April 20, 1965 J. J. SIMS ETAL 3,179,394

SOLID SEAL FOR INNER COVERS

Filed Sept. 11, 1963 3 Sheets-Sheet 1

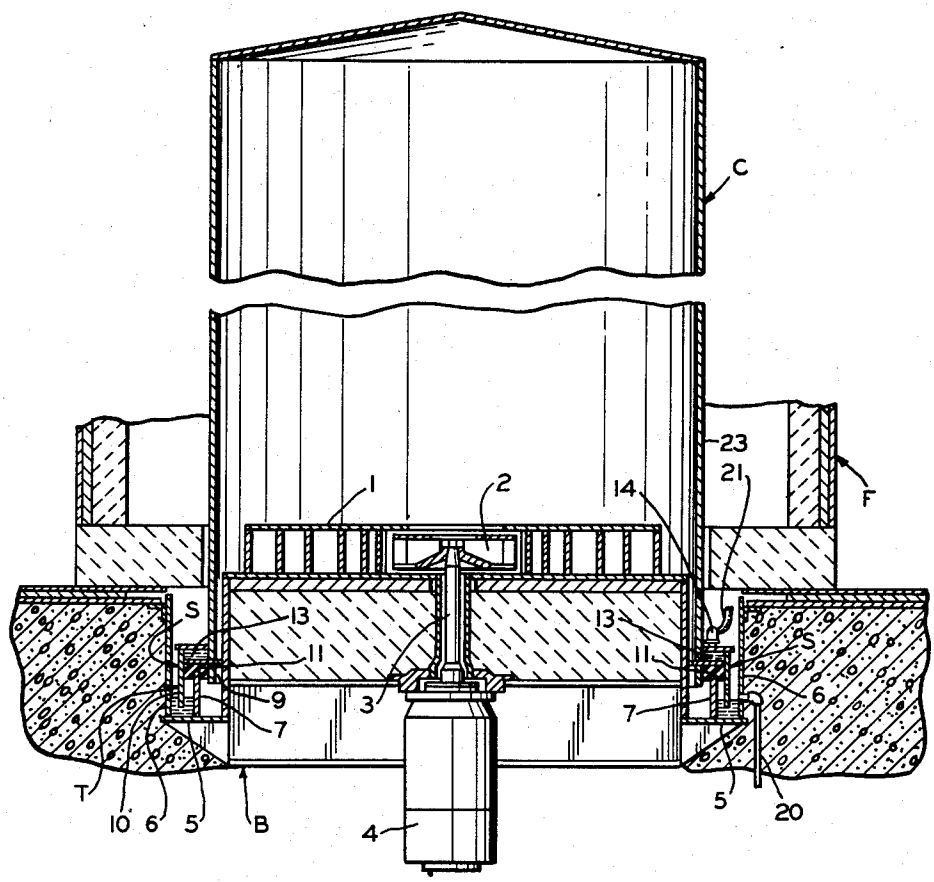

Fig. 1.

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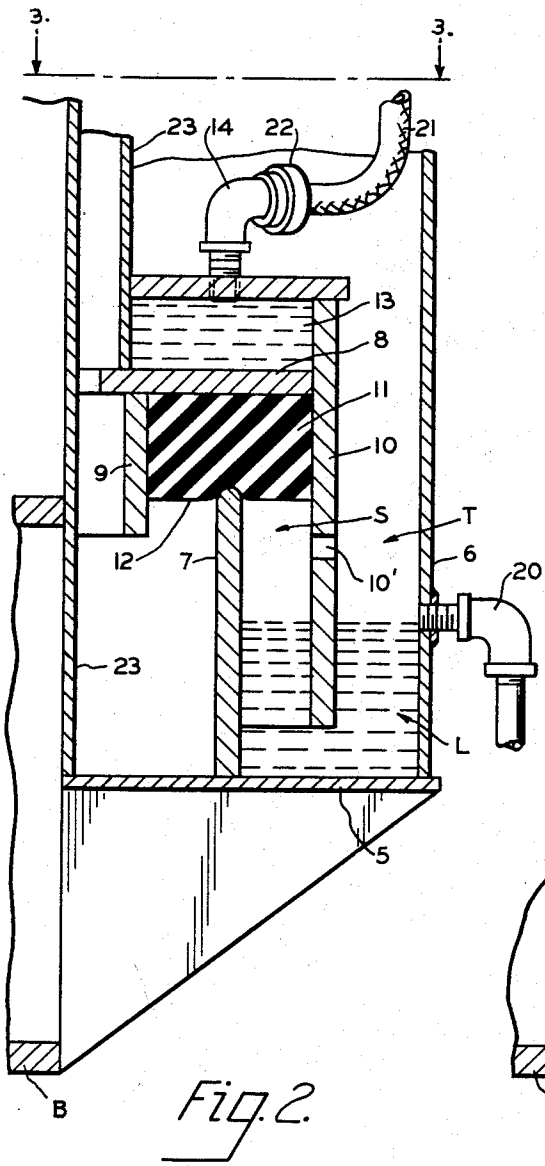

Fig. 2.

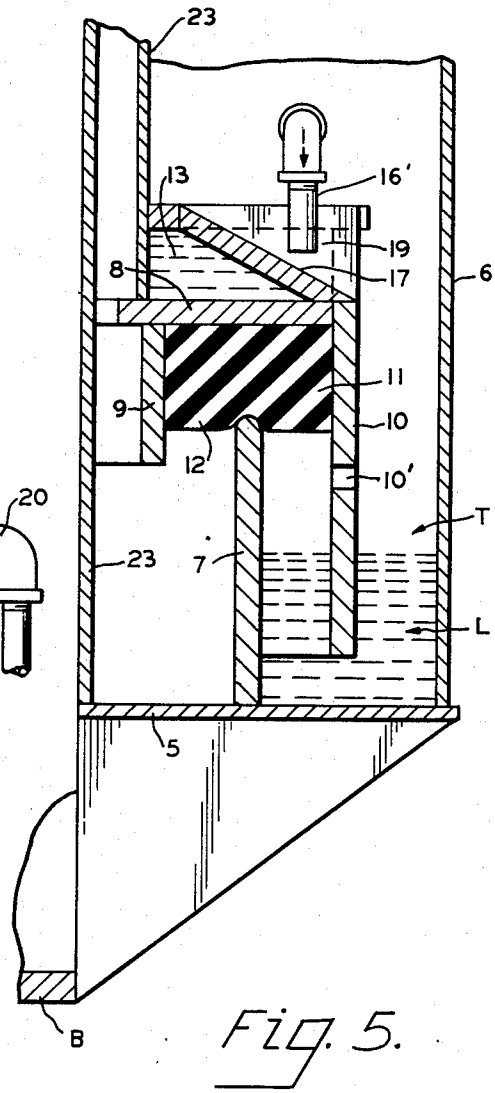

Fig. 5.

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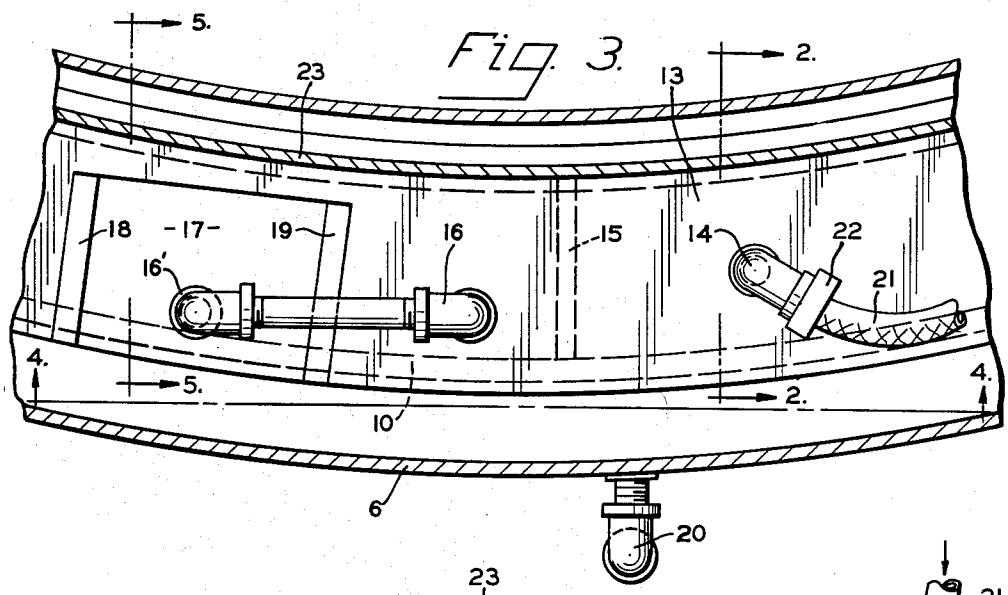
Fig. 3.



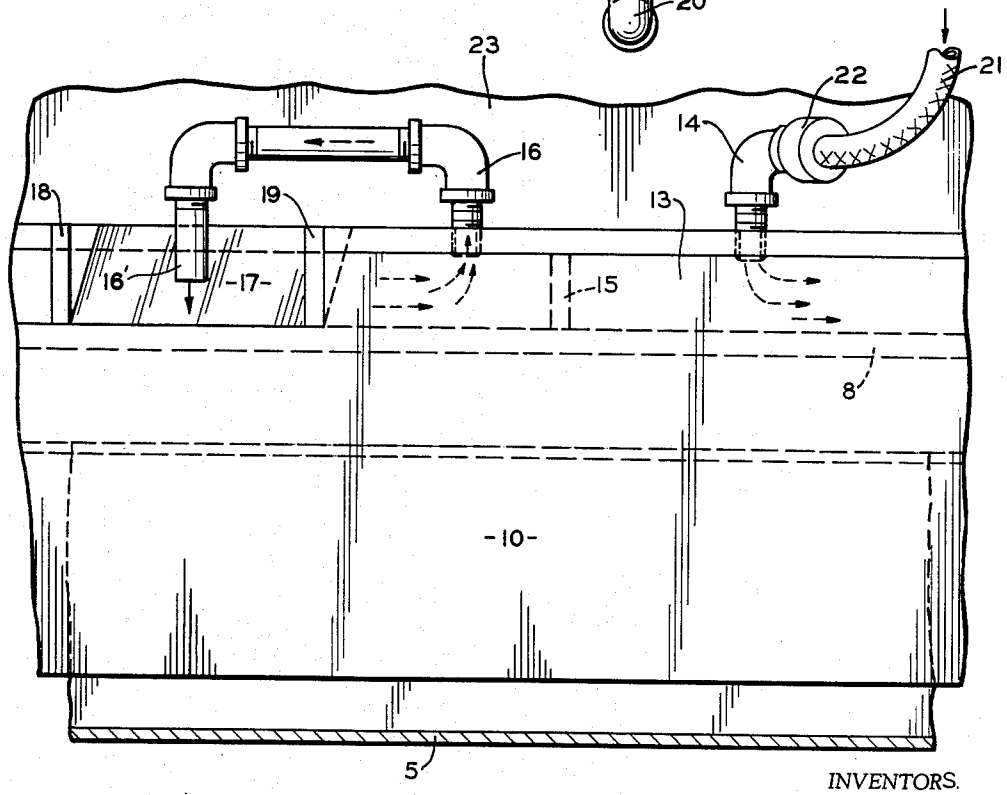


Fig. 4.

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3,179,394

SOLID SEAL FOR INNER COVERS

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3 Claims. (Cl. 263—49)

This invention relates to means for effecting an atmospheric seal between two separable elements and more particularly to an improved seal for use between a furnace base and a work enclosing cover member which is removably supported on the base.

Various means have been provided for effecting an atmospheric seal betwen a cover member and a base structure. Troughs in the base structure, filled with sand or liquid, into which a depending flange on the cover member extends are commonly used. These have disadvantages, however, in certain applications because of the possibility of sand, liquid or vapor from the liquid being carried up into the chamber enclosed by the cover member with undesirable results.

It is among the objects of the present invention to provide an improved sealing means for use between a base and cover member, particularly those used in furnace structures or the like, which provides an effective atmospheric seal, which is not harmfully affected by high temperatures, which will maintain a proper seal without cleaning or other attention such as is required with other types of seals, which in no way modifies the atmosphere within the chamber enclosed by the cover member, and which may readily be renewed when necessary without putting out of operation the base structure with which it is used.

The above and other objects of our invention will appear from the following description of one embodiment thereof, reference being had to the accompanying drawings, in which:

FIGURE 1 is a vertical cross sectional view illustrating a typical furnace base for a bell type annealing furnace together with a cover member in the form of an inner cover disposed on the base and forming an enclosed work chamber, our improved seal being incorporated in the apparatus;

FIGURE 2 is an enlarged fragmentary cross sectional view of the sealing means shown in FIGURE 1 and taken substantally on line 2—2 of FIGURE 3;

FIGURE 3 is an enlarged fragmentary plan view, taken substantially on line 3—3 of FIGURE 2 and illustrating the cooling liquid connections for our improved sealing means;

FIGURE 4 is a fragmentary side elevationel view, taken substantially on line 4—4 of FIGURE 3, and illustrating the seal and liquid connections therefor; and

FIGURE 5 is an enlarged vertical cross sectional view, generally similar to FIGURE 2, but taken on line 5—5 of FIGURE 3 and illustrating the means for directing the cooling liquid into the trough portion of the base structure.

Although our improved seal may advantageously be used in numerous applications, we have illustrated it herein as providing the sealing means between the removable cover member which forms the furnace chamber and the base structure of a bell-type annealing furnace such as is commonly used for annealing coils of strip metal or the like.

In FIGURE 1 the base structure of such a furnace is generally indicated at B and the removable cover member, commonly called an inner cover, is seen at C. In this type of furnace a furnace bell, fragmentarily seen at F, is supported by the base structure B, encloses the cover member C, and usually carries the heating means (not shown) such as radiant combustion tubes or the like.

The base structure B includes a charge support and diffuser 1 and a blower 2 which is supported on shaft 3 and driven by a motor 4 to circulate the atmosphere enclosed within the cover member C when it is positioned on the base structure.

In use of this type of furnace the work to be treated, for example a coil or coils of strip metal, is placed on the charge support 1 and the cover member C is then lowered into the position seen in FIGURE 1 where it encloses the work and forms, with the base structure B, an enclosed chamber. When it is desired to maintain a special atmosphere within the cover C means must be provided to provide a seal between the open bottom end of the cover C and the base structure B.

In the embodiment illustrated the base structure B is provided with a trough portion T which is cricular in form and concentric with the blower 2. This trough portion T has a bottom wall 5, an outer side wall 6 and an inner side wall 7, the inner side wall 7 forming an upstanding flange as will later appear.

Extending around the open bottom end of the removable cover member C (which is also circular in horizontal crosssection) is an open bottom channel portion S which, as is clearly seen in FIGURES 2–5, is defined by a top wall 8 and spaced side walls 9 and 10. It will be understood that the trough portion T and channel portion S are also circular in form and it will be seen from FIGURE 1 that the diameter of the inner side wall 9 of the channel S is less than the diameter of the upstanding flange portion 7 while the diameter of the outer side wall 10 of the channel portion S is greater than that of the upstanding flange 7 with the result that, when the cover member C is lowered into position as seen in FIGure 1, the flange 7 extends upwardly into the inverted channel portion S in spaced relation to the side walls 9 and 10 thereof.

In order to provide an effective atmospheric seal between the cover member C and the base structure B a mass or block of resilient rubber-like sealing material 11 is placed in the channel portion S, substantially filling same and having an exposed continuous bottom sealing face 12. The upper edge of the sealing flange 7 is preferably rounded as seen in FIGURES 2 and 5 and when the cover C is in position on the base B said upper edge of flange 7 engages the flat continuous bottom sealing face 12 of the mass of resilient sealing material 11. This resilient mass 11 may be of any suitable rubber-like material, for example either solid or sponge rubber or neoprene, resilient plastic, etc., and where the term "rubber-like" material is used herein is inteneded to extend to and include any such resilient materials. The resiliency of the mass of material 11 is such that the weight of the cover C will cause the upper edge of flange 7 to distort the bottom face of the sealing material 11 and form a firm and effective atmospheric seal therewith.

In order to complete the seal between the base B and the cover C the mass of sealing material 11 also has sealing engagement with at least one of the walls of the channel S and thus leakage of atmosphere to or from the chamber formed by the cover C is effectively prevented.

By providing an inverted open bottom sealing channel portion S on the cover member C with a mass of resilient rubber-like sealing material therein having an exposed bottom sealing face 12, and providing the upstanding sealing flange 7 on the base structure B, any collection of dirt between the sealing members which would interefere with a proper seal is effectively prevented. It will be apparent that no dirt can collect in the channel S as it is always "upside down" and there is no chance for scale, or other

shop dirt or debris, to collect on the sealing surface 12 of the resilient sealing material 11. The upper edge of the flange 7 is narrow and rounded and thus no material amount of dirt can collect thereon. The trough T in the base structure B may collect some dirt but this trough is made of such a depth that even the dirt that collects therein in long periods of operation will not prevent effective sealing engagement between the top edge of flange 7 and the bottom face 12 of the sealing material 11. With previously proposed resilient seals the problem of the collection of dirt between the cooperating sealing surfaces has made them impractical for commercial use.

Furthermore our inverted resilient seal arrangement also completely avoids trouble caused by water vapor from water which may collect on top of the resilient material in the sealing trough of non-inverted seals that have previously been proposed. With such non-inverted arrangements vapor from water standing on the resilient seal material may freely rise and enter the work chamber with, in many cases, most undesirable results.

As the cover member C is heated to high temperature during operation of the furnace we preferably provide a cooling liquid chamber 13, annular in form, disposed on top of the channel portion S and having a common wall 8 therewith. Water or other suitable cooling liquid is discharged into this cooling chamber through an inlet pipe 14, flows around the entire length of the cooling chamber 13 because of the baffle wall 15 across the chamber 13 and exits through an outlet pipe 16 (see FIGS. 3 and 4). The pressure of the cooling liquid supplied to the pipe 14 and the size of the outlet pipe 16 are such that the cooling chamber 13 is always completely full of cooling liquid and a continuous flow is maintained through the outlet pipe 16 during use of the apparatus.

As best seen in FIGURES 3 and 5, a portion of the top wall of the cooling chamber 13 is cut away adjacent the outlet pipe 16 and is replaced by an inclined plate 17 and closure plates 18 and 19 which form a transverse inclined liquid guide trough adapted to receive the discharged cooling liquid that exits from the outlet end 16' of pipe 16.

It will be noted that the outer side wall 10 of the channel portion S is greater in vertical height than the inner side wall 9 thereof and extends down farther into the trough T on the base structure B. This depending side wall 10 extends down into the discharged cooling liquid which flows down into the trough T from the pipe 16, the level of the body L of liquid in the trough T being maintained at the desired height by a suitable overflow pipe 20 thus providing a second atmospheric seal between cover member C and the base structure B. Holes 10' in wall 10 are located above the top level of the body L of sealing liquid and serve to equalize the atmospheric pressure on the opposite sides of wall 10.

The body of water in the trough T also serves to cool the upstanding sealing flange 7 so that it will not be heated to a temperature that would injure the resilient sealing material 11. Thus the cooling liquid which circulates through the chamber 13 and serves to prevent the resilient material 11 from reaching a harmfully high temperature is also effective to cool the upstanding sealing flange 7 and prevent possible damage to the sealing material 11 which might otherwise occur through contact therewith. Water vapor from the trough cannot enter the work chamber enclosed by cover C because of the resilient seal 11 and thus the harmful effects of such vapor are prevented.

A flexible cooling liquid supply line 21 is adapted to conduct the cooling liquid through the pipe 14 and the quick disconnect coupling 22 of any suitable type is adapted to facilitate connection of supply line 21 and the inlet pipe 14 preliminarily to lowering the cover member C and its sealing channel S into position on the base B. It will be noted that the inlet and outlet pipes 14 and 16 do not extend radially outwardly beyond the outer wall 10 of the channel portion S and thus the possibility of damage to the cooling water pipes during handling of the inner cover is minimized.

In addition to the elimination of any possibility of dirt or other foreign material interfering with an effective seal, our improved apparatus is particularly adapted to high temperature installations because of the effective means that are provided for preventing high temperature damage to the resilient rubber-like sealing material. Furthermore, by mounting the rubber-like sealing material in the cover member C, as distinguished from the base B, shutdown of the furnace base B when it becomes necessary to replace the sealing material 11 due to wear, is eliminated. As one furnace base structure B is ordinarily serviced by a number of cover members C it will be seen that, with our improved seal, no interference in production of the furnace base is incurred when changing sealing material. Furthermore, as the cover member C is removable, it may readily be positioned in such a manner as to receive sealing material of any particular type, for example materials which are poured into position in trough 11 in liquid form when the cover member is inverted so that the open end of the channel 11 is upward, and which then solidify in the channel.

Although we have illustrated and described in considerable detail one embodiment of our invention it will be understood that modifications and variations may be made in the specific form and arrangement of the parts of our improved seal without departing from the spirit of our invention. For example, the inner wall of the trough portion 11 may be made longer than the outer wall thereof and the sealing liquid may be diverted into the annular space between the upstanding flange 7 and the wall 23 of the cover member C or, alternatively, both the inner and outer walls 9 and 10 may extend downwardly into the trough in the base structure B to provide a double liquid seal. Accordingly we do not wish to be limited to the specific apparatus herein illustrated and described but claim as our invention all embodiments thereof coming within the scope of the appended claims.

We claim:

1. In a furnace structure or the like, a base structure having a sealing trough portion, said trough portion having a bottom wall and spaced side walls, one of said side walls forming an upstanding sealing flange, a removable cover member having an open bottom and supported on said base portion to form a work enclosing chamber, a continuous inverted open bottom channel portion extending around said open bottom of said cover member and having a top wall and spaced side walls, a mass of resilient sealing material disposed in said open bottom channel portion and having a continuous exposed bottom sealing face, said resilient sealing material being secured in said inverted channel portion, said inverted channel portion overlying said upstanding sealing flange and the top edge of said upstanding sealing flange sealingly engaging said exposed bottom sealing face of said mass of resilient sealing material, one of said side walls of said inverted channel portion extending downwardly into said trough portion of said base structure, and means for maintaining liquid in said trough portion at a level above the bottom edge of said one of said side walls of said inverted open bottom channel portion which extends downwardly into said trough portion.

2. In a furnace structure or the like, a base structure having a trough portion, said trough portion having a bottom wall and spaced inner and outer side walls, one of said side walls forming an upstanding sealing flange, a removable cover member having an open bottom and supported on said base portion to form a work enclosing chamber, an inverted open bottom channel portion extending around said open bottom of said cover member and having a top wall and spaced side walls, a mass of resilient sealing material disposed in said inverted open bottom channel portion and having an exposed bottom sealing face, said mass of resilient sealing material being

secured in said inverted channel portion against drop-out therefrom and having sealing engagement with at least one of said walls thereof, said inverted channel portion having its open bottom overlying said upstanding sealing flange and the top edge of said upstanding sealing flange sealingly engaging said exposed bottom sealing face of said mass of resilient sealing material, one of said side walls of said inverted channel portion extending downwardly into said trough portion of said base structure, a cooling liquid chamber on said cover member substantially coextensive with said inverted channel portion and disposed to cool said mass of resilient sealing material therein, means for conducting cooling liquid to and discharging same from said cooling liquid chamber, means for conducting discharged cooling liquid from said cooling liquid chamber into said trough portion of said base structure, and means for maintaining the level of liquid in said trough portion above the bottom edge of said one of side walls of said inverted open bottom channel which extends thereinto.

3. In a furnace structure or the like, a base structure having a trough portion, said trough portion having a bottom wall and spaced inner and outer side walls, the inner one of said side walls forming an upstanding sealing flange, a removable cover member having an open bottom and supported on said base portion to form a work enclosing chamber, an inverted open bottom channel portion extending around said open bottom of said cover member and having a top wall and spaced side walls, a mass of resilient sealing material disposed in

said inverted open bottom channel portion and having an exposed bottom sealing face, said mass of resilient sealing material being secured in said inverted channel portion against drop-out therefrom and having sealing engagement with at least one of said walls thereof, said inverted channel portion having its open bottom overlying said upstanding sealing flange and the top edge of said upstanding sealing flange sealingly engaging said exposed bottom sealing face of said mass of resilient sealing material, the outer one of said side walls of said inverted channel portion extending downwardly into said trough portion of said base structure, a cooling liquid chamber on said cover member substantially coextensive with said inverted channel portion and disposed to cool said mass of resilient sealing material therein, means for conducting cooling liquid to and discharging same from said cooling liquid chamber, means for conducting discharged cooling liquid from said cooling liquid chamber into said trough portion of said base structure, and means for maintaining the level of liquid in said trough portion above the bottom edge of said outer one of side walls of said inverted open bottom channel portion.

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