


(54) Title: A GASKET-TANK FOR A CAR RADIATOR AND MANUFACTURE METHOD THEREOF

(57) Abstract: A gasket-integrated tank is formed in a heat exchanger, such as a radiator, which cools circulating hot cooling water in order to cool an engine of a vehicle, or an intercooler, which cools compressed air and feeds the cooled air to the engine, in which a gasket made of LSR is integrally formed on the tank, so that a cap made of aluminum can be easily provided on the tank and the reliability of coupling of the heat exchanger can be improved.

A method of manufacturing the gasket-integrated tank includes steps of: injection-molding the tank of the heat exchanger; seating the tank, molded in the injection-molding step, into a lower mold; seating an upper mold, having a gasket-forming recess, on a top face of the molded tank; feeding a liquid silicone, including a main material and a curing material, into a molding space; and curing the liquid silicone.

Continued on next page
Designated States (unless otherwise indicated, for every kind of regional protection available): ARIO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG). Published: with international search report
[DESCRIPTION]

[invention Title]
A GASKET-TANK FOR A CAR RADIATOR AND MANUFACTURE METHOD THEREOF

[Technical Field]
The invention relates to a tank formed in a heat exchanger, such as a radiator, which cools circulating hot cooling water in order to cool an engine of a vehicle, or an intercooler, which cools compressed air and feeds the cooled air to the engine, and a method of manufacturing the same.

[Background Art]
In general, a vehicle is equipped with a water cooling device having a heat exchanger, which allows cooling water, after being heated by the engine, to exchange heat with air.

The heat exchanger for a vehicle includes tubes, through which cooling water flows, heat radiator fins, which connect the tubes to each other and enlarge the area of contact with air in order to increase heat exchange efficiency, and a header and a tank, each of which is coupled to the top or bottom portion of a respective tube.

It is required that the header and the tank, connected to the top or bottom portion of the respective tube, be hermetically coupled thereto in order to ensure that fluid flows through the heat exchanger without leaking therefrom. For this purpose, a gasket is disposed between the
header and the tank.

Conventionally, the gasket is separately provided, and when the tank is fitted to the header, the gasket is disposed in a recess of the header and the tank is fixedly disposed in the recess where the gasket is disposed.

In the case where the gasket is constructed separately from the tank, leakage may take place if the gasket is not properly disposed in the recess of the header. During the coupling between the tank and the header, the gasket may escape from the header, thereby delaying the working time for the coupling.


Korean Patent Publication No. 2002-0078303, Japanese Patent Publication No. Hei 11-118386 and Japanese Patent Publication No. 2000-220988 disclose an integral header tank made of an aluminum material, which is the same as that of a radiator core, in order to solve problems related to the gasket of a conventional header tank having a header separated from a tank. However, in the integral header tank, it is expensive to manufacture the header and the tank from the same metal material, and maintenance is difficult, since the header is not
separated from the tank.

Furthermore, United States Patent No. 5160474 discloses a gasket fixed to a tank of a header tank, in which the tank is separated from a header, in order to integrate the tank and the gasket. In order to integrate the tank and the gasket, the tank is provided with a protrusion, which is pressed down by an upper die to protrude laterally, and the gasket is integrated therewith. However, since the gasket is not bonded to the top face of the tank, it may still escape from a recess in the top face of the tank. When rubber is inputted to form the gasket, bubbles may be formed, thereby causing leakage.

[Disclosure]

[Technical Problem]

The present invention has been made to solve the foregoing problems with the prior art, and therefore an aspect of the present invention is to provide a gasket-integrated tank (i.e., a tank having a gasket integrated therewith) for use with a heat exchanger for a vehicle and a method of manufacturing the same, in which a gasket made of Liquid Silicone Rubber (LSR) is integrally formed on the top face of the tank of the heat exchanger in order to prevent the gasket from being separated and prevent fluid from leaking.

[Technical Solution]

According to an aspect of the invention for realizing the object, the invention provides a tank for use with a heat
exchanger for a vehicle, which includes a gasket made of liquid silicone, in which the gasket is integrated with the top face of the tank.

According to another aspect of the invention for realizing the object, the invention provides a method of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle, which includes steps of: (S10) injection-molding the tank of the heat exchanger; (S20) seating the tank, molded in the injection-molding step (S10), into a lower mold; (S40) seating an upper mold, having a gasket-forming recess, on the top face of the molded tank; (S50) feeding liquid silicone, including a main material and a curing material, into a molding space, which is defined by the top face of the tank and the upper mold; and (S60) curing the liquid silicone.

According to still another aspect of the invention for realizing the object, the invention provides a method of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle, which includes steps of: (S10) injection-molding the tank of the heat exchanger; (S51) feeding liquid silicone, including a main material and a curing material, to the top face of the molded tank using a dispenser; and (S60) curing the liquid silicone.

[Advantageous Effects]

In the gasket-integrated tank for use with a heat exchanger for a vehicle, which includes a gasket made of liquid silicone, in which the gasket is integrated with the top face of the tank.
exchanger for a vehicle, a gasket is integrally formed on the top face of the heat exchanger tank and is securely coupled with the top face of the tank in order to reliably prevent fluid from leaking.

Furthermore, the integrally molded gasket is securely coupled with the top face of the tank and is not separated therefrom when the tank is assembled to a header in order to raise the efficiency of a manufacturing process.

There are other effects in that the manufacturing process is performed efficiently and the gasket-integrated tank can be mass-produced in order to reduce manufacturing costs.

[Description of Drawings]

FIG. 1 is a flowchart illustrating a process of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle according to an embodiment of the invention;

FIG. 2 is a flowchart illustrating a process of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle according to another embodiment of the invention;

FIG. 3 is a cross sectional view illustrating a heat exchanger tank according to an embodiment of the invention;

FIG. 4 is a cross sectional view illustrating the heat exchanger tank according to an embodiment of the invention, which is injection-molded;
FIG. 5 is a cross sectional view illustrating the heat exchanger tank of the invention, which is injection-molded and then seated into a lower mold;

FIG. 6 is a cross sectional view illustrating a procedure of seating an upper tank on the heat exchanger tank of the invention, which is seated in the lower mold;

FIG. 7 is an enlarged view illustrating a molding space, which is defined by the top face of the tank of the invention and the upper mold;

FIG. 8 is an enlarged view illustrating the gasket formed by injecting LSR into the molding space, which is defined by the top face of the tank of the invention and the upper mold;

FIG. 9 is an enlarged view illustrating the top face of the tank of the invention;

FIG. 10 is an enlarged view illustrating the top face of the tank of the invention, in which protrusions are formed;

FIG. 11 is a configuration view illustrating another embodiment of the invention using a dispenser; and

FIG. 12 is a perspective view illustrating the gasket-integrated tank manufactured according to the invention.

[Best Mode]

According to an aspect of the invention, a tank to be used for a heat exchanger for a vehicle includes a gasket made of liquid silicone, wherein the gasket is integrated to the top face of the tank. The top face of the tank may be formed flat,
or may have a recess for receiving the LSR therein.

The top face of the tank may have fine protrusions for increasing the contact area between the top face and the liquid silicone.

The top face of the tank may be coupled with the gasket by an adhesive made of a primer composition.

The tank may be made of plastic, and the liquid silicone may be implemented as a two-liquid mixture, which includes a main material and a curing material.

Furthermore, the main material and the curing material may be mixed at an equal weight ratio.

According to another aspect of the invention, a method of manufacturing a gasket-integrated tank to be used for a heat exchanger for a vehicle includes steps of: (S10) injection-molding the tank of the heat exchanger; (S20) seating the tank, molded in the injection-molding step (S10), into a lower mold; (S40) seating an upper mold, having a gasket-forming recess, on a top face of the molded tank; (S50) feeding a liquid silicone, including a main material and a curing material, into a molding space, which is defined by the top face of the tank and the upper mold; and (S60) curing the liquid silicone.

According to still another aspect of the invention, a method of manufacturing a gasket-integrated tank to be used for a heat exchanger for a vehicle includes steps of: (S10) injection-molding the tank of the heat exchanger; (S51) feeding
liquid silicone, including a main material and a curing material, to the top face of the molded tank using a dispenser; and (S60) curing the liquid silicone.

The lower mold may have a recess corresponding to the contour of the tank, and the upper mold may have a protrusion corresponding to the interior of the tank.

The upper mold may have a gasket-forming recess.

The upper mold may have a protrusion surrounding the gasket-forming recess, the protrusion of the upper mold preventing the liquid silicone from leaking.

The protrusion of the upper mold may have a V-shaped cross section.

According to another embodiment of the invention, the method of manufacturing a gasket-integrated tank may further include a step (S30) of priming the tank after the step (S20) of seating the tank into the lower mold, wherein the priming step (S30) applies an adhesive to the top face of the tank in order to help the LSR adhere to the top face of the tank.

According to a further embodiment of the invention, the method of manufacturing a gasket-integrated tank may further include a step (S30) of priming the tank before the step (S51) of feeding liquid silicone to the top face of the molded tank using a dispenser, wherein, in the priming step (S30), an adhesive is applied to the top face of the tank in order to help the LSR adhere to the top face of the tank.
According to each embodiment of the invention, the feeding step may feed the liquid silicone by maintaining the top face of the tank at a temperature ranging from 70 to 90°C.

The feeding step may feed the liquid silicone using a liquid silicone-feeding device by maintaining the temperature of the feeding device in a range from 5 to 30°C.

The curing step may be carried out at a temperature ranging from 100 to 160°C to facilitate a chemical reaction of the fed liquid silicone.

The liquid silicone fed in the feeding step may be implemented as a two-liquid mixture, in which the main material and the curing material are mixed at an equal weight ratio.

[Mode for Invention]

FIG. 12 shows a gasket-integrated tank 20 (i.e., a tank having a gasket integrated therewith) for use with a heat exchanger for a vehicle according to the invention. The tank 20 has a gasket 60 made of Liquid Silicone Rubber (LSR), which is integrally and securely attached to the top face 21 of the tank 20.

The tank 20 having the gasket 60 integrated thereto is assembled to a header, thereby forming a header tank, in which the header is attached to the top or bottom portion of a tube in which fluid (refrigerant) flows. Since the tank 20 of the invention is securely and integrally coupled with the gasket 60, when the tank 20 is assembled to the header, there is no
reason to worry about the separation of the gasket or the erroneous assembly of the tank. Accordingly, this makes it possible to prevent fluid from leaking, and also enhances the efficiency of the process, thereby reducing costs.

In the tank 20 having the gasket 60 integrated thereto, the top face 21 may be basically formed flat. Even if the top face 21 of the tank 20 is flat, the gasket is securely coupled with the top face 21 of the tank 20 since it is made of LSR.

While an adhesive can be used to further enhance the coupling between the gasket 60 and the top face 21 of the tank 20, this is not essentially required. The adhesive may be implemented with a primer composition, which is most effective for coupling the tank made of a plastic material with the gasket made of LSR.

A seating recess or fine protrusions may be formed on the top face 21 of the tank 20, the fine protrusions serving to enlarge the coupling area for the gasket 60. In this case, the contact area between the gasket 60, made of the LSR, and the top face 21 of the tank is enlarged to further enhance the coupling force between the gasket 60 and the tank 20, so that the tank 20 is more securely coupled with the gasket 60.

While the gasket 60 can be implemented with various types of LSRs, a two-liquid LSR can be preferably used, in which a main material and a curing material are mixed at the same weight percent. This can be varied according to the material
of the tank 20, since the two-liquid LSR, with the main material and the curing material mixed at the same weight percent, is effective in coupling the gasket 60 with the tank 20.

Hereinafter, a method of manufacturing the gasket-integrated tank for use with a heat exchanger for a vehicle of the present invention will be described in detail.

The heat exchanger includes a plurality of header tanks, each of which includes one tank 20 and one matching header coupled with the tank, a plurality of tubes, which connect the header tanks to each other, and a plurality of heat radiator fins, which connect the tubes with each other.

The tank 20 has an inlet and an outlet, which allow cooling water to flow, and (protrusions, which make it easy to assemble the tank.

In the gasket-integrated tank for use with a heat exchanger for a vehicle, the gasket is integrated with the top face of the tank of the heat exchanger by applying Liquid Silicon Rubber (LSR) thereto via LSR injection molding.

Of various methods of integrally forming the gasket 60 on the top face 21 of the tank of the heat exchanger, a method of manufacturing the gasket-integrated tank using LSR injection molding includes process steps as shown in FIG. 1. That is, the method includes a molding step S10 of forming a tank of a heat exchanger by injection molding, a tank-seating step S20 of
seating the tank, obtained in S10, into a lower mold, an upper mold-seating step S40 of seating an upper mold, which has a gasket-forming recess, on the top face of the tank, an LSR-feeding step S50 of feeding LSR, including a main material and a curing material, into a molding space, which is defined by the top face of the tank and the upper mold, and a curing step S60 of curing the LSR.

In the case of using an adhesive in order to more securely couple the gasket 60 to the tank, after the step S20 of seating the tank into the lower mold, the method may include a priming step S30 of applying the adhesive to the top face of the tank in order to help the LSR adhere to the top face of the tank.

While the tank 20 of the heat exchanger can be molded via various methods, the heat exchanger tank 20 is generally made of plastic, and is injection-molded using a mold 10, which includes an upper mold 12 and a lower mold 11, as shown in FIG. 3.

The heat exchanger tank 20, molded by the mold 10, is removed from the mold 10 as shown in FIG. 4. Since the heat exchanger tank 20 may be deformed by an external tank if it is removed in a state in which it is not completely solidified, it is preferable that the heat exchanger tank 20 be removed after being completely solidified.

As shown in FIG. 8, the heat exchanger tank 20 is seated
into the lower mold 30 by applying external force. The lower mold 30 is provided with a recess 31, which has the same shape as the contour of the heat exchanger tank 20.

The lower mold 30 can be replaced by the lower mold 11, which is used in the injection molding of the tank 20, in order to reduce the cost of manufacturing the mold and reduce process time.

That is, after the tank 20 is formed in the mold 10, the tank 20 is not removed from the lower tank 11, but only the upper mold 12 is detached from the tank 20, so that the lower mold 11 can replace the lower mold 30.

While the LSR may be applied to the top face 21 of the tank 20, which is seated in the lower mold 30, an adhesive can be applied to the top face 21 of the tank 20 in order to obtain a more secure bond. Preferably, the adhesive is implemented with a primer composition.

Generally, in a priming procedure using the primer composition, the primer is diluted with water, and the diluted primer is sufficiently sprayed or brushed and is allowed to dry for about 1 to 2 hours. The priming procedure, conducted as above, acts to enhance the bonding force between the LSR and the top face 21 of the tank and to prevent bubbles from forming in a bonding surface.

After the tank 20 is seated into the lower mold 30 and is treated with the primer, an upper mold 40 is seated on the tank.
20.

The upper mold 40 has a protrusion 41, which has the same shape as the interior of the tank 20, and a gasket-forming recess 43. As shown in FIG. 7, a V-shaped protrusion 42 is formed around (i.e., on the circumference of the opening of) the gasket-forming recess 43.

The protrusion 42 tightly contacts the top face 21 of the tank in order to prevent the LSR from leaking when the LSR is injected.

The recess 31 of the lower mold 30 and the protrusion 41 of the upper mold 40 are shaped to match the contour and the interior of the tank 20 in order to prevent the tank 20 from being deformed when the tank 20 is being cured.

The LSR is injected into a molding space defined by the top face 21 of the tank 20 and the gasket-forming recess 43 of the upper mold 40, thereby forming a gasket 60.

The LSR is injected from an LSR injector 80 according to an LSR injection, in which a main material and a curing material of a two-liquid LSR are mixed at a 1 to 1 ratio by weight percent, and are formed into a solid through a chemical reaction.

The LSR has characteristics such as innoxiousness, meaning that it is harmless to the human body, excellent heat insulation, excellent heat resistance, oil resistance, cold resistance, hot water resistance and flame resistance.
The LSR injection is performed by injecting a two liquid mixture, including a main material and a curing material, followed by a chemical reaction thereof, so that LSR can be uniformly inputted and applied in a desired shape even with a small injection (application) pressure.

In this invention, a mixer 64 is provided upstream of an inlet 51 to mix a main material 61 and a curing material 62, so that the main material 61 and the curing material 62 can undergo a chemical reaction in the molding space 50, defined by the top face 21 of the tank and the gasket-forming recess 43 of the upper mold.

In general, when LSR composed of a main material and a curing material is fed into the molding space 50, defined by the top face 21 of the tank 20 and the upper mold 40, no compressing force or shearing force is applied to a feeding screw. Accordingly, the LSR is inputted into the molding space with a minimum pressure, so that the tank is not additionally deformed during the feeding of the LSR.

In addition, a common cleaner is generally used since it is necessary to adjust the temperature of the screw and a barrel in the range from 5 to 30°C and to cool a runner portion, which leads to the molding space 50, so that the main material and the curing material do not undergo a chemical reaction when they are fed.

When the temperature of the screw and the barrel is below
5°C, the viscosity of the fed LSR can decrease, or when the LSR is being fed, dew can form, thereby causing defects in a resultant gasket. When the temperature of the screw and the barrel exceeds 30°C, the viscosity of the fed LSR can increase too excessively, thereby making application difficult.

The temperature is maintained in the range from 100 to 160°C in order to promote a chemical reaction when the main material 61 and the curing material 62, inputted into the molding space 50, are being cured. As a method of maintaining the temperature in the range from 100 to 160°C, heaters 35 and 45 are provided in the lower and upper molds 30 and 40, and are controlled by a controller 70, as shown in FIG. 6.

While the most desirable temperature for curing ranges from 130 to 140°C, a temperature in the range from 100 to 160°C can be selected in consideration of the efficiency of the process.

A curing temperature below 100°C delays the reaction time, so that poor productivity and insufficient reaction degrade the quality of the gasket. At curing temperatures higher than 160°C, the materials may be chemically reacted before being inputted into the molding space 50, and thus may not be sufficiently molded.

The top face 21 of the heat exchanger tank, injection-molded through the mold 10, is formed flat in order to facilitate the application of the LSR. A seating recess 22 may
be formed on the flat top face 21 in order to enhance the bonding force of the molding LSR.

In addition, the top face 21 may be provided with fine protrusions 23 in order to increase the contact area of the LSR applied thereto, thereby enhancing the bonding force.

When the flat top face 21, formed by the injection, maintains a temperature in the range from 70 to 90°C, or is preheated, the surface activity of the top face 21 increases. Accordingly, the SLR can be formed on the tank without a priming treatment of processing the seating recess 22 or the fine recesses 23 or applying an adhesive thereto.

When the temperature of the top face of the tank is below 70°C, the viscosity of the LSR is decreased to the extent that the LSR flows out. At temperatures of the top face of the tank above 90°C, the viscosity of the LSR is increased to the extent that the LSR may not completely enter the mold, and thus may not be sufficiently molded.

Another method of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle uses a dispenser, and includes a molding step S10 of forming a heat exchanger tank by injection molding, an LSR-feeding step S51 of feeding LSR, composed of a main material and a curing material, to the top face of the molded tank using the dispenser, and a curing step S60 of curing the LSR.

In the case of using an adhesive, before the step S51 of
feeding the LSR to the top face of the molded tank using the
dispenser, the method further includes a priming step S30 of
applying the adhesive to the top face of the tank in order to
help bond the LSR to the top face of the tank.

Another embodiment of the invention is a method of
forming LSR on the top face of the tank 20 using the dispenser
as described below.

Parts the same as or similar to those of the former
embodiment will not be described again. As in the former
embodiment, the tank 20 is injection-molded, and the LSR is
uniformly applied to the top face 21 of the tank, seated into
the lower mold 30, using a dispenser 90.

The dispenser 90 is a device that uniformly dispenses a
small amount of liquid material (e.g., epoxy, silicone and
urethane) according to the application and use. Here, liquid
materials, including a main material and a curing material, are
mixed, and the dispenser 90 dispenses LSR in the form of a gel,
which is produced by the chemical reaction of the resultant
mixture, to the top face 21 of the tank 20.

The subsequent curing step will not be described.

[industrial Applicability]

According to the gasket-integrated tank of the invention
as set forth above, the gasket is integrally coupled with the
tank. This structure makes it possible to remarkably reduce
the possibility of leakage, effectively prevent the gasket from
being separated from the tank, and increase the efficiency of a manufacturing process, thereby reducing manufacturing costs and facilitating mass production.
[CLAIMS]

[Claim 1]
A tank for use with a heat exchanger for a vehicle, comprising a gasket made of a liquid silicone, wherein the gasket is integrated with a top face of the tank.

[Claim 2]
The tank according to claim 1, wherein the top face of the tank is formed flat.

[Claim 3]
The tank according to claim 1, wherein the top face of the tank has a recess for receiving the LSR therein.

[Claim 4]
The tank according to claim 1, wherein the top face of the tank has fine protrusions for increasing a contact area between the top face and the liquid silicone.

[Claim 5]
The tank according to any one of the preceding claims 2 to 4, wherein the top face of the tank is coupled with the gasket using an adhesive made of a primer composition.

[Claim 6]
The tank according to claim 1, wherein the tank is made of plastic.

[Claim 7]
The tank according to claim 1, wherein the liquid silicone is a two-liquid mixture, which includes a main
material and a curing material.

[Claim 8]
The tank according to claim 7, wherein the main material and the curing material are mixed at an equal weight ratio.

[Claim 9]
A method of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle, comprising:

(S10) injection-molding the tank of the heat exchanger;
(S20) seating the tank, molded in the injection-molding step (S10), into a lower mold;
(S40) seating an upper mold, having a gasket-forming recess, on a top face of the molded tank;
(S50) feeding a liquid silicone, including a main material and a curing material, into a molding space, which is defined by the top face of the tank and the upper mold; and
(S60) curing the liquid silicone.

[Claim 10]
A method of manufacturing a gasket-integrated tank for use with a heat exchanger for a vehicle, comprising:

(S10) injection-molding the tank of the heat exchanger;
(S51) feeding a liquid silicone, including a main material and a curing material, to a top face of the molded tank using a dispenser; and
(S60) curing the liquid silicone.

[Claim 11]
The method according to claim 9, further comprising:
(S30) priming the tank after the step (S20) of seating the tank into the lower mold, wherein the priming step (S30) applies an adhesive to the top face of the tank in order to help the LSR adhere to the top face of the tank.

[Claim 12]
The method according to claim 10, further comprising:
(S30) priming the tank before the step (S51) of feeding a liquid silicone to a top face of the molded tank using a dispenser, wherein, in the priming step (S30), an adhesive is applied to the top face of the tank in order to help the LSR adhere to the top face of the tank.

[Claim 13]
The method according to claim 9, wherein the lower mold has a recess corresponding to a contour of the tank, and wherein the upper mold has a protrusion corresponding to an interior of the tank.

[Claim 14]
The method according to claim 9, wherein the upper mold has a gasket-forming recess.

[Claim 15]
The method according to claim 14, wherein the upper mold has a protrusion surrounding the gasket-forming recess, the protrusion of the upper mold preventing the liquid silicone from leaking.
[Claim 16]
The method according to claim 15, wherein the protrusion of the upper mold has a V-shaped cross section.

[Claim 17]
The method according to claim 9 or 10, wherein, in the feeding step, the liquid silicone is fed by maintaining the top face of the tank at a temperature ranging from 70 to 90°C.

[Claim 18]
The method according to claim 9 or 10, wherein, in the feeding step, the liquid silicone is fed using a liquid silicone-feeding device by maintaining the temperature of the feeding device in a range from 5 to 30°C.

[Claim 19]
The method according to claim 9 or 10, wherein the curing step is carried out at a temperature ranging from 100 to 160°C to facilitate a chemical reaction of the fed liquid silicone.

[Claim 20]
The method according to claim 9 or 10, wherein the liquid silicone fed in the feeding step is a two-liquid mixture, in which the main material and the curing material are mixed at an equal weight ratio.
FIG. 1

MOLDING STEP (S10)
INJECTING-MOLDING TANK

SEATING STEP (S20)
SEATING TANK INTO LOWER MOLD

PRIMING STEP (S30)
APPLYING ADHESIVE ON TOP FACE OF TANK, SEATED IN LOWER TANK, SO THAT LSR CAN BE APPLIED THEREON

SEATING STEP (S40)
SEATING UPPER MOLD HAVING GASKET-FORMING RECESSION ON TANK SEATED IN LOWER MOLD

FEEDING STEP (S50)
FEEDING LSR, INCLUDING MAIN MATERIAL AND CURING MATERIAL, INTO SPACE FORMED BETWEEN TANK TOP FACE AND UPPER MOLD, SO THAT CHEMICAL REACTION BETWEEN MAIN MATERIAL AND CURING MATERIAL TAKES PLACE IN SPACE

CURING STEP (S60)
CURING LSR AT 100 TO 160°C TO FACILITATE CHEMICAL REACTION
FIG. 2

MOLDING STEP (S10)

INJECTING-MOLDING TANK

SEATING STEP (S20)

SEATING TANK INTO LOWER MOLD

PRIMING STEP (S30)

APPLYING ADHESIVE ON TOP FACE OF TANK, SEATED IN LOWER TANK, SO THAT LSR CAN BE APPLIED THEREON

FEEDING STEP (S51)

FEEDING LSR, INCLUDING MIXTURE OF MAIN MATERIAL AND CURING MATERIAL, TO TANK TOP FACE

CURING STEP (S60)

CURING LSR AT 100 TO 160° C TO FACILITATE CHEMICAL REACTION
3/12

FIG. 3

10

12

11

20
FIG. 4
FIG. 5
INTERNATIONAL SEARCH REPORT

PCT/KR2007/004217

A. CLASSIFICATION OF SUBJECT MATTER

F28F 9/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 F28F 9/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models since 1975
Japanese utility models and applications for utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS (KIPO internal) & keywords tank, header, packing, gasket, seal*, silicon, mold*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 5,160,474 A (HUFF) November 3, 1992 See column 7 and figures 5, 6, and 7</td>
<td>1 - 3, 6, 9 - 19</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td>4, 5, 7, 8, 20</td>
</tr>
<tr>
<td>Y</td>
<td>US 6,579,487 B1 (LICHTINGER) June 17, 2003 See figures 3a and 3b</td>
<td>4, 5</td>
</tr>
<tr>
<td>Y</td>
<td>EP 0593863 A1 (SONDERHOFF ERNST FA) April 27, 1994 See abstract and figure</td>
<td>7, 8, 20</td>
</tr>
</tbody>
</table>

* Special categories of cited documents
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search
10 DECEMBER 2007 (10 12 2007)

Date of mailing of the international search report
10 DECEMBER 2007 (10.12.2007)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No 82-42-472-7140

Authorized officer

LEE, Byung Jae

Telephone No 82-42-481-8560

Form PCT/ISA/210 (second sheet) (April 2007)
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US05160474</td>
<td>03.11.1992</td>
<td>CA2041602 AA</td>
<td>22.06.1992</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US5160474 A</td>
<td>03.11.1992</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US5246065 A</td>
<td>21.09.1993</td>
</tr>
<tr>
<td>US06579487</td>
<td>17.06.2003</td>
<td>AT221444 E</td>
<td>15.08.2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA2347842 AA</td>
<td>27.04.2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE19848246 A1</td>
<td>27.04.2000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE59902229 CO</td>
<td>05.09.2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP01126961 B1</td>
<td>31.07.2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP1126961 B1</td>
<td>31.07.2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HK1044311 A1</td>
<td>09.05.2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP14527264</td>
<td>27.08.2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>US6579487 B1</td>
<td>17.06.2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE4235639 A1</td>
<td>28.04.1994</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE59307816 CO</td>
<td>22.01.1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DK593863 T3</td>
<td>23.02.1998</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP00593863 A1</td>
<td>27.04.1994</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EP593863 A1</td>
<td>27.04.1994</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ES2110547 T3</td>
<td>16.02.1998</td>
</tr>
</tbody>
</table>