



(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/EP2011/058609

(22) International Filing Date:
26 May 2011 (26.05.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201010190971.9 28 May 2010 (28.05.2010) CN

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: SEALING SYSTEM AND HOUSEHOLD APPLIANCE HAVING THE SEALING SYSTEM

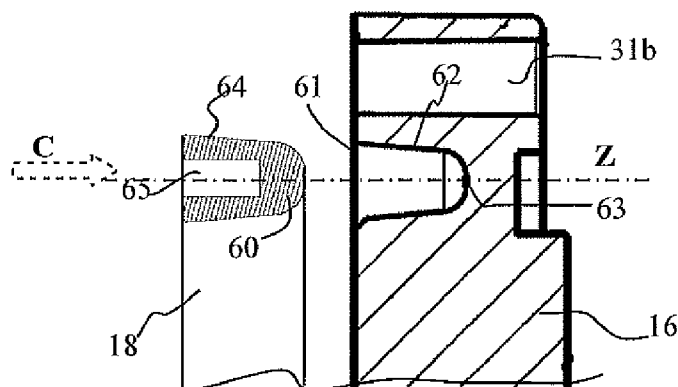


Figure 6

(57) Abstract: The present invention relates to a sealing system and a household appliance having such a sealing system. The sealing system comprises a first member (16, 17), a second member (11), and a sealing element (18) configured to form sealing between the first member (16, 17) and the second member (11), the first member (16, 17) having a groove (30) for receiving at least a part of the sealing element (18). According to the disclosure of the present invention, the groove (30) and the sealing element (18) each have a tapered shape in an insertion direction (C) of the sealing element (18), and the sealing element (18) comprises a head portion (60) which is smaller in size than an opening portion (61) of the groove (30).



SEALING SYSTEM AND HOUSEHOLD APPLIANCE HAVING THE SEALING SYSTEM

5 FIELD OF THE INVENTION

The present invention relates to a sealing system and a household appliance, such as a refrigeration appliance, having such a sealing system.

10 BACKGROUND

Sealing systems are widely used in household appliances, such as refrigeration appliances. For example, for a refrigeration appliance having an evacuable storing chamber (also called "low-pressure chamber" or "vacuum chamber"), the storing
15 chamber must have sufficiently high degree of airtightness to prevent outside air from entering into the storing chamber after the storing chamber has been evacuated of air.

In a refrigeration appliance having an evacuable storing chamber (low-pressure chamber) as disclosed in Chinese patent application CN101358797A, a main body of
20 the low-pressure chamber having a food access opening is configured as comprising an box-shaped casing or external contour formed by a resin and defining the access opening, a glass panel formed of a reinforced glass, and a plurality of metal plates extending along inner side walls of the casing. The glass panel is airtightly carried on an upper opening portion of the casing by means of a ring like gasket which has an
25 upper portion, a side portion and a lower portion for covering an upper surface, a side surface and a lower surface along the edges of the glass panel respectively. The glass panel is inserted into a groove formed by the upper portion, the side portion and the lower portion of the gasket and is thus held by elastic clamping forces of the gasket. The opening portion as an upper portion of the casing is provided with a step part on

which the gasket is seated. The combined actions of the weight of the glass panel and the pressure difference between the inside and outside of the low-pressure chamber deform the gasket to ensure the sealability between the glass panel and the opening portion. The efficiency of such a sealing system is depended on the locations of the glass panel and the opening portion. Specifically, the sealing efficiency is low when the glass panel and the opening portion are provided on the side walls or the bottom of the low-pressure chamber.

US 4,923,260 discloses a sealing system for a refrigerator shelf. The sealing system is configured to be arranged between a frame and a glass panel of the shelf, the frame having a U-shaped cross section defining a receiving groove therein. An edge of the glass panel is inserted into a groove defined in a U-shaped sealing member, which is then inserted into the receiving groove of the frame. This sealing system is applicable in sealing between two components at various locations. However, in such a sealing system, the sealing member must have certain elasticity and form interference fit with the receiving groove of the frame, and thus it is difficult to insert the sealing member into the groove in an uncompressed state.

SUMMARY OF THE INVENTION

It is an objective of the present invention to provide an improved sealing system and a household appliance having such a sealing system.

To this end, the present invention in one aspect relates to a sealing system comprising a first member, a second member, and a sealing element configured to form sealing between the first member and the second member, the first member having a groove for receiving at least a part of the sealing element, characterized in that the groove and the sealing element each have a tapered shape in an insertion direction of the sealing element, and the sealing element comprises a head portion which is smaller in size than

an opening portion of the groove.

In this way, it becomes easier to align the sealing element with and insert it into the groove, so that the assembling of the sealing element is facilitated. In addition, if the
5 groove is formed by injection molding, a shape having a larger opening and smaller bottom also facilitates the mold releasing in the molding process. By properly adapting the sealing element and the groove with each other, it is expected that an even more reliable sealing effect is formed between the sealing element and the groove as the sealing element is gradually inserted into the groove.

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Other individual features or features which are combined with other features so as to be considered as belonging to the characteristic of the present invention are defined in the preferred embodiments described below.

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According to a preferred embodiment of the present invention, the groove has at least one inclined surface extending generally in the insertion direction as well as a bottom surface, and the sealing element comprises, in addition to the head portion which is configured for tightly contacting the bottom surface, a side sealing portion configured for tightly contacting the inclined surface. A more reliable sealing effect can be obtained
20 between the sealing element and the groove by forming more than one sealing area therebetween.

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According to a preferred embodiment of the present invention, an outer surface of the side sealing portion and the inclined surface have approximately the same inclined
25 angle.

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According to a preferred embodiment of the present invention, an angle of the inclined surface relative to a middle axial plane of the groove is not less than 4 degrees, for example, the angle may be 5 to 6 degrees.

According to a preferred embodiment of the present invention, the groove has a pair of opposed side surfaces to form a pair of opposed inclined surfaces, the bottom surface is connected to the pair of inclined surfaces, and the pair of inclined surfaces and the
5 bottom surface form three continuous sealing interfaces with the sealing element.

According to a preferred embodiment of the present invention, the sealing element has a receiving groove configured for receiving an edge portion of the second member, and the receiving groove is surrounded by the three continuous sealing interfaces.

10

According to a preferred embodiment of the present invention, the sealing element has a generally U-shaped cross section.

The present invention in another aspect relates to a household appliance which
15 comprises a sealing system according to any one of preceding claims.

According to a preferred embodiment of the present invention, the household appliance comprises a low-pressure storage unit having an evacuable storage chamber, and the first members and the second member are components of the low-pressure storage unit
20 that are separately constructed and then fixed together.

According to a preferred embodiment of the present invention, the first member is made of a plastic material, and the second member is made of a metal and forms a main body of the low-pressure storage unit.

25

According to a preferred embodiment of the present invention, the second member has a box-shaped structure formed with at least one end opening, the first member is attached to an edge portion of the end opening, and the sealing element is disposed along the whole edge portion of the end opening.

According to a preferred embodiment of the present invention, the household appliance comprises a fixing unit configured for fixing the first member and the second member together, and the fixing unit maintains the head portion in a state of being pressed and deformed in the insertion direction.

The configuration of the present invention and other objectives and beneficial effects thereof will be well understood by description of preferred embodiment in accompany of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

As a part of the description and provide further explanation of the present invent, the drawings illustrate preferred embodiments of the present invention and are used together with the description to explain the principle of the present invention. In the drawings:

Figure 1 shows a schematic perspective view of a refrigeration appliance according to a preferred embodiment of the present invention, wherein a door of the refrigeration appliance is not shown;

Figure 2 shows a schematic assembly perspective view of a low-pressure storage unit according to a preferred embodiment of the present invention;

Figure 3 is a schematic perspective view showing that the low-pressure storage unit according to the preferred embodiment of the present invention is opened;

Figure 4 is a schematic exploded view showing a main body of the low-pressure storage unit according to the preferred embodiment of the present invention;

Figure 5 is a schematic partial perspective view of a rear cover according to a preferred embodiment of the present invention;

- 5 Figure 6 is a schematic partial sectional view showing a state before a sealing member is inserted into a groove according to a preferred embodiment of the present invention;

Figure 7 is a cross-sectional view taken in the direction A-A in figure 2; and

- 10 Figure 8 is an enlarged view of the portion "B" indicated in Figure 7.

DETAILED DESCRIPTION OF THE INVENTION

- As shown in figure 1, a refrigeration appliance 1 comprises a thermally insulated
15 cabinet 2, the cabinet 2 comprising an outer shell 2a, an inner shell 2b and a thermal insulation layer (not shown) therebetween. The cabinet 2 defines a plurality of thermally insulated storage compartments 3, 4 and 5 to store items such as foods. In the present embodiment, these storage compartments are an upper refrigeration compartment 3, a lower freezing compartment 5 and a preservation compartment 4
20 which is located between the upper and lower compartments and is maintained at a temperature of slightly higher than zero degree Celsius. These storage compartments 3, 4 and 5 can be closed by respective doors (not shown).

- It should be understood that the present invention is not limited by the specific
25 arrangement of the storage compartments of the refrigeration appliance. The present invention can be applied for other types of refrigeration appliance, such as a refrigerator having refrigerating and freezing compartments arranged one above the other, a side-by-side combination refrigerator as well as a refrigerator having a drawer-typed door and/or a French door refrigerator or the like.

The refrigeration appliance 1 has a close-looped evaporative refrigeration system. The refrigeration system comprises at least a compressor (not shown), a condenser (not shown), a throttling device (not shown) and an evaporator (not shown). Since this kind of refrigeration system is well-known in the prior art, its detailed explanation is omitted here.

The refrigeration appliance 1 is provided with a low-pressure storage unit 7, having an evacuable storing chamber 32, and an evacuation device (not shown) for evacuating gas out of the storing chamber 32. The evacuation device can comprise a vacuum pump and a pipeline (not shown) connecting between the vacuum pump and the low-pressure storage unit 7.

In the present embodiment, the low-pressure storage unit 7 is provided in the preservation compartment 4. The low-pressure storage unit 7 is located at a bottom of the preservation compartment 4, and is supported on a bottom wall of the preservation compartment 4. In the present embodiment, a preservation container 6 is provided above the low-pressure storage unit 7, which preservation container has a higher humidity and is adapted for storing foods such as vegetables. It should be understood that, in an alternative embodiment, the low-pressure storage unit 7 can be provided in other storage compartments, such as the refrigerating compartment 3 or a variable compartment whose temperature zone can be changed between a refrigerating temperature zone and a freezing temperature zone.

Figurer 2 is a schematic assembly perspective view showing the low-pressure storage unit 7 according to a preferred embodiment of the present invention. Figure 3 is a schematic perspective view showing that the low-pressure storage unit 7 according to the preferred embodiment of the present invention is opened. As shown in figures 2 and 3, in this embodiment, the low-pressure storage unit 7 is generally in the form of a

flat rectangular parallelepiped and comprises a main body 8 being opened at one end and a drawer-typed container 9 which is movably received in the main body 8.

The main body 8 defines a flat receiving space having a front opening. The
5 drawer-typed container 9, at its front wall, is formed with a door 10 for closing the front opening of the main body 8. A tray-shaped container body 12 is connected at a rear side of the door 10 for storing items. The main body 8 is received and secured in the cabinet 2. It is preferable that the main body 8 is detachably secured in the preservation compartment 4. A user can draw out the draw-typed container 9 to have
10 access to the items in the low-pressure storage unit 7.

The main body 8 and the door 10 have widths which each are slightly less than the width of the preservation compartment 4. Thus it is ensured that the main body 8 and the door 10 can be inserted into the preservation compartment 4 or be pulled out of the
15 preservation compartment 4. Therefore, gaps can be formed between both sides of the low-pressure storage unit 7 and the inner shell 2b of the preservation compartment 4 respectively. In order to shield these gaps, the low-pressure storage unit 7 can comprise a deformable gap shielding member 50 which is provided at the front end of the main body 8.

20 The low-pressure storage unit 7 has a housing 40 which is constituted by the main body 8 and the door 10 of the drawer-typed container 9. The housing 40 defines the evacuable storing chamber 32, wherein the tray-shaped container body 12 is located in the storing chamber 32. In the present embodiment, the storing chamber 32 is
25 essentially formed by the receiving space of the main body 8.

When the storing chamber 32 is closed by the door 10 and the evacuation device is switched on, gas in the storing chamber 32 is evacuated off and the storing chamber 32 is in a low-pressure state. According to a preferred embodiment of the present

invention, after the evacuation procedure is completed, the storing chamber 32 has a pressure therein, which pressure is between one standard atmospheric pressure and the absolute vacuum (for example, the absolute vacuum being less than 690 millibars). Because the gas pressure in the storing chamber 32 is less than one standard
5 atmospheric pressure, this chamber can also be called as "a vacuum chamber" by the skilled in the art. In the present embodiment, the storing chamber 32 has a volume of about 20 L.

A sealing element (not shown) can be provided at the front end of the main body 8
10 and/or at the door 10, such that there is a gas tightness engagement formed between the main body 8 and the door 10 after the drawer-typed container 9 is completely closed. Therefore, gas is prevented from entering into the storing chamber 32 via the engagement site between the main body 8 and the door 10.

15 A telescopic guide unit 14 is provided between the drawer-typed container 9 and the main body 8, such that the drawer-typed container 9 can be smoothly pulled out of the main body 8 or pushed into the main body 8.

The door 10 is provide with a gas filling passage (not shown), which gas filling passage
20 fluidly communicates with the interior and exterior of the storing chamber 32, and a gas filling valve (not shown) for opening or closing the gas filling passage. When the gas filling passage is opened by the gas filling valve, gas from the exterior can enter into the storing chamber 32 via the gas filling passage such that the low-pressure state of the storing chamber 32 is released.

25 The door 10 is provided with a handle 13 at its front end. The user can operate the drawer-typed container 9 by the handler 13. In a preferred embodiment, the gas filling valve is provided in such a way that it is associated with the handle 13. That is, when the handle 13 is operated, the gas filling valve is opened such that the storing chamber

32 fluidly communicates with the exterior. Therefore, gas can enter into the storing chamber 32 such that the low-pressure state of the storing chamber 32 is released. In an alternative embodiment, the gas filling valve can be provided independently from the handle 13. For example, the door 10 is provided with a button thereon. The gas
5 filling valve is opened by pressing the button. Then, the user can operate the handle 13 to open the door 10.

The door 10, constituting the front wall of the storing chamber 32, is made of plastic which is easy to be molded, because some complex structures such as the gas filling
10 valve and the handler 13 and so on will be formed. In the present embodiment, the door 10 is made of ABS resin (acrylonitrile butadiene styrene).

The inner surface of the door 10 is exposed to the storing chamber 32, and the outer surface of the door constitutes a part of the external contour of the low-pressure
15 storage unit 7 so as to form a part of the wall of the storing chamber 32. When the storing chamber 32 is in the low-pressure state, the door 10 must endure a pressure difference between the interior and the exterior. However, the tray-shaped container body 12 endures no pressure because it is located in the storing chamber 32.
Therefore, the door 10 has a thickness which is larger than the tray-shaped container
20 body 12. In the present embodiment, the thickness of the door 10 is 6 millimeters, and the tray-shaped container body 12 can have a thickness of about 1 to 2 millimeters.

Figure 4 is a schematic exploded perspective view showing the main body 8 according to a preferred embodiment of the present invention. As shown in figures 2 and 3 by
25 combination with figure 4, the main body 8 comprises a box-shaped box body 11 which is opened at front and rear ends, a rear cover 16 which is secured at the rear end of the box body 11 to close a rear opening 26 of the box body 11, and a front jointing unit 17, which is secured at an edge of a front opening 25 of the box body 11.

A sealing element 18 is provided between the box body 11 and the rear cover 16 as well as between the box body 11 and the front jointing unit 17 respectively, such that the box body 11 forms a gas tightness engagement with the rear cover 16 and a gas tightness engagement with the front jointing unit 17 respectively.

5

In the present embodiment, the box body 11 comprises a top wall 21, a bottom wall 23, left and right side walls 22 which are connected between the top wall 21 and the bottom wall 32. The top, bottom, left and right side walls are made of metal having a larger material strength. The box body 11 constitutes a main part of the housing 40. In the present embodiment, the top wall 21, the bottom wall 23 and the left and right side walls 22, all of which are made of metal, are exposed at their inner sides to the storing chamber 32 respectively. Outer surfaces of these walls constitute a part of the external contour of the low-pressure storage unit 7, and constitute the majority of the upper wall, the lower wall and two side walls of the storing chamber 32. The front jointing unit 17 is also exposed at its inner side to the storing chamber 32. Therefore, it constitutes the minority of the upper boundary, the lower boundary and the two side boundaries of the storing chamber 32. When the storing chamber 32 is at the low-pressure state, the box body 11, the front jointing unit 17 and the rear cover 16 endure a pressure caused by the pressure in the storing chamber 32 being less than the pressure of the exterior. It should be understood that, in an alternative embodiment, it is also possible that all of the upper, lower and two side walls of the storing chamber 32 are completely formed by the box body 11 made of metal.

The top wall 21, the bottom wall 23 as well as the left and right side walls 22 can be produced by a metal sheet, whose thickness is not more than 4 millimeters. Preferably, the thicknesses of these walls 21-23 are 2 millimeters to 2.5 millimeters.

The top wall 21, the bottom wall 23 as well as the left and right side walls 22 of the box body 11 are preferably formed in a one-piece structure, such that any jointing seam

between these walls can be reduced or even eliminated. In the present embodiment, the top wall 21, the bottom wall 23 as well as the left and right side walls 22 are formed by a piece of metal sheet (cold rolled plate), which is bent into a rectangular shape and then is welded. As shown in figures 3 and 4, a welding seam 33 is located at the middle site of the right side wall 22. On the one hand, because the side wall 22 endures a less pressure than the top wall 21 and the bottom wall 23, this may facilitate reducing a possibility that air leakage occurs at the welding seam 33 under pressure. On the other hand, this may also facilitate arranging a clamp during the welding procedure. Furthermore, because the welding seam is located at a side wall which cannot be readily noticed by the user, this may facilitate achieving a better aesthetic of the refrigeration appliance 1.

It should be understood that, in an alternative embodiment, it is also possible that the top wall 21, the bottom wall 23 as well as the left and right side walls 22 of the box body 11 are formed by a plurality of metal sheets, which are jointed (such as welded) together.

Furthermore, the box body 11 can also be made of other metal such as aluminum. On the case that the box body is made of aluminum, the box body is preferably achieved by an integrally extruding procedure. Because the modulus of elasticity of aluminum is less than that of steel, it is preferable that the box body made of aluminum has a thickness of larger than 2 millimeters, for example being 4 millimeters.

In the present embodiment, the top wall 21 is symmetrical to the bottom wall 23. The two walls constitute the majority of the total wall area of the box body 11. When the low-pressure storage unit 7 is in the low-pressure state, the top wall 21 and the bottom wall 23 endure more pressure than the other walls of the low-pressure storage unit 7. In order to increase moments of inertia of the top wall 21 and the bottom wall 23, the top wall 21 and the bottom wall 23 each are stamped with a plurality of protruding

zones 34 which protrude outwards.

According to a preferred embodiment of the present invention, as shown in figures 3, 4 and 5, mounting plates 27 are provided at the front and rear ends of the box body 11 and at outer sides of the top wall 21, the bottom wall 23 as well as the left and right side walls 22, such that no penetrating hole needs be provided on the top wall 21, the bottom wall 23 as well as the left and right side walls 22 to secure the front jointing unit 17 and the rear cover 6 to the box body 11. The mounting plates 27 can be made of metal, for example made by steel sheets.

Each mounting plate 27 comprises a jointing foot 27a, which is horizontally secured on a corresponding one of the walls 21 to 23. In the present embodiment, the mounting plate 27 is secured on the box body 11 by welding the jointing foot 27a to the corresponding one of the walls 21 to 23. In an alternative embodiment, the mounting plate 27 can be secured on the box body 11 in other ways, for example is adhered on the box body 11.

The mounting plate 27 comprises an extension 27b, which folds from the jointing foot 27a and then extends outwards. In the present embodiment, the extension 27b is substantially perpendicular to the corresponding one of the walls 21 to 23. The extension 27b has a plate shape. It has planar front and rear surfaces. The extensions 27b at the front and rear ends of the box body 11 each are at a distance from the front and rear end faces of the box body 11.

In the present embodiment, the mounting plate 27 has an L-shape in its cross-section, which is formed by the extension 27b and the jointing foot 27a. However, in an alternative embodiment, the extension 27b can be formed integrally on the corresponding one of the walls 21 to 23 such that the extension extends outwards directly from the corresponding one of the walls 21 to 23 of the box body 11.

Each extension 27b is provided with a plurality of first holes 31a which extend through the front and rear surfaces of the extension. Preferably, the first holes 31a of each extension 27b are arranged at a predetermined interval with each other, and they are
5 arrayed in a row. The first holes 31a located at the front and rear ends of the box body 11 each form a rectangular frame, whose size is larger than the front/rear opening 25, 26. The corresponding rectangular frame encloses the box body 11 therein. The first holes 31a at the rear end of the box body 11 are threaded. However, the first holes 31a at the front end of the box body 11 are not threaded.

10 The rear cover 16 and the front jointing unit 17 according to a preferred embodiment of the present invention are particularly explained in their structures in detail below.

The rear cover 16 is connected to the rear opening 26 of the box body 11, constitutes
15 the rear wall of the housing 40 and delimits the rear boundary of the storing chamber 32. The rear cover 16 is in the form of a square plate, which corresponds to the rear opening 26. The rear cover 16 has a size which is larger than that of the rear opening 26. The rear cover 16 extends beyond the rear opening 26.

20 The rear cover 16 is provided with an evacuation passage (not shown) penetrating through the rear cover 16 and an evacuation valve unit 36 for selectively closing or opening the evacuation passage. In the present embodiment, the evacuation valve unit 36 extends above the top wall 21, and has a jointing opening 39 above the top wall 21. The low-pressure storage unit 7 connects with a pipeline secured on the cabinet 2 via
25 the jointing opening 39, such that the low-pressure storage unit 7 can fluidly communicate with the evacuation device.

The rear cover 16 comprises a main wall portion 20 constituting the most part of the rear cover and a rear jointing portion 19, which is provided around the main wall portion

20 and connects the rear cover 16 to the edge of the rear opening 26. The rear jointing portion 19 connects with the entire edge of the rear opening 26.

5 In the present embodiment, the rear jointing portion 19 and the main wall portion 20 are produced by integral injection molding of plastic, whose modulus of elasticity is less than metal. Preferably, the rear cover 16 is made of material having a larger material strength, such as polycarbonate (PC). The main wall portion 20 made of PC has a thickness of about 6 millimeters. In order to enhance the strength of the main wall portion 20, the main wall portion 20 is provided with a plurality of reinforcing ribs 35 on
10 its rear surface.

It should be understood that, in an alternative embodiment, the rear jointing portion 19 and the main wall portion 20 can be provided independently with each other, and then they are airtightly secured to form the rear cover 16. This will be particularly beneficial
15 in the case that the rear jointing portion 19 and the main wall portion 20 are made of different materials.

The front jointing unit 17 connects at the entire edge of the front opening 25, and has a square framed structure forming a close-loop. The front jointing unit 17 has an abutting
20 face 37 for abutting with the door 10. In the present embodiment, the abutting face 37 is planar, and is in the same longitudinal plane. When the door 10 is closed, the sealing element on the door 10 is pressed between the abutting face 37 and the door 10 to make a sealing effect.

25 In order that the front jointing unit 17 and the rear cover 16 are airtightly connected on the box body 11 respectively, the front jointing unit 17 and the rear cover 16 each are provided with a ring-shaped groove 30 at a side facing the box body 11, which groove is used to receive a ring-shaped sealing element 18. The front and rear ends of the top wall 21, the side walls 22 and the bottom wall 23 of the box body 11 each are inserted

into the corresponding groove 30. The sealing element 18 is located between the groove 30 and the box body 11.

Outside of the groove 30, the front jointing unit 17 and the rear cover 16 each are
5 provided with a plurality of second holes 31b. These second holes 31b are provided on the outer surface portions of the front jointing unit 17 and the rear jointing unit 19 beyond the top wall 21, the side walls 22 and the bottom wall 23, and are located outside of the storing chamber 32. The second holes 31b on the front jointing portion 17 and the rear cover 16 form rectangular frames respectively, each of which
10 rectangular frames has a size which is larger than the front/rear opening 25, 26.

In the present embodiment, the second holes 31b on the front jointing unit 17 extend forwardly from the rear side of the front jointing unit 17, do not extend through the front jointing unit 17 and thus form blind holes, which are threaded therein for attaching
15 screws 29. The second holes 31b on the rear cover 16 extend forwardly from the rear side of the rear jointing portion 19 through the rear jointing portion 19 and form through holes to be inserted through by corresponding screws 29.

The front jointing unit 17 is formed by integral injection molding of plastic. In the
20 present embodiment, because the front jointing unit 17 is provided with the threaded holes for attaching the screws 29, the front jointing unit 17 is formed from a mixture of PC resin having a larger strength and ABS resin having a better toughness by injection molding, such that the strength and the toughness of the unit is balanced.

25 The securing manner between the front jointing unit 17, the rear cover 16 and the box body 11 will be particularly explained below with reference to Figures 4 and 7.

The front jointing unit 17 and the rear cover 16 are secured on the front and rear ends of the box body 11 by a plurality of securing units respectively.

In the present embodiment, each securing unit comprises the screw 29, the first hole 31a provided on the mounting plate 27 of the box body 11 and the second hole 31b provided on the front jointing unit 17/the rear cover 16. By inserting the screw 29 into
5 the first hole 31a and the second hole 31b and then screwing the screw 29 with the threaded first hole 31a or the threaded second hole 31b, the front jointing unit 17/the rear cover 16 each can be reliably secured on the box body 11. By use of the screw 29, the securing unit provides a pretension force between the front jointing unit 17 and the box body 11 as well as between the rear cover 16 and the box body 11, such that the
10 sealing elements 18 located between the front jointing unit 17/the rear cover 16 and the box body 11 can be pressed and thus the sealing effect between the front jointing unit 17/the rear cover 16 and the box body 11 can be enhanced.

In an alternative embodiment, the securing unit can adopt another securing piece
15 which can provide the pretension force. For example, the screw can be replaced by a rod-shaped piece which is integrally injection molded on the front jointing unit 17 and the rear cover 16. In this case, the second holes 31b on the jointing frame 17 and the rear cover 16 can be omitted.

20 In the present embodiment, because all of the first holes 31a and the second holes 31b are located outside of the storing chamber 32, the interior of the storing chamber 32 cannot fluidly communicate with the exterior due to the arrangement of the first holes 31a and the second holes 31b. Furthermore, because the first holes 31a and the second holes 31b are located outside of the ring-shaped sealing element 18, the first
25 holes 31a and the second holes 31b is in fact separated from the storing chamber 32 and does not communicate with it. In this way, a possibility that gas from the exterior enters into the storing chamber 32 via the first holes 31a and the second holes 31b is eliminated. That is, these first and second holes 31a, 31b cannot have a negative effect on the air tightness of the storing chamber 32, such that the air tightness of the

low-pressure storage unit 7 is improved.

In the embodiment of the present invention, the housing 40 of the low-pressure storage unit 7 comprises a first member (such as the box body 11), which is made of metal
5 having a larger material strength, and a plurality of second members (such as the front jointing unit 17, the rear cover 16 and the door 10), which are made of plastic, which has a relatively smaller material strength and is easily molded. Therefore, on the one hand, the first member can obtain a larger strength by a smaller thickness to endure the exterior pressure, such that any deformation of the storing chamber 32 at the
10 low-pressure state can be reduced so as to improve the air tightness of the storing chamber 32. This advantage is particularly prominent in the case that the walls (such as the top wall 21 and the bottom wall 23) of the storing chamber 32 occupying the largest area are mainly or completely made of metal. Especially, when the housing 40 is mainly made of metal, this advantage is particularly prominent. On the other hand,
15 because the housing comprises the second members (such as the front jointing unit 17, the rear cover 16 and the door 10), which are made of plastic and endure the pressure when the storing chamber 32 is at the low-pressure state, structures which are relatively complex and require high accuracy and high degree of air tightness (such as a gas filling valve, an evacuation valve unit and the like requiring perfect air tightness)
20 can be provided on the second members so as to improve the air tightness of the low-pressure storage unit. Further, because the first member made of metal can have a smaller thickness and a good thermal conductivity, heat can be well conducted between the exterior and the interior of the storing chamber even if the second member has a larger thickness. Furthermore, when the second members constitute
25 only a small portion of the housing and especially they are not provided in a box-shaped structure, the molding process of them is relatively easy. Meanwhile, because they are only the small portion of the low-pressure storage unit 7, they do not have a significant effect on the heat conducting between the exterior and the interior of the low-pressure storage unit 7.

Now a preferred embodiment of a sealing system for sealing the box body 11 to the front jointing unit 17 and the rear cover 16 will be described in details.

5 In this embodiment, sealing elements 18 for the front jointing unit 17 and the rear cover 16 have substantially the same construction, and the front jointing unit 17 and the rear cover 16 have substantially the same engaging structure. Therefore, only the sealing system between the rear cover 16 and the box body (also called main unit below) 11 will be described as an example.

10 With reference to Figures 4 to 8, the ring-shaped groove 30 is formed along peripheries of the rear cover 16, forming an opening portion 61 on a side towards the main unit 11. The groove 30 is formed within an imaginary rectangular frame delimited by the second holes 31b.

15 The sealing element 18 is elastic and is formed preferably of a silicone rubber. The sealing element 18 is in a form of a closed-loop frame having a shape and dimensions corresponding to that of the front opening 25. The sealing element 18 has a receiving groove 65 for receiving an edge of the front opening 25. Preferably, in a state that the
20 sealing element 18 covers the whole edge of the front opening 25, the sealing element 18 and the edge of the front opening 26 are inserted into the groove 30 together.

The groove 30 has a tapered shape in the inserting direction C of the sealing element 18. Therefore, in the same cross section, the opening portion 61 of the groove 30 has
25 larger dimension than other portions of the groove.

The groove 30 comprises a pair of inclined surfaces 62 opposed to each other and extending generally in inserting direction C and a bottom surface 63 connected between the inclined surfaces 62. An angle formed between each inclined surface 62

and an axial middle plane D of the groove 30 is preferably not less than 4 degrees, for example, it may be 5 degrees to 6 degrees. The inclined surfaces 62 are formed by inner side walls of the groove 30.

5 The sealing element 18 has a generally U-shaped cross section. The sealing element 18 comprises a pair of side sealing portions 64 for tightly contacting against the inclined surfaces 62 respectively and a head portion 60 connected between the side sealing portions 64. The receiving groove 65 is enclosed by the side sealing portions 64 and the head portion 60.

10

The outer profile of the sealing element 18 formed by the outer surfaces of the side sealing portions 64 and the head portion 60 is also tapered gradually in the inserting direction C of the sealing element, so that the head portion 60 has smaller dimension than other portions of the sealing element 18 in the same cross section.

15

Each of the outer surfaces of the side sealing portions 64 has substantially the same inclined angle as the corresponding inclined surface 62. Preferably, in a free state, the shape and dimensions of the outer profile of the sealing element 18 are substantially the same as that of the groove 30. Since the head portion 60 of the sealing element 18 is smaller in size than the opening portion 61 of the groove 30, the sealing element 18 can be easily aligned with and inserted into the groove 30 when it is desired to insert the sealing element 18 into the groove 30. As the sealing element 18 is inserted gradually deep into the groove, the side sealing portions 64 of the sealing element 18 gradually come into contact with the inclined surfaces 62. The head portion 60 of the sealing element 18 tightly contacts the bottom surface 63 and is thus compressed to become shortened, so as to create a sealing interface therebetween, and at the same time, the side sealing portions 64 with inclined outer surfaces are also compressed to deform by the inclined surfaces 62 to tightly contact and create a sealing interface with the inclined surfaces 62. Then, the rear cover 16 and main unit 11 are fixed together by

20

25

means of a fixing unit which comprises screws 29, so that the head portion 60 is held in a compressed state in which it is deformed to become shortened in the inserting direction C.

5 It becomes easier to align the sealing element 18 with and insert it into the groove 30 since the sealing element 18 and the groove 30 each have a tapered shape in the inserting direction C of the sealing element 18. In addition, the side sealing portions 64 of the sealing element 18 are not compressed or under small compression forces from the inclined surfaces 62 of the groove 30 before the head portion 60 is compressed to
10 become shortened, which facilitates the insertion of the sealing element 18; then, when the head portion 60 is gradually compressed to become shortened, the side sealing portions 64 will be further moved forwardly and is compressed by narrowed portions of the groove 30, so that effective sealing is formed between the side sealing portions 64 and the inclined surfaces 62.

15

Further, by forming the above described three sealing interfaces between the sealing element 18 and the groove 30, more reliable sealing therebetween is obtained. Meanwhile, the edge portion of the front opening 26 is clamped in the receiving groove 65 to form three sealing interfaces between them.

20

It can be understood that the above described sealing system is not limited to be applied between the main unit 11 and the front jointing unit 17 and/or the rear cover 16. Rather, it is applicable between any two components that are formed separately and then fixed together. Obviously, the sealing system can also be applied to other
25 household appliances in addition to refrigeration appliances, such as water heaters, laundry machines, cooking appliances, and the like.

CLAIMS

1. A sealing system, comprising:
 - 5 a first member (16, 17);
 - a second member (11); and
 - a sealing element (18) configured to form sealing between the first member (16, 17) and the second member (11), the first member (16, 17) having a groove (30) for receiving at least a part of the sealing element (18);
 - 10 characterized in that the groove (30) and the sealing element (18) each have a tapered shape in an insertion direction (C) of the sealing element (18), and the sealing element (18) comprises a head portion (60) which is smaller in size than an opening portion (61) of the groove (30).
- 15 2. The sealing system according to claim 1, characterized in that the groove (30) has at least one inclined surface (62) extending generally in the insertion direction (C) as well as a bottom surface (63), and the sealing element (18) comprises, in addition to the head portion (60) which is configured for tightly contacting the bottom surface (63), a side sealing portion (64) configured for tightly contacting the inclined surface (62).
- 20 3. The sealing system according to claim 2, characterized in that an outer surface of the side sealing portion (64) and the inclined surface (62) have approximately the same inclined angle.
- 25 4. The sealing system according to claim 2 or 3, characterized in that an angle of the inclined surface (62) relative to a middle axial plane (Z) of the groove (30) is not less than 4 degrees, for example, the angle is 5 to 6 degrees.
5. The sealing system according to claim 2, 3 or 4, characterized in that the groove (30)

has a pair of opposed side surfaces to form a pair of opposed inclined surfaces (62), the bottom surface (63) is connected to the pair of inclined surfaces (62), and the pair of inclined surfaces (62) and the bottom surface (63) form three continuous sealing interfaces with the sealing element (18).

5

6. The sealing system according to claim 5, characterized in that the sealing element (18) has a receiving groove (65) configured for receiving an edge portion of the second member (11), and the receiving groove (65) is surrounded by the three continuous sealing interfaces.

10

7. The sealing system according to any one of preceding claims, characterized in that the sealing element (18) has a generally U-shaped cross section.

8. A household appliance, comprising a sealing system according to any one of preceding claims.

15

9. The household appliance according to claim 8, characterized in that the household appliance comprises a low-pressure storage unit (7) having an evacuable storage chamber, and the first members (16, 17) and the second member (11) are components of the low-pressure storage unit (7) that are separately constructed and then fixed together.

20

10. The household appliance according to claim 8 or 9, characterized in that the first member (16, 17) is made of a plastic material, and the second member (11) is made of a metal and forms a main body of the low-pressure storage unit (7).

25

11. The household appliance according to claim 8, 9 or 10, characterized in that the second member (11) has a box-shaped structure formed with at least one end opening (25, 26), the first member (16, 17) is attached to an edge portion of the end opening (25,

26), and the sealing element (18) is disposed along the whole edge portion of the end opening (25, 26).

12. The household appliance according to claim 8, 9, 10 or 11, characterized in that the
5 household appliance comprises a fixing unit configured for fixing the first member (16, 17) and the second member (11) together, and the fixing unit maintains the head portion (60) in a state of being pressed and deformed in the insertion direction.

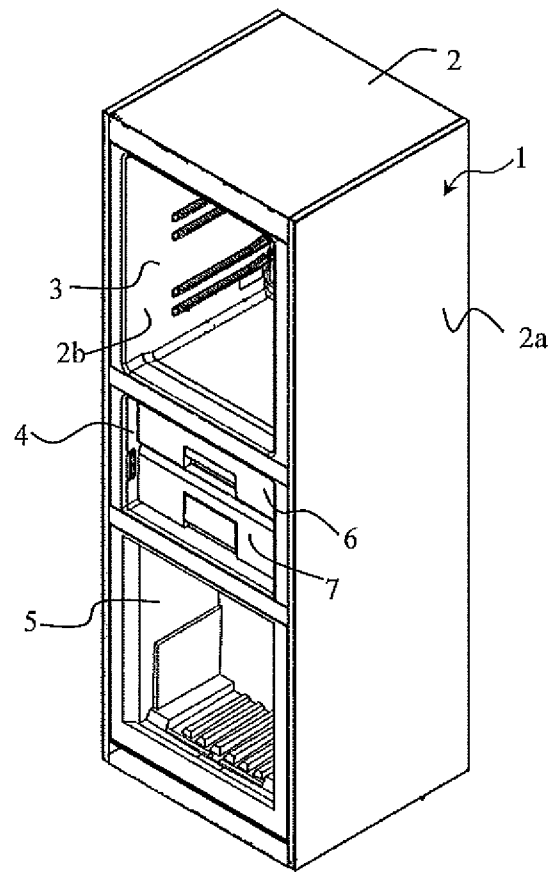


Figure 1

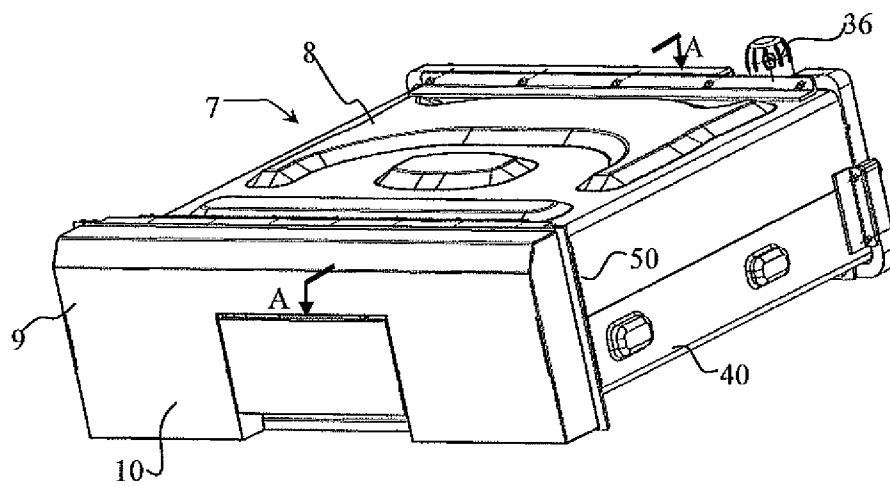


Figure 2

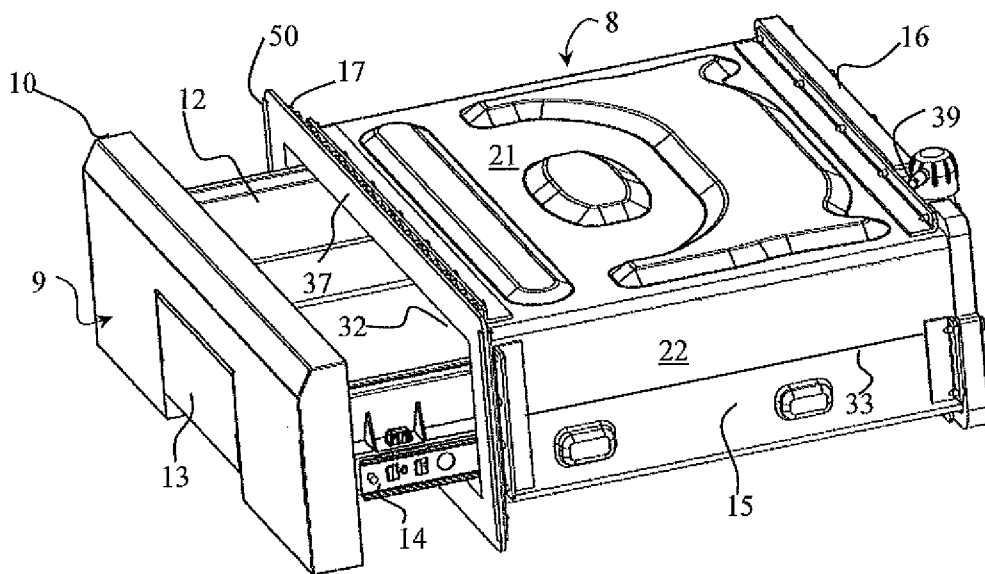


Figure 3

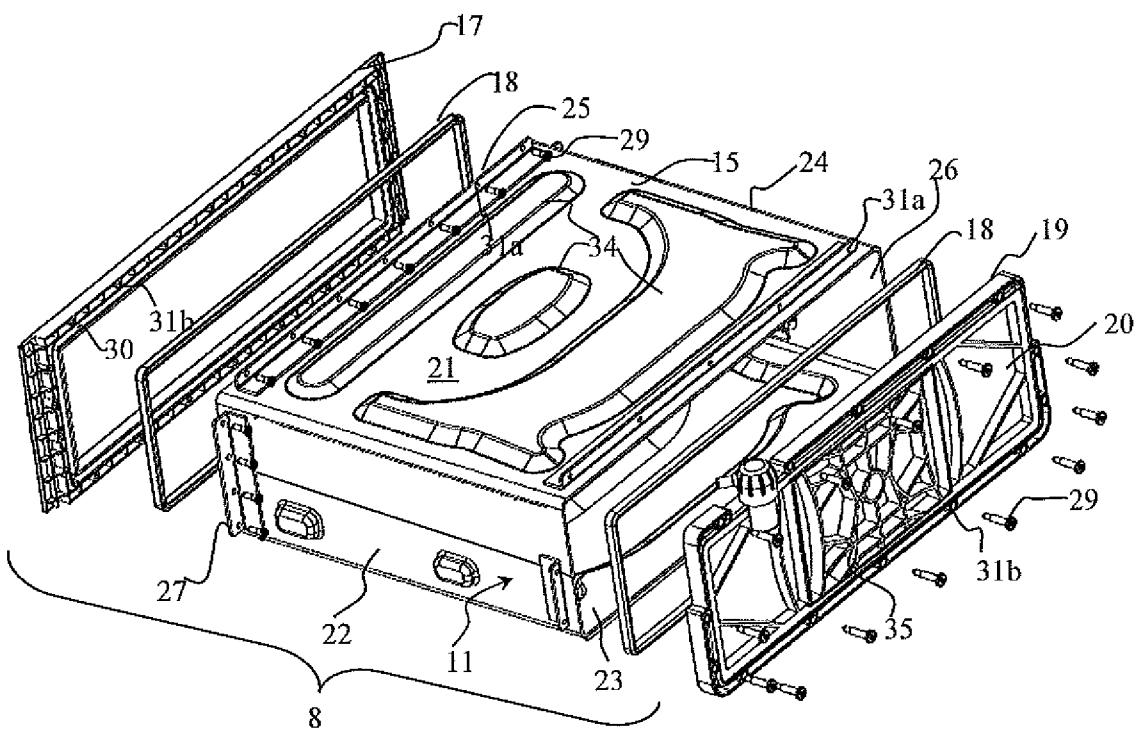


Figure 4

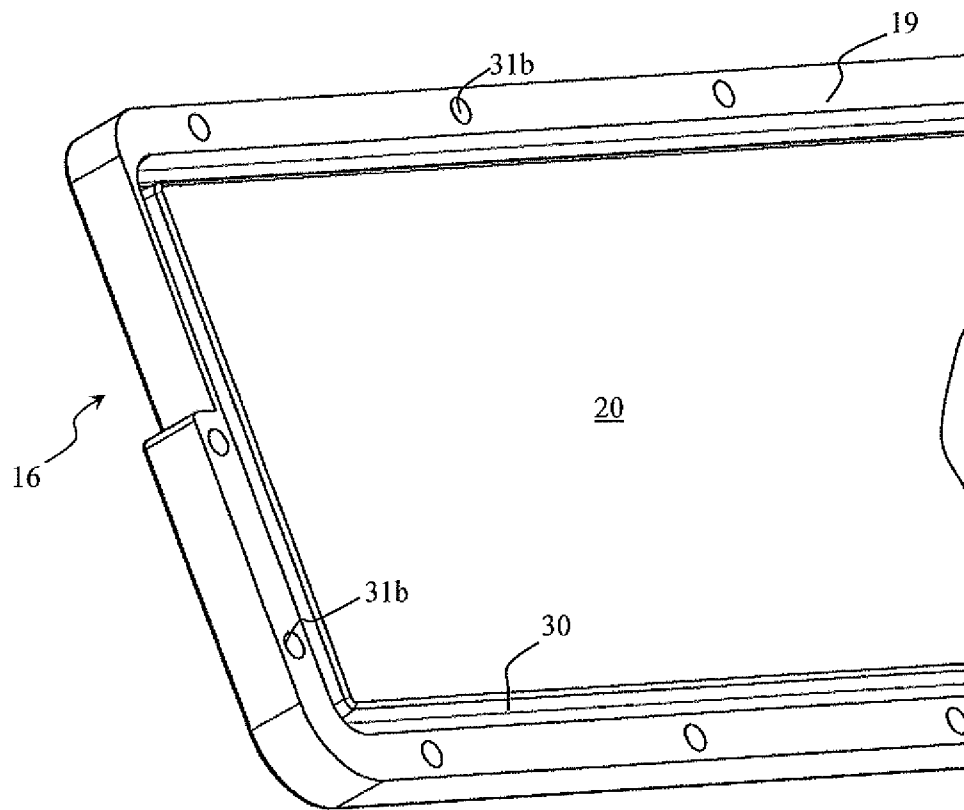


Figure 5

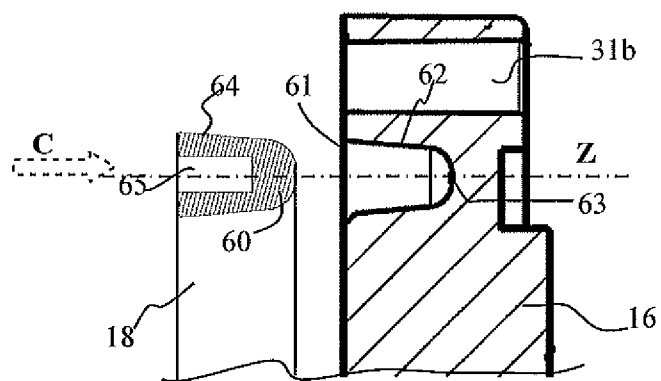


Figure 6

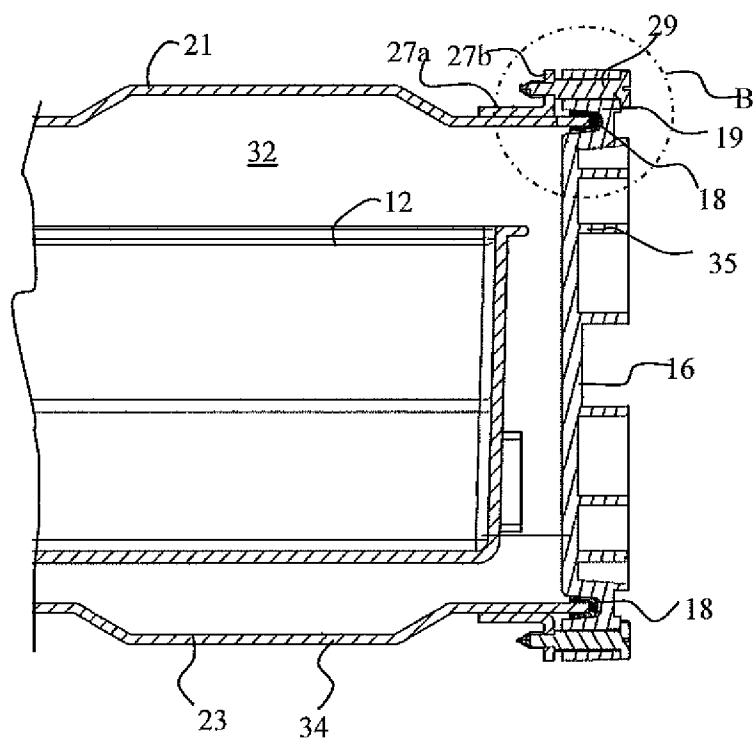


Figure 7

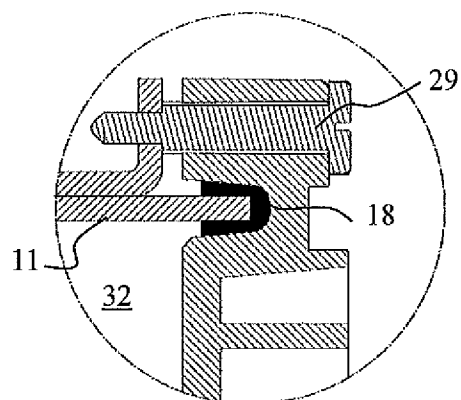


Figure 8