emitted from the operation indicator 53 arranged on the upper surface 41 of the door 40, in a forward direction of the door 40.

**[0056]** In addition, the protective panel 60 may have at least one diffuser pattern 67 integrally formed at an upper surface 65 thereof to diffuse the light directed from the operation indicator 53 to the protective panel 60.

**[0057]** The diffuser pattern 67 may function to reflect or refract the light introduced through the incidence surface 61 of the protective panel 60, to transmit the light to the emission surface 63 of the protective panel 60.

**[0058]** The diffuser pattern 67 may be provided at the upper surface 65 of the protective panel 60 at a position facing the operation indicator 53 arranged on the upper surface 41 of the door 40. The diffuser pattern 67 may take the form of a V-shaped recess indented inward from the upper surface 65 of the protective panel 60, to refract or reflect the light introduced into the protective panel 60 at a predetermined angle.

**[0059]** As the diffuser pattern 67 in the form of a triangular recess reflects or refracts the light that have emitted from the operation indicator 53 and introduced into the protective panel 60 through the incidence surface 61 and thus, causes condensation of the light emitted from the emission surface 63, enhanced forward brightness and visibility may be accomplished.

**[0060]** In one embodiment, a plurality of diffuser patterns 67 may be spaced apart from one another in a front-and-rear direction F of the protective panel 60, and more particularly, may be equidistantly arranged as illustrated in FIG. 5A.

**[0061]** In another embodiment, as illustrated in FIG. 5B, a plurality of diffuser patterns 67 may be arranged such that a distance S between the neighboring diffuser patterns 67 is reduced away from the operation indicator 53, i.e. toward the emission surface 63.

**[0062]** Some of the diffuser patterns 67 adjacent to the operation indicator 53 receive a sufficient quantity of light emitted from the operation indicator 53, but the quantity of light introduced into the remaining diffuser patterns 67 is reduced away from the operation indicator 53. Therefore, when reducing the distance S between the neigh-

boring diffuser patterns 67, it may be possible to increase the quantity of light to be emitted from the emission surface 63 and consequently, enhance visibility of the user.

**[0063]** Although not illustrated in the present embodiment, the shape of the diffuser patterns 67 is not limited to the above description. When it is desired to diffuse the light directed from the operation indicator 53 over a wide range, the diffuser patterns 67 may have a curved cross sectional shape.

**[0064]** For example, owing to various combinations of, e.g., the shape, size or distance of the diffuser patterns 67 integrally formed at the upper surface 65 of the protective panel 60, it may be possible to effectively irradiate the light emitted from the operation indicator 53 through the emission surface 63 in a forward direction of the door 40.

**[0065]** In addition, a reflective sheet 69 (see FIG. 4) may be provided at the incidence surface 61 of the protective panel 60 located between the operation indicator 53 and the emission surface 63. Once the light emitted from the operation indicator 53 is introduced into the incidence surface 61 of the protective panel 61, the reflective sheet 69 prevents the light from leaking from the incidence surface 61 rather than being directed toward the emission surface 63.

**[0066]** The reflective sheet 69 may be formed at the incidence surface 61 by a silk screen method using paste containing materials exhibiting a high degree of reflectivity.

**[0067]** Meanwhile, although the present embodiment illustrates the diffuser patterns 67 as being formed at a partial region of the upper surface 65 of the protective panel 60 to correspond to the operation indicator 53, as illustrated in FIG. 6, at least one diffuser pattern 67 may be elongated in a direction of the protective panel 60 designated by the arrow W.

**[0068]** Even if a plurality of operation indicators 53 is provided on the upper surface 41 of the door 40, it may be unnecessary to form the diffuser patterns 67 at every position corresponding to the respective operation indicators 53 when the elongated diffuser pattern 67 extending in the direction W is formed at the upper surface 65 of the protective panel 60 and thus, enhanced productivity and universality of the protective panel 60 may be accomplished.

**[0069]** For example, even if a plurality of operation indicators 53 is provided on the upper surface 41 of the door 40 to emit different colors of light according to a washing, rinsing or drying course of the dishwasher 10, it may be unnecessary to form the diffuser patterns 67 to correspond to the operation indicators 53 in a one to one ratio.

**[0070]** Hereinafter, operation and effects of the dishwasher according to the embodiment will be described.

**[0071]** First, if the user inputs a washing condition and washing time to the control panel 50 in an open state of the door 40 and then, closes the door 40, the dishwasher 10 begins to be operated. During operation of the dish-

washer 10, the operation indicator 53 emits light corresponding to a current operating state of the dishwasher 10.

**[0072]** In this case, since the dishwasher 10 is embedded in the receiving space 3 of the external structure 1, the outer appearance of the dishwasher 10 is hidden by the external structure 1 once the door 40 is closed, but the light emitted from the operation indicator 53 is introduced into the incidence surface 61 of the protective panel 60 attached to the ceiling 5 of the receiving space 3. Thereby, as the light is directed to the emission surface 63 so as to be emitted to the outside, the user may perceive an operating state of the dishwasher 10.

**[0073]** Moreover, as the diffuser patterns 67 diffuse the light passing through the protective panel 60, the user visibility may be further enhanced.

**[0074]** Meanwhile, even if high-temperature steam within the dishwasher 10 is discharged upon opening of the door 40 after the operation of the dishwasher 10 is completed, the high-temperature steam contacts the protective panel 60 attached to the ceiling 5 of the receiving space 3. Accordingly, it may be possible to prevent the high-temperature steam from directly contacting the external structure 1, thereby preventing deformation of the external structure 1.

**[0075]** That is, the protective panel 60 of the present embodiment may serve not only to prevent the high-temperature steam within the dishwasher 10 from directly contacting the external structure 1, but also to allow the user to perceive a current operating state of the built-in dishwasher 10 from the outside.

**[0076]** The diffuser patterns 67 may be integrally formed at the protective panel 60 and this may enhance productivity of the protective panel 60.

**[0077]** As is apparent from the above description, a built-in dishwasher according to an embodiment may allow a user to easily perceive a current operating state of the dishwasher from the outside.

**[0078]** Further, the built-in dishwasher according to the embodiment may prevent deformation of an external structure in which the dishwasher is embedded, thus providing enhanced reliability in operation.

**[0079]** Although a few embodiments have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

## Claims

1. A built-in dishwasher configured to be inserted into a receiving space of an external structure through an opening of the receiving space, comprising:

a case;  
a wash tub placed in the case;

a door to open or close the wash tub;  
 an operation indicator to indicate an operating  
 state of the dishwasher; and  
 a protective panel provided at a ceiling of the  
 receiving space facing the operation indicator  
 and serving to prevent steam, discharged from  
 the wash tub upon opening of the door, from  
 contacting the external structure,

wherein the protective panel is made of a light trans-  
 mitting material to transmit light, emitted from the  
 operation indicator, in a forward direction of the door.

2. The built-in dishwasher according to claim 1, wherein  
 the protective panel is made of any one of glass and  
 transparent resin.
3. The built-in dishwasher according to claim 1, wherein  
 the protective panel has a length corresponding to  
 a width of the receiving space and is located adjacent  
 to the opening of the receiving space to face an upper  
 surface of the door.
4. The built-in dishwasher according to claim 3, wherein  
 at least one diffuser pattern is integrally formed at a  
 portion of the protective panel facing the operation  
 indicator and serves to diffuse the light emitted from  
 the operation indicator.
5. The built-in dishwasher according to claim 4, wherein  
 the diffuser pattern takes the form of a V-shaped  
 recess indented inward from an upper surface of the  
 protective panel.
6. The built-in dishwasher according to claim 4, wherein  
 the at least one diffuser pattern includes a plurality  
 of diffuser patterns spaced apart from one another  
 in a front-and-rear direction of the protective panel.
7. The built-in dishwasher according to claim 6, wherein  
 the plurality of diffuser patterns is equidistantly ar-  
 ranged.
8. The built-in dishwasher according to claim 6, wherein  
 a distance between the plurality of diffuser patterns  
 is reduced away from the operation indicator.
9. A built-in dishwasher configured to be inserted into  
 a receiving space of an external structure through  
 an opening of the receiving space, comprising:

an operation indicator provided at an upper sur-  
 face of a door that opens or closes a wash tub;  
 and  
 a protective panel having a length correspond-  
 ing to a width of the receiving space and mount-  
 ed at a ceiling of the receiving space adjacent  
 to the opening of the receiving space, the pro-

ective panel serving to prevent deformation of  
 the external structure due to steam discharged  
 upon opening of the door,

wherein the protective panel is made of a light trans-  
 mitting resin and includes an incidence surface fac-  
 ing the operation indicator and an emission surface  
 facing a forward direction of the door, and  
 wherein at least one diffuser pattern is integrally  
 formed at a portion of an upper surface of the pro-  
 tective panel facing the operation indicator and  
 serves to reflect light introduced through the inci-  
 dence surface to enable emission of the light through  
 the emission surface.

10. The built-in dishwasher according to claim 9, wherein  
 an ornamental panel having the same texture and  
 color as the external structure is provided at a front  
 surface of the door.
11. The built-in dishwasher according to claim 9, wherein  
 the at least one diffuser pattern takes the form of a  
 V-shaped recess indented inward from the upper  
 surface of the protective panel, and includes a plu-  
 rality of diffuser patterns spaced apart from one an-  
 other in a front-and-rear direction of the protective  
 panel.
12. The built-in dishwasher according to claim 11,  
 wherein the diffuser patterns are elongated in a width  
 direction of the protective panel.
13. The built-in dishwasher according to claim 11,  
 wherein a distance between the plurality of diffuser  
 patterns is reduced toward the emission surface.
14. The built-in dishwasher according to claim 11,  
 wherein a reflective sheet is provided at a portion of  
 the incidence surface and serves to prevent the light  
 from leaking through the incidence surface, rather  
 than being directed to the emission surface.
15. A built-in dishwasher configured to be inserted into  
 a receiving space of an external structure through  
 an opening of the receiving space, comprising:

an operation indicator to emit light according to  
 an operating state of the dishwasher; and  
 a light guide plate having a length corresponding  
 to a width of the receiving space and mounted  
 at a ceiling of the receiving surface, the light  
 guide plate including an incidence surface fac-  
 ing the operation indicator and an emission sur-  
 face toward the opening of the receiving space,

wherein at least one diffuser pattern is indented in  
 the light guide plate at a position facing the operation  
 indicator and serves to diffuse light introduced into

the light guide plate through the incidence surface.

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FIG. 1

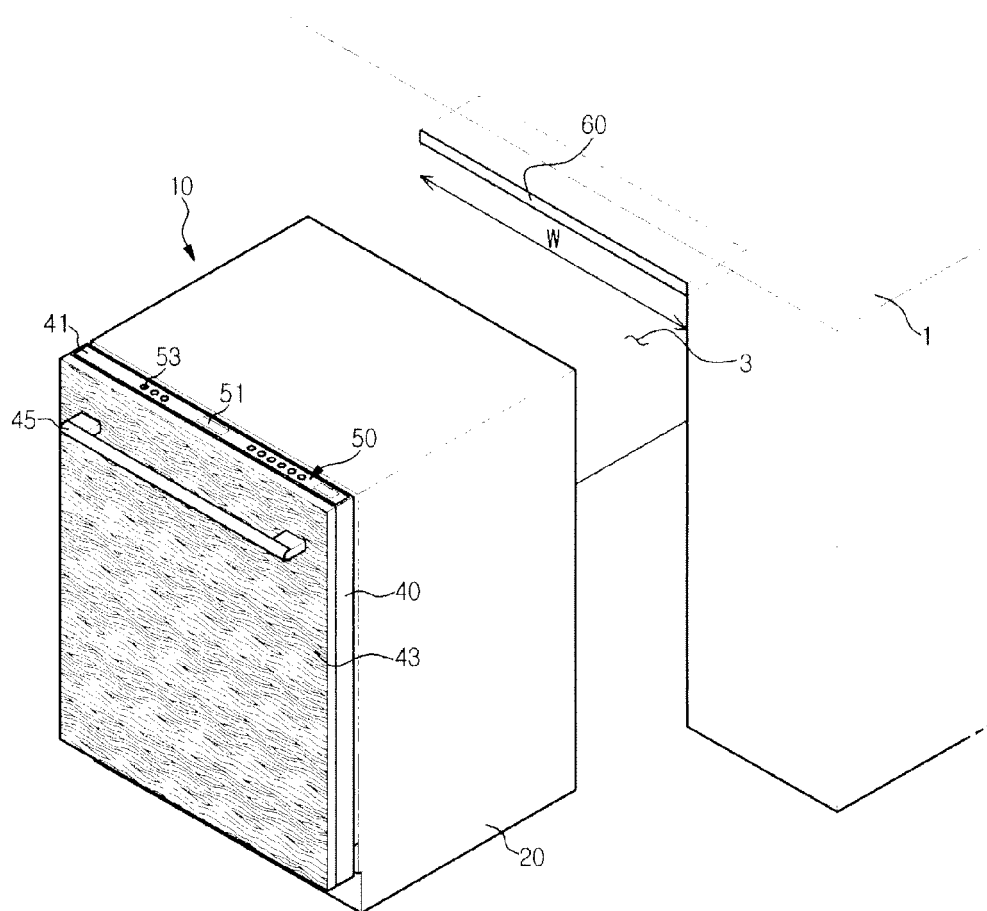




FIG. 2

10

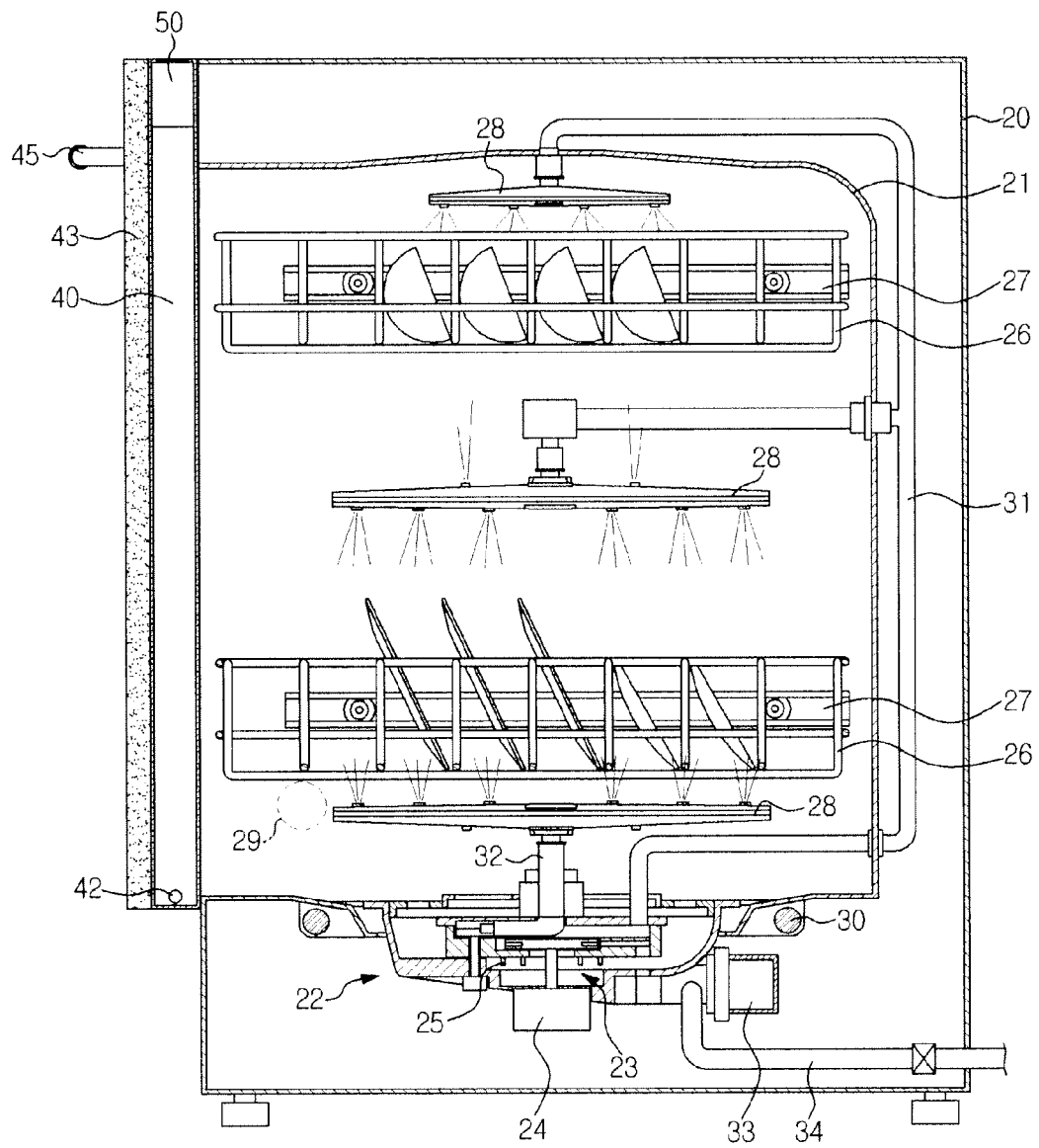


FIG. 3

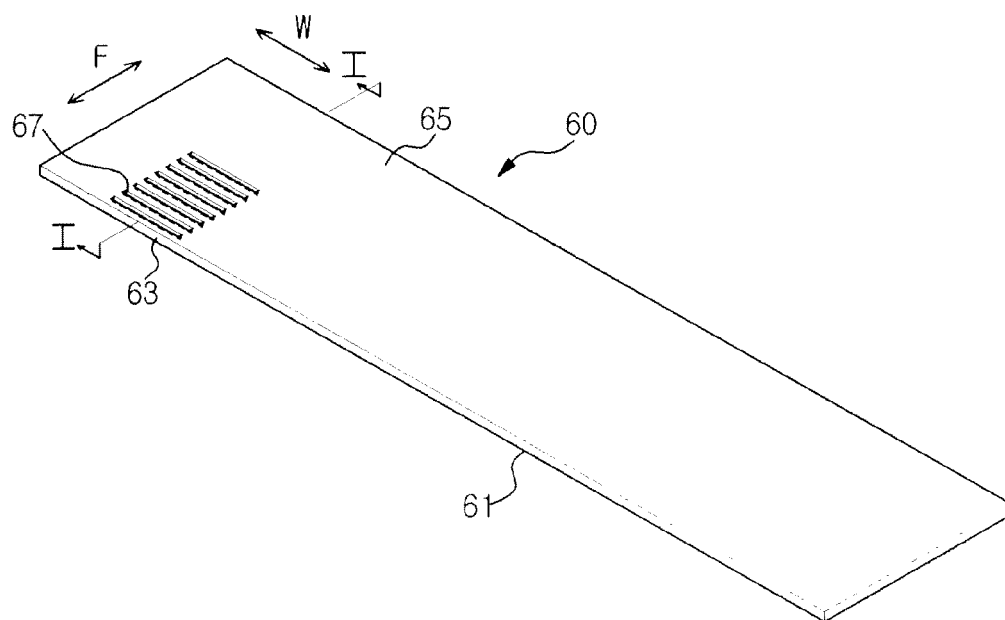


FIG. 4

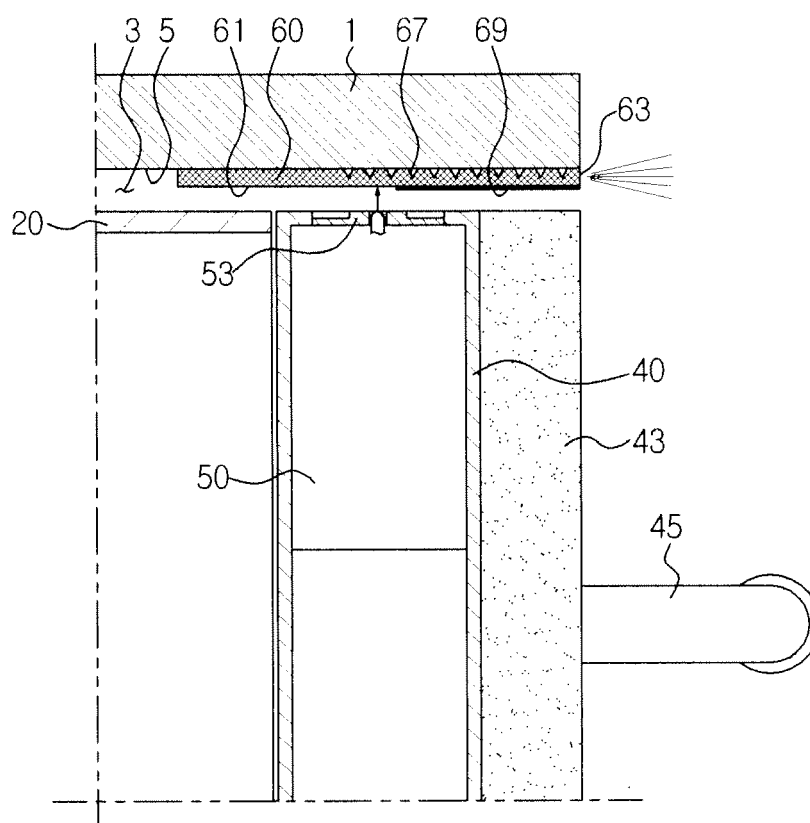


FIG. 5A

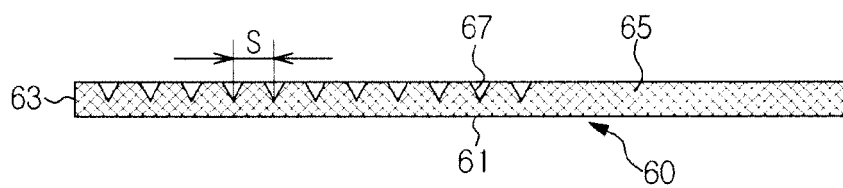


FIG. 5B

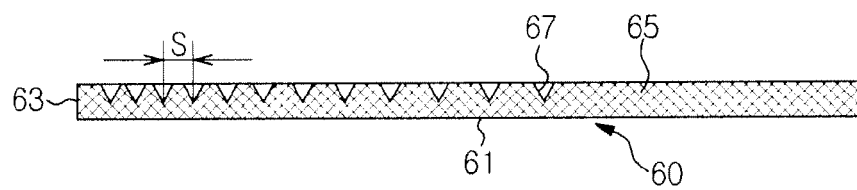


FIG. 6

