April 1, 1952 H. A. QUIST 2,591,098

BREATHING DEVICE FOR STORAGE TANKS

Filed July 24, 1947 3 Sheets-Sheet 1

Fig.2

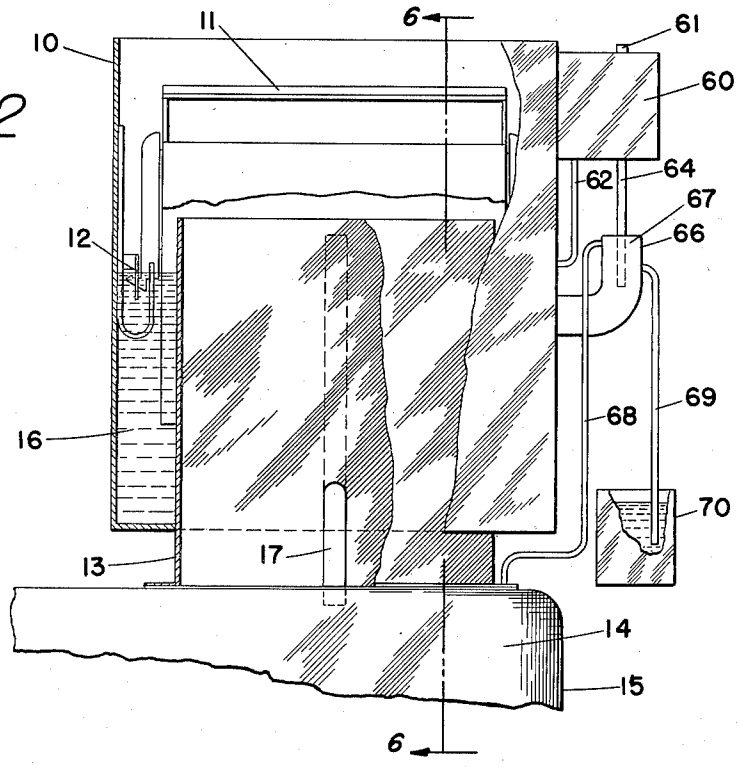
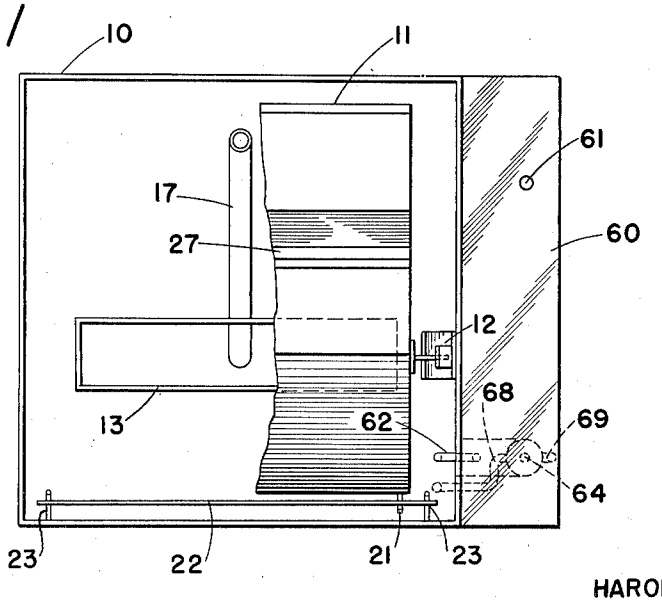


Fig.1



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April 1, 1952 H. A. QUIST 2,591,098

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Filed July 24, 1947 3 Sheets-Sheet 2

Fig. 4

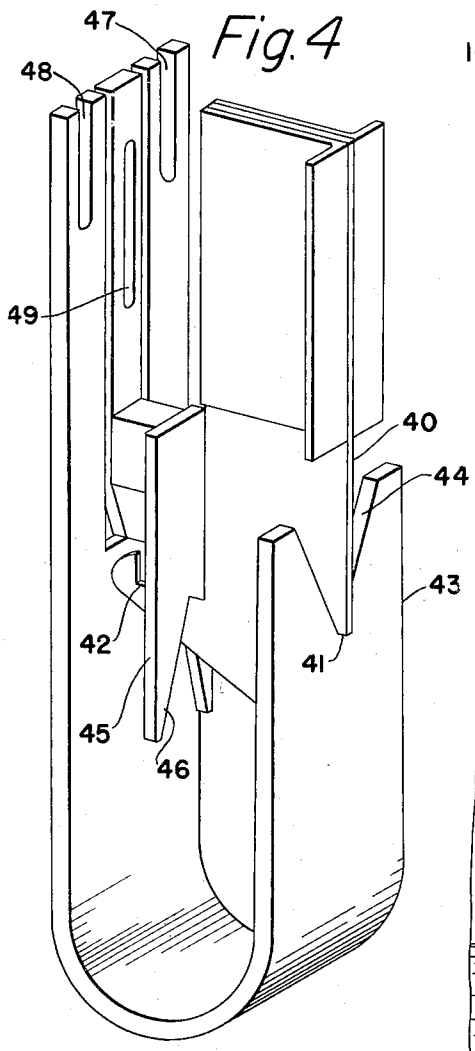
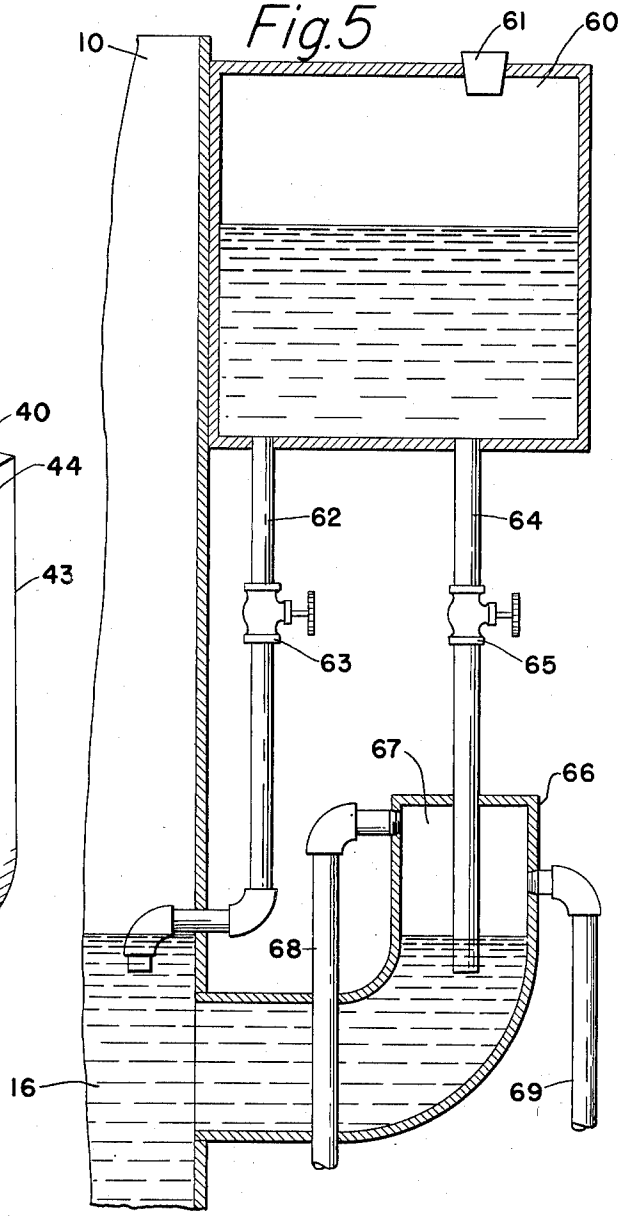


Fig. 5



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BREATHING DEVICE FOR STORAGE TANKS

Filed July 24, 1947 3 Sheets-Sheet 3

Fig.6

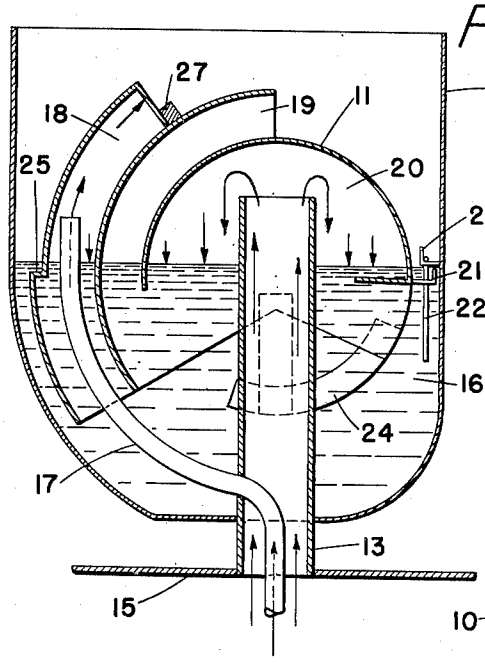


Fig.7

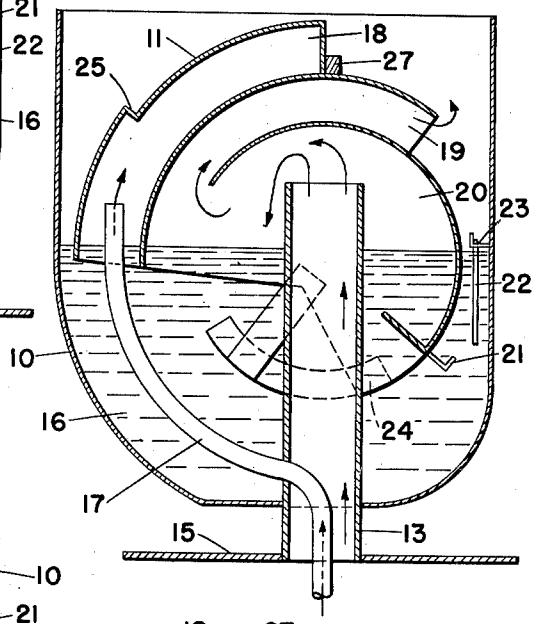


Fig.8

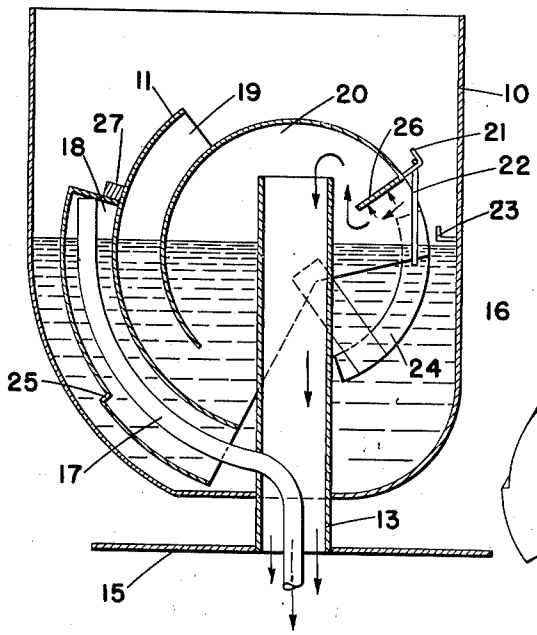
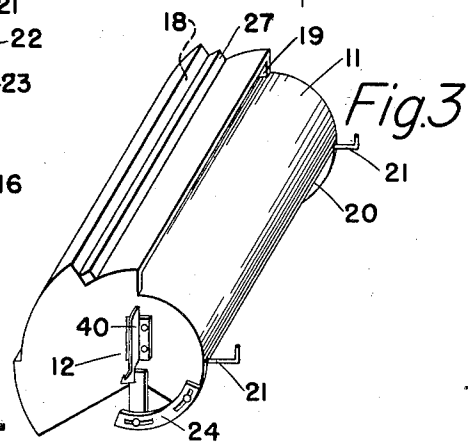


Fig.3



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2,591,098

UNITED STATES PATENT OFFICE

2,591,098

BREATHING DEVICE FOR STORAGE TANKS

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Application July 24, 1947, Serial No. 763,347

4 Claims. (Cl. 137—53)

1

The present invention relates to improvements in breathing devices for storage tanks, and more particularly, to valves for sealing and venting fluid storage tanks under changing conditions of pressure and vacuum.

It is an object of the invention to correct pressure variations in bulk storage tanks in response to fluctuations of pressures within the storage container.

Another object is to maintain the operating pressure of the bulk tank until a condition of unbalance is reached and preventing spasmodic exhausting of the pressure to the atmosphere causing chattering and rapid movement of the valve by releasing the internal pressure to a predetermined point below normal operating pressure.

A further object is to utilize both the static and velocity pressure heads of either positive or negative pressure differences to perform a complete venting function with fewest operations of the valve.

Still another object is to disclose a valve member for use with tank breathers, as herein described, which is pivoted about the longitudinal axis thereof and will respond in a positive manner to pressure changes in the storage tank.

Yet another object is to disclose a tank breathing valve which operates in a sealing medium, the medium level being controlled by pressure variations within the bulk storage tank with which the venting valve operates and transmitted through a reservoir of such sealing medium.

Still a further object is to insure the uninterrupted operation of this cylindrical valve member by suspending it to rotate about its longitudinal axis on knife edge bearings of unique and efficient design.

Other objects of this invention, including certain features for utilization of pressure differences and provisions for quick closing action after pressures have been balanced, will be best understood from the following description of one illustrative embodiment of the invention, taken in connection with the appended claims and the accompanying drawings in which:

Figure 1 is a plan view, partly broken away, of the breathing device.

Figure 2 is a sectional elevation with parts removed.

Figure 3 is a perspective view of the cylindrical valve member.

Figure 4 is a pictorial representation of the pivot bearing.

Figure 5 is a sectional view of the reservoir attachment, and

Figures 6, 7 and 8 are sectional views along line 6—6 or Figure 2 showing the cylindrical valve member in operating positions.

A description of the parts of the breather device will require consideration of Figures 1, 2, 3, 4 and 5 of the drawings where like parts are indicated by like numerals, while the operation will refer to Figures 6, 7 and 8 where the parts are also similarly numbered. Referring now to Figures 1, 2 and 3, housing 10 supports the cylindrical valve member 11 on pivotal members 12, the knife edges of which are aligned in prolongation of the longitudinal axis of the cylindrical valve member 11 and are submerged below the sealing liquid level. Rectangular conduit 13 connects the vapor space 14 of the storage tank 15, passing through a sealing liquid 16 and projects into the body of the cylindrical valve member 11. The pressure transfer pipe 17 connects the vapor space 14 of tank 15 through conduit 13 to the valve activating chamber 18 of valve member 11.

2

In addition to the valve activating chamber 18, the cylindrical valve member 11, shown in perspective in Figure 3, may be considered as including two additional chambers. A pressure release chamber 19 is open to vent positive pressures to the atmosphere and another, the vacuum release chamber 20, admits atmospheric pressure to the storage tank 15 when a vacuum is created during operation. In the normal position vacuum release chamber 20 acts as a seal, as will be described later in discussing the operation of the breather. Weight suspension brackets 21 are fastened to the cylindrical valve member 11 below sealing liquid level in the normal position to keep the bar weight 22 free under freezing conditions or gumming action of escaping gases. When weight 22 is not supported by brackets 21 it is retained by similar brackets 23 in position for engagement with brackets 21 as required by the operation of the valve. Balance weights 24 are attached at each end of the cylindrical valve member 11 which are readily adjusted to keep the rotatable valve of the breather device in operating balance. To attain the desired delayed action after balancing internal tank pressures and to insure positive closing action, weight 27 is attached to the rotating valve member 11 as shown.

Figure 4 pictorially represents the pivot suspension generally designated as 12 in Figures 1, 2 and 3. In the preferred embodiment it comprises a knife edge member 40 adapted to be attached to the cylindrical valve member 11 as shown in Figure 3. Returning to Figure 4, member 40 is characterized by two separate, knife edge bearings 41 and 42 which are in alignment with each other and, as fastened to valve member 11, are also in alignment with the longitudinal axis of the cylinder. The bearings are attached so that they are immersed in the sealing liquid 16, thereby preventing interference of operation by freezing or gumming through the action of released gases. A support bearing

43, widely notched at 44, receives knife edge bearing 41 as it thrusts downwardly, suspending the weight of cylindrical valve member 11. An anchor bearing 45 locks knife edge bearing 42 in wide notch 46, thereby counteracting the up-thrust caused by rotation and pressure, preserving alignment and insuring continuous positive breathing action. The shape of bearing 43, as illustrated, showing a slot 47 to receive the anchor bearing 45, is a preferred embodiment of this pivotal member and may be changed to many different shapes still retaining the spirit of the disclosure. Accurate alignment is obtained more readily by the use of elongated bolt holes 48 and 49 in members 43 and 45 respectively.

A closed reservoir tank 60 is shown in operating position in Figures 1 and 2 and in detail in Figure 5. A stopper 61 is shown in the top of tank 60, thereby enclosing the supply of sealing fluid and subjecting it to pressure variations to be described with the breather operation. The tank 60 is filled at necessary intervals by pouring the liquid through the stopper opening as required. For ordinary purposes a light oil which will not freeze and which has been treated with a fire proofing liquid is most satisfactory for use as a sealing fluid. A liquid supply pipe 62 connects the reservoir tank 60 with the liquid seal in housing 10 at a point below the maintained level of the sealing liquid. Valves 63 and 65 close pipes 62 and 64 while removing plug 61 and filling tank 60. A second tube 64, with valve 65, connects tank 60 with pressure equalizing chamber 66, also extended to a position below the maintained liquid level. Pressure equalizing chamber 66 is positioned with relation to the maintained liquid level of sealing liquid 16 in chamber 10 to be partially filled with liquid and to have a sealed vapor or pressure space 67 above that level. A tube or pipe 68 connects the closed pressure space 67 with the vapor space 14 making the liquid level responsive to pressure changes in the attended storage tank 15. An overflow 69 is attached to vapor space 67 and is trapped or sealed to retain the pressure as conventionally illustrated by submersion in fluid in container 70.

The operation of the breather device, described in detail above, will now be readily understood by reference to Figures 6 to 8 inclusive. These figures are sectional views along line 6—6 in Figure 2 and show the rotated positions of the cylindrical valve member 11 during the breathing operations of the storage tank which the device attends. Figure 6 illustrates the cylindrical valve member 11, positioned in housing 10 to enclose the projection of conduit 13 above the sealing fluid 16 in the normal position. The conduit 13 transmits the pressure variations from the vapor space of storage tank 15 to the vacuum release chamber 20 within the cylindrical valve member 11, where a sealed condition attains by cooperation of the valve cylinder with the surface of the sealing liquid. By selection and adjustment of balancing weights 24 and 27, and bar weight 22, the valve member 11 can be operated within wide ranges of pressure variations.

The normal position described above and illustrated in Figure 6 forms a seal of the breather device which will not be broken until pressure or vacuum conditions become effective sufficiently great to cause the cylindrical valve member 11 to oscillate about pivotal member 12. Figure 7 illustrates the valve member functioning under pressure conditions which may arise within a storage tank because of additional quantities of stores being pumped in, expansion or volatility due to temperature changes, and other conditions. The pressure within conduit 13 increases as well as in pressure transfer pipe 17. Arcuate valve actuating chamber 18 receives the pressure from pipe 17 and causes cylindrical valve member 11 to rotate about the longitudinal axis. As the valve member rotates, an increased cross-sectional area of chamber 18 with its attendant bearing surface 25 is presented to the pressure action from pipe 17 causing the valve to rotate rapidly and positively to the pressure relieving position. The valve starts to rotate slowly exerting force on weight 27 which is at a maximum lever arm distance from the center of rotation of valve member 11. As pressure causes the valve member to rotate the effectiveness of weight 27 decreases and the valve operates more rapidly. In closing the valve, the reverse is true and a positive closing action is obtained. Reference to Figure 7 will disclose chamber 19 as now lifted from the sealing liquid 16 and venting freely to the atmosphere, indicated by the arrows. The static pressure head within the vapor space of the storage tank now moves to escape setting up a velocity pressure component. Pressure transfer pipe 17, let into the path of the released pressure in conduit 13, as illustrated, receives the impact of the velocity pressure and transmits it to chamber 18 where it keeps the valve member 11 in an open position beyond that required to merely release the static pressure head. Consequently, the reduction in pressure in the storage tank vapor space is carried below that required to permit the valve to rotate to the closed position, and the resultant action is positive to the closed position again assisted by weight 27, without chattering common to the devices described in the prior art.

Vacuum conditions within the vapor space of the storage tank arise where stored liquids are being pumped out or reductions in temperature cause contraction and condensation of volatile liquids. Under these conditions, a negative pressure or vacuum is created which must be balanced with atmospheric conditions to avoid danger to personnel and injury to equipment. Figure 8 illustrates the rotation of the valve member to release a vacuum condition. The negative pressure in the storage tank vapor space causes a similar condition in chamber 18. Arcuate chambers 18 and 19 and weight 27 increase the tendency of the valve to revolve about the longitudinal axis and when not supported by normal predetermined pressure cause the cylindrical valve member 11 to rotate opposite to the pressure rotation and lift chamber 20 from the sealing liquid 16 to receive pressure for transmission through conduit 13 to the vapor space. Weight 27, in this operation, increases the opening action by increasing the lever arm about the center of rotation and holds the valve in the open position insuring a balance of the internal vacuum with external pressures. On closing, the effectiveness of the weight is decreased and the valve closes rapidly and firmly. To counter-balance this actuating weight and insure rapid, chatter-free closure after the vacuum is released, a bar weight 22 is held in position by brackets 23 on the inside of housing 10, and is picked up by brackets 21 on the periphery of the valve member as it rotates to vent the vacu-

um condition. It will be noted that the bar weight 22 is inactive during the pressure venting operation. To obtain a positive action of the valve, free from chattering and repeated useless operation to gain pressure balance, similar to the use made of velocity pressure head in the pressure release function described above, lip 26 is attached perpendicularly to the tangent on the lower edge of arcuate vacuum release chamber 20. In the vacuum release position, lip 26 is lifted from sealing liquid 16 and presents a surface large enough in area, to respond to the velocity pressure head of the atmosphere pushing in to satisfy the vacuum. This velocity pressure head continues operation beyond the requirements of the vacuum condition due to the motion of the air moving toward the vacuum, and insures the firm and steady seating of the valve member. Arrows have been added to this figure as well, to assist in a full understanding of the breather device operation.

The sealing liquid 16 in housing 10, Figures 1, 2 and 5 is maintained at a predetermined depth to preserve a seal with the cylindrical valve member 11 and prevent venting until the conditions are such as to require positive action. The level of the sealing liquid is preserved by a supply in reservoir 60 which forms part of the housing body. Stopper 61 closes the reservoir and retains the fluid supply therein by atmospheric pressure on the fluid surface in housing 10 and the pressure in equalizing chamber 66. Under conditions of positive pressure as contrasted with vacuum, existing in vapor space 14, referring to Figure 2, the pressure is transmitted upwardly in tube 68 to the space 67 in chamber 66. The liquid level in chamber 66 will be forced down and, if there is not sufficient liquid in the system, the under edge of tube 64 will be above the liquid level thus permitting vapors under pressure to enter chamber 60 displacing liquid and thus causing a limited quantity of liquid to move downward to chamber 10. The pressure will also be transmitted through overflow pipe 69 to liquid seal 70 where the design is such as to present an effective seal under all operating conditions. If the liquid seal level is at the predetermined depth the lower end of tube 64 projecting downward into chamber 66 will not be exposed and, consequently, the vapor in chamber 66 will not be permitted to rise through tube 64 to reservoir 60.

Where a negative pressure or vacuum exists in tank 15, the vacuum is transmitted to equalizing chamber 66 where under extreme conditions the liquid will rise about tube 64 and spill into overflow pipe 69. This condition exists only when there is too much liquid in housing 10. Within housing 10 immediately preceding the rotation of valve member 11 to release the vacuum as shown in Figure 3, the atmospheric pressure will force the liquid seal to rise in chamber 20 of the valve member 11 and depress the level about the mount of tube 62. Under these conditions, if there is not sufficient liquid and the mouth of tube 62 is exposed to the air, atmospheric pressure will force air upward through tube 62 to reservoir 60, thereby releasing sufficient liquid to supply the deficiency.

The construction and operation disclosed herein illustrate the preferred embodiment of a storage tank breathing device. It is not intended that the details described be regarded as limitations upon the scope of the invention except in so far as is included in the accompanying claims.

I claim:

1. A breathing device comprising in combination; a housing adapted to contain sealing liquid having a normal level therein; an inverted open sided valve member pivotally mounted in said housing for oscillating movement from an intermediate position in opposite directions, said member being positioned in said housing when it is in its intermediate position so that both edges are below the normal liquid level and thereby submerged in the sealing liquid and when oscillated in one direction one edge is below the normal liquid level and the other edge is above the normal liquid level to form a vacuum relief chamber, and when oscillated in the other direction the said one edge is raised above the normal liquid level to provide a pressure relief passage, a conduit extending from the exterior of said housing thereinto and to a point above the normal liquid level and within said valve member and adapted to be connected to a source of pressure; and a separate pivotally mounted oscillatable operating chamber secured to said valve member for oscillating the same in either direction, said operating chamber having two ends, one of which is sealed to the atmosphere and projects above the normal liquid level at all times during its oscillating movements and the other being open and positioned below the normal liquid level at all times during its oscillating movements; and a second conduit being adapted to be connected to the same source of pressure as said first conduit and extending into said operating chamber.

2. A breathing device as set forth in claim 1 further including means for supplying liquid to said housing for maintaining the sealing liquid at the normal liquid level.

3. A breathing device as set forth in claim 2 wherein the liquid supply means includes a closed liquid reservoir mounted adjacent said housing and positioned above the normal liquid level therein, a closed pressure equilizing chamber positioned below said reservoir and in communication with said housing at a point below the normal liquid level, conduit connections between said reservoir and said housing and between said reservoir and said pressure equalizing chamber, a conduit extending from said pressure equalizing chamber and adapted to be connected to the same source of pressure, and an overflow conduit from said pressure equalizing chamber.

4. A breathing device comprising in combination, a housing containing a sealing liquid, an open sided cylindrical valve member pivotally mounted along its longitudinal axis parallel to the surface of the sealing liquid for oscillatory movements about said axis, said member being partially submerged in the sealing liquid to form a vacuum relief chamber, a pipe extending from the exterior of said housing to a point above the liquid level within said cylindrical member, a first arcuate plate on said member and extending in spaced relation along a portion of said cylindrical valve member to form a pressure relief passage open at one end to the interior of the cylindrical member and open at the other end to the atmosphere, a second arcuate plate attached to and extending along a portion of said first plate in spaced relation thereto and forming an operating chamber closed at one end from the atmosphere and sealed at the other end by said liquid, a conduit extending from said pipe and through the liquid sealed end of the operating chamber to a point above said sealing liquid, said

cylindrical member and said first mentioned arcuate plate, respectively, cooperating with the sealing liquid to control the supply and exhaust of fluid to and from said pipe as the cylindrical member oscillates in response to pressure changes in said pipe.

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