May 6, 1958 V. WEBER 2,833,893

THERMOSTATIC SWITCH

Filed Nov. 16, 1956 2 Sheets-Sheet 1

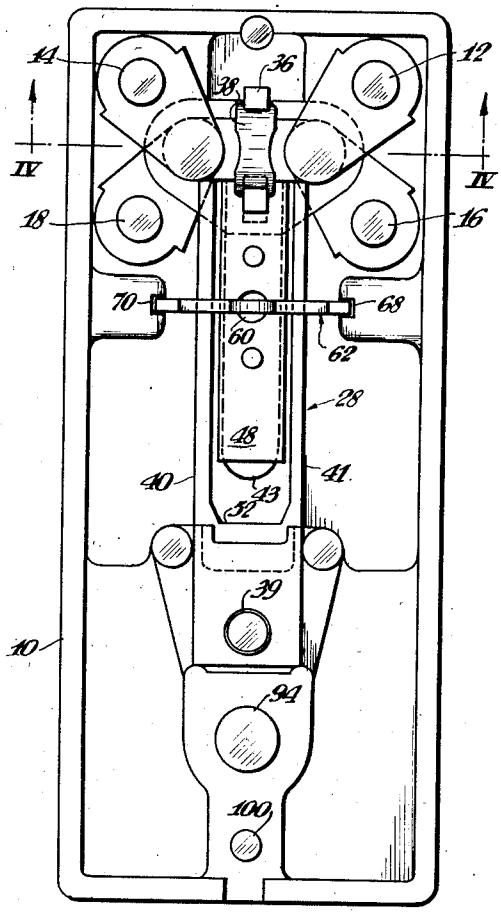


Fig. 1.

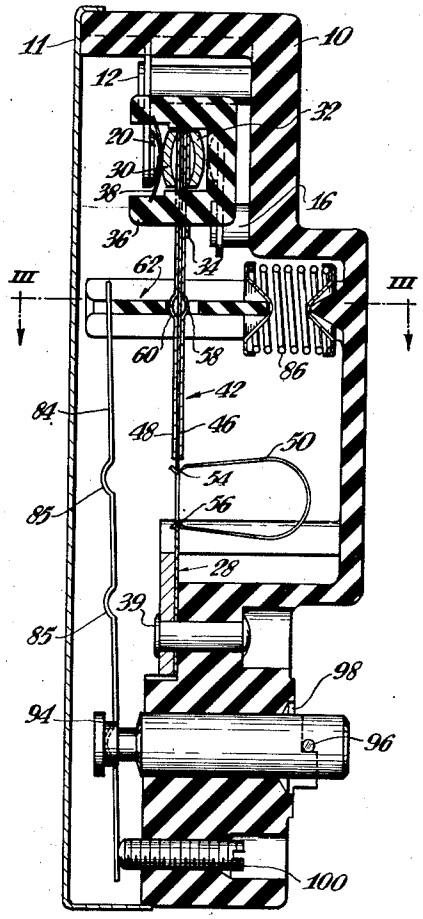


Fig. 2.

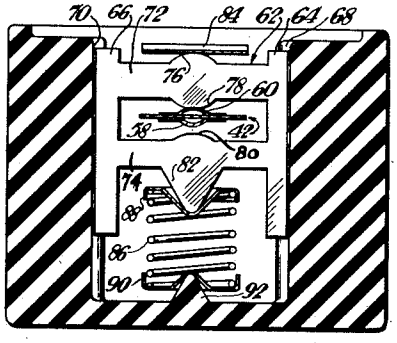


Fig. 3.

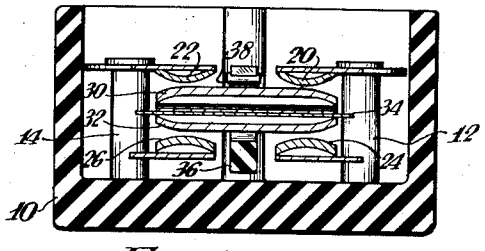


Fig. 4.

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May 6, 1958 V. WEBER 2,833,893

THERMOSTATIC SWITCH

Filed Nov. 16, 1956 2 Sheets-Sheet 2

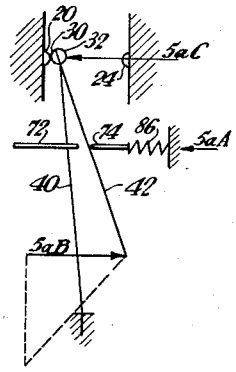


Fig. 5a.

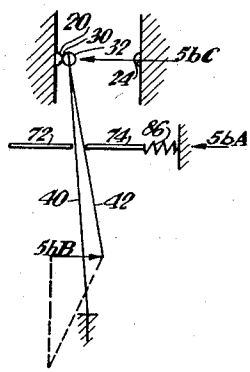


Fig. 5b.

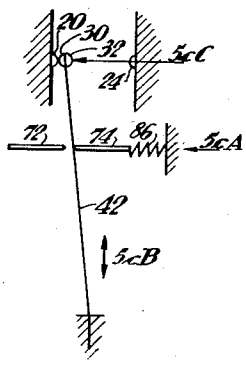


Fig. 5c.

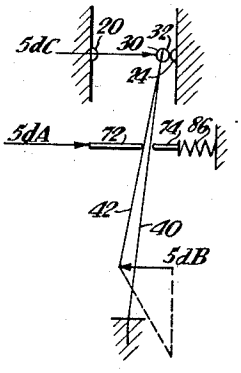


Fig. 5d.

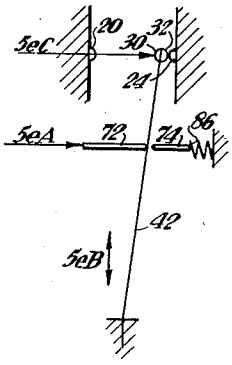


Fig. 5e.

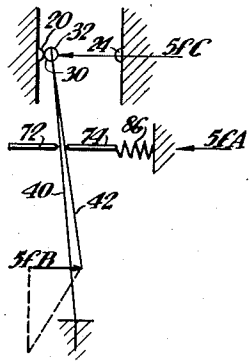


Fig. 5f.

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THERMOSTATIC SWITCH

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Application November 16, 1956, Serial No. 622,623

8 Claims. (Cl. 200—138)

This invention relates to circuit breakers and more particularly to thermostatic switches having snap action mechanisms for automatically opening and closing electric circuits of the type utilized in electric water heaters.

An object of this invention is to utilize a snap action mechanism in a thermostatic switch which will operate in accordance with small temperature differentials.

Another object of this invention is to utilize a floating spring-loaded actuating member in a snap switch to reduce the friction losses to a negligible level.

Another object of this invention is to incorporate a snap action mechanism in a switch having a contact carrying member which moves between spaced stationary contacts and in which substantial contact pressure holds the mating contacts together with a positive pressure until the instant of movement by the snap action mechanism.

It is another object of this invention to eliminate arcing and chattering of the contacts of a snap switch by an over-center spring which exerts a varying force on the end of a tongue whose movement is alternately actuated by a thermal element and by a return coil spring whereby another force is exerted on the tongue at its pivot point.

Other objects and advantages of this invention will become apparent from the following description when considered in connection with the accompanying drawings wherein:

Fig. 1 is a plan view of a double-throw double-pole switch embodying this invention;

Fig. 2 is a side view of Fig. 1 with parts in section to show certain details of construction;

Fig. 3 is a sectional view taken along the line III—III of Fig. 2;

Fig. 4 is a sectional view taken along the line IV—IV of Fig. 1; and

Figs. *5a* through *5f* are diagrams of the forces involved in a sequence of operation of the switch mechanism.

As shown in Figs. 1 and 2, the thermostatic switch comprises a supporting base **10** fabricated of suitable insulating material cooperating with a cover **11** to form an enclosed casing for the switch mechanism to be described hereinafter. Terminal posts **12**, **14**, **16**, and **18** are fastened to base **10** in such a manner as to provide contact area for the attachment of lead wires (not shown) from the outside of base **10**. Contacts **20** and **22** (Fig. 4) are secured to terminal posts **12** and **14**, respectively, while contacts **24** and **26** are secured to terminal posts **16** and **18**, respectively, in spaced parallel relation to contacts **20** and **22**.

The contact carrier indicated generally at **28**, carries on one of its ends an upper contact bridge **30** and a lower contact bridge **32** with a bridge insulator **34** positioned therebetween. The upper and lower bridges **30** and **32** are assembled on the end of carrier **28** by means of a U-shaped insulator **36** and a cooperating fastener clip **38**. As is illustrated in Fig. 4, the contact carrier is movable with a snap action between an upper position where bridge **30** completes an electric circuit for contacts **20** and **22** and a lower position where bridge **32** completes an electrical circuit for contacts **24** and **26**. The contacting surfaces of the bridge members **30** and **32**, as well as the contacts **20**, **22**, **24**, and **26** have an arcuate shape to provide linear contact between corresponding contacts.

One end of contact carrier **28** is movable so that bridges **30** and **32** affixed thereto oscillate between the spaced contacts affixed to base **10**, while the opposite end thereof is securely anchored to base **10** by any suitable means such as rivet **39**. Contact carrier **28** comprises part of the snap mechanism and is in the shape of a rectangular strip having a central rectangular cutout having sides **40** and **41** and a tongue **42** extending therein from a common end so that the sides **40** and **41** of the rectangular strip and the tongue **42** constitute three parallel arms lying in the same plane. The tongue part of the snap mechanism may be fabricated from separate elements or, as is illustrated in Figs. 1 and 2, it may be formed from flat spring material with rigid plates **46** and **48** attached to opposite surfaces of tongue **42** in order to render the tongue inflexible.

Snap movement is imparted to the contact carrier **28** by an over-center U-shaped resilient spring **50**. The two leg portions of the spring **50** extend between a knife edge bearing **52** formed on the secured end of the switch arm **28** and the free end **43** of the tongue **42**, which serves as a second bearing member. The bearing members are received in bearing seats **54** and **56** formed by providing suitable indentations in the end portions of the legs of the spring **50**.

Embossed portions **58** and **60** centrally located in plates **46** and **48**, respectively, act as bearing surfaces for the inflexible tongue **42**. Linear movement is imparted to tongue **42** by an actuating member, indicated generally at **62**, whose sides **64** and **66** are guided in slots **68** and **70**, respectively, formed in opposing projections on base member **10**. The sides **64** and **66** of the actuating member **62** are joined by spaced parallel bars **72** and **74** defining a central opening therebetween. Upper bar **72** has opposing embossed portions **76** and **78** while lower bar **74** has opposing embossed portions **80** and **82** in vertical alignment therewith. Embossed portions **78** and **80** extend into the central opening defined by parallel bars **72** and **74** and act as pivot points for tongue member **42**.

The actuating member **62** is moved downward in response to an operating member **84** which engages embossed portion **76** on parallel bar **72** and is moved upward in response to return spring **86** that is contained on both ends by floating cups **88** and **90** which engage embossed portion **82** on lower parallel bar **74** and a boss **92** formed on base member **10**, respectively.

The operating member **84** is a thermally responsive element in the form of an elongated strip with a plurality of spaced transverse raised portions **85** and having one end abutting embossed portion **76** on the upper parallel bar **72**. Adjacent its opposite end the member **84** is positioned on a reduced portion of adjusting shaft **94** by means of a keyhole slot (not shown). The opposite end of the shaft **94** protrudes outside the base **10**. A pin **96** transversely positioned within the exposed end of shaft **94** travels on a cam **98** which is part of the base **10**, and the rise of the cam is related to temperature markings (not shown) on the base **10**. Rotation is transmitted to shaft **94** by any suitable means such as a conventional control knob (not shown) positioned on the exposed end of shaft **94**. An additional adjusting screw **100** is threaded through the base **10** and abuts the rearwardmost portion of the thermally responsive element **84** for a purpose to be described hereinafter.

A sequence of operation of the switch mechanism will now be described with reference to the force diagrams illustrated in Figs. *5a* through *5f*. Assume that adjusting

shaft 94 is at the low temperature stop on cam 98 so that contacts 24 and 26 are made by the contact bridge 32 and that adjusting screw 100 has been rotated to position the operating member 84 in the correct relation to the actuating member 62 for a desired temperature range. The arcuate shape of the contacts 20, 22, 24, and 26 and of the contact bridges 30 and 32 protects against faulty switching by providing contact ventilation and linear contact through the cycle.

The rotary motion of the shaft 94 to a desired temperature setting is converted into longitudinal motion due to the provision of the transverse pin 96 and the rise of cam 98. Hence, the shaft 94 causes the operating member 84 to impart movement to actuating member 62 against the bias of the coil spring 86. Actuating member 62 in turn moves the tongue 42 to a position where its free ends 43 are beyond the snap point as shown in Fig. 5*a*. The force exerted by U-shaped spring 50, as shown by vector 5*a*B causes the tongue 42 at its bearing portion 58 to engage the embossed portion 80 on the lower bar 74 of the actuating member 62. The force exerted by the return coil spring 86 is shown by vector 5*a*A. The vectors 5*a*A and 5*a*B combine to give a resulting vector 5*a*C which forces the bridge 30 against the contacts 20—22 with a high contact pressure. The vectors shown on Figs. 5*a* through 5*f* are representative of the direction of the forces involved and are not intended to represent the magnitudes thereof.

As the temperature rises and heat is transferred through the cover 11, the thermally responsive operating member 84 reacts by moving away from the actuating member 62. Return coil spring 86 forces the actuating member to follow, thereby reducing the value of the vector 5*b*B as is illustrated in Fig. 5*b*. However, the vectors 5*b*A and 5*b*B combine to result in vector 5*b*C which maintains the bridge 30 in engagement with the contacts 20—22. As the temperature approaches the desired temperature setting, the vector 5*c*B equals zero but as is shown in Fig. 5*c*, the vector 5*c*A results in vector 5*c*C which maintains the contact pressure.

When the temperature reaches the desired temperature setting, the tongue end 43 transfers to the other side of its center position with a snap action by the energy stored in the over-center spring 50. This reverses the direction of vector 5*d*A (Fig. 5*d*) causing lower bridge 32 to engage contacts 24—26 and bearing portion 60 of the tongue 42 is now in engagement with embossed portion 78 on the upper bar 72 of the actuating member 62. In this position, contact pressure is maintained by vector 5*d*C which is the result of the combination of vector 5*d*B exerted by the U-shaped spring 50 and the vector 5*d*A exerted by the thermally responsive operating member 84 against the bias of the coil spring 86.

With contacts 20—22 broken there is a reduction of heat causing operating member 84 to move the tongue 42 until the vector 5*e*B (Fig. 5*e*) again equals zero whereupon the vector 5*e*A results in vector 5*e*C which maintains the contact pressure. Additional movement of the actuating member 62 by the thermally responsive operating member 84 causes the tongue end 43 to return to the original side of its center position with a snap action by the energy stored in the over-center spring 50. Upper bridge 30, once again, engages contacts 20—22 and the vectors 5*f*A and 5*f*B (Fig. 5*f*) combine to give a resulting vector 5*f*C.

Inasmuch as this invention is subject to many variations and modifications, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

It is claimed and desired to secure by Letters Patent:

1. In a snap switch, a contact carrier having oppositely internally stressed arms, a spring biased between one end of said carrier and one of said arms, said spring exerting a force on said one arm, an actuating member positioned adjacent said one arm and acting as pivot therefor, and resilient means engaging said actuating member and biasing the same to exert another force on said one arm at its pivot, said forces combining to form a resultant force on said contact carrier.

2. In a snap switch having a movable switch arm and a tongue integral therewith at one end, a spring biased between the other end of said switch arm and said tongue whereby a spring force is exerted on said tongue to cause movement of said switch arm with a snap action, an actuating member engaging said tongue at a pivot point, and resilient means in biased engagement with said actuating member, said resilient means cooperating with said actuating member to exert a force opposite to said spring force whereby said switch arm is rendered immovable until said spring passes a dead center position.

3. In a snap switch, a flexible member having a fixed end and a free end movable between two positions, an inflexible member having one end fixed to said flexible member and a free end, a spring mounted between the fixed end of said flexible member and the free end of said inflexible member to exert a thrust thereon for causing the movable end of said flexible member to move between said two positions with a snap action, a floating spring-loaded actuating member engaging said inflexible member to provide a pivot therefor, and means operatively connected to said actuating member to cause pivoting of said inflexible member.

4. In a snap switch, a base member, a flexible member having a free end movable between two positions and a fixed end secured to said base member, an inflexible member having one end secured to said free end of said flexible member and an actuating end, a spring biased between the fixed end of said flexible member and the actuating end of said inflexible member, an actuating member engaging said inflexible member and cooperating with said spring to cause translation and rotation of said inflexible member whereby the free end of said flexible member is movable between said two positions, and resilient means in biased engagement with said actuating member and cooperating with said spring to retain the free end of said flexible member in one of said two positions.

5. In a snap switch as recited in claim 4, in which said resilient means comprises a coil spring biased between said base member and said actuating member.

6. In a snap switch, a base member, a contact carrier having a cut-out forming a switch arm and a tongue disposed one within the other and extending in the same direction from a common end, a spring biased between said switch arm and said tongue at their ends opposite to said common end, said spring placing said switch arm under tension and said tongue under compression to cause movement of the common end of said contact carrier with a snap action when said spring is moved past a dead-center position, an actuating member engaging said tongue and providing a pivotal axis therefor, and yieldable means engaging said actuating member to exert a force on said tongue at said pivotal axis opposite to a force exerted on the end of said tongue by said spring.

7. In a thermostatic switch, a supporting base, electrical contacts fixed to said base, a contact carrier having a cut-out forming a switch arm and a tongue disposed one within the other and extending in the same direction from a common end with the opposite end of said carrier being fixed to said base, a spring biased between said arm and said tongue at their ends opposite to said common end, said spring exerting a force on said tongue to cause movement of the common end of said carrier with a snap action when said spring is moved past a dead center position, electrical contacts fixed to said arm at said common end and adapted to engage the contacts on said base, an actuating member for said tongue having a pair of pivot points therefor, a thermally responsive element connected to said actuating member, a coil spring biased between said base and said actuating member, said tongue being

pivoted about one of said pivot points in response to movement of said actuating member by said thermally responsive element against the bias of said coil spring and being pivoted about the other of said pivot points in response to movement of said actuating member by the bias of said coil spring.

8. A thermostatic switch comprising a supporting base, an oscillating member having one end affixed to said base and carrying electrical contacts on its free end for engagement with stationary contacts on said base, said member having an opening therethrough, a tongue secured at one end to said member and having a free end disposed within said opening, a U-shaped spring operatively mounted between the free end of said tongue and the fixed end of said oscillating member, an actuating member having a central opening therethrough with oppositely disposed projections extending into said central

opening, a coil spring mounted between said actuating member and said base to bias said actuating member from said base, said tongue being disposed through said central opening to engage each of said projections upon corresponding positions of said over-center spring, an operating element having one end adjustably mounted on said base and a free end in engagement with said actuating member in opposed relation to said coil spring, said operating element being operative in response to variations in temperature to effect movement of said actuating member causing pivotal movement of said tongue on one of said projections.

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