Dec. 23, 1941. A. B. NEWTON 2,267,164

SNAP ACTING CONDITION RESPONSIVE DEVICE

Filed Sept. 30, 1939

Fig.1

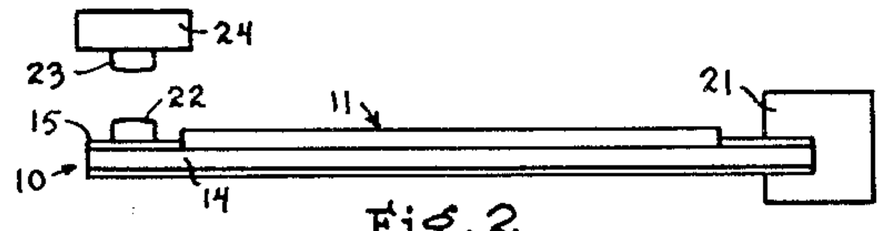

Fig.2

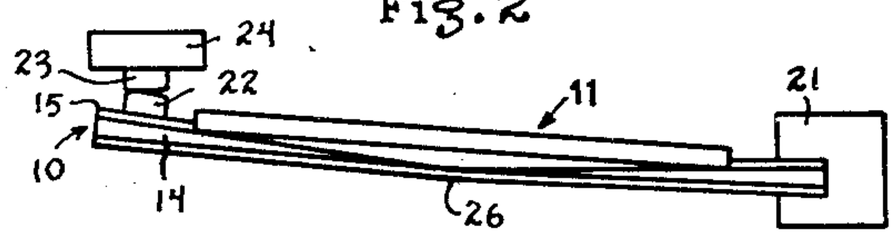

Fig.3

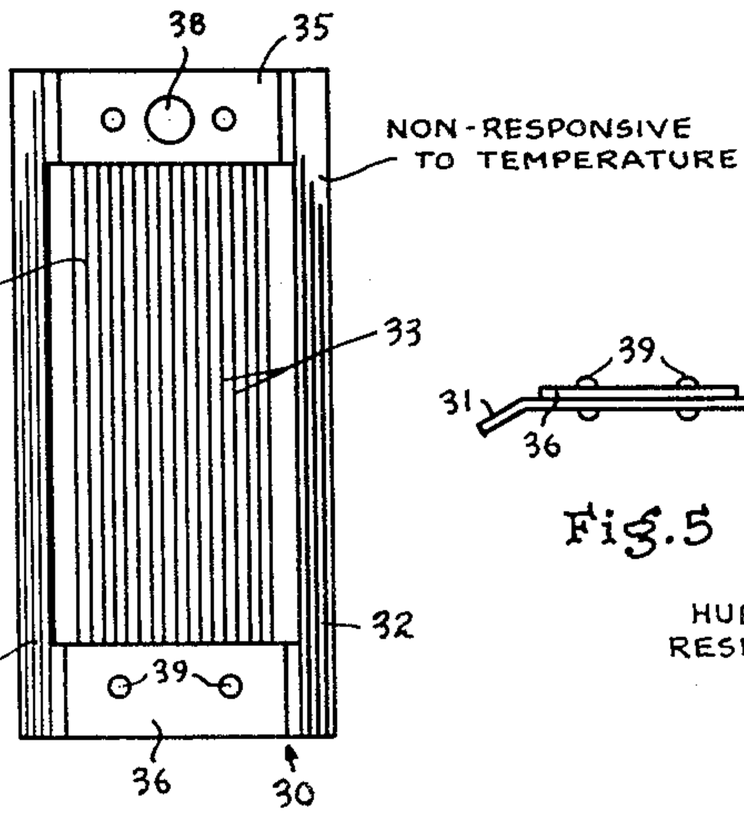

Fig.4

Fig.5

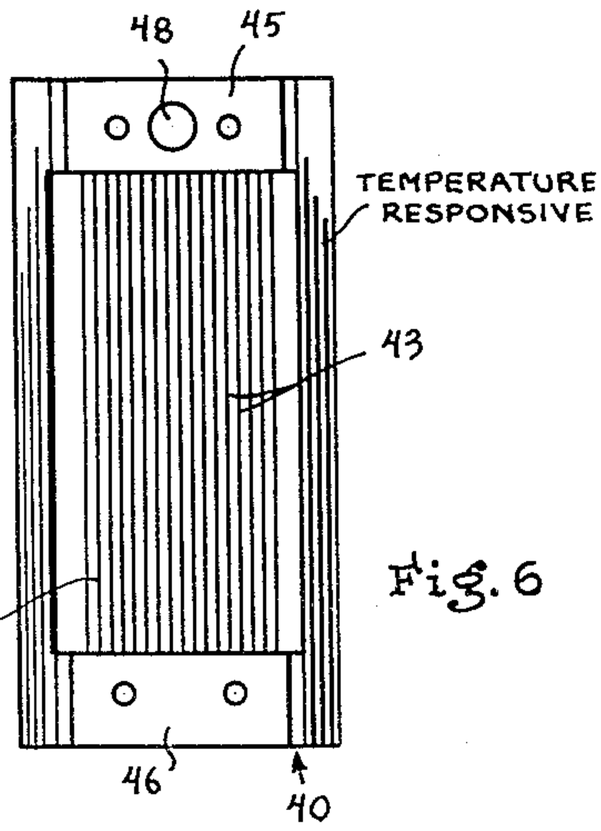

Fig.6

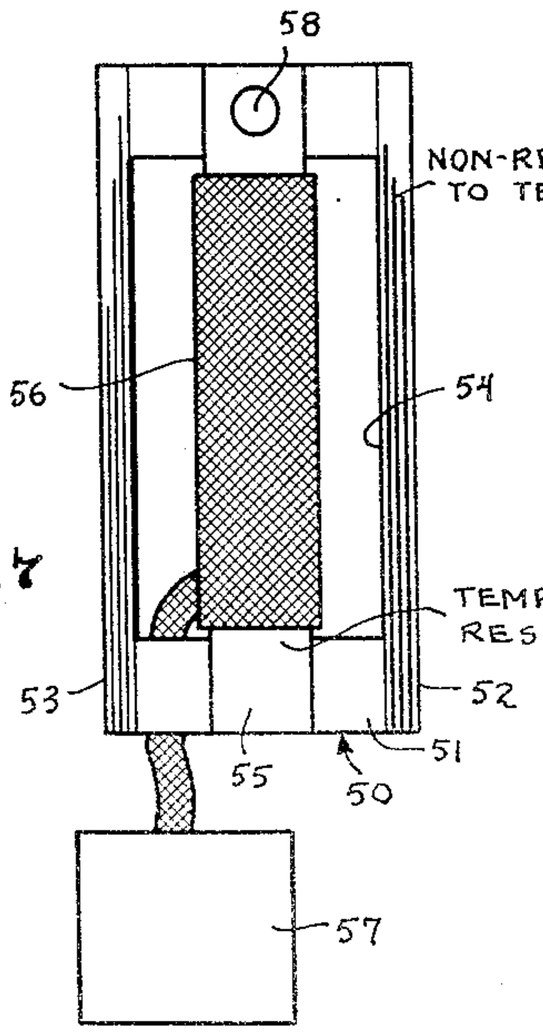

Fig.7

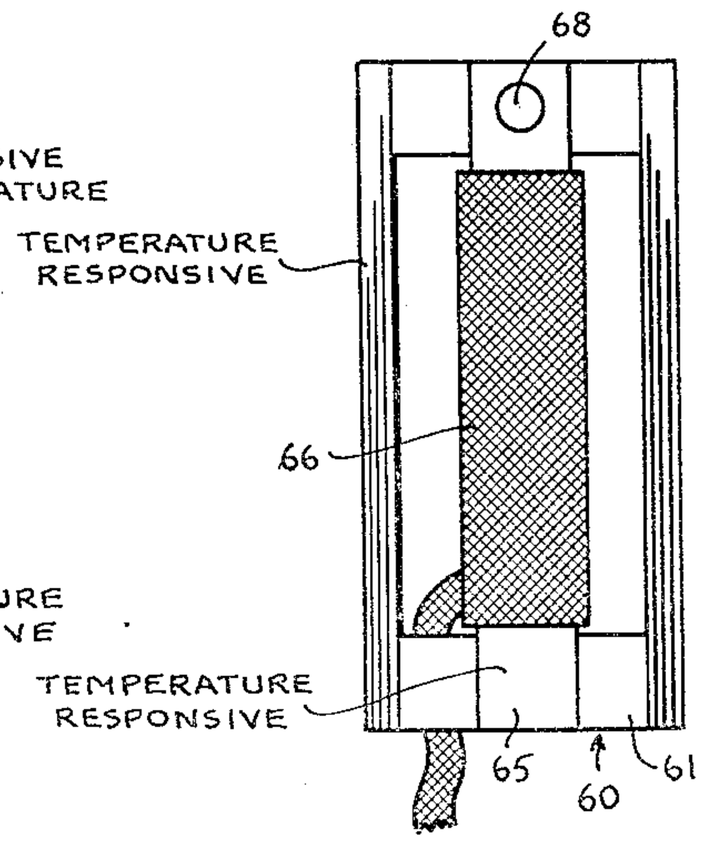

Fig.8

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SNAP ACTING CONDITION RESPONSIVE DEVICE

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19 Claims. (Cl. 200—137)

The present invention relates to a condition responsive device and more particularly to one designed to operate with a snap action.

In many instances, in the condition controlling art, it is desirable to have a condition responsive device which upon the condition reaching a predetermined value, operates switch contacts or other control members with a snap action. Such a snap movement is essential in the case of switches in order to reduce arcing between the contact points. There are many other cases in which a snap movement may be desirable. Thus, in the gas burning art it is often desirable to move the gas valve with a snap action to prevent "pop back" in the burner mixing chamber. The present invention is concerned with an improved form of condition responsive snap action device characterized by an extremely simple construction.

An object of the present invention is to provide a snap acting condition responsive device comprising a channel shaped member of resilient material and a second member secured to such channel shaped member at longitudinally spaced points thereof, said members having different rates of expansion and contraction with change in the value of the condition whereby upon the condition reaching a predetermined value, the channel shaped member is abruptly bent.

A further object of the present invention is to provide such a device in which switch contacts are actuated thereby.

A still further object of the present invention is to provide such a condition responsive arrangement in which one of the members is responsive to one condition and the other member to a second condition so that the device as a whole is responsive to the resultant of the two conditions.

A still further object of the present invention is to provide such an arrangement in which the condition is a temperature condition.

A further object of the present invention is to provide such a device in which the condition is effective temperature.

A stlil further object of the device is to provide such an arrangement in which the device responds to the wet bulb temperature.

An even further object of the device is to provide such an arrangement in which the device responds to the amount of wet bulb depression.

Other objects of the present invention will be apparent from a consideration of the accompanying specification, claims and drawing, in which

Figure 1 is a perspective view of one form of the condition responsive device of the present invention;

Figure 2 is a side elevational view of the device employed as a thermostatic switch;

Figure 3 is a view of the device of Figure 2 in its contact making position;

Figure 4 is a plan view of the device adapted for the control of humidity;

Figure 5 is an end elevational view of the device of Figure 4;

Figure 6 is a plan view of a modification of the device adapted to respond to effective temperature;

Figure 7 is a plan view of a modification of the device adapted to respond to wet bulb temperature, and

Figure 8 is a modification of the device adapted to respond to wet bulb depression.

Referring to Figure 1, the device as illustrated therein comprises a lower channel shaped member 10 and an upper channel shaped member 11. The lower channel shaped member is made of resilient material, preferably a resilient metal, and comprises a base portion 12 and flanges 13 and 14. The upper channel shaped member 11 is formed of somewhat heavier material so as to constitute a relatively rigid member. The upper member 11 similarly comprises a base portion 15 and two flanges 16 and 17. The base portion 12 of member 10 is cut away for a substantial portion of its length as indicated at 19, the width of the cut-away portion being slightly greater than the width of member 11. The flanges 16 and 17 of member 11 extend only over the length of this cut-away portion 19. The portions of base 15 of member 11 that project beyond the flanges 16 and 17 are secured to the base 12 of member 10 by welding or in some other similar manner. The flanges 16 and 17 of the upper member 11 are perpendicular to the base so as to make member 11 relatively rigid. The flanges 13 and 14 of the lower member 10, however, are disposed at an obtuse angle with respect to the base so that they do not resist bending to as great an extent as if they were perpendicular to the base. It is to be understood that the expression "channel shaped" as used in the specification and claims is intended to refer to any member having at least two portions disposed angularly with respect to each other along a longitudinal axis to provide a channel or trough.

The device as shown in Figure 1 is intended to respond to dry bulb temperature. Either member 10 or member 11 may be made responsive to temperature by being formed of material having

a relatively high temperature coefficient of expansion. The other member is preferably made of material substantially unaffected by temperature changes. If it is desired, however, both members 10 and 11 may be made effective to temperature but to different degrees. In any of the above cases, changes in temperature will result in one of the members changing in length with respect to the other. In Figures 2 and 3, the device is shown as applied to a switch and the operation is shown in the case in which the upper member 11 becomes shorter than the lower member 10. It will be noted that the right-hand end of members 10 and 11 are rigidly mounted in a block 21. The left-hand end of base portion 15 of member 11 carries a contact 22 which is adapted to be engaged with a contact 23 carried by a suitable support 24. Let it be assumed that member 11 has the highest temperature coefficient of expansion and member 10 the lower coefficient of expansion. As the elements are shown in Figure 2, the members 10 and 11 are substantially the same in length so that the channel shaped member 10 assumes normal channel shape. If the temperature begins to drop, member 11 will tend to shorten in length with respect to member 10 tending to bow the ends of member 10 upwardly. This tendency is resisted by the fact that the flanges 13 and 14 do not lie in the same plane and therefore resist bending transversely of the member 10. The result is that the bending stress is gradually increased without any bending of member 10 until the bending stress reaches a predetermined value at which the middle portions of flanges 13 and 14 are abruptly forced into a position in which they lie in the same straight line. Member 10 is then able to bend freely about its mid portion. This action is clearly illustrated in Figure 3 wherein member 10 is bent around a point generally designated by the reference numeral 26. It will be noted that member 11 is still perfectly straight, the only bending thereof being in the extending portions of the base portion 15. As indicated in Figure 3, the bending of channel shaped member 10 upwardly moves contacts 22 and 23 into engagement. This engagement, moreover, is effected with a snap action.

When the temperature begins to rise, the channel shaped member 11 will lengthen with respect to member 10. As the length of this member tends to approach that of member 10, the resiliency of the side portions 13 and 14 will subsequently cause channel shaped member 10 to assume its original form thereby abruptly moving contacts 22 and 23 out of engagement. It will thus be seen that with the extremely simple construction of the present arrangement, a very decisive snap movement in both directions is provided.

While the condition has been discussed in which member 11 shortens with respect to member 10, the device will also work to provide snap action in the other direction when member 11 becomes longer than member 10. Any tendency of member 11 to become longer than member 10 applies a bending stress to member 10 tending to move the outer ends thereof downwardly with respect to the central portion. This is likewise resisted by the flanges 13 and 14 until the stress reaches a predetermined value, at which the outer ends will be bent downwardly in an abrupt movement. The cut-away portion 19 of base 12 of member 10 permits this movement since in order for this movement to take place the mid portion of member 11 must pass below the upper surface of base 12 of member 10. In other words, member 10 in bending causes the base 12 to assume a somewhat arcuate form. The rigid member 11 forms a chord of this arc as clearly indicated in Figure 3. Where the bending is in the other direction, a portion of this chord must lie below the upper surface of base 12. The opening 19 makes this possible. The device thus can, if desired, be utilized to provide a three position switch which moves between each of its positions with a snap action. Thus in the case in which member 11 is the more highly expansible, when the temperature drops sufficiently member 10 is snapped from the position shown in Figure 2 to that shown in Figure 3. When the temperature rises considerably above the value corresponding to the position of Figure 2, member 10 is snapped downwardly away from the position shown in Figure 2. If desired, an extra contact may be provided on the under side of member 10 to engage with a fixed contact beneath the device.

In Figure 4, there is shown a modification in which the device is responsive to relative humidity. In this species as in all of the species there is a lower channel shaped member which is designated in this species by the reference numeral 30. It is to be understood that this member corresponds as far as structural details is concerned to member 10. In other words, this member has side flanges 31 and 32 which are bent downwardly to resist transverse bending of member 30. In the present species the other element of the unit is formed of a humidity responsive element. Any type of element may be used which has the property of expanding and contracting with changes in humidity. In the present case the humidity responsive unit comprises a number of silk strands 33 which are secured at their ends between the member 30 and bars 35 and 36. As indicated in Figure 5, these bars are securely fastened by rivets 39 or other suitable fastening means to the member 36 and thus serve to securely clamp the ends of strands 33. Silk is one of a number of materials which has the property of contracting upon increase in relative humidity. The clamping bar 35 carries a contact 38 corresponding to the contact 22.

The element is shown in Figures 4 and 5 in the position it assumes when the length of the humidity responsive strands 33 is approximately the same as that of member 30. It is to be understood that member 30 is relatively insensitive both to changes in temperature and humidity. This member may, for example, be made of Invar or some similar material. Thus as the humidity increases, a point will be reached at which suitable tension is applied to member 30 tending to bend the ends of the same into the position shown in Figure 3 in connection with that species. As in the case of the previous species, this bending is initially resisted by side flanges 31 and 32 which ultimately abruptly yield to permit such bending and hence to permit abrupt movement of contact 38 into engagement with its cooperating contact (not shown). When the temperature rises again, the length of the strands 33 will eventually permit the member 30 to abruptly assume its original form causing separation of contact 38 from its associated contact. The device of Figures 4 and 5 thus provides an extremely simple device for controlling humidifying apparatus in accordance with the value of the relative humidity.

In Figure 6, there is shown a device which may be employed for control in accordance with effective temperature. The device is structurally similar to that of Figures 4 and 5 comprising a channel shaped base member **40** and silk strands **43** clamped between end members **45** and **46**. The only difference between the devices of the two figures is that in the species of Figures 4 and 5, member **30** is unaffected by temperature change whereas in the species of Figure 6 member **40** has a substantial temperature coefficient of expansion as indicated by the legends adjacent these figures. The result is that an increase in humidity with its accompanying shortening of strands **43** will have no effect if it is accompanied by a simultaneous and corresponding decrease in the temperature adjacent the device. In such a case the member **40** will shorten as the strands **43** shorten. Under such circumstances, it is not desired to have the device **40** changed since the effective temperature is remaining constant. If either the humidity alone should increase or if the temperature alone should increase, the strands **43** will become shorter with respect to member **40** so that member **40** is caused to snap into the position corresponding to the position of member **10** of Figure 3. Secured to clamping bar **45** is a contact **48** which when the member **40** is bent in the manner just described will be moved into engagement with an associated contact (not shown).

It will be seen that the device of Figure 6 in spite of its extreme simplicity responds in a thoroughly accurate and efficient manner to the value of effective temperature to which it is subjected.

In Figure 7, a modification of the device is shown, this modification being designed to respond to wet bulb temperature. The distortable channel shaped member in this species is designated by the reference numeral **50**. As in the other forms, this member comprises a base portion **51** and side flanges **52** and **53**. Likewise, as in the other species, the base portion **51** is cut away at **54**. Extending between the two remaining portions of base **51** is a relatively rigid metallic strip **55**, this strip being formed of material having a relatively high temperature coefficient of expansion. Member **50** is formed of Invar or some other metal having substantially zero temperature coefficient of expansion. Surrounding the member **55** is a wick **56**, the lower end of which extends into a container **57** containing water. The water will be drawn from the container **57** up through the wick so as to maintain the entire wick saturated. By reason of the presence of wick **56**, the metallic strip **55** will be subjected to wet bulb temperature. It is believed that the operation of the device **57** will be obvious in view of the description of the operation of the preceding species. When the wet bulb temperature decreases to a predetermined value, member **50** will be snapped abruptly into the position corresponding to that of Figure 3. This bending movement of member **50** is utilized to actuate a contact **58**.

In Figure 8, a still further species of the device is shown. This species is similar to the species of Figure 7 comprising a channel shaped member **60** having a cut-away base portion **61**, the two parts of which are bridged by a strip **65** having a substantial temperature coefficient of expansion. A wick **66** surrounds this member **65** and the lower end of the wick extends into a suitable container of water to keep the same saturated as in the species of Figure 7. The member **65** similarly carries a contact **68** designed to be moved upon the bending of member **60**. As indicated by the legends on the drawing, the essential difference between the species of Figures 7 and 8 is that member **60** is responsive to temperature changes while member **50** is not. The two members **65** and **60** are made of materials having substantially the same temperature coefficients of expansion so that the bending force exerted by member **60** is a function of the difference between wet and dry bulb temperatures. In other words, member **65** is responsive to dry bulb temperature. When the difference between these two temperatures reaches a predetermined value, member **60** is abruptly bent with a snap action to cause actuation of contact **68**.

While various specific embodiments of the invention have been disclosed for purposes of illustration, it is to be understood that the invention is limited only by the scope of the appended claims.

I claim as my invention:

1. In a condition responsive device, a generally rectangular channel shaped member of resilient material and a second member secured substantially parallel with said channel shaped member at longitudinally spaced points thereof, said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value said channel shaped member will be abruptly bent.

2. In a condition responsive device, a generally rectangular channel shaped member of resilient material and a second member secured substantially parallel with the convex side of said channel shaped member at longitudinally spaced points thereof, said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value said channel shaped member will be abruptly bent.

3. In a condition responsive switch, a condition responsive unit comprising a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value said channel shaped member will be abruptly bent, a fixed contact, a movable contact associated with one end of said unit in proximity to said fixed contact, and means for rigidly supporting the other end of said unit.

4. In a condition responsive device, a generally rectangular channel shaped member of resilient material and a relatively rigid second member secured parallel with said channel shaped member at longitudinally spaced points thereof, said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value, said channel shaped member will be abruptly bent.

5. In a temperature responsive device, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, said members having different temperature coefficients of expansion whereby upon said temperature reach-

ing a predetermined value, said channel shaped member will be abruptly bent.

6. In a condition responsive device, a generally rectangular channel shaped member of resilient material expansive and contractive with changes in the value of a first condition and substantially unaffected by a second condition, a second member secured parallel with said channel shaped member at spaced points thereof, said second member being expansive and contractive with changes in the value of said second condition and substantially unaffected by said first condition whereby upon the values of said two conditions attaining a predetermined relation said channel shaped member will be abruptly bent.

7. In a humidity responsive device, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, said members having different rates of expansion and contraction with change in the value of the humidity whereby upon the humidity reaching a predetermined value said channel shaped member will be abruptly bent.

8. In an effective temperature responsive device, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, one of said members having an appreciable temperature coefficient of expansion but being relatively unaffected by changes in the value of the humidity, and said other member having the property of expansion and contraction with changes in humidity and being relatively unaffected by changes in temperature, whereby upon the effective temperature assuming a predetermined value said channel shaped member will be abruptly bent.

9. In a wet bulb temperature responsive device, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, one of said members being substantially unaffected by temperature and the other of said members having a relatively large temperature coefficient of expansion and having a moist body adjacent it, whereby upon the wet bulb temperature reaching a predetermined value said channel shaped member will be abruptly bent.

10. In a device responsive to the amount of wet bulb depression, a pair of parallelly secured together members each having the same temperature coefficient of expansion, a moist body adjacent one of said members, and means snap actuated in accordance with the relative length of said members.

11. In a device responsive to the amount of wet bulb depression, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, each of said members having the same temperature coefficient of expansion, and a moist body adjacent one of said members, said members coacting to cause said channel shaped member to be abruptly bent when the wet bulb depression assumes a predetermined value.

12. In a condition responsive device, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, the sides of said channel shaped member being disposed non-perpendicularly to the base thereof and said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value the sides of the channel shaped member will be abruptly distorted to permit bending of said channel shaped member.

13. In a condition responsive device, a generally rectangular channel shaped member of resilient material and a second member secured parallel with said channel shaped member at longitudinally spaced points thereof, the sides of said channel shaped member being disposed at an obtuse angle with respect to the base thereof and said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value the sides of the channel shaped member will be abruptly distorted to permit bending of said channel shaped member.

14. In a condition responsive device, a pair of generally rectangular channel shaped members parallelly disposed back to back and secured together adjacent their ends, the sides of a first of said channel shaped members being disposed perpendicularly to the base thereof and the sides of the other of said channel shaped members being disposed non-perpendicularly to the base thereof, and said members having different rates of expansion and contraction with change in the value of the condition whereby upon said condition reaching a predetermined value the sides of said other channel shaped member will be abruptly distorted to permit bending of said member.

15. In a condition responsive device, a resilient generally rectangular member having side flanges which normally lie in intersecting planes, and a second member secured to said resilient member at the ends thereof, said members having different form changing characteristics for change in the value of a variable condition whereby upon said condition reaching a predetermined value a portion of at least one of said flanges will be caused to change in shape and lie in a different plane.

16. A snap acting device comprising a first generally rectangular frame member having a pair of opposite sides disposed in intersecting planes and a second member secured to said first member at the ends thereof, said members having different condition responsive characteristics so that upon said condition reaching a predetermined value a portion of at least one of said sides will be caused to change in shape and lie in a different plane.

17. In a condition responsive device, a first generally rectangular resilient channel shaped member for storing a force, and a force exerting second member parallel with the channel and secured to said first member at the ends thereof, said first and second members having different form changing characteristics for change in the value of the condition whereby upon said condition reaching a predetermined value said first member will change its channel shape and be abruptly bent.

18. In a condition responsive device, an oblong resilient member having downturned flanges along the longitudinal sides thereof and bridging lateral end pieces at the ends thereof, and a second member secured to said lateral end pieces of said oblong member, said members having different coefficients of expansion for change

in the value of a variable condition whereby upon said condition reaching a predetermined value said flanges will be caused to change shape to cause said device to move with a snap action.

19. In a condition responsive device, a resilient member formed as a rectangular frame normally lying in a plane, resilient flanges formed as opposite sides of said frame, said flanges normally lying in different planes which intersect the plane of said frame, and a second member secured to opposite ends of said frame, said members having different coefficients of expansion for change in the value of a variable condition whereby upon said condition reaching a predetermined value said flanges will be caused to change shape to cause said device to move with a snap action.

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