

A VALVE ASSEMBLY FOR A STEAM TRAP

FIELD

The present disclosure relates to the field of steam traps.

BACKGROUND

- 5 The background information herein below relates to the present disclosure but is not necessarily prior art.

Steam traps work on a principle of buoyancy. Typically, an outlet orifice of the steam trap is opened by virtue of buoyant force acting on a hollow float of the steam trap. The float is configured such that the buoyant force acting on the float is sufficient enough to overcome
10 the self-weight of the float, the self-weight of a mechanism connected to the float, and the differential pressure acting across the outlet orifice. A conventional steam trap, which is used in high pressure applications, experiences high differential pressure across an outlet orifice thereof. To overcome the higher differential pressure, the conventional steam trap requires larger float which makes the steam trap bulky. Further, there is constraint on the size of the
15 outlet orifice. If the outlet orifice is made bigger, the steam trap becomes bulky. If the outlet orifice is made smaller, the discharge capacity of the steam trap gets severely hampered.

Therefore, there is felt a need for a valve assembly for a steam trap that alleviates the abovementioned drawbacks of the conventional steam traps.

OBJECTS

- 20 Some of the objects of the present disclosure, which at least one embodiment herein satisfies, are as follows:

An object of the present disclosure is to provide a valve assembly for a steam trap that is compact in nature.

- Another object of the present disclosure is to provide a valve assembly for a steam trap that is
25 suitable for high pressure operations as well as low pressure operations.

Another object of the present disclosure is to provide a valve assembly for a steam trap that has a high discharge capacity.

Yet another object of the present disclosure is to provide a valve assembly for a steam trap that is easy to manufacture, install and maintain.

Other objects and advantages of the present disclosure will be more apparent from the following description, which is not intended to limit the scope of the present disclosure.

5 SUMMARY

The present disclosure envisages a valve assembly for draining condensate from the housing of a steam trap. The assembly comprises a pilot orifice, a main seat, an outlet orifice defined in the main seat, a pilot head configured for blocking the pilot orifice, a main head blocking the outlet orifice, a lever connected to the pilot head and coupled to the main head via a delay
10 link. A float is configured to angularly displace the lever to a first position such that the pilot head is displaced to uncover the pilot orifice and to a second position for displacing the main head via the delay link to uncover the outlet orifice to facilitate the draining of condensate to the atmosphere.

The diameter of the outlet orifice is greater than the diameter of the pilot orifice.

15 The first position of the lever corresponds to a first predetermined level of the condensate in the housing of the steam trap while the second position of the lever corresponds to a second predetermined level of the condensate in the housing. The second predetermined level is higher than the first predetermined level of the condensate.

The valve assembly includes a constraining member which is provided in proximity to the
20 pivoted end of the lever, wherein the constraining member is further configured to engage with the delay link when the level of condensate in the housing rises above the second predetermined level.

The delay link extends from an operative bottom end of the main head.

A slot is provided in the delay link and the slot is further configured to receive the
25 constraining member of the lever.

The pilot head and the lever pivots about a pilot pivot provided in the housing.

Further, the main head is pivoted about a main pivot provided in the housing.

According to an aspect of the present invention, the housing is provided with a pressure sensor and a condensate level monitoring sensor for monitoring the operation of the valve assembly.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWING

- 5 A steam trap of the present disclosure will now be described with the help of the accompanying drawing, in which:

Figure 1 illustrates an enlarged sectional view of a conventional steam trap valve assembly;

Figure 2 illustrates an isometric view of the steam trap, in accordance with an embodiment of the present disclosure;

- 10 Figure 3 illustrates an enlarged isometric view of the steam trap of Figure 2;

Figure 4 illustrates a sectional view of the steam trap of Figure 2; and

Figure 5a through Figure 5c illustrates the different levels of condensate and the respective position of the valve assembly.

LIST OF REFERENCE NUMERALS

- 15 01 – Float
02 – Lever
03 – Pilot head
04 – Pilot pivot
05 – Pilot orifice
20 06 – Main head
07 – Main seat
08 – Main pivot
09 – Delay link
10 – Slot

- 11 – Outlet orifice
- 12 – Constraining member
- 13 – Delay link surface
- 100 – Conventional steam reop valve assembly
- 5 101 – Main valve seat
- 103 – Intermediate seat element
- 104 – Intermediate passage
- 107 – Main seat element
- 109 – Axis
- 10 111 – Operating member
- 200 – Steam trap
- 205 – Housing
- 210 – Flange
- 250 - Valve assembly
- 15 C – Enlarged isometric view of the steam trap of the present disclosure

DETAILED DESCRIPTION

Embodiments, of the present disclosure, will now be described with reference to the accompanying drawing.

- Embodiments are provided so as to thoroughly and fully convey the scope of the present disclosure to the person skilled in the art. Numerous details, are set forth, relating to specific components, and methods, to provide a complete understanding of embodiments of the present disclosure. It will be apparent to the person skilled in the art that the details provided in the embodiments should not be construed to limit the scope of the present disclosure. In some embodiments, well-known processes, well-known apparatus structures, and well-known techniques are not described in detail.

The terminology used, in the present disclosure, is only for the purpose of explaining a particular embodiment and such terminology shall not be considered to limit the scope of the present disclosure. As used in the present disclosure, the forms "a," "an," and "the" may be intended to include the plural forms as well, unless the context clearly suggests otherwise.

5 The terms "comprises," "comprising," "including," and "having," are open ended transitional phrases and therefore specify the presence of stated features, integers, steps, operations, elements, modules, units and/or components, but do not forbid the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The particular order of steps disclosed in the method and process of the present
10 disclosure is not to be construed as necessarily requiring their performance as described or illustrated. It is also to be understood that additional or alternative steps may be employed.

When an element is referred to as being "mounted on," "engaged to," "connected to," or "coupled to" another element, it may be directly on, engaged, connected or coupled to the other element. As used herein, the term "and/or" includes any and all combinations of one or
15 more of the associated listed elements.

The terms first, second, third, etc., should not be construed to limit the scope of the present disclosure as the aforementioned terms may be only used to distinguish one element, component, region, layer or section from another component, region, layer or section. Terms such as first, second, third etc., when used herein do not imply a specific sequence or order
20 unless clearly suggested by the present disclosure.

Terms such as "inner," "outer," "beneath," "below," "lower," "above," "upper," and the like, may be used in the present disclosure to describe relationships between different elements as depicted from the figures.

Conventional steam float traps works on the principle of buoyancy. The float is configured in
25 such a way that the buoyant force is sufficient enough to overcome the self-weight of the mechanism of the steam trap and the force due to the differential pressure across the orifice. The size of the float is thus governed mainly by the diameter of the orifice at the given specific differential pressure across the orifice.

Figure 1 illustrates an enlarged sectional view of the conventional steam trap valve assembly
30 100.

The assembly 100 has a valve seat comprising a main seat element 107 and an intermediate seat element 103. The main seat element 107 is pivotably displaceable about a pivot 109 with respect to a main valve seat 101. The intermediate seat element 103 has the intermediate passage 104. In a closed condition, the main seat element 107 and the intermediate seat
5 element 103 are seated on the respective seating edges. During a first part of the movement of an operating member 111, the main seat element 107 is withdrawn from the intermediate seat element 103, and during the second part of the movement of the operating member 111, the intermediate seat element 103 is withdrawn from the main valve seat 101. In this case, both the seating means, i.e., the main seat element 107 and the intermediate seat element 103,
10 rotate about the same pivot 109. However, the assembly 100 experiences high differential pressure across an outlet orifice thereof. To overcome the higher differential pressure, the conventional steam trap assembly 100 requires larger float which makes the steam trap bulky. Further, there is constraint on the size of the outlet orifice. If the outlet orifice is made bigger, the steam trap becomes bulky. If the outlet orifice is made smaller, the discharge capacity of
15 the steam trap gets severely hampered. Further, because of single pivot, the travel required by the float will be more to open the orifice fully, thereby making the steam trap larger in size.

The present disclosure envisages a valve assembly 250 for a steam trap 200 that alleviates the aforementioned drawbacks. The valve assembly 250 of the present disclosure is compact in nature, and can be used for high pressure as well as low pressure applications.

20 The valve assembly 250 for the steam trap 200 of the present disclosure is now described with reference to Figure 2 through Figure 4. Figure 2 illustrates an isometric view of a steam trap 200, in accordance with an embodiment of the present disclosure. Figure 3 illustrates an enlarged isometric view of the portion 'C' of the steam trap 200. Figure 4 illustrates a sectional view of the steam trap 200 depicting the detailed construction of the valve assembly
25 250.

The valve assembly 250 and the steam trap 200 in accordance with the present disclosure comprises at least one float 01, at least one lever 02, at least one pilot head 03, at least one pilot pivot 04, at least one pilot orifice 05, at least one main head 06, at least one main seat
30 07, at least one main pivot 08, at least one delay link 09, a delay slot 10 in each of the delay link 09, and at least one outlet orifice 11.

The steam trap 200 is typically connected between a heat exchanger (not specifically shown in figures) and a condensate return system (not specifically shown in figures). The condensate return system is further connected to feed water tank (not specifically shown in figures). The steam trap 200 is in fluid communication with the feed water tank via a pipe. The outlet orifice is defined in the main seat 07 of the valve assembly 250. The pipe is connected to the outlet orifice 11 of the steam trap via a flange 210. The steam trap 200 receives condensate from the heat exchanger via an inlet pipe (not specifically shown in figures) and discharges the received condensate via the outlet orifice 11.

The steam trap 200 comprising the housing 205 and the valve assembly 250 is shown in Figure 2. The float 01 enclosed with the housing 205 has a hollow configuration, and is displaceable along a vertical plane under the influence of buoyant force exerted by the condensate accumulated within the housing 205.

The outlet orifice 11 is configured in the main seat 07. The main head 06 is pivotally connected to the housing 205 via the main pivot 08. The main head 06 rests against the main seat 07, and is configured to control flow of condensate through the outlet orifice 11. The delay link 09 is connected to the main head 06. The delay link 09 further extends orthogonally from the main head 06. The delay link 09 is has a slot 10 formed therein and a delay link surface 13.

The pilot orifice 05 in the form of a hole is defined in the central region of the main head 06. The diameter or size of the pilot orifice 05 is smaller than the diameter or size of the outlet orifice 11. The pilot orifice 05 is configured to provide a fluid passage between interior of the housing 205 and the outlet orifice 11. The fluid flows through the pilot orifice when the level of condensate rises above a first predetermined level (L1).

Further, the float 01 is pivotably coupled to the main head 06. More specifically, the steam trap 200 includes a lever 02 extending from the float 01. The lever 02 is pivotably connected to the main head via a pilot pivot 04. A pilot head 03 is configured on the lever 02 such that the pilot head 03 restricts the condensate flow through the pilot orifice 05 when the float 01 is at its lowermost position. In an embodiment, the pilot head 03 is welded to the lever 02. In another embodiment, the lever 02 has a partial U-shaped configuration as shown in Figure 3.

A constraining member 12 is connected to a free end of the lever 02, and is received in the slot 10. As the constraining member 12 has limited travel in the slot 10, the constraining member 12 limits the pivotal motion of the lever 02, and thereby of the float 01.

The working of the steam trap 200 is now elaborated in subsequent paragraphs.

5 Initially both the outlet orifice 11 and the pilot orifice 05 are closed. The pilot head 03 sits firmly on the pilot orifice 05, and thus, no condensate flow takes place through the outlet orifice 11 and the pilot orifice 05. As the condensate starts accumulating in the steam trap 200, the accumulated condensate starts exerting buoyant force on the float 01. When the level of condensate in the housing 205 rises above a first predetermined level (L1) the lever 02
10 moves to a first position. The movement of the lever 02 beyond the first position displaces the pilot head 03 to uncover the pilot orifice 05. The displacement of the pilot 03 allows the condensate to flow through the pilot orifice 05. At this stage, the main head 06 is not displaced. As the diameter of the pilot orifice 05 is smaller than the outlet orifice 11, the buoyant force required to overcome the differential pressure across the pilot orifice 05 is less
15 which helps in reducing the size of the float as against the conventional steam trap and, thereby making the new steam trap 200 compact.

As the condensate within the steam trap 200 starts accumulating more and more, the float 01 is further pivotally displaced about the pilot pivot 04. As the level of condensate rises beyond the first predetermined level (L1) the constraining member 12 displaces through the slot 10.
20 When the condensate level rises up to a second predetermined level (L2) the lever 02 move to a second position. At the second position of the lever 02 the constraining member 12 travels to the extreme end of the slot 10. When the level of the condensate rises above the second predetermined level (L2), the further displacement of the float 01 engages the constraining member 12 with the delay link 09 as the constraining member 12 can be displaced freely only
25 upto the delay link surface 13. Any further increase in the level of the accumulated condensate above the second predetermined level (L2) results in pivotal displacement of the main head 06 about the main pivot 08 under the influence of the lever 02 and the constraining member 12.

The change in the degree of opening of the valve assembly 250 with the increasing level of
30 condensate is illustrated using Figures 5a, 5b, and 5c. The level of condensate is shown by L0, L1, and L2 such that: $L0 < L1 < L2$. When the level of the condensate is at level L0, both

the outlet orifice 06 and the pilot orifice 05 are in closed configuration. As the level of the condensate reaches L1, the pilot head 03 is moved by the lever 02 so as to open the pilot orifice 05. The condensate starts draining at a lower flow rate at this state. Further, with an increase in the level of condensate beyond L2, both the outlet orifice 11 and the pilot orifice 05 are in an open state and the condensate starts draining through the outlet orifice 05 at an increased flow rate, thereby expediting the discharge of the condensate.

The pivotal displacement of the main head 06 uncovers the outlet orifice 11, and thus, the accumulated condensate is discharged from the steam trap 200 at an increased flow rate to empty the housing in minimum time.

Once the pilot orifice 05 is open, the condensate starts flowing out through the pilot orifice 05. This results in drop in the differential pressure across the outlet orifice 11. Thus, the float 01 does not require to overcome the differential pressure across the outlet orifice 11 as it is already countered due to piloting.

In the steam trap 200, the dimensions of the float 01 and the lever 02 are determined in accordance with the size of the pilot orifice 05.

The technical advantage of implementing the valve assembly 250 of the present disclosure is due the provision of multiple pivots, i.e. the main pivot 08 and the pilot pivot 04, the main head 06 with bigger outlet orifice diameter can be operated with the aforementioned arrangement. Further, the travel of the float 01 to open the outlet orifice 11 is minimal as compared to steam traps with single pivot arrangement. Thus, in the same travel of the float 01, outlet area available for the condensate is larger as compared to steam traps with single pivot arrangement. This makes the steam trap 200 compact for the same discharge capacity. In an embodiment, the travel of the float 01 is reduced by about 50% as compared to the travel of a float in conventional steam traps having single pivot arrangement.

The multiple pivots make the location of the pilot orifice 05 and the pilot pivot 04 independent of the main seat 07 and main pivot 08.

Further, the multiple pivot arrangement provides sufficient self-seating freedom for both the sealing edges as the pivots are independent of each other.

The multiple pivot arrangement makes the sizing of the outlet orifice 11 independent of the pilot orifice 05. This makes the steam trap 200 suitable for high pressure applications as well as low pressure application with high discharge capacity. Further, the multiple pivot arrangement reduces the complexity of the steam trap 200 by eliminating the interdependency
5 of the critical components, thereby making the steam trap 200 easy to manufacture, install, and maintain.

The housing 205 is provided with a pressure sensor (not shown in figures) and a condensate level monitoring sensor (not shown in figures) for monitoring the operation of the valve assembly 250.

10 The steam trap 200 can cater to extreme pressure and condensate conditions. The steam trap 200 has high discharge capacity at very low differential pressure as well as at very high differential pressure.

The foregoing description of the embodiments has been provided for purposes of illustration and not intended to limit the scope of the present disclosure. Individual components of a
15 particular embodiment are generally not limited to that particular embodiment, but, are interchangeable. Such variations are not to be regarded as a departure from the present disclosure, and all such modifications are considered to be within the scope of the present disclosure.

TECHNICAL ADVANCEMENTS

20 The present disclosure described herein above has several technical advantages including, but not limited to, the realization of a valve assembly for a steam trap that:

- is compact in nature;
- has high discharge capacity;
- is suitable for high pressure operations as well as low pressure operations; and
- 25 • is easy to manufacture, install and maintain.

The embodiments herein and the various features and advantageous details thereof are explained with reference to the non-limiting embodiments in the following description. Descriptions of well-known components and processing techniques are omitted so as to not

unnecessarily obscure the embodiments herein. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments
5 herein.

The foregoing description of the specific embodiments so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended
10 to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of
15 the embodiments as described herein.

The use of the expression “at least” or “at least one” suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the disclosure to achieve one or more of the desired objects or results.

Any discussion of documents, acts, materials, devices, articles or the like that has been
20 included in this specification is solely for the purpose of providing a context for the disclosure. It is not to be taken as an admission that any or all of these matters form a part of the prior art base or were common general knowledge in the field relevant to the disclosure as it existed anywhere before the priority date of this application.

The numerical values mentioned for the various physical parameters, dimensions or
25 quantities are only approximations and it is envisaged that the values higher/lower than the numerical values assigned to the parameters, dimensions or quantities fall within the scope of the disclosure, unless there is a statement in the specification specific to the contrary.

While considerable emphasis has been placed herein on the components and component parts of the preferred embodiments, it will be appreciated that many embodiments can be made and
30 that many changes can be made in the preferred embodiments without departing from the principles of the disclosure. These and other changes in the preferred embodiment as well as

other embodiments of the disclosure will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the disclosure and not as a limitation

WE CLAIM:

1. A valve assembly (250) for draining condensate from a housing (205) of a steam trap (200), said assembly (250) comprising at least one pilot orifice (05), at least one main seat (07), at least one outlet orifice (11) defined in said main seat (07), at least one pilot head (03) pivoted about a pilot pivot (04) and configured for blocking said pilot orifice (05), at least one main head (06) pivoted about a main pivot (08) and configured for blocking said outlet orifice (11), at least one lever (02) connected to said pilot head (03) and coupled to said main head (06) via at least one delay link (09), at least one float (01) configured to pivotally displace said lever (02) to a first position for displacing said pilot head (03) to uncover said pilot orifice (05) and to a second position for displacing said main head (06) via said delay link (09) to uncover said outlet orifice (11).
5
 2. The valve assembly (250) as claimed in claim 1, wherein the diameter of said outlet orifice (11) is greater than said pilot orifice (05).
10
 3. The valve assembly (250) as claimed in claim 1, wherein said first position of said lever (02) corresponds to a first predetermined level (L1) of the condensate in said housing (205) while said second position of said lever (02) corresponds to a second predetermined level (L2) of the condensate in said housing (205), wherein said second predetermined level (L2) is higher than said first predetermined level (L1).
15
 4. The valve assembly (250) as claimed in claim 1, includes at least one constraining member (12) provided proximal to the pivoted end of said lever (02), wherein said constraining member (12) is configured to engage with said delay link (09) when the level of condensate in said housing (205) rises upto and above said second predetermined level (L2).
20
- 25

5. The valve assembly (250) as claimed in claim 1, wherein said delay link (09) extends from an operative bottom end of said main head (06).
6. The valve assembly (250) as claimed in claim 1, wherein a slot (10) is provided in each of said delay link (09) and said slot (10) is configured to receive corresponding said constraining member (12).
7. The valve assembly (250) as claimed in claim 1 is provided with a pressure sensor and a condensate level monitoring sensor in said housing (205).