

[54] HEAT ACTUATED LINK

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[58] Field of Search 16/48.5; 49/2, 7, 8;
160/1, 2, 5, 6, 7

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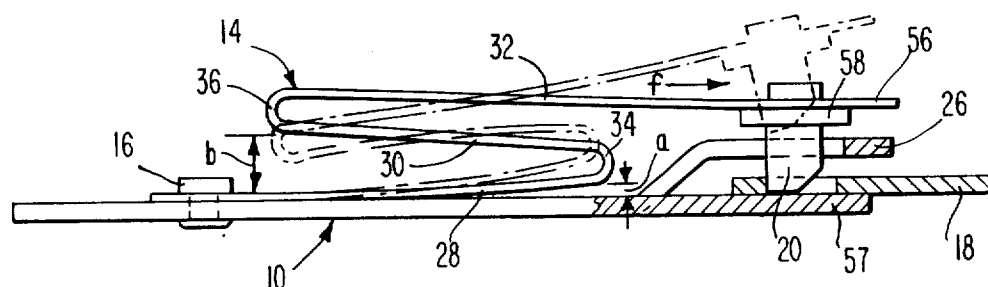
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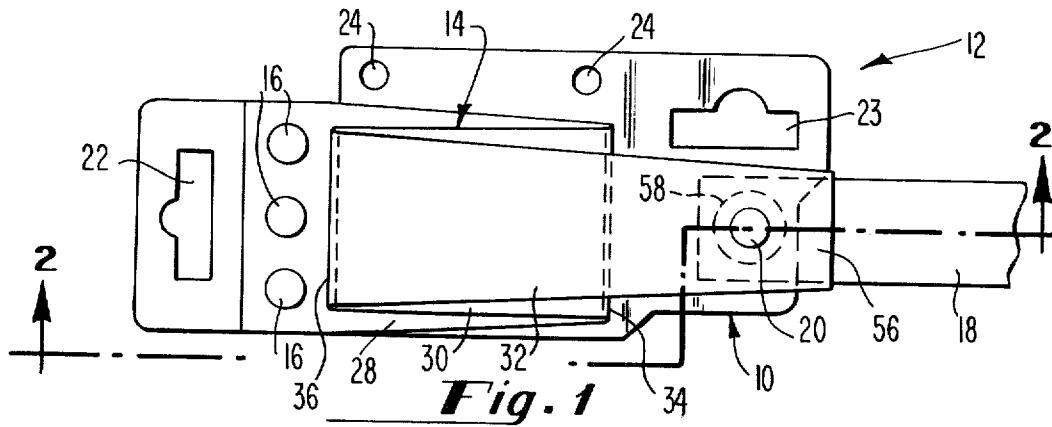
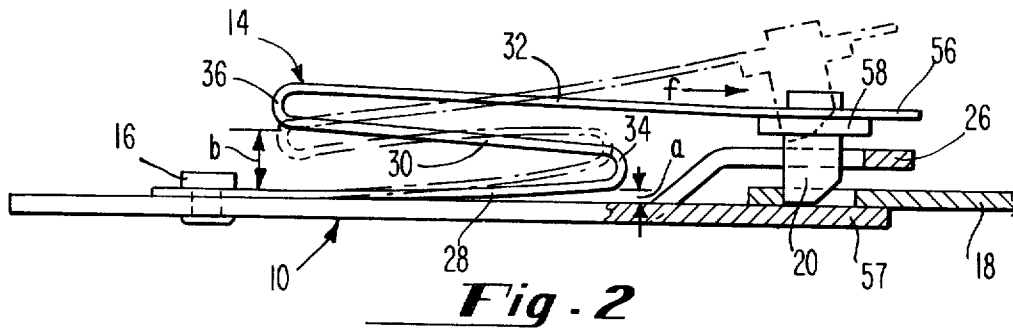
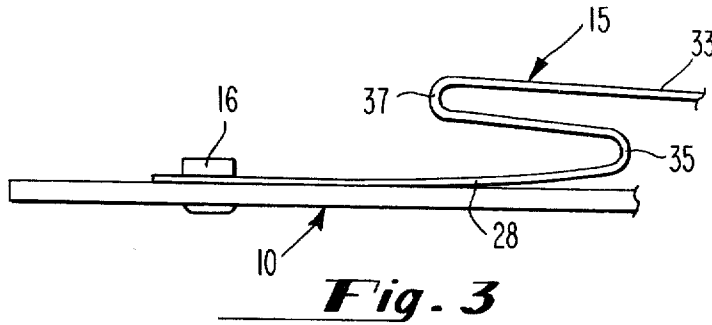
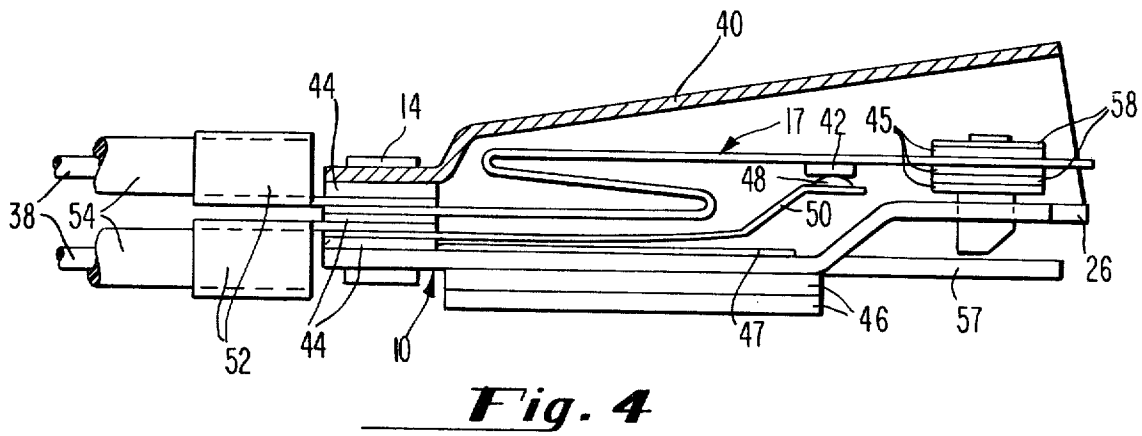
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[57] **ABSTRACT**

A releasable link is provided to open under predetermined conditions; said link having the capacity to reset under predetermined temperature conditions. The link includes a novel tapered, serpentine bimetallic element which acts to amplify the response of said link to temperature increases. The link may include heating means for actuating the bimetallic element, and may also include a housing to reduce the effect of ambient temperatures upon the condition of the bimetallic element.

12 Claims, 4 Drawing Figures





HEAT ACTUATED LINK

BACKGROUND OF THE INVENTION

This invention relates to links for use in automatically actuated equipment forming a part of a fire fighting system, and more particularly to a fire link for use with devices such as fire dampers in air ducts. In the past, such links have been made from two pieces of metal fused together with solder, the solder being the means for releasing the link when the ambient temperature rose above a certain level; for example, 160°F.

More recently a link has been developed which utilizes a bimetal to respond to temperature changes, thereby creating a reuseable device which is not dependent upon the melting of any of its components. A bimetallic link of this sort is disclosed in my prior U.S. Pat. No. 3,725,972. This U.S. patent discloses a link having a bimetallic element attached at one end to a base and extending directly outwardly a certain length, to a point at which a simple bend reorients the plane of the bimetallic element with respect to the base element.

SUMMARY OF THE INVENTION

My invention provides a mechanically operable resettable link which represents an improvement over the prior art link disclosed in my U.S. Pat. No. 3,725,972. This improved link provides a novel tapered bimetallic element which is folded back on itself in a serpentine manner. The link basically comprises a bimetallic element and a mounting element which are interconnected with a releasable member by a pin which, in the engaged position, pierces the releasable member and is positioned by the bimetallic element at an angle slightly obtuse with respect to the mounting element of the link. Heating the bimetallic element results in withdrawal of the pin and the release of the releasable member. Further means are provided in alternate embodiments for heating this bimetallic element by remote means and for partially shielding this element from the direct effect of ambient temperatures.

Accordingly, it is an object of my invention to provide an improved fire link with a novel serpentine bimetallic element.

Another object of my invention is to provide a resettable link which utilizes this novel bimetallic element to amplify the response of the pin thereby facilitating low activation temperatures.

A further object is to provide a link which responds rapidly to changes in ambient temperature.

Another aim of the invention is to provide a link whose activation temperature may be varied by substituting bimetallic elements having various overlapping configurations.

A further aim of the invention is to provide a link in which the pin is withdrawn along a path substantially perpendicular to the element to be released.

Another aim of the invention is to provide a link which operates efficiently under high tension conditions.

One object of the invention is to produce a link having an overall length less than that of conventional links designed for the same temperature of activation.

A further object of the invention is to provide a link which can be remotely controlled.

Another aim of the present invention is to provide a link which may be partially insulated from the effects of ambient temperature conditions.

These and other objects of my invention will become apparent from the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a fire link in accordance with one embodiment of the present invention;

FIG. 2 is a partial cross-section taken along the line II—II of the link shown in FIG. 1. The activated position of said link is shown in phantom;

FIG. 3 is a partial cross-section of an alternate embodiment of the invention designed for relatively higher temperature of activation; and

FIG. 4 is a side view of an alternate embodiment of the present invention designed to be activated electrically and having a housing which is shown in cross-section.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Although specific forms of the invention have been selected for illustration in the drawings, and the following description is drawn in specific terms for the purpose of describing these forms of the invention, this description is not intended to limit the scope of the invention which is defined in the appended claims.

FIG. 1 is a top view of the basic link, designated generally 12, which incorporates the features of the present invention. The link 12 generally comprises a releasable member (shown in the drawings as a pawl 18); and a mounting element, designated generally 10; and a bimetallic element, designated generally 14, which together comprise a gripping means for normally engaging the releasable member and for releasing the releasable member in response to an increase in ambient temperature. The link is designed for use in automatically actuated equipment forming a part of fire fighting systems. The embodiment shown in FIG. 1 is intended to respond to an increase in ambient temperature by allowing the separation of the releasable member from the remainder of the link 12.

The link of the present invention may be used to actuate a wide variety of fire fighting systems. One common method for utilizing the link of the present invention is to join two pieces of cable which together hold open a fire door, fire damper, in an air duct, fire curtain or similar device. Since long term tensions are often exerted on the cables, and consequently on the link, a link is provided, which in the normal position, is able to withstand these tensions for extended periods of time. As the ambient temperature of the air around the link increases to unacceptable levels, indicating that a fire is burning in the vicinity, the bimetallic element 14 reacts to the increased temperature through a deformation in its configuration, resulting in the disengagement of the releasable member from the remainder of the link, thereby activating the fire damper, fire door, or other responsive device.

As shown in FIG. 1, various attachment means are provided to ensure flexibility in installation. The mounting element 10 of the link of the present invention has two attachment sites 22 and 23 for cables, chains or straps. Further means for attachment are normally positioned on the far end of the releasable mem-

ber (this attachment means is not shown in the drawings). The mounting element 10 also has mounting holes 24 which are useful in certain installations for rigidly affixing said link to a desired mounting member (not shown).

Referring now to FIG. 2, the interrelationship between the mounting element 10, the bimetallic element 14, and the pawl 18 is clearly demonstrated. The releasable member may comprise any member which can readily be engaged by the gripping means in the normal position and released by said gripping means in the actuated position. Although a pawl 18 is shown in the drawings, an S hook, or other suitable member, may be substituted therefore, depending upon the requirements of the particular installation. The mounting element 10 is substantially planar and is attached to the bimetallic element 14 by fastening means 16, which are rivets, or other metal fasteners. The end of the mounting element 10 which engages the pawl 18 is differentiated into an offset portion 26 and a striker portion 57.

The bimetallic element is shown attached by means of the aforementioned fastening means 16 to the mounting element 10 near the end of the mounting element which is remote from its interconnection with the pawl 18. In its normal position, the bimetallic element has a base portion 28 which extends along the mounting element 10 arching slightly away therefrom to a maximum separation, *a* (shown in FIG. 2). A first bend 34 substantially reverses the direction of extension of the bimetallic element. This first bend 34 should have as small a radius as possible, while allowing a safe margin against the tendency for the bimetal to fatigue or otherwise fracture at this point. A mid-portion 30 of the bimetallic element 14 extends from the first bend 34 back over at least a portion of the base portion 28 in a plane which diverges from the base portion 28. A minimum separation, *b* (shown in FIG. 2) must be attained at the end of the mid-portion 30 which is remote from the first bend 34. The bimetallic element then extends through a second bend 36 to an end portion 32, which, in the normal, inactivated position, diverges slightly with respect to the mid-portion 30 as it advances towards the tip 56. As a result of the serpentine configuration just described, the end portion 32 of the bimetallic element 14 converges slightly with the mounting element 10 towards the pawl 18.

The tip 56 of the bimetallic element, which is a substantially planar extension of the end portion 32, is fixedly attached to a perpendicular pin 20, which is shown in FIG. 2 having an annular member 58 engaging the undersurface of the tip 56. This annular member 58 tends to transfer the torque exerted by the pin 20 to the tip 56, as will be more fully explained herein. As shown in FIG. 2, the pin 20 extends through a void defined by the offset portion 26 of the mounting element 10, and then through a hole in the pawl 18, terminating in an end which is close to or touching the striker portion 57. The end of the pin 20 which is remote from the tip 56 is beveled to allow the pawl 18, which also may be formed with a complementary beveled edge (not shown), to be manually inserted. When the link is in its normal (unheated) position, engagement of the pawl 18 is effected by pushing the pawl against the bevel of the pin 20, thereby forcing the pin 20 away from the striker portion 57 and allowing the pawl 18 to slide into the position in which the hole in

the pawl aligns with the pin and is pierced thereby as the pin 20 returns to its normal position.

The bimetallic element 14 should be formed so that it assumes the normal position shown in FIG. 2 when exposed to the ambient air temperature of its expected installation. The element itself is a normal bimetal selected for its characteristic strength, elastic memory, and ability to resist fatigue when bent to a tight radius.

The operation of the gripping means in selectively gripping or releasing the pawl 18 is quite simple. As can be seen in FIG. 2, the configuration of the bimetallic element 14 exposes a large surface area to the ambient air which surrounds the link. As the temperature of the air around the link rises, the bimetallic element is heated, causing the element to assume the configuration shown in phantom. Upon heating, the base portion 28 tends to pull away from the mounting element 10 while the mid-portion 30 arches back over the base portion 28, thereby reducing the separation between the mid-portion 30 and the base portion 28. The end portion 32 and tip 56 of the bimetallic element 14 similarly arch away from the mounting element 10, producing a withdrawal of the pin above the offset portion 26, and the consequent release of the pawl 18.

In effect, the serpentine configuration of the bimetallic element 14, in acting to amplify the pin response to a given temperature, produces a link which is very sensitive to changes in ambient temperature. This amplification is partially a result of the separation, *a*, between the base portion 28 and the mounting element 10 which adds magnitude to the distance that the pin 20 is withdrawn, as well as the separation, *b*, between the base portion 28 and the mid-portion 30 which allows a clearance for the second bend 36 to move closer to the mounting element 10 during activation. As the distance between the base portion 28 and midportion 30 diminishes during heating, the pivot point of the end portion 32 and the top 56 moves towards the mounting element 10. As seen in FIG. 2, the release of the pawl 18 usually occurs as soon as the clearance between the striker portion 57 and the pin 20 becomes slightly greater than the thickness of the pawl 18.

In releasable links utilizing a straight, or substantially straight bimetallic elements, the pin which extends therefrom to engage the pawl acts as a moment arm for the torque exerted upon the bimetallic element by the pawl. Fire links utilizing substantially straight bimetallic elements usually incorporate a bend therein which orients the tip portion of the bimetallic element substantially parallel to the mounting element.

The present invention utilizes the serpentine configuration of its bimetallic element to counteract the torque which is exerted upon it by the pawl 18. The overlapping disposition of the base, mid and end portions of the bimetallic element is such that a force exerted along the plane of the end portion, represented by an arrow *f*, in FIG. 2, tends to increase the separation between the second bend 36 and the mounting element 10. Since the torque exerted by the pawl 18 acting through the moment arm of the pin tends to force the second bend 36 towards the mounting element 10, a natural equilibrium is established by the link in its normal position which allows the link to withstand relatively high, long term tensions.

As the bimetallic element is heated through the action of ambient air upon the bimetallic element 14, the natural equilibrium condition of the link is disturbed.

The torque which is exerted by the pawl 18 tends to reinforce the tendency of the second bend 36 to assume the position shown in phantom in FIG. 2. Since the second bend 36 acts as the pivot point for the tip 56 and pin 20, its movement towards the mounting element 10 tends to bring the pin into a perpendicular position with respect to the mounting element. This change in pivot point occurs simultaneously with the deformation of the remainder of the bimetallic element thereby producing a withdrawal of the pin from its engagement with the pawl along a path which is substantially perpendicular to the plane of the mounting element. As shown in FIG. 2, in the normal position the plane of the tip 56 and end portion 32 converges with the plane of the mounting element 10 towards the pawl 18. In the activated (heated) position, these planes become non-convergent towards the pawl, that is to say, either parallel or divergent towards the pawl. The effect of the deformation of the bimetallic element upon heating is therefore, to ensure the rapid release of the pawl even under high tension conditions. These facts have been confirmed by experimental tests which indicate that the link of the present invention produces a greater amplitude of pin withdrawal than a similar link having a substantially straight bimetallic element. The applicant has found that the amount of this amplitude amplification is proportional to the amount of overlap of the layers of the bimetallic element.

Another feature in the construction of the bimetallic element is its novel, tapered configuration. The applicant has found that a link of suitable strength may be obtained by forming the bimetallic element from a bimetallic strip which has a maximum width at the end which engages the mounting element 10 and which has a minimum width at the tip 56. A bimetallic element of this sort which tapers uniformly along its length has been found to effectuate a great savings in material, to establish an unrestricted air flow through and around the bimetallic element, and to produce a bimetallic element with strength characteristics which are easily capable of withstanding the extreme stresses under which the link must operate. One of the primary features of the present invention is the provision of a bimetallic element having a substantially lesser heat capacity than conventional untapered elements, thereby facilitating a rapid heating of the element and consequent activation of the link.

Referring now to FIG. 3, an alternate embodiment of the present invention is shown which incorporates a bimetallic element 15 which is intended to respond to a relatively higher temperature of activation. This alternate embodiment of the present invention is substantially identical to the embodiment described above, except for the substitution of a bimetallic element having a shortened overlap. Although the base portion 28 is substantially the same as that in the embodiment described above, the shortening of the mid-portion 31 and end portion 33 of the bimetallic element results in a first bend 35 and the second bend 37 which each have slightly different configurations from those bends described above. It should be noted that the overall configuration of the bimetallic element is substantially the same as that of the preferred embodiment described above. The action of this alternate embodiment upon heating is substantially the same as that of the link shown in FIG. 2, except that the lesser response amplification provided by this configuration results in a

higher activation temperature. Consequently, one of the features of the present invention is the provision of a standard link which may be tailored to meet the requirements of a given installation through the substitution of bimetallic elements having various overlapping configurations, whereby a particular temperature of activation may be selected.

In certain installations, a link may be desired which can be activated from a remote location. FIG. 4 shows a second alternate embodiment of the present invention which is designed for such an installation. This embodiment utilizes current from a remote source to heat the bimetallic element 17 thereby activating the link in a manner similar to that described above. Basically, this electrical link further comprises two leads 38 which make electrical contact with the bimetallic element 17 and an electrical element 50. The bimetallic element 17 is provided with a bimetallic contact 42 which is located so that, in the normal position of the link, electrical contact is made between contact 42 and a second contact 48 disposed on the tip of the electrical element 50. In order to prevent accidental grounding, the leads 38, the bimetallic element 17, the electrical contacts 42 and 48 and the electrical element 50 are all well insulated. The leads 38 are insulated by a wire covering 54 which is shown cut away in FIG. 4. These leads 38 are electrically connected to two lugs 52, which make contact with an end of the bimetallic element 17 and electrical element 50 respectively. The lugs 52, bimetallic elements 17, and electrical element 50 are sandwiched between layers of insulation 44 as shown in FIG. 4. Insulation 45 is similarly used to insulate the pin 20 and annular members 58 from the bimetallic element 17. Insulation 47 is provided between the mounting element 10 and the electrical element 50.

This electrical embodiment of the present invention is operated by connecting an electrical input to leads 38 and inducing a current to flow through the circuit which includes the bimetallic element 17, thereby heating the bimetallic element to effect a deformation of that element similar to that described above. The electrical element 50 is constructed of a suitable conductive material which is sprung in such a manner as to follow the bimetallic contact 42 as the bimetallic element 17 undergoes this deformation.

In certain installations, such as air conditioning ducts and other cold air ducts, it may be desirable to partially shield the bimetallic element 17 from the direct effect of the ambient air. Consequently, a housing 40 which is shown cut away in FIG. 4, may be provided to effect this shielding, thereby reducing the time and/or current needed to raise the temperature of the bimetallic element to a sufficient level to release the pawl. This housing 40 may be attached to the bimetallic element by means of the mounting holes 24 shown in FIG. 1, or alternatively by engagement with the fastening means 16 as shown in FIG. 4. It should be emphasized that this housing is only necessary in insulations where the volume and/or temperature of the ambient air is such that suitable heating of the bimetallic element 17 may not be effected in its absence. Normally, it would be desirable to provide a link which would alternatively release the pawl either upon remote activation by a current or by response to an unacceptable increase in ambient temperature.

Unlike the preferred embodiments described above, this electrical embodiment of the present invention

would most commonly be installed by permanently affixing this embodiment to a rigid mounting surface. Correspondingly, this embodiment is shown having several spacers 46 attached to the bottom surface of the mounting element 10, said spacers providing additional clearance for the lugs 52. In certain insulations, it may also be desirable in addition to the clearance provided by these spacers 46 to provide additional insulation surrounding the lugs 52 in order to prevent a short circuiting of those lugs against each other or through any supplemental apparatus.

It will be understood that various changes in the details, materials and arrangement of parts which have been herein described and illustrated in order to explain the nature of this invention may be made by those skilled in the art within the principle and scope of the invention as expressed in the following claims.

It will further be understood that the "Abstract of the Disclosure" set forth above is intended to provide a non-legal technical statement of the contents of the disclosure in compliance with the Rules of Practice of the U.S. Patent Office, and is not intended to limit the scope of the invention described and claimed herein.

What is claimed is:

1. A releasable fire link comprising a releasable member and gripping means, for engaging said releasable member in the normal position, and for releasing said releasable member in the activated position, said gripping means further comprising heat responsive means for causing said gripping means to move to the normal position in response to an ambient temperature and for causing said gripping means to move to the activated position in response to a preselected increase in said ambient temperature, said heat responsive means comprising means for mechanically amplifying the response of said gripping means to said increase in ambient temperature.

2. The invention of claim 1, wherein said means for mechanically amplifying the response of said gripping means comprises a serpentine bimetallic element.

3. The invention of claim 2, wherein said gripping means further comprises a mounting element and wherein said serpentine bimetallic element further comprises a base portion connected to said mounting element, a mid-portion extending back over at least a part of said base portion, an end portion extending back over said mid-portion, and a tip portion comprising a substantially planar extension of said end portion and having a pin protruding therefrom which, in the normal position, coacts with said mounting element to directly engage said releasable member.

4. The invention of claim 3, wherein said mid-portion extends back over substantially all of said base portion, thereby facilitating a relatively low temperature of activation.

5. The invention of claim 3, wherein said mid-portion extends back over only a small portion of said base portion, thereby facilitating a relatively high temperature of activation.

6. The invention of claim 3, wherein the axis of said pin is substantially perpendicular to the plane of said

tip portion, and wherein the plane of said tip portion and the plane of said mounting element in the normal position converge slightly towards said releasable member, and wherein the plane of said tip portion and the plane of said mounting element in the actuated position are non-convergent towards said releasable member.

7. The invention of claim 6, wherein said bimetallic element is formed from a bimetallic strip having a maximum width at the point of connection between said base portion and said first element and a minimum width at said tip.

8. The invention of claim 7, wherein the width of said bimetallic strip is tapered uniformly along its length.

9. The invention of claim 2, wherein a remotely controlled heating means for heating said heat responsive means is connected to said last mentioned means, thereby allowing said releasable member to be released from a remote location.

10. The invention of claim 9, wherein said releasable link further comprises a housing substantially surrounding said heat responsive means, thereby reducing the effect of ambient temperatures upon the condition of said releasable link.

11. A releasable fire link comprising a releasable member and a gripping means for normally engaging said releasable member and for releasing said releasable member in response to heating of said gripping means, said gripping means comprising a pin which in the normal position is oriented with its axis at an acute angle with respect to said releasable member and which moves towards a perpendicular orientation with respect to said releasable member upon the heating of the gripping means.

12. A releasable fire link comprising a releasable member and a gripping means for normally engaging said releasable member and for releasing said releasable member in response to the heating of said gripping means, said gripping means comprising a serpentine bimetallic element and a mounting element, said bimetallic element having a base portion connected to said mounting element, a mid-portion extending back over at least a part of said base portion, an end portion extending back over said mid-portion, and a tip portion comprising a substantially planar extension of said end portion and having a pin protruding therefrom which in the normal position coacts with said mounting element to directly engage said releasable member, and wherein the axis of said pin is substantially perpendicular to the plane of said tip portion, and wherein the plane of said tip portion and the plane of said mounting element in the normal position converge slightly towards said releasable member wherein the plane of said tip portion and the plane of said mounting element in the heated position are non-convergent towards said releasable member and wherein said bimetallic element is formed from a bimetallic strip having a maximum width at the point of connection between said base portion and said first element and a minimum width at said tip and wherein said bimetallic strip is tapered uniformly along its length.

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