ABSTRACT: An automatic fire protection sprinkler head including a frame having means providing a passage for water or the like terminating in an outlet closed by a valve disc, together with a temperature responsive linkage acting between the valve disc and the frame to normally maintain the outlet closed comprising a pair of bimetal elements which react similarly on a slow rate of temperature rise below a predetermined high value to produce no effect, and which react differentially when the high temperature is exceeded or when there is a rapid rate of rise in temperature, to release the valve member and let the water flow. Five embodiments are illustrated.
AUTOMATIC SPRINKLER HEAD

BACKGROUND OF THE INVENTION

The art relating to automatic fire protection sprinkler heads is fairly well developed. In the past, there have been a large number of patented devices and a good number of commercial devices operable automatically for opening the water outlet in a sprinkler head in response to a rise in ambient temperature to some predetermined high value indicative of the existence of some dangerous fire hazard. Such devices have operated in response to movement of a thermostatic element such as a bimetal piece, and they have operated in response to fusible elements which melt or yield on existence of some predetermined high temperature. Usually, however, the prior art devices have been responsive only to the attainment of some predetermined high temperature in the vicinity of the automatic control, and have not been responsive to a high rate of rise of temperature below the predetermined high value, when in fact the high rate of rise may also be indicative of a dangerous fire hazard requiring sprinkler operation. While U.S. Pat. No. 2,471,240 illustrates a device responsive to high temperature and to rate of rise, the device is in the nature of a diaphragm or bellows control intended to operate remotely from the sprinkler head itself. While U.S. Pat. No. 1,107,845 illustrates high temperature and rate-of-rise response in a sprinkler head, there are separate devices for obtaining the two responses.

Recent tests of a number of commercially available automatic sprinkler heads have indicated that many of them require a time lapse after a fire starts and before the sprinkler head operates involving 2 to 20 minutes depending upon the type of fire, the height at which the sprinklers are installed and other factors. In fact, there may be a number of situations where a very dangerous condition may be indicated by a high rate of rise of temperature well before the predetermined high value is reached. In other situations, there may be flash fires which generate relatively high rate-of-rise conditions without ever stimulating the predetermined high value for which many sprinklers are set.

Accordingly, it is desirable that an automatic head be provided responsive not only to some predetermined high temperature value but also to a high rate of rise of temperature, which would be simple to manufacture, economical in cost and reliable in operation.

SUMMARY OF THE INVENTION

According to the present invention, there is provided an automatic sprinkler head which responds not only to a predetermined high temperature value but also to a high rate of rise of temperature below the predetermined value. An important advantage in the present invention is the provision of both responses in a single mechanism all incorporated in a unitary device situated at the water outlet. In preferred constructions, a strut acts on the valve closure disc to hold the latter in closed position on the outlet, a lever is pivoted on a fulcrum opposed to the disc and acts on the strut to hold the latter in place, and a thermostatic means adjacent the lever and the strut holds the latter in place, but responds to either high temperature or high rate of rise to release the lever letting the closure member loose to free the water. The preferred thermostatic controls involve the use of two bimetal elements which react similarly in response to slow temperature rise below the predetermined high value so that there is no effect on the valve closure linkage, but which react differentially when the predetermined high value is attained or when there is a high rate of rise below the high value. When the two bimetal elements react differentially, the valve closure linkage is released. In order to demonstrate the breadth of the invention, five embodiments are illustrated.

The embodiments of Figs. 6 and 9 emphasize ease of release, that is, the constructions are designed to require as little force as possible for releasing or unlatching the linkage holding the valve closure disc in place. The embodiments of Figs. 4 and 5 emphasize simplicity in the mechanism employed. The embodiment of Figs. 1 and 2 enjoys advantages of both features.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of one form of sprinkler head apparatus embodying the principles of the present invention;

FIG. 2 is a sectional view taken along the line 2-2 on FIG. 1;

FIG. 3 is a front elevational view of a sprinkler head embodying another form of linkage incorporating the invention;

FIG. 4 is a sectional view taken at about the line 4-4 on FIG. 3;

FIG. 5 is a sectional view similar to those in Figs. 2 and 4, illustrating a third form of the发明);

FIG. 6 is a sectional view similar to the previous sectional views illustrating a fourth form of the invention;

FIG. 7 is a rear elevational view, partly in section, taken at about the line 7-7 of FIG. 6;

FIG. 8 is a front elevational view of a fifth form of the invention; and

FIG. 9 is a sectional view taken at about the line 9-9 of FIG. 8.

DESCRIPTION OF EMBODIMENT OF FIGS. 1 AND 2

Referring now to Figs. 1 and 2, a head generally designated 10 in its entirety, includes a somewhat oval-shaped frame 11 having symmetrically opposed arms 12 and 13 which approach each other near the bottom of the frame at opposite sides of a pipe or fitting 14 threaded externally at 15 for connection with a pipe or the like for conducting water. The fitting 14 is hollow and provides a passage therethrough at 16 terminating in an outlet providing a valve seat at 17 adapted to be closed by a valve closure member in the form of a disc 18. Where the arms 12 and 13 approach each other near the top of the frame 11, there is a cylindrical or conical boss 20 having a central opening therethrough which is threaded to receive a threaded screw 22 having a pointed end 23 providing a fulcrum for leverage acting to hold the disc 18 seated on the outlet 17. In order to spread the water issuing from outlet 18 in the event the sprinkler head is put in operation, a deflector 25 of annular configuration is conically shaped and slotted to disperse the water and has a central portion fitted on a reduction 26 of the boss 20 which is headed over as at 28 to retain the deflector in place.

In order to retain the valve closure disc member 18 in position on the seat 17 to block the outlet and prevent the flow of water, a bowed bimetal element 29 of somewhat C-shaped configuration has a lower end portion seated on top of the disc 18 and retained against movement thereon by means of a pin 30 passing through the bimetal element and seated in the top of the disc. The bimetal element 29 is comprised of two layers of metal 31 and 32 of different composition adhered together and having different rates of expansion so that the bow of the bimetal element is altered on change in ambient temperature.

The upper surface of the lower portion of the bimetal element 29 is engaged by the lower end of a strut 35 preferably seated in a depression on the disc. A lever 36 has an upper end portion engaging the fulcrum 23, an adjacent portion engaging the upper end of the strut 35 and a lower portion projecting through an aperture 37 in the strut, and terminating in an upward and rearwardly turned projection 38. The lever terminates 38 engages a groove in the lower end of a second bimetal element 40 comprised of two layers of metal of different composition, such as 41 and 42 adhered together and having different coefficients of expansion. The bimetal 40 is formed with a bowed intermediate portion so that on change of ambient temperature, the shape of the bow is altered. An intermediate portion of the bimetal 40 engages the edge of the strut 35 adjacent the upper portion of the aperture 37 and the upper end of the bimetal element 40 is engaged by the upper end of the bimetal element 29.
If desired, the lower end of the bimetal element 29 may be attached to the disc 18 by other means such as a projection on the bimetal seated in a complementary recess in the disc, or alternately, the end of the bimetal element 29 may be attached to the lower end of the strut 35 as by pin, rivet or welding, with the strut directly engaging the disc 18. In operation, the disc 18 and bimetal element 30 are placed in position after which the strut 35 is positioned with the lever 36 engaging the fulcrum 23 and engaging the upper end of the strut 35. The linkage thus formed is locked or latched in position by the bimetal element 40 which engages the terminus 38, the fulcrum at the edge of the aperture 37 and the upper end of the bimetal element 30. The linkage may be tightened in place, if desired, by the fulcrum screw 22 which has a slot at the upper end adapted to receive a screwdriver.

In a preferred form of the device constructed and tested, the bimetal element 29 has a thickness on the order of .090 inch while the bimetal 40 has a lesser thickness on the order of .060 inch. In each element the outer layer, that is, 31 or 41, has a relatively high rate of expansion while the inner layer, 32 or 42, has a lower rate of expansion, as a result of which both elements will tend to bow more in the event of a rise in ambient temperature. A suitable commercially available bimetal includes 0.010 inch thick bimetals having expansion rates for the outer layer 29 as the material with a low rate of expansion and brass as the material with a high rate of expansion.

In event of a relatively slow rate of temperature rise, the elements 29 and 40 increase in curvature at a rate such that the adjacent engaging ends move at approximately the same rate until a predetermined high temperature (106° F. for example) is attained, at which time the outer thicker bimetallic element 29 of greater thermal inertia will cease to expand while the inner thinner bimetallic element 40 of less inertia continues increasing in curvature, thereby shortening its length. Ultimately, the upper end of the element 40, acting as a lever, is released from the holding effect of the upper end of the element 29, so that the element 40 pivots counterclockwise about the fulcrum at the upper edge of the aperture 37. This releases or unlatches the lever 36 for movement in a counterclockwise direction about the upper end of the strut 35. The strut is thereby freed, releasing its holding effect on the disc 18 so that the water pressure forces the disc off the seat, opening the outlet for flow of water.

On a rapid rate of temperature rise (15 - 30° per minute, for example), the thinner bimetallic element 40 of less inertia increases in curvature at a greater than the bimetal 29, so that the length of the bimetal 40 is shortened more rapidly, and the upper end of element 40 is freed from the holding effect of the upper end 29 and the release or unlatching occurs as described above.

If the fulcrum at 23 is fixed rather than adjustable, the linkage mechanism may be set by snapping the lever terminus 38 over the end of the bimetal element 40. The mechanical advantage in the linkage or leverage mechanism illustrated in FIGS. 1 and 2 may be relatively great, something on the order of 25:1 for example, between the disc 18 and the interengaged ends of the bimetal elements. More particularly, the mechanical advantage provided by the lever 36 may be on the order of 5:1 when comparing the distance between the fulcrum 23 and the upper end of the strut 35 to the distance between the upper end of the strut 35 and the lower end of the lever at the terminus 38. Similarly, the mechanical advantage may be on the order of 5:1 in the bimetal element 40 when comparing the distance between the terminus 38 and the upper end of the aperture 37 to the distance between the upper end of the aperture and the upper end of the bimetal. Thus, if it is necessary to have a force on the valve closure disc 18 having a value of 300, the force at the cooperating ends of the bimetal elements may be only on the order of 12.

In FIGS. 1 and 2, differential action of the two bimetals in different bimetallic thicknesses which can result in different masses and different thermal inertias. That is, though the materials are similar in the two bimetals, a slower and lesser reaction may be obtained from the greater mass because of the greater thermal inertia, i.e., resistance to temperature change. It should be understood, however, that different reactions can be obtained by utilizing different materials in the two bimetals, and by arranging the bimetals so that different lengths provide differential movement, and by arranging the bimetals in different configurations.

In the embodiment of FIGS. 3 and 4, valve disc 40 is held in place by a strut 41 seated in a groove in the upper surface of the disc. A lever 42 has an upper end portion engaging fulcrum 43, an adjacent intermediate portion engaging the upper end of strut 41 and a lower end portion engaged by a link 44 which has a backwardly turned beveled terminus 45 engaging an indentation in the lever 42 in a manner such that the link 44 may pivot on the lever. The link 44 extends through an aperture 46 in the strut 41 and has an upwardly turned end portion 48 which is latched behind a bowed bimetal element 49 which has a recessed midportion engaging the upward end 48 and engaging the strut 41 though contact with the strut would not be necessary if the bimetal is otherwise suitably restrained against lateral movement.

As best seen in FIG. 3, the bimetal element 49 extends transversely of the oval frame and has opposite ends as at 51 and 52 seated in recesses in the frame arms 53 and 54 respectively, so as to retain the bimetal element in place. Such element consists of two separate layers of different material suitably adhered together and having different coefficients of expansion. In the form illustrated, the layer 55 representing the outer surface of the bow has the higher expansion rate and the inner layer 56 has a lower expansion rate.

A second bimetal element 58 has an upper portion as at 59 secured to an upper portion of the strut 41 and includes a bowed intermediate portion as well as a free opposite end disposed immediately above the upward end portion 48 on the link 44. Bimetal element 58 is thicker than element 49 and consists of two layers of material of different coefficients of expansion, including an outer layer 61 having a relatively high rate of expansion and an inner layer 62 having a lower coefficient of expansion.

In operation, in case of a relatively slow rate of temperature rise, the outer layers of the bowed bimetal elements expand at a greater rate than the inner layers as a result of which the curvature of both elements increases. While the temperature rises slowly, the adjacent portions of the two bimetal elements rise together and approximately equally, having no visible effect on the sprinkler head. At a predetermined high ambient temperature, the thicker bimetal element 58 ceases to respond, while the thinner bimetal element 49 continues to respond, carrying the link end 48 into contact with the end of the bimetal element 58 whereupon the link 44 is unlatched and the linkage falls apart to release the disc 40.

Similarly, in event of a rapid rate of temperature rise, the thinner bimetal element 49 moves more rapidly than the thicker bimetal element 58, so that the latter has the effect of unlatching the upward end 48 from the former.

In FIG. 5, disc 70 is held in place by a strut 71 having a lower end in contact with the upper surface of the disc. A lever 73 of reversed approximate C-shape, has an upper end portion engaging adjustable fulcrum 74, an intermediate portion engaging the upper end of strut 71, a lower portion passing through an aperture 75 in the strut, and an upwarded terminus 76 latched behind the material of the strut 71 adjacent the upper edge of the aperture 75. If desired, the terminus 76 may carry a small ball 77 or other projection affixed to the terminus and providing point contact with the strut in order to reduce the friction which must be overcome to unlatch the lever from the strut.
A first relatively thick bimetal element 78 has one end portion as at 79 affixed to the upper end of the strut as by rivets or other suitable means. A second thinner bimetal element 80 has an upper end portion secured to the other end of the first bimetal element as by means of rivets or the like at 82. The free end of the bimetal element 80 is disposed adjacent and immediately above the upturned end portion 76 on the lever 73. The thicker bimetal element 78 has an inner layer 84 having a relatively high rate of expansion and an outer layer 85 having a relatively low coefficient of expansion. Similarly the bowed bimetal element 80 has an inner layer 86 of a relatively high coefficient of expansion and an outer layer 87 having a relatively low rate of expansion.

In operation, in event of a gradual temperature rise toward a high predetermined value, the two bimetal elements tend to straighten out at approximately similar rates. As a result, the joint 82 is slightly elevated relative to the mounting 79, while the free end of element 80 is slightly lowered relative to the joint 82. Thus the free end stays approximately stationary and there is no effect on the linkage. Ultimately, at some predetermined high temperature value, the thicker bimetal element 78 ceases to respond so that the joint 82 becomes stationary, while the thinner bimetal element continues to respond and the free end thereof unlatches the lever 73 from behind the strut 71, breaking the linkage and setting the disc 70 free.

In similar fashion, when there is a relatively high rate of temperature rise, the thinner bimetal element 80 responds at a more rapid rate than the thicker bimetal element 78, to unlatch the lever 73 from behind the strut 71. In FIGS. 3-5, where one bimetal is described as being thicker than the other bimetal in order to obtain different responses from the two bimetals, namely a slower response and a less thicker bimetal, with a faster response and a greater response from the thinner bimetal, it should be understood that different functions may be obtained from two bimetals in other ways as described in connection with FIGS. 1 and 2.

In the construction of FIGS. 6 and 7, a valve closure disc 90 is held in place by a strut 91 having a lower end portion engaging the outer surface of the disc 90 and preferably seated in a groove therein. A reverse generally C-shaped lever 92 has an upper end portion engaging an adjustable fulcrum 93, an adjacent portion engaging the upper end of strut 91, a lower end portion projecting through an aperture 95 in the strut 91 and an upturned terminus 96 latched to hold the lever and the strut as shown with the valve disc closing the pipe outlet. Lever terminus 96 is latched behind a lever 98 having a terminus 99 engaging terminus 96 and an intermediate portion 100 bearing against the strut 91 adjacent the upper edge of aperture 95. The upper end of lever 98 is backwardly turned as at 101 to retain the end 102 of a link 103 which terminates at its opposite end in a loop or eyelet 104.

The loop or eyelet 104 is engaged and held in place by the outer end 106 of a spiral member having an inner end anchored on the strut 91 as by means of a screw 107. The spiral consists of two bimetallic elements joined together end to end. As illustrated, the two bimetallic elements have the same thickness, but have different lengths. In particular, an inner bimetal element 109 has a longer length than an outer bimetal element 110. The two bimetales each include two layers of material of different coefficients of expansion. The longer inner length of bimetal has the material of low coefficient of expansion disposed inwardly and the material of high coefficient of expansion disposed outwardly. The shorter outer length of bimetal has the material of low coefficient of expansion disposed outwardly and the material of high coefficient of expansion disposed inwardly. In order to manufacture the spiral in continuous form, one of the materials may be continuous throughout the spiral and crossover from an outer position in one bimetal element to an inner position in the other bimetal element. As illustrated in FIG. 7, the material having a high coefficient of expansion is continuous and the crossover point is illustrated at 115. That is, the material 112 and 114 is a continuous strip throughout the spiral, but as disposed as an outer layer inwardly from crossover 115 and an inner layer outwardly from crossover 115.

In operation, in the case of a relatively slow rate of temperature rise below a predetermined high value, the two bimetallic elements respond approximately similarly so that the crossover point 115 tends to move inwardly while the terminus 106 tends to move outwardly at approximately the same rate so that there is no effect on the linkage. After attainment of a predetermined high ambient temperature, the longer inner bimetal element is wound upon itself and thus ceases to function while the outer bimetal element continues to expand, whereupon the terminus 106 is withdrawn from the loop 104, releasing the linkage holding the disc 90.

In the event of a relatively high rate of temperature rise, the shorter outer bimetal element expands at a more rapid rate than the inner bimetal element contracts, as a result of which the terminus 106 is withdrawn from the loop 104, releasing the linkage.

In FIGS. 8 and 9, a disc 120 is held in place by a strut 121 having a lower end seated in a depression in the upper surface of the disc. A lever 122 has an upper end engaging fulcrum 123, and adjacent portion engaging the upper end of strut 121 and a lower end carrying a projection in the form of an adjustable screw 125 having an enlarged terminus 126 illustrated as spherically shaped, at the end of a reduced stem 127 projecting through an aperture 128 in the strut 121. The linkage is held tight by a plurality of balls 130, three as illustrated, positioned behind the enlarged terminus 126 and abutting the strut 121. The balls are normally held in position by means of a surrounding unclosed ring comprised of a pair of bimetal elements 131 and 132. The bimetal elements 131 and 132 may be of similar thickness and they may utilize similar materials, but they are of different lengths and as illustrated they are connected together as by spot welding illustrated at 134. The shorter bimetal element 131 includes an outer layer 135 having a relatively low coefficient of expansion and an inner layer 136 having a relatively high rate of expansion, while the longer bimetal element 132 includes an outer layer 138 having a relatively high rate of expansion and an inner layer 139 having relatively low coefficient of expansion. If desired, the ring formed by the bimetal elements may be secured to the strut 121 as by welding adjacent the place where the two elements are connected together at 134.

In operation, the adjacent free ends of the bimetales 131 and 132 are movable relative to the joint 134. Thus, in event of a relatively slow rate of temperature rise below a predetermined high value, the curvature of the element 131 tends to decrease while the curvature of the element 132 tends to increase at approximately the same rate so that there is no effect on the linkage. Ultimately, the shorter element 131 would cease to respond before the longer element 132 ceases to respond. However, at some point in the form of a bump or projection 140 in the path of the end of bimetal 132 limits its movement while movement of 131 continues finally to the place where the balls 130 are permitted to spread radially outwardly sufficiently to release the enlarged spherical end 126 on the stem 127 whereby the lever 122 may be pivoted in a manner to unlash the linkage, releasing the disc 120 for water flow.

In the event of a relatively rapid rate of temperature rise, the shorter bimetal element 131 expands more rapidly than the longer bimetal 132 contracts and releases the spheres 130. We claim:

1. In an automatic fire protection sprinkler head operable responsive to a high temperature or to a high rate of temperature rise:
   a. a frame;
b. a pipe on the frame having an outer end adapted for connection with a source of fire extinguishing fluid and an inner end terminating in a valve seat providing a fluid outlet; 

c. a valve closure member having an inner surface engageable with the valve seat to close the outlet and an outer surface having a fulcrum; 

d. means on the frame providing a fulcrum opposed to the valve member fulcrum; 

e. a linkage acting between the two fulcrums to hold the valve member closed; 

said linkage comprising: 

e1. a strut having one end acting against one of said fulcrums; 

e2. a lever having a first portion acting against the other fulcrum, a second portion cooperating with the other end of the strut and a third portion adjacent said one strut end; and 

e3. means acting between the strut and the lever third portion to hold the lever with the valve closed; and 

f. heat sensitive means connected with the linkage and responsive to a high temperature and responsive to a high rate of temperature rise below the high temperature to break the linkage and let the valve open in event of a predetermined high ambient temperature or in event of a predetermined high temperature; 

2. In an automatic fire protection sprinkler head operable responsive to a predetermined high temperature or to a predetermined high rate of temperature rise: 

a. a generally oval frame; 

b. a pipe on the frame having an outer end adapted for connection with a source of fire extinguishing fluid and an inner end terminating in a valve seat providing a fluid outlet; 

c. a valve member having an inner surface engageable with the valve seat to close the outlet; 

d. means on the frame providing a fulcrum opposed to the valve member; 

e. a strut having one end acting against the valve member; 

f. a lever having a first portion acting against the fulcrum and a second portion cooperating with the other end of the strut; 

g. means acting between the strut and the lever holding the latter with the valve closed; and 

h. heat expandable means effective on the lever and responsive to a predetermined high temperature and responsive to a predetermined high rate of temperature rise below the high temperature to release the lever and let the valve open on occurrence of either event; 

said expandable means comprising: 

a. first bimetal element having one end anchored adjacent the place of cooperation between the strut and the valve member and the other end free; 

b. second bimetal element, generally parallel to the first having one end connected to the lever, an intermediate portion engaging the strut and the other end free and engaging the free end of the first bimetal element; and 

the arrangement being such that the free ends of the bimetal elements move together on slow temperature rise and hold the valve closed, and move differentially to release the valve member after a predetermined high temperature is attained slowly or on rapid temperature rise. 

3. A combination as defined in claim 1, said expandable means comprising: 

a first bimetal element having one end anchored adjacent the place of cooperation between the strut and said one fulcrum; 

a second bimetal element having one end connected to the lever, an intermediate portion acting against the strut and another end cooperating with the other end of the first bimetal element; and 

the arrangement being such that the cooperating ends of the bimetal elements move differentially on a rapid rate of rise in temperature or after a predetermined high temperature is attained slowly, to release the lever member. 

4. A combination as defined in claim 1, including: 

a first bimetal element on the frame interposed between the latching means and the strut; 

a second bimetal element on the strut and adjacent the latching means; and 

the arrangement being such that adjacent portions of the two bimetal elements move differentially on a rapid rate of rise in temperature or after a predetermined high temperature is attained slowly, to release the latching means. 

5. A combination as defined in claim 1, including: 

means latching the lever to the strut; 

a first bimetal element on the strut; 

a second bimetal element on the first bimetal element and disposed adjacent the latching means; and 

the arrangement being such that the two bimetal elements move differentially on a rapid rate of rise in temperature or after a predetermined high temperature is attained slowly, to release the latching means. 

6. A combination as defined in claim 1, including: 

means latching the lever on the strut; 

a first bimetal element anchored on the strut; 

a second bimetal element connected to the first bimetal element and holding the latching means; and 

the arrangement being such that the two bimetal elements move differentially on a rapid rate of rise in temperature or after a predetermined high temperature is attained slowly, to release the lever means. 

7. A combination as defined in claim 1, including: 

means latching the lever on the strut; 

a first bimetal element; 

a second bimetal element on the first bimetal element and arranged with the latter to surround and restrain the latching means; and 

the arrangement being such that two bimetal elements move differentially on a rapid rate of rise in temperature or after a predetermined high temperature is attained slowly, to release the lever from the strut. 

8. A combination as defined in claim 2, said expandable means comprising: 

a first bowed bimetal element having one end anchored adjacent the place of cooperation between the strut and the valve member and the other end free; 

a second bowed bimetal element generally parallel to the first having one end connected to the lever, an intermediate portion engaging the strut and the other end free and engaging the free end of the first bimetal element; and 

the arrangement being such that the free ends of the bimetal elements move together on slow temperature rise and hold the valve closed, and move differentially to release the valve member after a predetermined high temperature is attained slowly or on rapid temperature rise. 

9. A combination as defined in claim 2, including: 

a link having one end pivoted on the lever; 

a first bowed bimetal element having opposite ends anchored on the frame and an intermediate portion interposed between the strut and the other end of the link so the link is latched; 

a second bowed bimetal element disposed generally transverse to the first bimetal element and having one end secured to the strut and the other end adjacent said other end of the link; and 

the arrangement being such that adjacent portions of the two bimetal elements move together on slow temperature rise, and move differentially to unlatch the link after a predetermined high temperature is attained slowly or on rapid temperature rise. 

10. A combination as defined in claim 2, including: 

an end portion on said lever latching the lever on the strut; 

a first bowed bimetal element having one end secured to the strut; 

a second bowed bimetal element having one end secured to the other end of the first bimetal element and a free end disposed adjacent said lever latching portion; and 

the arrangement being such that the two bimetal elements move equally, offsetting each other on slow temperature
rise, leaving the lever latched, and move differentially to unlatch the lever after a predetermined high temperature is attained slowly or on rapid temperature rise.

11. A combination as defined in claim 2, including:
a second lever engaging the strut and latching the first lever;
a link holding the second lever in place;
a first coiled bimetal element having an inner end secured to the strut;
a second coiled bimetal element having an inner end secured to the outer end of the first bimetal element and an outer end holding the link; and
the arrangement being such that the two bimetal elements move equally, offsetting each other on slow temperature rise, holding the link, and move differentially to release the link after a predetermined high temperature is attained slowly or on rapid temperature rise.

12. A combination as defined in claim 2, including:
a projection on the lever having an enlarged end;
a plurality of balls surrounding the projection and engaging the enlarged end to restrain the lever;
a first curved bimetal element;
a second curved bimetal element having one end connected to one end of the first bimetal element and surrounding the balls to hold the latter in place; and
the arrangement being such that the two bimetal elements move equally, offsetting each other on slow temperature rise, holding the balls, and move differentially to release the balls after a predetermined high temperature is attained slowly or on rapid temperature rise.

13. A combination as defined in claim 1, wherein said heat sensitive means acts between the strut and the holding means.

14. In an automatic fire protection sprinkler head operable responsive to a predetermined high temperature or to a predetermined high rate of temperature rise:
a. a generally oval frame;
b. a pipe on the frame having an outer end adapted for connection with a source of fire extinguishing fluid and an inner end terminating in a valve seat providing a fluid outlet;
c. a valve member having an inner surface engageable with the valve seat to close the outlet;
d. means on the frame providing a fulcrum opposed to the valve member;
e. a strut having one end acting against the valve member;
f. a lever having a first portion acting against the fulcrum and a second portion cooperating with the other end of the strut;
g. means acting between the strut and the lever holding the latter with the valve closed;
h. heat expandable means effective on the lever and responsive to a predetermined high temperature and responsive to a predetermined high rate of temperature rise below the high temperature to release the lever and let the valve open on occurrence of either event; and
i. said holding means including the expandable means.