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LIQUID SEAL FOR IMPELLER SHAFTS OF CENTRIFUGAL AND ROTARY PUMPS

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Fig. 1.

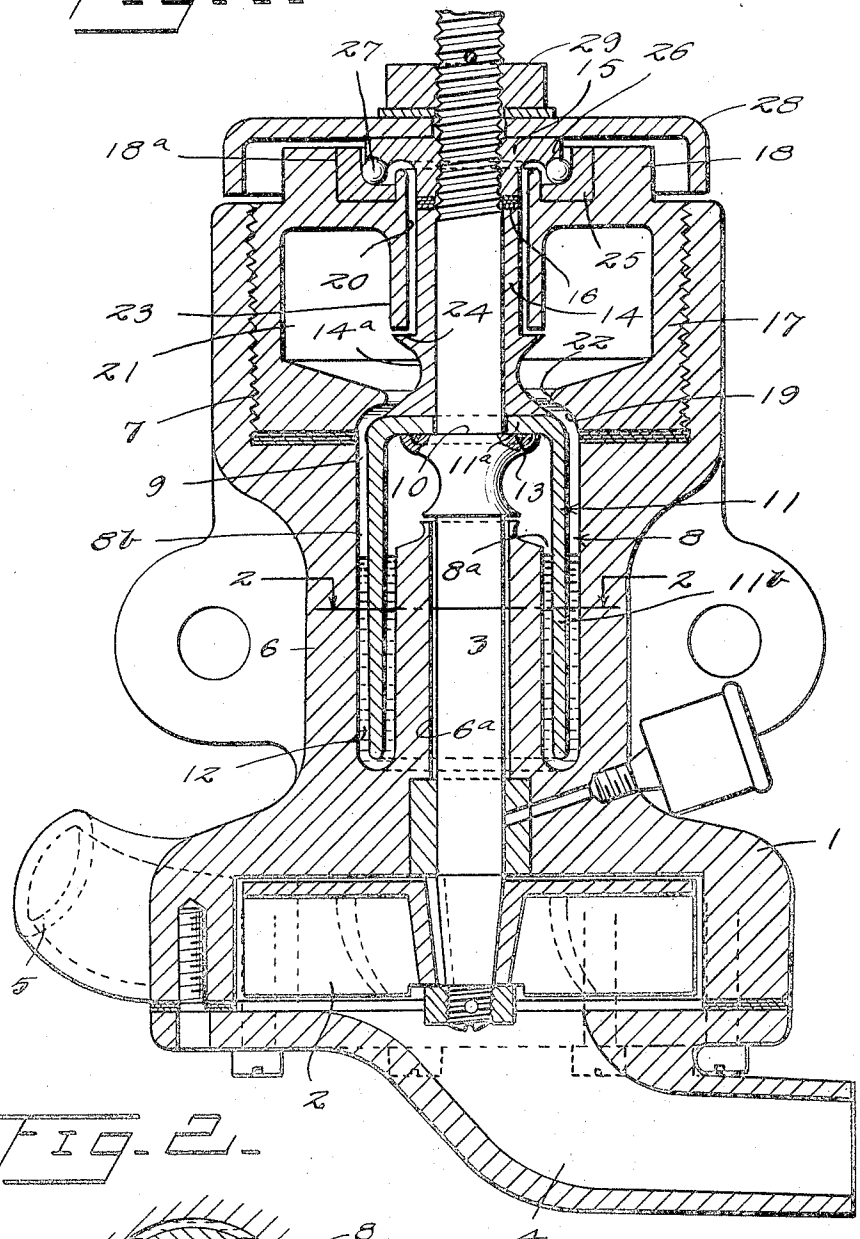
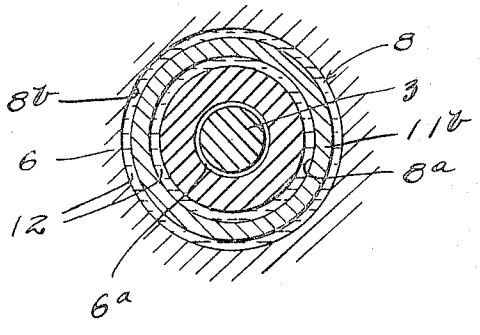


Fig. 2.



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LIQUID SEAL FOR IMPELLER SHAFTS OF CENTRIFUGAL AND ROTARY PUMPS

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3 Claims. (Cl. 286—9)

This invention relates to liquid and gas pumps of the centrifugal and rotary types having vertically disposed impeller shafts, and more particularly to novel means for establishing a liquid and gas tight connection between the shafts and casings of pumps of this character.

The invention has for one of its objects to provide means of the character stated which will offer comparatively little or no resistance to the rotation of the impeller shaft of a centrifugal or rotary pump and which will so effectively seal the casing hub through which the shaft passes as to positively prevent gas or liquid from escaping from the casing by way of the hub.

To attain the foregoing and other objects, the nature of which will appear as the description proceeds, the invention comprehends providing the casing hub with a mercury well of annular formation and arranged in surrounding relation to the impeller shaft, and mounting an inverted cup on the impeller shaft with the lower portion of its side wall immersed in the mercury, said cup wall being spaced from the bottom and side walls of the well to separate the well into outer and inner communicating compartments of which the latter has its upper end arranged in communication with the interior of the hub and cut-off from communication with the atmosphere by the cup.

The invention further comprehends providing the casing hub above the mercury well with a chamber communicating at its lower side with the upper end of the outer well compartment, for the reception of the mercury as it is displaced from the inner compartment by the pressure in the casing of the pump.

The invention further comprehends providing an overflow chamber of such formation as to positively prevent the mercury from being dispelled upwardly therefrom by the centrifugal force developed therein by the impeller shaft when rotated at high speed.

The invention is hereinafter more fully described and claimed, and illustrated in the accompanying drawing, wherein:—

Figure 1 is a sectional view taken on a plane extending vertically and centrally through a pump equipped with a liquid seal constructed in accordance with my invention, and

Figure 2 is a sectional view taken on the horizontal plane indicated by the line 2—2 of Figure 1.

Referring in detail to the drawing, 1 designates the casing, 2 the impeller, and 3 the impeller shaft of a centrifugal liquid or gas pump. The pump is arranged with its impeller shaft 3 vertically disposed. The casing 1 is provided in its lower side with an intake port 4 and in its lateral side with a discharge port 5, and it is provided at its upper side with a hub 6 through which the impeller shaft 3 passes. The casing 1 and impeller 2 may be of any well-known or appropriate construction.

In accordance with my invention, the hub 6 is provided in its upper end with an axial recess 7 and is provided below the recess with a mercury well 8 of annular formation. A cylindrical passage 9 extends from the bottom of the recess 7 to the upper side of the well 8. The well 8 is arranged in surrounding and concentric relation to the shaft 3 which extends axially through the passage 9 and recess 7 to a point above the hub 6. The shaft 3 has that portion thereof which is located in the passage 9 laterally enlarged to provide an annular shoulder 10. An inverted cup 11 of cylindrical formation is mounted concentrically on the shaft 3 with its top wall 11*a* resting upon the shoulder 10 and with its side wall 11*b* immersed in the mercury 12 in the well 8. The cup wall 11*b* is spaced from the bottom and side walls of the well 8 to separate the well into inner and outer annular compartments 8*a* and 8*b*, respectively, which communicate with each other at their lower ends. The upper closed end portion of the cup 11 communicates with the interior of the casing 1 by way of the hub bore 6*a* through which the shaft 3 passes, and the front end of the well compartment 8*a* communicates with the cup and is cut-off from communication with the atmosphere by the cup.

The gas and liquid tight connection is established between the shoulder 10 and the cup wall 11*a* by a gasket 13. The cup 11 is held against upward movement with relation to the shaft 3 by a thimble 14 which is mounted upon the shaft above and contacts with the cup wall 11*a* and which is in turn held against upward displacement with respect to the shaft by a nut 15 which is screw threadedly engaged with the shaft above the thimble. Shims 16 are mounted upon the shaft 3 between the thimble 14 and nut 15.

A chambered member 17 is located in the recess 7 of the hub 6, and is screw threadedly engaged with the side wall of the recess. The chambered member 17 is provided at its upper side with an annular boss or extension 18 to permit it to be turned into and out of the recess 7 by a wrench. The chambered member 17 is provided in its lower side with a central opening 19 for the reception of the upper end of the cup 11 and the lower end of the thimble 14, and is pro-

vided in its upper side with an opening 20 for the reception of the upper end of the thimble and the upper portion of the shaft 3. The upper end of the well compartment 8*b* communicates with the passage 9, and this passage communicates by way of the opening 19 with the chamber 21 of the member 17 so as to permit the mercury as it is displaced by excessive tilting vibration or inversion of the pump casing 1 from the compartment 8*a* to flow into this the trap chamber. The upper portion of the wall of the opening 19 is extended inwardly to provide an annular shoulder 22 which extends into an annular groove 14*a* formed in the sleeve 14 and serves to retard the passage of the mercury into the chamber 21. A sleeve 23 extends downwardly from the upper wall of the chambered member 17 about the opening 20, and is arranged in spaced surrounding relation to the thimble 14 and has its lower end located above and spaced from an annular shoulder 24 formed on the thimble. The chamber 21 communicates with the atmosphere by way of the opening 20, and the sleeve 23 and shoulder 24 serves to prevent the mercury in the chamber from being displaced upwardly therefrom by excessive tilting, vibration or inversion of the pump.

The impeller 2 and shaft 3 are suspended from the chambered member 17 by a bearing which comprises a race 25 which is recessed into the boss 18, a comb 26 which is carried by the nut 15, and anti-friction elements 27 located between the race and comb. The inner wall of the race receiving recess 18*a* of the boss 18 extends upwardly above the bottom wall of the race to prevent lubricant from flowing from the race into the overflow chamber 21.

A cap 28 which is secured to the shaft 3 above and in surrounding relation to the bearing and the opening 20 of the chambered member 17, protects the bearing from dust and other foreign matter entering the overflow chamber 21. The cap 28 rests upon the nut 15, and is secured in place by a nut 29.

From the foregoing description, taken in connection with the accompanying drawing, it will be understood that the cup is tightly joined to the impeller shaft 3, that the cup surrounds the hub opening 6*a* through which the shaft passes, and that the lower portion of the cup is immersed in the mercury 12 in the well 8, with the result that the hub opening is so effectively sealed as to positively prevent gas or liquid from escaping from the casing 1 by way of such opening. The pressure in the casing 1 acts against the upper surface of that portion of the mercury 12 in the well compartment 8*a* due to the communication of the upper end of this compartment with the cup 11 and the hub opening 6*a*. The pressure will cause the mercury to move upwardly in the well compartment 8*b* of which compartment the annular space between the opposite walls of the cup 11 and the passage 9 forms a part, the mercury rising into this outer compartment until it balances the pressure in the casing.

The shoulder 22 in the chamber opening 19 leads the passage of the mercury into the trap chamber 21, and the sleeve 23 and shoulder 24 prevent the mercury from being displaced upwardly from the trap chamber. The impeller 2 and the shaft 3 may be adjusted downwardly with relation to the casing 1 by removing one or more of the shims 16, and the impeller and shaft may be adjusted upwardly with relation to the casing by increasing the number of shims between the thimble 14 and nut 15. The liquid seal is simple, durable and highly efficient, and it may be used in connection with low and high pressure gas pumps, water circulating pumps or automobile cooling systems especially when the water of such systems contains anti-freezing compounds, pumps used in mechanical refrigerators and the like.

While I have described the principle of the invention, together with the structure which I now consider the preferred embodiment thereof, it is to be understood that the structure shown is merely illustrative and that such changes may be made, when desired, as fall within the scope of the invention as claimed.

What is claimed is:—

1. A means for retaining a liquid seal about a shaft rotatably carried by a housing and having an inverted cup-shaped member fixed to the shaft and projecting into a liquid disposed in a well in the housing, comprising a member having a diameter relatively larger than the diameter of the well threadably engaging the housing at a point closely adjacent the top of the cup-shaped member and having a chamber therein communicating at the bottom with the well, the bottom of the chamber being inclined downwardly to permit any liquid therein to flow downwardly into the well, said chamber having a capacity sufficient to hold the total quantity of liquid in the well.

2. A means for retaining a liquid seal about a shaft rotatably carried by a housing and having an inverted cup-shaped member fixed to the shaft and projecting into a liquid disposed in a well in the housing, comprising a member having a chamber engaging about the shaft at a point closely adjacent the top of the inverted cup-shaped member, said chamber having communication with the well and having a bottom inclined downwardly toward the well, a sleeve carried by the latter member extending downwardly into the chamber, and a grooved member secured to the shaft and extending upwardly from the top of the inverted cup-shaped member into the chamber and terminating at its upper end adjacent the lower end of the sleeve, the diameter of the grooved member at the upper end thereof being substantially equal to the outer diameter of the sleeve.

3. A means for retaining a liquid seal about a shaft rotatably carried by a housing and having an inverted cup-shaped member fixed to the shaft and projecting into a liquid disposed in a well in the housing, comprising a member having a chamber therein engaging loosely about the shaft, said housing having an enlarged threaded portion extending upwardly from the well to threadably receive the latter member, said latter member having a diameter substantially greater than the diameter of the well and the chamber in the member having a capacity sufficient to hold the total quantity of liquid in the well, said chamber communicating at the bottom with the well, and means carried by the shaft and the latter member and extending into the chamber to prevent contact of the liquid with the shaft while permitting the liquid to flow downwardly into the well.

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