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A. L. RICHE

2,236,699

SNAP SWITCH

Filed Nov. 30, 1938

Fig. 5.

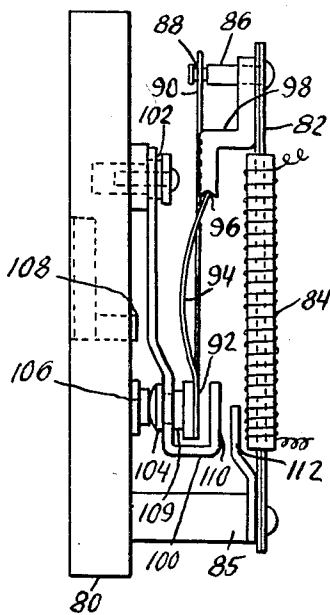


Fig. 1.

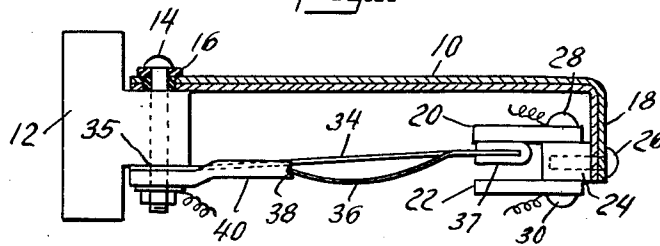


Fig. 2.

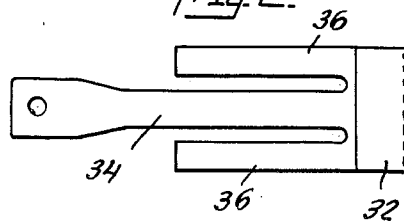


Fig. 3.

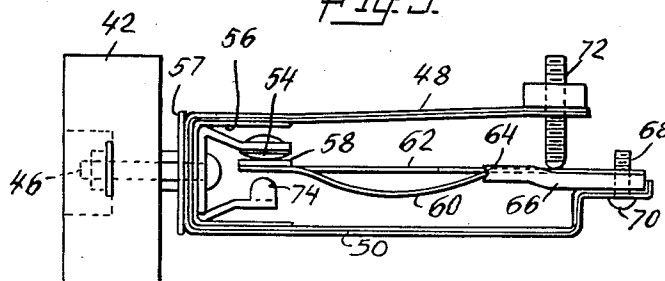


Fig. 4.

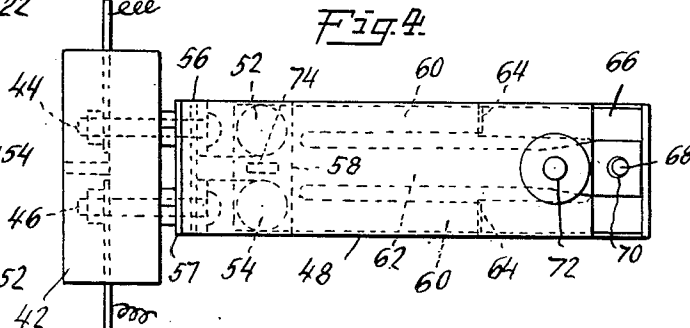
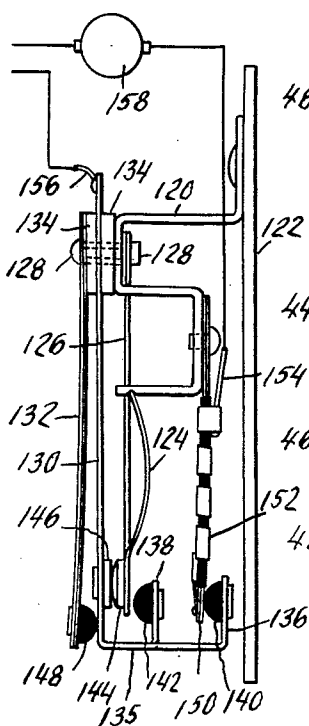


Fig. 6.



INVENTOR
A. L. Riche
BY
Karl H. Sommermeier
ATTORNEY

UNITED STATES PATENT OFFICE

2,236,699

SNAP SWITCH

Arthur L. Riche, Freeport, Ill., assignor to Micro Switch Corporation, Freeport, Ill., a corporation of Illinois

Application November 30, 1938, Serial No. 243,286

13 Claims. (Cl. 200—138)

This invention relates to improvements in snap switches and more particularly to improvements in the snap switch forming the subject matter of the McGall Patent No. 1,960,020 issued May 22, 1934.

This application is a continuation in part of my earlier application Serial 52,778, filed December 4, 1935.

It is an object of this invention to provide a compact and serviceable snap switch of the McGall type which is especially adapted to be used in conjunction with thermostatic metal.

The specification is to be read in conjunction with the appended drawing which illustrates specific embodiments of my invention and in which:

Fig. 1 is a partial cross sectional elevation of one form of switch operated by thermostatic metal in which the stops move with respect to the base;

Fig. 2 is the combined compression and tension element of Fig. 1;

Fig. 3 is an elevation of another form of switch operated by thermostatic metal in which the stops are stationary with respect to the base;

Fig. 4 is a top view of the base section of the switch of Fig. 3;

Fig. 5 shows a specific type of switch incorporating my invention; and

Fig. 6 is an elevation, partly in diagram, of a thermal control apparatus employing a switch in which the stops move with respect to the base.

Referring to Fig. 1 of the drawing, a strip of suitable thermostatic metal 10, which may be made of any desirable combination of two or more superimposed layers of metals is attached to the insulating base 12 by means of a bolt 14. The bolt is insulated from the thermostatic metal by insulation 16. The outer end 18 of strip 10 is bent over as shown and forms a convenient element to which to attach the stationary contacts or stops of the switch. This bent-over end may be replaced by other equivalent constructions such as an angle which is bolted to the longer horizontal section of the thermostatic metal. Suitable spaced apart stops or contacts 20 and 22 are attached to part 18 by means of insulating block 24 and screws 26, 28 and 30. Movable contact 32, which moves between stops or contacts 20 and 22 with a snap action, is attached to the connected free ends of tension member 34 and compression members 36. Tension member 34 is operatively mounted at 35 at its opposite end on base 12 by means of bolt 14. A member 40 is mounted on the base and projects substantially parallel to thermostatic strip 10. Compression members 36

are operatively mounted, preferably in pivotal fashion as shown, in notches 38 adjacent and between the supported and connected ends of tension member 34 and formed in member 40.

The tension and compression members may be conveniently made as by stamping out of one piece sheet spring material such as phosphor bronze, beryllium bronze, etc., both members therefore being formed of strip springs. Strip 34 is put in tension when strips 36 are mounted in notches 38 which are so placed with respect to the connected end of the tension and compression members that members 36 are bowed in compression as shown. The contact 32 and the cooperating stationary contacts preferably are made of silver to minimize sparking and terminal corrosion. The circuit or circuits to be controlled are connected to the switch at bolts 14 and 28 and/or 30.

The device of Fig. 1 operates as follows if an increase of temperature causes the thermostatic metal strip to bow downward. As the temperature increases stops or contacts 20 and 22 gradually drop and force contact 32 downward. Tension member 34 and specifically its tension center line or dead center line, which is not necessarily the physical center line, approaches the pivot points 38 (in Fig. 1). When contact 32 is forced down sufficiently so that the tension center line crosses the pivot points, the contact 32 moves downwardly with a snap action to stop or contact 22. Assuming that this movement of the switch results in the cutting off of the source of heat which caused the raise in temperature of thermostatic element 10, then element 10 begins to straighten to its original position as it cools. Stop or contact 22 pushes contact 32 upwardly until the tension center line recrosses pivot points 38 when contact 32 snaps upwardly to again abut stop or contact 20 as shown.

The average temperature (average of the "on" and "off" temperatures) at which the switch operates may be controlled by raising and lowering either or both of the mounting points 38 and 35 of the compression and tension members respectively or shifting in a vertical direction stops 20 and 22. The temperature differential on which the switch operates may be varied by changing the spacing between stops or contacts 20 and 22.

Another embodiment of my invention is shown in Figs. 3 and 4. The switch is mounted on base 42 by means of bolts 44 and 46. The terminal wires of the circuit to be controlled may be connected to these bolts. The switch comprises a U-shaped strip of thermostatic metal with legs

48 and 50 between which is located the snap switch. At the interior base portion of the U-shaped thermostatic metal are two stationary stops or contacts 52 and 54 insulated from each other and also from the thermostatic metal by insulating strips 56 and 57. The two contacts and the thermostatic metal are bolted to base 42 by bolts 44 and 46 to thereby make a compact and sturdy unit. A contact 58 is attached to the connected free ends of compression and tension members 60 and 62 and it is of sufficient length to make electrical contact simultaneously with stationary contacts 52 and 54. This closes the circuit between terminal wires on bolts 44 and 46 when in the position shown. The compression members 60 are mounted, as by pivoting at 64, in a notch in a member 66 attached to thermostatic leg 50, as by welding. Tension member 62 is provided with a hole (see Fig. 2) which receives a necked portion or the threads 68 of stud 70. The stud is, in turn, mounted on leg 50. The tension member may be mounted in non-pivotal fashion as in Fig. 1. Leg 48 carries an adjustable stud 72 at its free end, this stud bearing against tension member 62 near its mounted end at certain temperatures. Leg 48 may be entirely omitted as will be described hereinafter. A stop 74 is arranged adjacent the contact end 58 of the switch member.

The operation of the device of Figs. 3 and 4 is as follows, assuming that with increasing temperature the legs 48 and 50 bow inwardly, that tension member 62 is a spring strip and that compression members 60 are spring strips. As legs 48 and 50 bow inwardly the pressure of stud 72 on the tension member gradually forces the portion adjacent its mounted end downward without forcing the connected end contact 58 from stationary contacts 52, 54. When the tension center line of the tension member passes below pivot point 64 of the compression member, the contact 58 snaps downward against lower stop 74 to thereby break the circuit and stop the rise in temperature. As the temperature drops the legs 48, 50 bow outwardly and when the tension center line again passes pivot point 64 the contact 58 snaps upward to stops 52, 54 to close the circuit. With this construction stiff compression members may be used if the tension member is made of a tension spring of coiled spring wire or of a folded or S-shaped strip spring to allow for the necessary longitudinal flexing.

If leg 48 and stud 72 are omitted it is assumed that leg 50 bows outward with increase in temperature. The tension member may be of spring or stiff material if the compression member is of spring material, but if the compression member is stiff then the tension member must be a type of spring which flexes longitudinally. As the temperature increases tension member mounting point 68 moves on a greater radius and therefore a greater distance downwardly than pivot point 64. When the tension center line passes through the pivot point 64 the movable contact 58 snaps over against stop 74 thereby breaking the circuit. As the temperature again decreases the leg 50 bows upwardly until the tension center line recrosses pivot point 64 whereby the contact 58 again snaps back against contacts 52, 54.

In Fig. 5 my switch construction, which may be operated by a thermostatic member as shown, is used to control heavy electric currents through a secondary switch. The usual snap switch structure is used and is mounted on base 80. A

thermostatic member 82, subject to the heating effect of a coil 84 in either direct or indirect association with the circuit which is controlled by the secondary switch, is mounted on the base in cantilever fashion on post 85. Attached to the thermostatic member 82 is a stud 86 which is provided with a necked portion 88. The usual tension strip member 90 is mounted on the necked portion of the stud. It is connected at 92 to compression spring 94, the combination being of the type shown in Fig. 2. The compression spring is pivoted at 96 in a member 98 which is attached to the thermostatic member 82. A loosely mounted iron or other magnetic pendulum-like member 100 is suspended from a suitable stud support 102 which is mounted on the base. The bottom of pendulum-like member 100 is turned back on itself as shown. Attached to the bottom part of member 100 is a contact 104 which bridges double stationary contacts 106 as in Figs. 3 and 4 and is carried by the base. A magnet 108 is mounted on the base and spaced from the pendulum. The magnet tends to attract the pendulum and thus insure good electrical connection between contacts 104 and 106. It is obvious that the magnet may be mounted on the pendulum and that 108 may be a material attracted thereby. Upon heating of element 84 the thermostatic metal 82 bows outwardly so that the tension center line of the tension strip 90 crosses the pivot point 96 of the compression spring 94 to thereby cause the connected end 92 with its attached weight 109 to snap over and hit a hammer-like blow on the backwardly turned part 110 of the pendulum 100. This blow, in combination with the decrease in magnetic pull as member 100 is separated further from magnet 108, quickly separates contact 104 from contact 106 thereby breaking the circuit. This break is rapid enough to permit handling of heavy currents. The spring action of the compression spring 94 keeps part 110 against stop 112 thereby keeping the contacts apart until the switch returns with a snap to the original position when electric contact is again resumed.

The construction of Fig. 6 is a modification of that of Fig. 1 and is adapted particularly for the temperature control of translating devices such as electric motors. The base of the switch is a shaped piece of stiff sheet metal 120 which is mounted upon a supporting plate 122. The said plate 122 may be composed of electric insulating material, and is adapted to be mounted upon the translating device in such a manner that the control apparatus is subjected to the temperature of the translating device. A compression member 124 and a tension member 126 are mounted on base 120, which is of suitable shape to form supports for them. Tension member 126 is secured to the base by a stud 128. A shaped spring metal arm 130 and a bimetallic arm 132 are also mounted upon base 120 by means of stud 128, arm 130 being electrically insulated from the others by means of sheets of insulating material 134. The arms all extend in the same direction from the base. Arm 130 has a portion 135, remote from base 120, turned downwardly substantially at right angles and its end 136 turned back substantially at right angles toward the base. A tongue 138 is punched out of portion 135 at an intermediate point and turned in a direction toward base 120. End 136 and tongue 138 have stops 140 and 142 of electrical insulating material mounted thereon respectively.

The connected end portions of switch arms 124 and 126 have a switch contact 144 mounted thereon, and arm 130 has a switch contact 146 mounted thereon in opposed relation to contact 144. Stop 142 is located in spaced relation to the opposite side of contact 144 a suitable distance to permit the snap operation of the movable switch member between the said stop and contact 146. Bimetallic arm 132 has a stop member 148 of electrical insulating material mounted at its free end and in engagement with spring arm 130. A second bimetallic arm 150 is mounted upon an intermediate portion of base 120 and has its free end in engagement with stop 140. An electrical resistance element 152 is wound about bimetallic arm 150 and is insulated therefrom. One end of element 152 is electrically connected to arm 150 and the other end connected to a conductor 154. A second conductor 156 is connected to spring metal arm 130. Conductors 154 and 156 may be connected in series with the supply circuit of the translating device, which is indicated diagrammatically at 158.

Bimetal arms 132 and 150 both warp downwardly under the influence of temperature rise and each of them is adapted individually to move arm 130 downwardly. Contact 146 moves downwardly with arm 130 and moves contact 144 with it until the mounting point of compression member 124 crosses the tension center line of tension member 126, when contact 144 will leave contact 146 and move against stop 142 with a snap action. The apparatus is placed in direct heat transfer relation to the translating device and bimetal arm 132 is heated in accordance with the temperature of the device, the arrangement being such that arms 124 and 126 are moved downwardly to the operating point when the temperature of the translating device reaches the maximum safe limit. When the temperature of the translating device falls bimetal 132 warps upwardly again. Spring metal 130 is arranged so that it follows bimetal arm 132 and stop 142 moves arms 124 and 126 upwardly until the mounting point of arm 124 again crosses the tension center line of arm 126, when contact 144 will move with a snap into engagement with contact 146. In this position the circuit is again closed, the connection being from conductor 154 through resistance heating element 152, bimetal 150, base 120, arms 124 and 126, contacts 144 and 146, spring metal arm 130, to conductor 156.

In this apparatus bimetal arm 150 is constructed and arranged in such manner that its temperature response is less than that of bimetal arm 132. Under conditions of gradual temperature rise the movement of arm 150 lags behind that of arm 132 so that the movement of spring arm 130 and the operation of the switch is caused entirely by arm 132. In addition, resistance heater 150 is constructed in such manner that small overload current does not produce sufficient heat to overcome the said lag between arms 132 and 150. However, resistance heater 152 is so constructed that, upon the occurrence of a large overload, it produces sufficient heat to cause prompt operation of the switch. Upon the occurrence of a large overload, the general temperature rise of the translating device is relatively slow, so that arm 132 lags behind arm 150 and may not be depended upon to cause operation of the switch by the time dangerous temperatures are reached in the hot region of the translating device. In the apparatus of Fig. 6,

each bimetal arm operates individually to protect the translating device against one of the two overload conditions which may occur during its operation.

Each of the switches described operates so that the relative positions of the combined mounting points of the compression and tension members are changeable with respect to the stops, the change of the relative position of both mounting points with respect to the stops being in the same general direction. Furthermore, the change of relative position of the stops with respect to the mounting point of the tension member is at least as great as the change of the relative position of the stops with respect to the mounting point of the compression members. While this change of relative positions of the mounting points and stops is described in connection with thermostatic metal as the actuating force it is obvious that the same mode of operation may be secured by mechanical means aside from temperature actuated devices.

The base on which the thermostatic metal operating metal is mounted need not be confined to the end portions as shown in Figs. 1 and 3 but may be attached at the central portion of the thermostatic metal, as at central part of strip 10 or at the central part of either legs 48 or 50.

The compression strip spring preferably is mounted at the end opposite its connected end by a pivot or hinge. However, under some conditions the strip spring may be held rigidly at this point especially if an easily flexible spring is used whereby the equivalent of a pivot or hinge is obtained. With a stiff strip spring held rigidly the operation of the switch may be slightly modified in that the snap-over of the connected end may be shifted slightly from the tension center line of the tension member or the snap action may be prevented entirely. On the other hand, if another type of compression spring is used, such as a coiled spring which is more flexible in lateral movement, the snap action may not be influenced very much by the rigid fastening of the fixed end. However, when reference is made in the claims to the snapping of the switch when the pivot point passes through the tension center line it is intended to include those constructions where a small deviation therefrom occurs.

Various modifications may be made of structures illustrated and described herein without departing from the scope of the appended claims.

I claim:

1. A snap switch comprising in combination a tension member and an adjacent compression member each operatively mounted at one end and connected together at their opposite ends which are free to move, stops between which said connected end part moves, at least one of said members comprising spring means, said compression member being mounted operatively at a point whereby it has a different radius of action than said tension member, said mounting point of said compression member and the tension center line of said tension member being movable with respect to each other, said members being so constructed and arranged that said connected end portion moves with a snap action as said compression member mounting point and said tension member tension center line cross, the relative position of the combined mounting points of said tension and compression members and of said stops with respect to each other being changeable, the change of relative position of both said mounting points with respect to said

stops being in the same general direction, said change of relative position of said stops with respect to said mounting point of said tension member being at least as great as the change of relative position of said stops with respect to said mounting point of said compression member.

2. The construction of claim 1 in which said stops are mounted on one portion of a strip of thermostatic metal and said mounting points of said compression and tension members are mounted on another portion thereof, said construction being so arranged that, with changes in temperature, said thermostatic metal causes said relative movement of said stops with respect to said mounting points.

3. The construction of claim 1 in which said mounting points of said compression and tension members are mounted on a base, said stops are mounted on a strip of thermostatic metal attached to said base, and said construction is so arranged that, with changes in temperature, said thermostatic metal causes said stops to move relatively to said mounting points.

4. The construction of claim 1 in which said stops are mounted on a base, said mounting points of said compression and tension members are mounted on a strip of thermostatic metal attached to said base, and said construction is so arranged that, with changes in temperature, said thermostatic metal causes said mounting points to move relatively to said stops.

5. A thermostatic switch comprising in combination a U-shaped strip of multi-layered thermostatic metal, an elongated strip spring tension member operatively supported on one leg of said thermostatic strip in spaced relation to the interior surface of said leg and extending inwardly toward the base of the U, the interior end of said tension strip being free to move, an adjacent strip spring bowed in longitudinal compression connected at one of its ends to the free end of said tension strip, and means for pivotally supporting the other end of said adjacent strip spring, said means being operatively associated with said one leg of thermostatic metal and being so constructed and arranged as to cause the pivot of the compression spring to move with the support of said tension member, electrical contact means associated with the connected free ends of said tension member and adjacent strip spring, the second leg of said U-shaped strip having means thereon for engaging said strip spring tension member adjacent said supported end whereby when said legs bow inwardly sufficiently, said second leg exerts pressure on said strip spring to cause said connected free ends to move with a snap action, said construction being so arranged that at pre-determined temperatures said connected ends move with a snap action to operate said electrical contact means.

6. The construction of claim 1 in which said stops are so constructed and arranged that they move with said connected end portion when said connected end portion strikes a stop after leaving the opposite stop, at least one of said stops having electrical contact means thereon associated with a stationary electrical contact, the arrangement being such that electrical contact is made or broken as said end portion snaps from one stop to the other when said mounting point of said compression member and the tension center line of said tension member cross.

7. A snap switch comprising in combination, an elongated flexible member, a tension member

and an adjacent compression member each operatively mounted at one of its ends upon a first end of said elongated flexible member, said tension and compression members being connected together at their unmounted ends, and at least one of them comprising spring means, said compression member having a shorter radius of action than said tension member, and being so constructed and arranged that said connected end part may be moved to move the mounting point of said compression member across the tension center line of said tension member to cause said connected end part to move with a snap action, stops between which the connected end part of said tension and compression members move and is confined, at least one of said stops being rigidly fastened to the second end of said elongated flexible member so that when said connected end part lies against said one stop, the flexing of said elongated flexible member moves said one stop relative to the mounting points of said compression and tension members to cause said connected end part to move with a snap action into engagement with the other stop.

8. A snap switch comprising in combination a tension member and an adjacent compression member, each operatively mounted at one of its ends, said tension and compression members being connected together at their unmounted ends and at least one of them comprising spring means, said compression member having a shorter radius of action than said tension member and being so constructed and arranged that the connected end part of said tension and compression members may be moved to move the mounting point of said compression member across the tension center line of said tension member to cause said connected end part to move with a snap action, stops between which said connected end part moves and is confined, an elongated flexible member supported alongside said tension and compression members and lying approximately parallel thereto, at least one of said stops being rigidly fastened to one end of said elongated flexible member so that when said connected end part lies against said one stop, the flexing of said elongated flexible member moves said one stop relative to the mounting points of said compression and tension members to cause said connected end part to move with a snap action into engagement with the other stop.

9. A snap switch comprising in combination, a tension member and an adjacent compression member each operatively mounted at one end and connected together at their opposite ends which are free to move, at least one of said members comprising spring means, stops between which said connected end part moves and is confined, said stops being mounted movably with respect to the mounting points of said tension and compression members, said compression member having a different radius of action than said tension member, so that said connected end part may be moved to move the mounting point of said compression member relative to the tension center line of said tension member, said members being so constructed and arranged that said connected end part moves with a snap action as said compression member mounting point and said tension member center line cross, said tension and compression members being so arranged that as said connected end part is moved by one of said stops to a predetermined position the mounting point of said compression member

crosses the tension center line of said tension member and said connected end part moves with a snap against the other stop, and a plurality of thermostatic means, each so constructed as to be operable to move said stops under the influences of temperature change in said thermostatic means.

10. A snap switch comprising in combination, a tension member and an adjacent compression member each operatively mounted at one end and connected together at their opposite ends which are free to move, at least one of said members comprising spring means, stops between which said connected end portion moves and is confined, said stops being mounted movably with respect to the mounting points of said tension and compression members, said compression member having a different radius of action than said tension member, so that said said connected end portion may be moved to move the mounting point of said compression member relative to the tension center line of said tension member, said members being so constructed and arranged that said compression member mounting point and said tension member center line cross, said tension and compression members being so arranged that as said connected end portion is moved by one of said stops to a predetermined position the mounting point of said compression member crosses the tension center line of said tension member and said connected end portion moves with a snap against the other stop, a movable mounting member for said stops, said movable mounting member including a resilient strip, and a thermostatic member in operative relation to said mounting member and so constructed as to be operable to move said mounting member under the influence of temperature change.

11. A snap switch comprising in combination, a tension member and an adjacent compression member each operatively mounted at one end and connected together at their opposite ends which are free to move, at least one of said members comprising spring means, stops between which said connected end portion moves and is confined, said stops being mounted movably with respect to the mounting points of said tension and compression members, said compression member having a different radius of action than said tension member, said mounting point of said compression member and the tension center line of said tension member being movable with respect to each other, said members being so constructed and arranged that said connected end portion moves with a snap action as said compression member mounting point and said tension member center line cross, said tension and compression members being so arranged that as said connected end por-

tion is moved by one of said stops to a predetermined position the mounting point of said compression member crosses the tension center line of said tension member and said connected end portion moves with a snap against the other stop, a movable mounting member for said stops, and a plurality of thermostatic members arranged in operative relation to said mounting member, each of said thermostatic members being adapted individually to move said mounting member under the influence of temperature change to cause operation of said switch.

12. A snap switch comprising a base, a tension member and an adjacent compression member each operatively mounted at one end upon said base and having their opposite ends connected together and free to move, said compression member being mounted at such a point as to have a different radius of action than said tension member, at least one of said members comprising spring means, stops for said connected ends of said members, said connected ends being arranged to move between said stops, at least one of said stops being mounted movably on said base, and thermostatic means mounted on said base for moving said one stop in response to temperature change, said tension and compression members being so arranged that as said connected free ends of said members are moved by said one stop to a predetermined position the mounting point of said compression member crosses the tension center line of said tension member and said connected free ends move with a snap action against the other stop.

13. A snap switch comprising a base, a tension member and an adjacent compression member each operatively mounted at one end upon said base and having their opposite ends connected together and free to move, said compression member being mounted at such a point as to have a different radius of action than said tension member, at least one of said members comprising spring means, a resilient arm mounted on said base, stops mounted on said arm, said connected ends of said members being adapted to move between said stops, and a plurality of thermostatic members mounted on said base, each thermostatic member being separately arranged to move said resilient arm and said stops in response to temperature change, said tension and compression members being so arranged that as said connected free ends of said members are moved by one of said stops to a predetermined position the mounting point of said compression member crosses the tension center line of said tension member and said connected free ends move with a snap action against the other stop.

ARTHUR L. RICHE.