Oct. 11, 1949. J. B. BADER 2,484,145

THERMOSTATIC SWITCH

Filed May 11, 1945

Fig. 1.

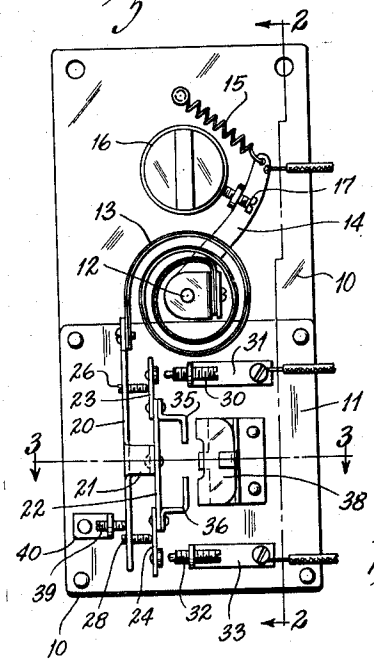


Fig. 2.

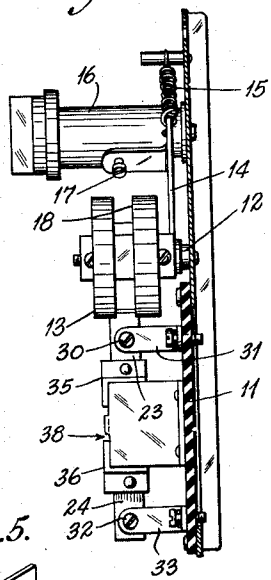


Fig. 4.

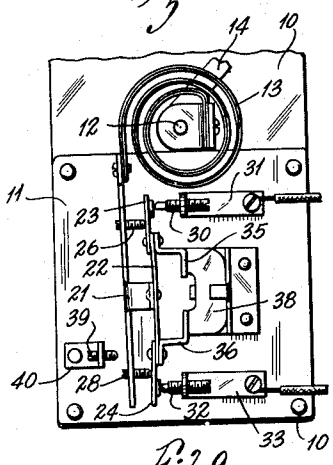


Fig. 5.

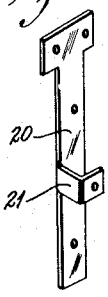


Fig. 3.

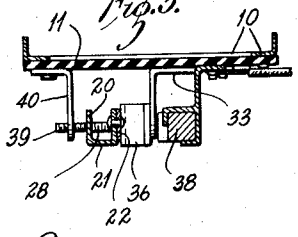


Fig. 10.

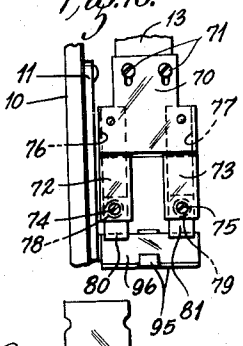


Fig. 9.

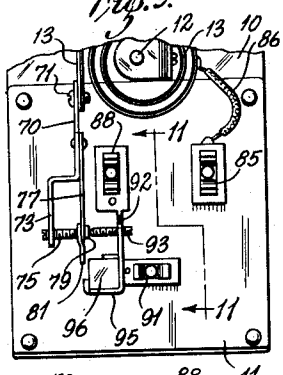


Fig. 7.

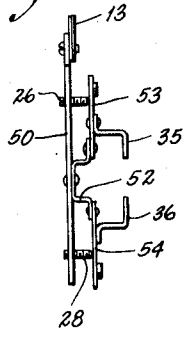


Fig. 8.

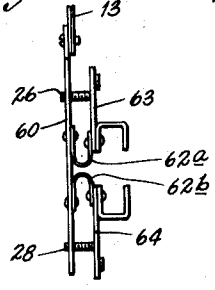


Fig. 6.

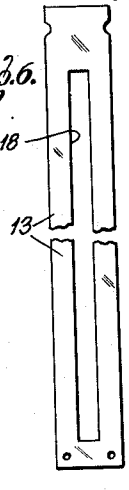
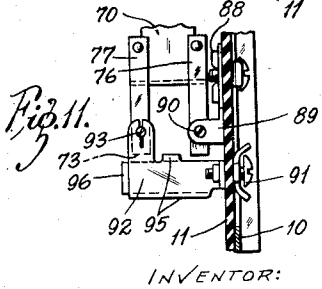


Fig. 11.



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THERMOSTATIC SWITCH

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Application May 11, 1945, Serial No. 593,134

13 Claims. (Cl. 200—139)

1

The present invention relates to a thermostat, and more particularly to a switch having particular use in connection with a thermal element giving independent snap action of a plurality of separate contacts supported on a single movable member.

It is an object of the invention to provide a switch of the foregoing character having a single switch blade and a plurality of switch elements carried thereby, each independently operated with an individual snap action.

An especial object is to provide a switch of the foregoing kind in which the switch blade is actuated by a walking movement such as is produced by a thermally-responsive member.

A further particular object is to provide a switch of the foregoing character in which the snap-action means comprises one mechanism operable upon both contact devices.

A further object is to provide a switch actuated by a walking type of blade, but having two independently closable contacts operated by a snap action and designed so that any necessary override of the blade beyond the contact point is resiliently absorbed.

In the drawings:

Fig. 1 is a front elevation of a switch embodying this invention;

Fig. 2 is a vertical section, taken on the line 2—2 at the right of Fig. 1;

Fig. 3 is a horizontal section taken on the line 3—3 across the lower part of Fig. 1;

Fig. 4 is a view of the switch operating parts of Fig. 1 in contact closing position;

Fig. 5 is a view of a portion of the switch blade;

Fig. 6 is an elevation in development of the bimetal;

Fig. 7 is a front elevation of the switch blade and contact mechanism in slightly modified form;

Fig. 8 is a view of the switch blade and contact mechanism in a further modified form;

Fig. 9 is a front view, partly broken away, of a modified form of switch;

Fig. 10 is a view from the left side of Fig. 9; and

Fig. 11 is a section on the line 11—11 at the middle of Fig. 9.

Referring to Figs. 1–6, the switch mechanism is shown as being mounted upon a base plate 10 of metal or the like, to which is attached a lower insulating section 11 designed to hold the electrical parts.

2

Mounted on the base plate 10 above the section 11 is a post 12 to which the inner convolution of a bimetal coil 13 is attached. The post 12 has secured to it a bracket 14 held by a spring 15 in contact with an adjustment cam 16. By rotation of the adjustment cam 16, the initial setting of the bimetal may be adjusted. Calibration of the setting is effected by means of a screw 17. It will be understood that the bimetal coil 13 loosens and tightens its convolutions in response to temperature changes. In order to prevent its warping transversely, it is slotted at 18, as appears in Figs. 2 and 6. Were the bimetal permitted to warp to a curved cross section, it would be strongly urged toward a straight condition in the manner of the familiar curved steel tapes.

The free end of the bimetal coil 13 has a blade 20 attached to it. This blade has an upstanding lug 21 (Fig. 5) thereon, the outer end of which is turned in to parallel the main portion of the blade. A spring member 22 of bronze or like spring metal is securely fastened, as by rivets, to the outer surface of the lug 21 so as to extend to each side of the lug in general parallelism with the blade 20. The free ends of the spring 22 receive electrical contact members, a contact member 23 being secured to the upper end of the spring 22 and a contact member 24 being secured to the lower end. It will be evident that these contact members may pivot on the spring 22 toward and away from the main blade 20. A screw 26, adjustably threaded through the blade 20, is engaged by the blade, the latter normally springing in that direction. Similarly, an adjustable screw 28 engages and positions the contact member 24.

The contact member 23 has a contact adapted to close with a contact 30 formed as a screw adjustable in a bracket 31 toward and from the member 23. A similarly adjustable contact 32, mounted in a bracket 33, is adapted to be engaged by the contact member 24.

The spring blade 22 likewise has a pair of armature brackets 35 and 36 secured thereto, preferably by the same rivets that hold the contact members 23 and 24 thereto. The ends of the brackets 35 and 36 extend adjacent the poles of a permanent magnet 38 supported upon the plate 11. It will be observed that this arrangement enables a single magnet to provide snap action for both blades.

Movement of the blade member 20 away from closure of the switch is limited by an adjustable

screw 39 supported in a bracket 40 on the plate 11.

The modification of Fig. 7 is similar in principle. In it, the blade 50 corresponds to the blade 20 of Fig. 1. However, in this case, the contact members 53 and 54 are mounted upon a bronze spring 52 that is generally U-shaped and secured to the member 50 in its bight portion. The action is the same as that of Fig. 1. Fig. 1, however, has the advantage of employing only a straight spring member and thereby eliminating the necessity of shaping this material which is not as easy to fabricate as the steel of the blade 20.

In Fig. 8, the blade 60 corresponds to the blades 20 and 50. However, the two contact members 63 and 64 are mounted by individual springs 62*a* and 62*b* to the blade 60. Otherwise the construction is the same.

The modification shown in Figs. 9–11 includes the same front plate elements 10 and 11 and the same bimetal coil 13. In this case, however, there is a switch blade 70 extending downwardly from the end of the bimetal coil 13. The blade 70 is attached to the bimetal coil by screws 71, providing a slot for adjustment up and down of the blade 70 on the end of the bimetal. The blade 70 has two arms 72 and 73, laterally offset from the blade itself and projecting downwardly therefrom. The two arms 72 and 73 have adjustable stop screws thereon, at 74 and 75, respectively. Two spring switch contact elements 76 and 77 are attached to the main blade 70, and extend down behind the two arms 72 and 73, respectively. They are riveted to the blade 70, but their free ends may flex relative to the downwardly extending arms 72 and 73. The two spring contact elements 76 and 77 have contacts 78 and 79, respectively. The contact element 76 has a magnetic armature member 80 projecting from its lower end, and the contact element 77 has a similar magnetic armature member 81 projecting from its lower end. The two armature elements and the two contacts may be secured to their respective spring elements by the same means. The natural springing of the two contact elements 76 and 77 is to the left in Fig. 9, so that normally they are urged to remain in contact with the two adjustment screws 74 and 75.

Three electrical terminals are provided for the switch. A terminal 85 is mounted on the insulating member 11 and carries a lead 86 that is attached to the bimetal coil at some suitable point, so that it makes the two contact springs 76 and 77 carry one polarity of the circuits. A second terminal 88 is mounted through the panel 11 and has a metallic portion held against the inner surface thereof. This metallic portion has an angular extension 89 extending upwardly opposite the end of the contact 78. The upstanding flange 89 has an adjustable contact screw 90 extending therethrough for contact with the contact member 78.

The third terminal is shown at 91 as mounted upon the insulating panel 11. It has an upstanding portion 92 disposed to extend opposite the contact 79. This upstanding portion carries an adjustable contact screw 93 that is adapted to be engaged by the contact 79. The terminal 91 also, as shown in Figs. 9 and 10, has flanged projections 95 that cradle and hold a permanent magnet 96, of the bar type, of a length to extend across adjacent the ends of both the armatures 80 and 81 on the switch blade mechanism.

Operation

Referring first to Figs. 1–6, the initial spring force of the spring 22 is in a direction to urge the two contact members 23 and 24 against the screws 26 and 28. As the bimetal 13 tightens its convolution, it moves the blade 20 to the right in Fig. 1. As this motion proceeds, in a walking manner, the two armature brackets 35 and 36 are brought more and more into the field of the magnet 38. At any point in the movement of the bimetal, the forces acting on each contact member are the force of its spring in one direction and the force of the magnet in the opposite direction. As the magnet is fixed relative to the blade, the individual adjustment of the screws 26 and 28 determines the relative distances each armature is into the magnetic field for any position of the bimetal coil. Ordinarily one armature will be adjusted further toward the magnet than the other.

At a point in movement of the blade 20 by the bimetal, the spring resistance acting on the armature nearer the magnet will be overcome by the magnetic pull, and that armature will be drawn away from its stop screw until its contact engages the opposite stop screw 30 or 32 as the case may be, the movement of the armature in advance of the bimetal being permitted by the yielding of the corresponding end of the spring blade. The magnet draws the armature with increasing force as the armature approaches, so that the contacts close with a snap action.

The second armature will act in the same manner when it enters the magnetic field to such a point that the magnetic field overcomes the spring resistance.

When the bimetal coil retracts the blade 20, the latter withdraws the middle of the spring 22 to the left in Fig. 4. The ends of the spring are held by the forces of the magnet on their armatures. These attractive forces are functions of the proximity of the respective armatures to the magnet, and hence of the individual adjustment of the screw contacts 30 and 32. The contact held further to the left by its screw will be held with less magnetic force.

The leftward movement of the blade 20 flexes the two ends of the spring 22, accumulating in each a flexing energy in opposition to the magnetic attraction. When this flexing force of one end of the spring 22 exceeds the particular magnetic pull acting oppositely, it will break the contact away. As the magnetic pull decreases exponentially with distance away from the magnet, the contact break occurs with a snap. Assuming the other contact screw to be adjusted to permit closer proximity of its armature, the other contact will break in like manner subsequently.

Thus this construction provides a plurality of contact elements operated by a single power means, with individually controllable opening and closing points, providing a snap action, and that in the form of a single magnet.

The main adjustment of the bimetal, by the cam knob 16, adjusts all of the foregoing on-and-off temperatures bodily, without changing the differentials between them.

It will be seen that the operation of the switches of Figs. 7 and 8 will be the same as that of Figs. 1–6.

The operation of the switch shown in Figs. 9–11 is very similar to that of Figs. 1–6. The bimetal element is the same, and it moves the blade

extension 70 in a manner similar to its movement of the blade 20. As already noted, the two spring blade elements 76 and 77 are normally maintained against the two screws 74 and 75 by the inherent resilience of the spring members. The two adjustments of the two screws 74 and 75, which may be done independently one of another, thereby preset the two contacts 78 and 79 to close at predetermined individual temperatures, in terms of the position of the main bimetal coil 13. As the bimetal coil moves the blade 70 to the right in Fig. 9, it will bring the two armature members 80 and 81 into the field of the magnet 96. The attracting power of the magnet is a function of the distance between it and the armature members. Hence, when one of the armature members comes so close to the magnet that the field is effective to overcome the urge of its spring member to the left in Fig. 9, the magnet will suddenly draw the armature 81 and its attached spring switch element to the right, away from its limit screw 74 or 75. This movement will bring the respective contact 78 or 79 against its adjustment screw 90 or 93 on the terminal members.

The two screws 90 and 93 provide individual adjustments for the temperatures at which the contacts are broken. As the bimetal coil 13 moves the blade 70 to the left, a breaking force is applied to withdraw the two armatures 80 and 81 from the magnetic field. This force is gradually built up with a gradual movement of the bimetal. It causes a flexing of the two blades 76 and 77 until the breaking force of the bimetal overcomes the effect of the magnet on each of the armatures. When this accumulated breaking force becomes greater than the attractive force of the magnet, the armature 81 will be drawn away from the magnet. As the effect of the magnetic field varies inversely as the square of the distance between the magnet and the armature, any movement of the armature away from the magnet decreases the magnetic pull very rapidly. The individual blade will spring back against its screw 74 or 75 which will have been withdrawn away from it as it was flexed. This provides snap-acting breaking of the contact points.

The individual adjustment of the two screws 90 and 93 determines how far into the magnetic field each of the individual armatures may be moved. Hence, the force resisting their displacement out of the magnetic field is a function of the position of the individual screw 90 or 93 in question. If one of the armatures is further away from the magnetic field when it is against its screw, it will be broken more easily as the bimetal coil moves the blade 70 to the left.

From the foregoing description, it will be seen that both the on and the off positions of the individual switch contacts are individually adjustable. Where the main bimetal coil is adjusted by the knob 16, all of the on-and-off temperatures are varied, but the differentials remain constant.

It is fairly obvious that the number of blade elements 77 and associated contacts and terminals may be varied widely to control any number of circuits.

Thus the switch of Figs. 9–11 has operating characteristics similar to those of Figs. 1–8. It is easier and cheaper to make, and is more compact, and offers a type of construction more flexible as it does not limit the number of blades that may be used.

While the invention has been described in connection with a bimetal type of thermostat switch, it is evident that it may be used with other power means. Also it may be used for other operations than switch actuation. It does, however, have peculiar advantages in the form shown.

What is claimed is:

1. In a mechanism of the kind described, a blade member, a magnetic member, power means for moving one of said members toward and away from the other member in a predetermined path, a pair of control elements mounted on the blade, for individual movement thereon, each including parts of magnetic material adapted to be individually attracted by the magnet as the two members approach each other, said magnetic parts being disposed on the blade so as to be moved by the magnetic field at separate points in the approach of the blade and magnetic members together, and means for adjusting the disposition of one of the magnetic parts on the blade member to adjust the points in approach of the blade and magnetic members at which one control element will be attracted to the magnetic member, relative to the point at which the other control element will be so moved.

2. In a mechanism of the kind described, a blade member, a magnetic member, means for moving one of said members toward and away from the other member in a predetermined path, a pair of control elements mounted on the blade, for individual movement thereon, and including parts of magnetic material adapted to be individually attracted by the magnet as the two members approach each other, said magnetic parts being disposed on the blade so as to be moved by the magnetic field at separate points in the approach of the blade and magnetic members together, means for adjusting the disposition of one of the magnetic parts on the blade member to adjust the points in approach of the blade and magnetic members at which one control element will be attracted to the magnetic member, relative to the point at which the other control element will be so moved, and means for adjusting the initial disposition of the blade and magnetic members relative to each other.

3. In a mechanism of the kind described, a support member, a magnetic member, means for moving one of said members toward and away from the other member in a predetermined path, a pair of control elements mounted on the support, there being means mounting each control element on the support for individual movement thereon, each control element that is thus mounted including parts of magnetic material adapted to be individually attracted by the magnet as the two members approach each other, said magnetic parts being disposed on the support so as to be moved by the magnetic field at separate points in the approach of the support and magnetic members together, said control elements being resiliently and yieldingly urged toward the support member and away from the magnetic member, and stop means on the support member against which the control elements may engage.

4. In a mechanism of the kind described, a support member, a magnetic member, means for moving one of said members toward and from the other, a pair of contact elements, spring means mounting the elements on the support and yieldingly urging them away from the magnetic member, parts of magnetic material, one associated with each control element, adapted to be individually attracted toward the magnetic member and to individually move their respective control elements correspondingly, against the spring

means, said parts of magnetic material being disposed on the support so as to be moved by the magnetic field at separate points in the approach of the support and magnetic members together, said spring means comprising a leaf spring attached between its ends to the support member, and having the contact elements and the parts of magnetic material attached to its projecting ends, for resilient movement thereon.

5. In a mechanism of the kind described, a support member, a magnetic member, means for moving one of said members toward and from the other, a pair of contact elements, spring means mounting the elements on the support and yieldingly urging them away from the magnetic member, parts of magnetic material associated with each control element and adapted to be individually attracted toward the magnetic member and to individually move their respective control elements correspondingly, against the spring means, said parts of magnetic material being disposed on the support so as to be moved by the magnetic field at separate points in the approach of the blade and magnetic members together, said spring means comprising a leaf spring attached between its ends to the support member, and having the contact elements and the parts of magnetic material attached to its projecting ends, for resilient movement thereon, the contact elements being normally resiliently held by the leaf spring in initial positions away from the magnetic member, but yieldable toward the same.

6. In a mechanism of the kind described, a blade member, a magnetic member, means for moving one of said members toward and from the other, a pair of contact elements, spring means mounting the elements on the blade and yieldingly urging them away from the magnetic member, parts of magnetic material associated with each control element and adapted to be individually attracted toward the magnetic member and to individually move their respective control elements correspondingly, against the spring means, said parts of magnetic material being disposed on the blade so as to be moved by the magnetic field at separate points in the approach of the blade and magnetic members together, said spring means comprising a leaf spring attached between its ends to the blade member, and having the contact elements and the parts of magnetic material attached to its projecting ends, for resilient movement thereon, the contact elements being normally resiliently held by the leaf spring in initial positions away from the magnetic member, but yieldable toward the same, and means for adjusting the initial positions of the contact elements.

7. In a mechanism of the kind described, a blade member, a magnetic member, means for moving one of said members toward and from the other, a pair of contact elements, spring means mounting the elements on the blade and yieldingly urging them away from the magnetic member, parts of magnetic material associated with each control element and adapted to be individually attracted toward the magnetic member and to individually move their respective control elements correspondingly, against the spring means, said parts of magnetic material being disposed on the blade so as to be moved by the magnetic field at separate points in the approach of the blade and magnetic members together, said spring means comprising a leaf spring attached between its ends to the blade member, and having the contact elements and the parts of magnetic material attached to its projecting ends, for resilient movement thereon, the contact elements being normally resiliently held by the leaf spring in initial positions away from the magnetic member, but yieldable toward the same, and means for limiting the movement of the contact elements away from the blade member.

8. In a device of the kind described, a support, power means operated in response to changes in physical conditions to effect movement of the support in opposite directions, a plurality of contact arms mounted on the support for individual movement and resiliently movable relative to the support, armature means for each arm, a single magnetic device extending adjacent each armature member, whereby it may individually attract each said member and its attached arm, and adjustable means to preset each contact arm individually on the support to alter the point in the movement of the blade at which each arm is drawn by the magnet.

9. In a mechanism of the kind described, a base, magnetic means on the base, support means on the base, power means for moving one of said first two means toward and from the other, a plurality of leaf spring elements, each attached at one end to the support means and with their free ends projecting parallel therefrom, and said support means projecting toward the free ends of said leaf spring elements, a stop means on the projecting parts of the support means engageable by each leaf spring to delimit the movement of the leaf spring away from the magnetic means, armature parts on the leaf springs adapted to be moved into and out of the magnetic field by movement of the support, and relatively fixed contacts on the base for engagement by the leaf springs, when the armatures are drawn to the magnetic means.

10. In a mechanism of the kind described, a base, magnetic means on the base, support means on the base, power means for moving one of said first two means toward and from the other, a plurality of leaf spring elements, each attached at one end to the support means and with their free ends projecting parallel therefrom, and said support means projecting toward the free ends of said leaf spring elements, a stop means on the projecting parts of the support means engageable by each leaf spring to delimit the movement of the leaf spring away from the magnetic means, armature parts on the leaf springs adapted to be moved into and out of the magnetic field by movement of the support, and relatively fixed contacts on the base for engagement by the leaf springs, when the armatures are drawn to the magnetic means, said relatively fixed contacts being adjustable to vary the relative proximity of the armature elements to the magnetic means.

11. In a device of the kind described, a support member and a magnetic member, means moving said members toward and from each other, a plurality of actuating elements movably mounted on the support member for movement relatively thereto, a plurality of magnetic elements cooperatable with the magnetic member, there being one magnetic element for each of said actuating elements, means mounting said magnetic elements on said support member including a resilient mounting for at least one of them, whereby it may yieldably move relatively to the support member, means adjusting the initial position of the resiliently mounted element relative to the support when the support and magnetic members are separated, said magnetic elements being individ-

ually attractable by the magnetic member when the support member and magnetic member approach each other, and the magnetic elements being connected with the actuating elements to effect movement thereof when the magnetic elements are attracted to the magnetic member.

12. In a device of the kind described, a support member and a magnetic member, means moving said members toward and from each other in a curved path, at least two actuating elements, means mounting said elements on the support member at substantially equal distances from the center of curvature of the path of movement aforesaid, including a movable mounting for at least one of them whereby it may be moved relatively to the support member, a magnetic element, means resiliently and yieldably mounting the magnetic element on the support for movement relatively thereto, toward and from the magnetic member, said magnetic element being constructed to move the movably mounted actuating element relatively to the support when the magnetic element and magnetic member approach, the remaining actuating elements being operated when the support member and magnetic member are moved relatively to each other.

13. In a device of the kind described, a support member and a magnetic member, means moving said members toward and from each other, at least two actuating elements, means mounting said elements on the support member including a movable mounting for at least one of them whereby it may be moved relatively to the support member, a magnetic element, means resiliently and yieldably mounting the magnetic element on the support for movement relatively thereto, toward and from the magnetic member, said magnetic element being constructed to move the movably mounted actuating element relatively to the support when the magnetic element and magnetic member approach, the remaining actuating elements being operated when the support member and magnetic member are moved relatively to each other, and means for adjusting the initial relative positions of the magnetic element and support when the support and magnetic member are separated, whereby to regulate the amount of movement of the moving means required to subject them to the attractive force between them.

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