United States Patent

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[54] **DEVICE FOR AUTOMATICALLY AND PERIODICALLY SPRAYING A PRESSURIZED LIQUID**

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[52] **U.S. Cl.**.....**222/54,** 239/67

[51] **Int. Cl.** **B67d 5/08**

[58] **Field of Search** 239/67; 222/54

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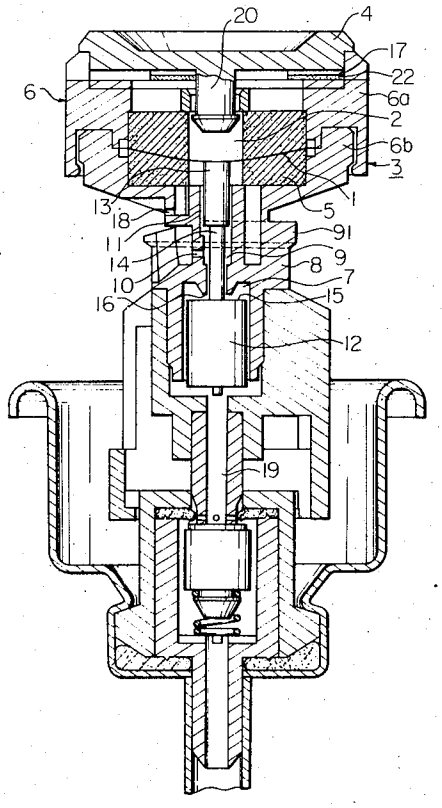
[57] **ABSTRACT**

An improved device for automatically and periodically spraying a pressurized liquid comprises a spray nozzle connected to a liquid source through valve means, a heat-responsive bimetal disc for periodically actuating spraying mechanism and means for defining a chamber for containing the bimetal disc, which defining means for bimetal disc chamber is provided with a vent means capable of adjusting ventilation area thereof, whereby the device is actuated at preselected time intervals for periodical spray.

6 Claims, 8 Drawing Figures



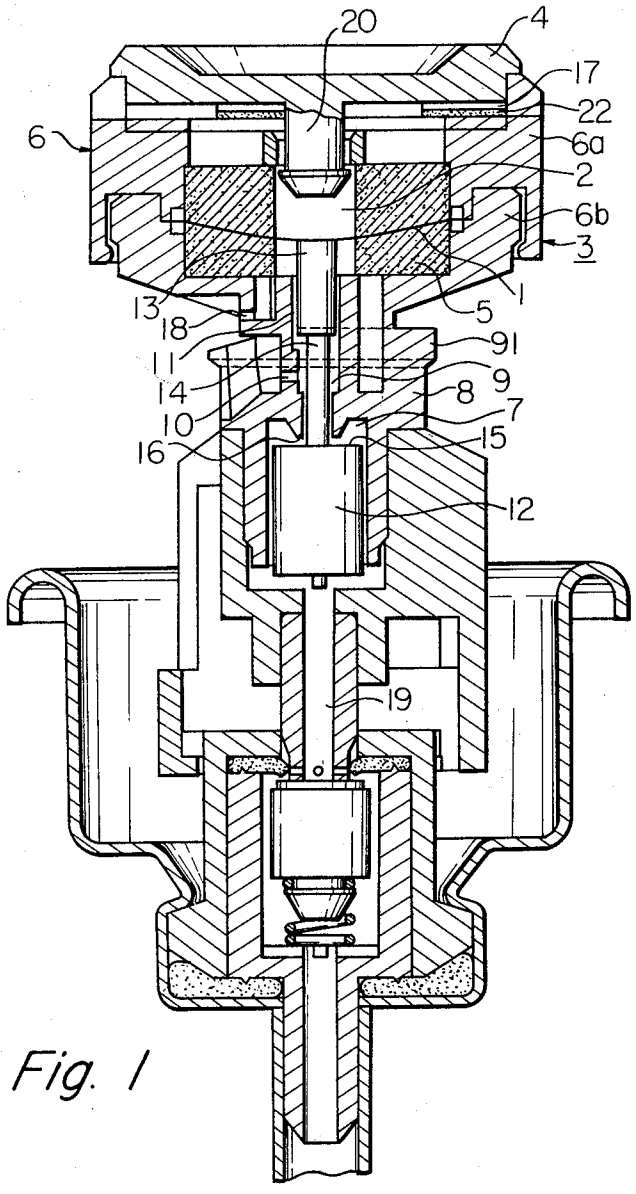


Fig. 1

Fig. 2

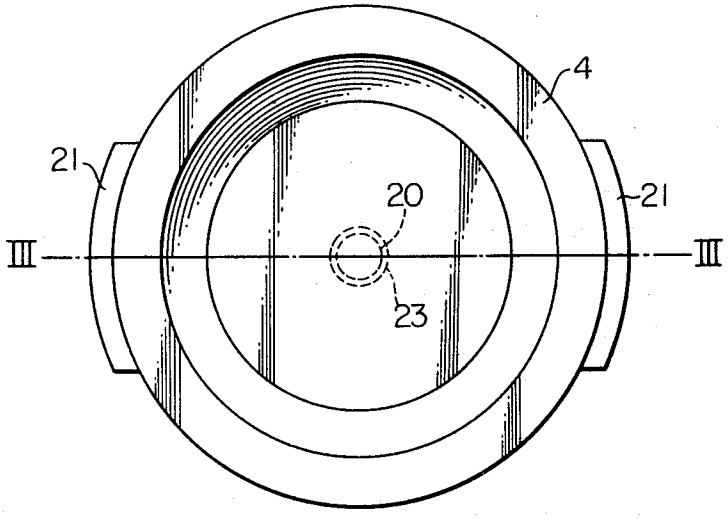


Fig. 3

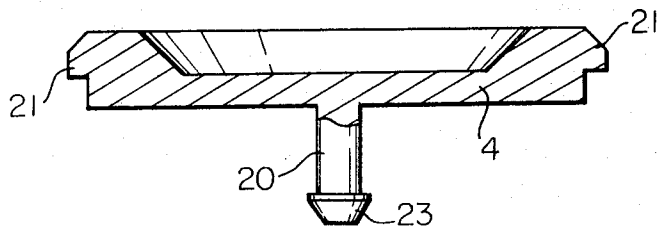


Fig. 8

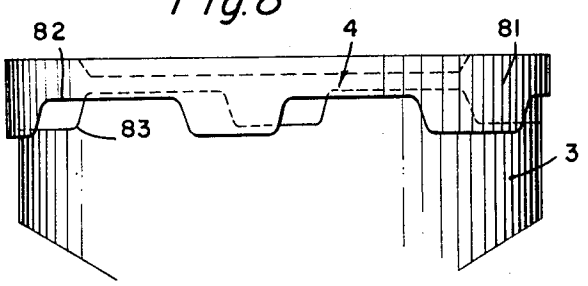


Fig. 4

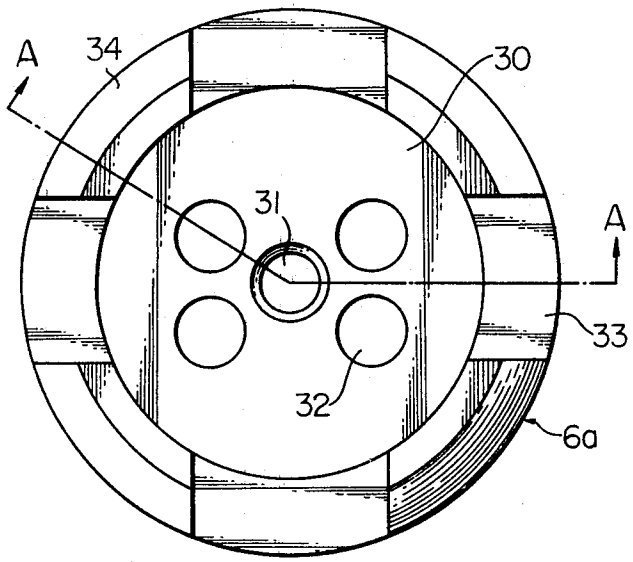


Fig. 5

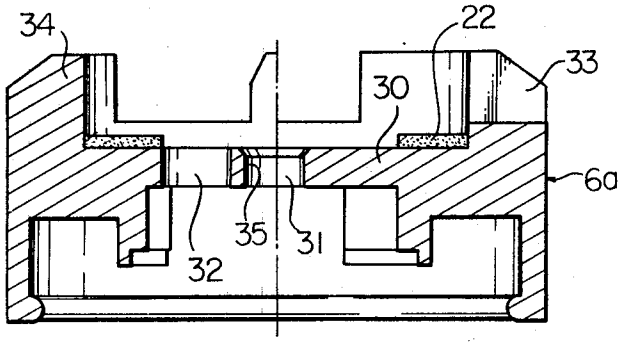


Fig. 6

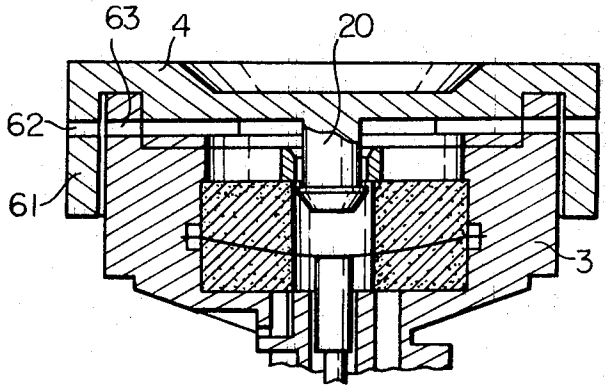
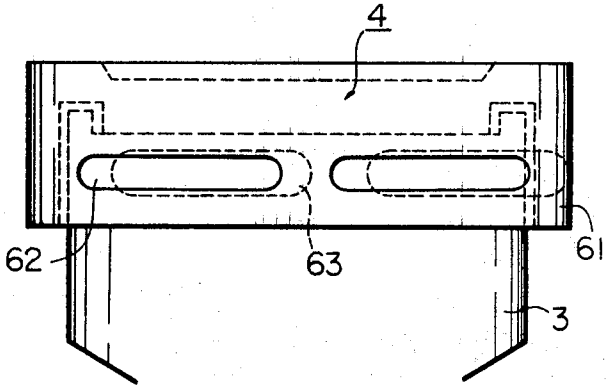


Fig. 7



DEVICE FOR AUTOMATICALLY AND PERIODICALLY SPRAYING A PRESSURIZED LIQUID

The present invention relates to a device for automatically and periodically spraying a pressurized liquid, more particularly, relates to an improved device for automatically and periodically spraying a pressurized liquid at preselected time intervals for periodical spray.

When it is required to spray a disinfectant, insecticide, deodorizer or perfume into a closed chamber such as a warehouse, bath room and toilet room, generally, the above-mentioned agents are dissolved in a solvent together with a high pressure liquefied gas and the solution is automatically and periodically sprayed into the chamber. For instance, when the insecticide is utilized for exterminating noxious insects in the warehouse, it is necessary to periodically spray a solution containing the insecticide in the warehouse at preselected time intervals for a long time. Generally, insecticides have an injurious effect on human health. Therefore, it is desirable that spraying of insecticides is carried out automatically in the absence of the operator. In order to accomplish the above purpose, various automatic spraying methods wherein the spraying is controlled electrically or electromagnetically, are provided. However, these proposed methods are not actually utilized owing to economical disadvantages due to high cost thereof.

In the above circumstance, an automatically and periodically spraying device which utilizes a heat-responsive bimetal disc was provided for eliminating the disadvantages of the prior device as mentioned above. Utilizing the device, the solution containing an agent together with a high pressure liquified gas is ejected from a container into atmosphere by the high pressure of the liquefied gas.

When the solution is sprayed, a portion of the solution, in which the liquefied gas is gasified while causing lowering of ambient temperature, contacts a bimetal disc which is heat-responsive and capable of reversing its bending direction depending on temperature thereof, so as to cool the bimetal disc. The bimetal disc reverses its bending direction through cooling, whereby the spraying of the solution is stopped. Next, the bimetal disc absorbs heat from ambient atmosphere. When the bimetal disc is heated to a prescribed temperature, the bending direction is reversed so as to actuate the spraying of the solution.

However, the above-mentioned automatic and periodic spraying device has the defect that the time intervals between sprayings fluctuate because the time intervals, namely, spray-releasing time period depend on ambient temperature which is changeable with time lapse.

From the above-mentioned defect, it is very difficult, in the conventional automatic and periodic spraying device utilizing the bimetal disc, to spray the solution with a predetermined constant quantity thereof at preselected fixed time intervals.

It is an object of the present invention to provide an improved device for automatically and periodically spraying a pressurized liquid at preselected time intervals.

These and other objects and features of the present invention will be made more apparent by the following

detailed description and the accompanying drawings, wherein

FIG. **1** shows a cross-sectional view of an embodiment of the spraying device of the present invention being in an actuating condition,

FIG. **2** shows a plan view of a lid member in the bimetal chamber defining means of the device shown in FIG. **1**,

FIG. **3** shows a cross-sectional side view of the lid member of FIG. **2**,

FIG. **4** shows a plan view of an upper member of a cup member in the bimetal disc chamber-defining means of the device shown in FIG. **1**,

FIG. **5** shows a cross-sectional side view of the upper member of FIG. **4**,

FIG. **6** shows a cross-sectional side view of another embodiment of the bimetal disc-defining chamber according to the present invention,

FIG. **7** shows a sketchy side view of the bimetal disc-defining chamber shown in FIG. **6**, and

FIG. **8** shows a sketchy side view of another embodiment of the bimetal disc-defining chamber according to the present invention.

Referring to FIG. **1**, a bimetal disc **1** is contained in a bimetal disc chamber **2** formed in a bimetal disc-defining means **6**. The bimetal disc chamber-defining means **6** is composed of a cup member **3** and a lid member **4** and the bimetal disc chamber **2** contains porous and permeable substances **5** by which the bimetal disc **1** is sandwiched. The cup member **3** is composed of an upper member **6***a* and bottom member **6***b*. A valve chamber **7** is formed in a body member **8** and connected to a spray nozzle **10** through a main passageway **9**. The main path **9** is also connected to the bimetal disc chamber **2** through a branched passageway **11**. A valve member **12** is disposed in the valve chamber **7** so as to open and close the communications between the main passageway **9** and the valve chamber **7** and the valve chamber **7** and a passageway **19** through which the valve chamber **7** is connected to a solution source which is not shown in the drawing. An actuating rod **13** located in the branched passageway **11** forms a narrow intervening space between the inside wall surface of the branched passageway **11** and the outside surface of the actuating rod **13**, and connected to the valve member **12** through a connection rod **14**.

A top end of the actuating rod **13** is operatively connected to the lower face of the bimetal disc **1**.

That is, when the temperature of the bimetal disc **1** rises to a preselected higher point, the bimetal disc **1** bends downwardly as shown in FIG. **1**, and therefore, the lower face of the bimetal disc **1** downwardly pushes the top end of the actuating rod **13**. The valve member **12** connected to the actuating rod **13**, accordingly, goes down so that the upper end **15** of the valve member **12** spaces from the lower face of a valve seat **16** which is extended from the body member **8** into the valve chamber **7**. Namely, the downward bending of the bimetal disc **1** results in opening he communication between the main passageway **9** and the valve chamber **7**. Then, the pressurized solution in the solution source flows into the main passageway **9** through the valve chamber **7**. The major portion of the pressurized solution flown in the main passageway **9** is sprayed into atmosphere through the spray nozzle **10**, and a minor

portion thereof is fed into the bimetal disc chamber 2 through the narrow branched passageway 11. The liquefied gas in the pressurized solution fed into the bimetal disc chamber 2 gasifies in the bimetal disc chamber 2 while absorbing the necessary latent heat for gasification from ambient atmosphere, whereby the bimetal disc 1 is cooled. When the temperature of the cooled bimetal disc 1 lowers to a preselected lower point, the bimetal disc 1 upwardly bends so as to release the operative connection between the bimetal disc 1 and the actuating rod 13. By this release, the valve member 12 in the valve chamber 7 is upwardly pushed so that the upper end 15 contacts the valve seat 16. That is, the upward bending of the bimetal disc 1 results in closing of the communication between the valve chamber 7 and the main passageway 9. Accordingly, the spray of the solution is stopped.

The quantity of the pressurized solution sprayed through the spray nozzle 10 during one spraying depends on a time period from the time when the bimetal disc 1 is downwardly bent, to the time when the bimetal disc 1 is upwardly bent. Therefore, the spray quantity of the pressurized solution during once spraying can be adjusted by preselecting the bending temperature difference of the bimetal disc 1 between the downward bending point and the upward bending point thereof.

In the case where a volatile liquid such as methyl alcohol, ethyl alcohol, acetone and ether is mixed in the pressurized solution, the solution fed into the bimetal disc chamber 2 through the branched passageway 11 is absorbed by the porous and permeable substance 5 such as sponge and synthetic resin spongy material, and then the volatile liquid in the solution is vaporized gradually while the liquefied gas is rapidly gasified. In this vaporization, the volatile liquid absorbs the latent heat for vaporization from ambient atmosphere in the bimetal disc chamber 2 so as to result in lowering of the temperature of the bimetal disc 1.

The bimetal disc 1 which was rapidly cooled with the rapid advance of gasification of the liquefied gas in the solution, therefore, is further gradually cooled with the advance of vaporization of the volatile liquid in the solution. The further cooling of the bimetal disc 1 causes an extension of the time period while the temperature of the bimetal disc 1 is raised from the preselected lower point or lowered to the preselected higher point.

The cooling effect for the bimetal disc 1 by the vaporization of volatile liquid strongly depends on ventilating conditions between the bimetal disc chamber 2 and atmosphere. When the bimetal disc chamber 2 has a vent having a larger ventilation area so as to successfully vaporize the volatile liquid, the cooling effect for the bimetal disc 1 is more remarkable than that of a smaller ventilation area. This higher cooling effect of the volatile liquid causes the extension of time intervals between a time when the bimetal disc 1 upwardly bends so as to stop spraying and a time when the bimetal disc 1 downwardly bends so as to start spraying. Additionally, when the bimetal disc chamber 2 has a small vent by which the vaporization of the volatile liquid is not substantially effected, the cooling effect of the volatile liquid is lower and accordingly, the time period from a time when the bimetal disc 1 upwardly bends to a time when the bimetal disc 1 downwardly bends becomes shorter than that of the bimetal disc chamber having a large vent. From the above fact, it is concluded that it is possible to control the time intervals for periodically spraying the pressurized solution by adjusting the ventilation area of the vent of the bimetal disc chamber 2.

A feature of the device of the present invention can be found in the point that the vent of the bimetal disc chamber 2 is capable of being adjusted in a desired ventilation area.

In the device shown in FIG. 1, a vent 17 is formed between an upper end of a side wall of the cup member 3 and a peripheral part of lower face of the lid member 4. Accordingly, the ventilation area can be adjusted by moving the lid member 4 with respect to the upper end of the side wall of the cup member 3.

An embodiment of the vent will be explained in more detail referring to FIGS. 1 to 5. FIG. 2 is a plan view of the lid member 4 shown in FIG. 1 and FIG. 3 is a partial cross-sectional side view of the lid member 4.

FIG. 4 is a plan view of the upper member 6*a* of the cup member 3 and FIG. 5 is a cross-sectional view of the upper member 6*a* along line A—A of FIG. 4. In this embodiment shown in FIGS. 1 to 5, an actuating projection 20 extends from the lower face of the lid member 4 into the bimetal disc chamber so as to approach the top end of the actuating rod 13. When the upper face of the lid member 4 is manually pushed downward, the lower end of the actuating projection 20 effects the pushing down of the valve means composed of the actuating rod 13, connecting rod 14 and valve member 12. Through manually pushing the lid member 4, the pressurized solution is sprayed through the spray nozzle 10.

Preferably, an elastic annular plate 22 is located on the upper member 6*a* facing the lower face of the lid member 4.

In order that the actuating projection 20 is operatively connected with the actuating rod 13 by manually pushing down the lid member 4 toward the cup member 3, the annular plate 22 as shown in FIG. 1 is preferably composed of an elastic resin foam which is easily compressed by pressing.

The lid member 4 has arc-shaped projection parts 21 extending from the peripheral end thereof as shown in FIG. 2.

Referring to FIGS. 4 and 5, the upper member 6*a* is provided with a supporting member 30 for the lid member 4. The actuating projection 20 of the lid member 4 as shown in FIGS. 2 and 3 is slidably inserted into a center opening 31 formed at center portion of the supporting member 20, whereby the actuating projection 20 acts as a rotation shaft for rotating the lid member 4 around a center thereof along the upper end 34 of the side wall of the upper member 6*a*. The actuating projection 20 can not be pulled out from the center opening 31 owing to the presence of a stopper 23 disposed at end of the actuating projection 20. The supporting member 31 has a plurality of openings 32 for fluidly connecting the internal space of the cup member 4 to atmosphere therethrough. The upper end 34 of the side wall of the upper member 6*a* has cut-offs 33 which are capable of fitting the projections 21 of the lid member 4. When the projections 21 of the lid member 4 are put on the upper end 34 of the upper

member 6a by rotating the lid member 4 around the actuating projection 20, the bimetal disc chamber 2 can be fluidly connected to atmosphere through vents 17 shown in FIG. 1 which vents are formed by the cut-offs 33. When the projections 21 of the lid member 4 are fitted in the cut-offs 33 by rotating the lid member 4, the cut-offs 33 is so closed by the projection 21 as to close the communication between the bimetal disc chamber 2 and atmosphere. Accordingly, it is possible that the vent 17 of the bimetal disc chamber 2 is opened or closed by rotating the lid member 4 around the actuating projection 20 along the upper end 34. The annular sheet 22 put on the supporting member 30 is effective for completely closing the communication when the projections 21 are fitted in the cut-offs 33. Also, under the condition that the projections 21 are fitted in the cut-offs 33, when the lid member 4 is manually pushed downwardly, the annular sheet 22 is compressed, whereby the lower end of the actuating projection 20 is operatively connected with the top end of the actuating rod 13 through the bimetal disc 1.

In the embodiment shown in FIGS. 1 to 5, the bimetal disc chamber 2 can have only one ventilation area. If the cup member 3 has two or more kinds of cut-offs having different depths from each other, or the lid member has two or more kinds of projections having different heights from each other, the bimetal disc chamber can have two or more kinds of vents having ventilation areas different from each other. Accordingly, the time intervals for periodically spraying is variable into two or more time periods.

Also, the ventilation area of the bimetal disc chamber 2 may be adjusted by sliding the actuating projection 20 up and down along the center opening 31 of which, internal surface 35 is coated by an elastic substance, for example, elastic resin foam and fiber mass so as to support the actuating projection 20. It may be that the actuating projection 20 is driveably fitted into the opening 31 by way of a screw.

As shown in FIG. 1, it is preferable that a supplementary vent 18 is formed in the bimetal disc chamber-defining means, in order to fluidly connect the bimetal disc chamber to atmosphere even when the vent 17 is completely closed. The supplementary vent 18 is effective for maintaining the bimetal disc chamber under normal pressure.

Referring to FIGS. 6 and 7 which show another embodiment of the vent means of the bimetal disc chamber, the lid member 4 has a side wall 61 extending from the peripheral end of the lid member 4 and surrounding the side wall of the cup member 3. The side wall 61 has one or more openings 62. The side wall of the cup member 3 also has one or more openings 63 corresponding to the opening 62. The openings 62 and 63 are located so that they can be superimposed with one another. Accordingly, the effective ventilation area can be optionally adjusted by rotating the lid member 4 around the actuating projection 6 along the upper end of the cup member 3.

Referring to FIG. 8 which shows another embodiment of the vent means, the side wall of the lid member 4 has one or more cut-offs 82 at a lower end thereof, and the side wall of the cup member 3 has one or more cut-offs 83 at an upper end thereof. These cut-offs 82 and 83 are located so that they can be superimposed with one another by rotating the lid member 4 along the upper end of the cup member 3. Accordingly, the ventilation area of the bimetal disc chamber can be optionally adjusted by rotation of the lid member 4.

What we claim is:

1. An improved device for automatically and periodically spraying a pressurized liquid comprising:
- means for defining a valve chamber connectable to a pressurized liquid source;
- means for defining a bimetal disc chamber disposed downstream from said valve chamber;
- a nozzle disposed downstream from said valve chamber for spraying said pressurized liquid into atmosphere;
- means for defining a main passageway providing communication between said valve chamber and said spray nozzle and a branched passageway providing communication between said main passageway and said bimetal disc chamber;
- valve means disposed within said valve chamber for opening and closing said communication between said pressurized liquid source and said main passageway;
- and a heat-responsive bimetal disc mounted within said bimetal disc chamber for actuating said valve means in a first position wherein said bimetal disc is heated to a temperature not lower than a preselected high temperature to effect opening of said communication between said pressurized liquid source and said main passageway, and in a second position wherein said bimetal disc is cooled to a temperature not exceeding a preselected low temperature to effect closing said communication, said bimetal disc chamber-defining means is provided with a vent means for providing communication between said bimetal disc chamber and atmosphere, capable of adjusting ventilation area thereof whereby said device is actuated at preselected time intervals for periodic spray.

2. A device as set forth in claim 1, wherein said bimetal disc chamber-defining means comprises a cup member connected to said branched passageway and a movable lid member covering said cup member, said vent means is formed between an upper end of said cup member and a lower end of said lid member, and said ventilation area is adjusted by moving said lid member with respect to said cup member.

3. A device as set forth in claim 2, wherein said lid member is capable of moving along an axis line of said cup member.

4. A device as set forth in claim 2, wherein said lid member is capable of moving along said upper end of said cup member.

5. A device as set forth in claim 2, wherein said upper end of said cup member has at least one cut-off and said lower end of said lid member at least one projection capable of fitting in said cut-off, whereby when said projection is put into said cut-off, said ventilation area becomes minimum, but when said projection is put outside said cut-off of said cup member, said ventilation area becomes maximum.

6. A device as set forth in claim 2, wherein said cup member has at least one vent opening formed on the side wall thereof, and said lid member has at least one vent opening formed on the side wall thereof capable of being superposed on said opening of said cup member.

* * * * *