Dec. 8, 1942. N. C. FETTER 2,304,347

THERMAL CONTROL DEVICE

Filed Nov. 15, 1940 2 Sheets-Sheet 1

Fig. 1

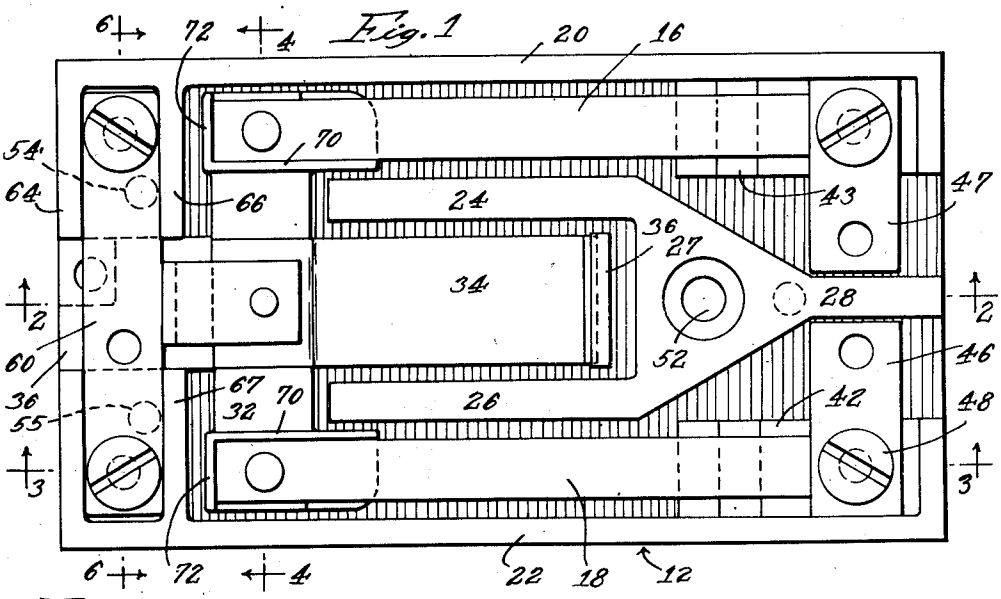


Fig. 2

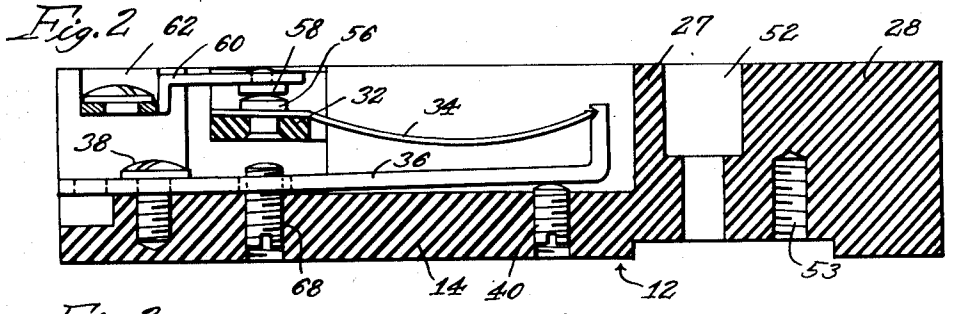


Fig. 3

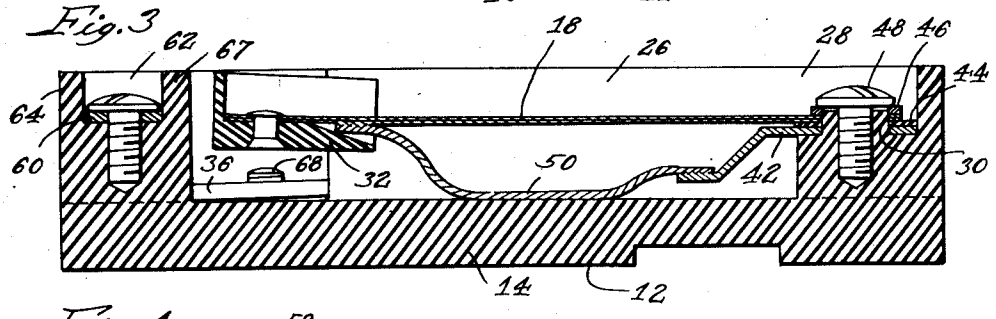
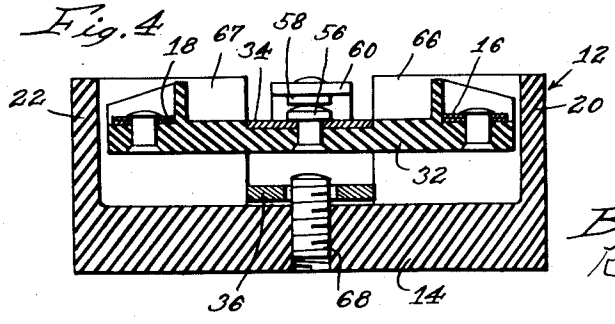


Fig. 4



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Dec. 8, 1942. N. C. FETTER 2,304,347

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Filed Nov. 15, 1940 2 Sheets-Sheet 2

Fig. 5

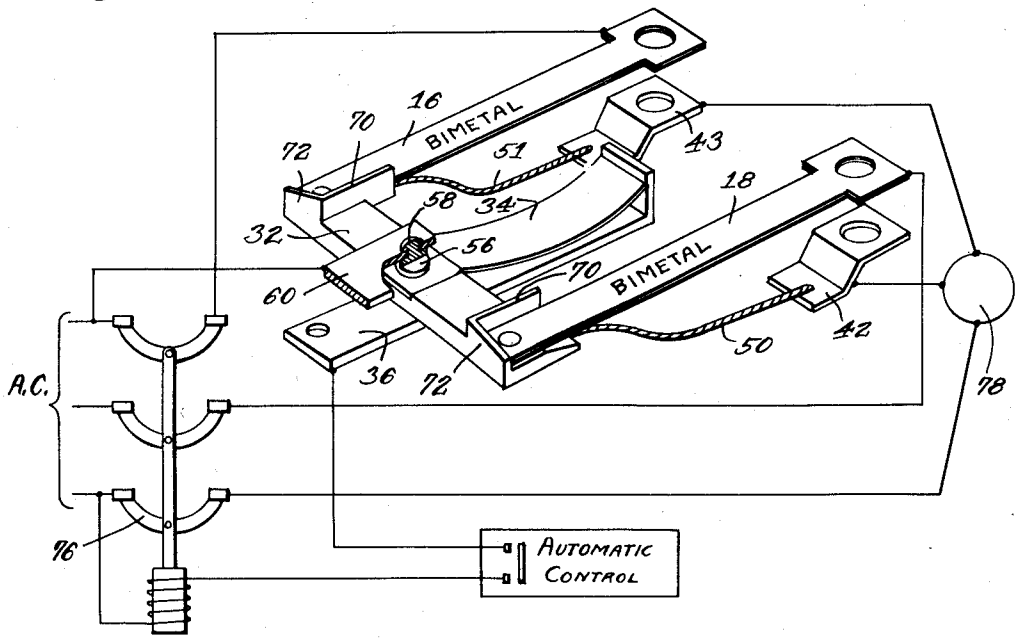
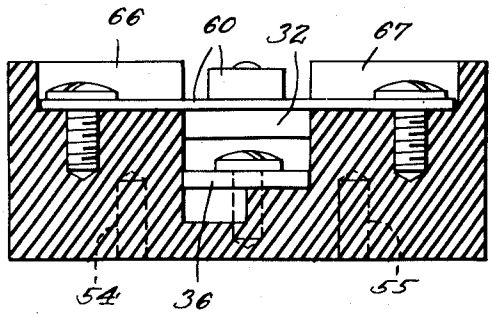


Fig. 6



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2,304,347

THERMAL CONTROL DEVICE

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Application November 15, 1940, Serial No. 365,784

7 Claims. (Cl. 200—113)

The present invention relates generally to snap acting thermostats, and more particularly to such thermostats for use in thermally operated, current responsive, electric switches.

This invention constitutes an improvement upon the invention of Malcolm W. Eaton, disclosed in his application Serial No. 277,438, filed June 5, 1939.

Objects of the invention include the provision of a new and improved snap acting thermostat and thermally actuated electric switch, a new and novel multiple-element electric thermostat, and an improved and simplified snap-acting bimetal switch construction. The invention resides in certain novel features of construction, combination of parts, and arrangements of apparatus, and is illustrated by the specific embodiment herein shown and described by way of example. In the drawings:

Fig. 1 is a plan view of one embodiment of my invention;

Figs. 2, 3, 4, and 6 are sectional elevations taken along the lines 2—2, 3—3, 4—4, and 6—6 in Fig. 1; and,

Fig. 5 is a view, partially pictorial for showing the moving parts of the device of Fig. 1 in perspective, and partially diagrammatic for showing the device connected in an electric circuit.

An elongated shallow housing 12 of molded insulating material consists of a base portion 14 (Figs. 2, 3, and 4) and a number of side and end walls and interior barrier walls. These various walls serve to electrically isolate and shield the conducting parts which are located in the several cavities formed by these insulating walls.

A pair of thermostatic bimetal strips 16 and 18 lie in two side cavities formed by side walls 20 and 22 of the housing and by interior barrier walls 24, 26, and 28 (as shown best in Fig. 1). Each of these bimetal strips is mounted rigidly, or in cantilever fashion, at its right hand end, as seen in Figs. 1, 2, and 3, on an insulating support boss 30 (Fig. 3) and is free to flex for moving its unmounted left end up and down as shown in Fig. 3. The unmounted left ends of these bimetal strips 16 and 18 are connected to an insulating cross bar 32 by rigid connections capable of transmitting bending moments between the bimetal strips and the cross bar. A resilient metal central member or bowed compression spring 34 lies in the central cavity between the two barriers 24 and 26 and has its left end rigidly connected to the central portion of the cross bar 32 as best seen in Fig. 2. The right hand end of spring 34 is pivotally supported by the metal anchor or bracket 36, which is secured to the insulating base 14 by a screw 38, and which is adapted to be flexed by an adjusting screw 40 for raising and lowering the axis of the pivotal support of the strip 34. The compression spring 34 serves to stress the two bimetal side strips 16 and 18 in tension, and these three strips 16, 18, and 34, lying approximately parallel and alongside each other, and connected together through the movable cross bar 32, constitute a snap acting thermostatic mechanism.

These three strips 16, 18, and 34 are separately mounted on the insulating base so as to be electrically isolated from each other. Consequently an electrical circuit through any one need not include the other strips. As may be seen in Figs. 1, 3, and 5, the insulating boss 30 that supports the bimetal strip 18 holds also a terminal 42 with an insulating spacer 44 for insulating the terminal 42 from the bimetal strip 18, and also a terminal 46 for the mounted end of the bimetal 18 itself. The whole assembly is secured by a mounting screw 48. A flexible conductor or pigtail 50 (Figs. 3 and 5) lies under the bimetal strip 18, and is welded to the movable left end thereof and also to terminal 42. Consequently electrical connections may be made to these terminals 42 and 46 for passing an electric current through the bimetal strip 18. Similarly, bimetal strip 16 has a flexible conductor 51 (Fig. 5) and circuit connections are made to the terminals 43 and 47. Since the contral compression spring 34, is shorter than the bimetal side strips 16 and 18, the two barrier walls 24 and 26 which flank the central cavity merge into a central insulating block 27, which closes the right hand end of the central cavity, and which in turn merges into a short barrier wall 28 extending to the right hand end of the housing (as best seen in Fig. 1). Accordingly, the cavities containing the bimetal side strips 16 and 18 have enlargements at their right hand ends as seen in Fig. 1, to provide ample space for bringing in the circuit wires and connecting them to the terminals 42, 43, 46, and 47, of the two bimetal strips 16 and 18. Holes 52 and 53 in the insulating block portion 27 and also holes 54 and 55 facilitate the mounting of the device on other apparatus.

The movable end of the metal compression spring 34 carries an electric contact 56 at its left end where it is fastened to the cross bar 32 and in alignment with a stationary contact 58 supported by a T shaped bracket 60 which in turn is mounted in shallow end cavities 62, formed by end walls 64 and transverse barrier walls 66 and

67 (Figs. 1, 2, 3, and 6). The circuit to the contacts 56 and 58 thus extends through the central compression spring 38 and its metal anchor 36, and the anchor 36 and contact bracket 60 serve as terminals for the contact circuit of the device. Also, the upward snap motion of the cross bar 32 (which carries the connected ends of the three strips 16, 18, and 34) stops against the stationary contact 58, and its downward motion is limited by an adjusting screw 68 which extends up through a large clearance hole in the anchor 36 as shown in Fig. 4. The difference between the "turn on" and "turn off" temperatures of the device is determined principally by the adjustment of this screw 68. The turn on and turn off temperatures may be raised and lowered together without substantially changing the difference between them, by turning the screw 40 which raises and lowers the right hand end of the anchor 36.

As may be best seen in Figs. 1 and 5, the insulating cross bar 32 has a pair of barrier fins 70 and 72 at each end partly surrounding the ends of the bimetal strips 16 and 18, and overlapping the barrier walls 24, 26, 66, and 67 for increasing the electrical clearances between the bimetal strips 16 and 18 and the compression spring 34 and its contact terminal 60.

It is thus seen that each of the bimetal strips 16 and 18 together with its own current conductors and terminals is mounted in a separate cavity of the insulating housing to effectively insulate and isolate it from the other, and also from the central strip 34 and its contact and terminal connections.

The three strips 16, 18, and 34 act together as a snap acting overcenter toggle mechanism actuated by temperature changes of the bimetal tension strips 16 and 18. In the specific embodiment here shown, these bimetal strips 16 and 18 have their high expansion faces upward as seen in Figs. 2, 3, and 5, and consequently respond to a rise in temperature for moving the crossbar 30 down to open the circuit through the contacts 56 and 58. The bimetal strips are adapted to be heated either by electric current passing through them or by heat otherwise applied to them, and either bimetal strip alone is capable of effecting the thermostatic operation of the device.

Thus, as shown in Fig. 5, the device may be connected to protect a polyphase electric circuit. Three phase power is applied through a magnetically operated contactor 76 to a polyphase motor 78. One of the three power conductors passes through each of the two bimetal strips 16 and 18 and thence to the motor, and the third runs to the motor directly. The contacts 56 and 58 are connected in series with the contactor's magnet 80 which, so long as it remains energized, holds the contactor 76 in its closed position. In addition, the thermostatic device may be mounted on the motor 78 itself so that the bimetal strips 16 and 18 are in thermal communication therewith.

The two bimetal elements 16 and 18 respond to high ambient temperatures and also to excessive temperatures of the motor 78 to open the contacts 56 and 58 with a snap action for deenergizing the coil 80 and thereby opening the contactor 76. Further, either of the bimetal strips 16 and 18, or both of them together, may respond to an excessive current drawn by the motor to open the contactor 76. If the motor 78 draws an excessive current, with the phases balanced as under heavy overload conditions, both of the bimetal elements 16 and 18 are heated so that, acting together, they operate the device with a snap action to open the contacts 56 and 58 for tripping open the contactor 76. On the other hand, if the motor should "single phase," the single phase energizing circuit would necessarily include at least one of the two bimetal elements 16 and 18, and the abnormal current drawn under such a condition would heat that one bimetal to cause a snap operation of the device for opening the contacts 56 and 58, and for in turn de-energizing the motor.

It will be apparent to those skilled in the art that the particular example herein shown and described is capable of numerous modifications and variations, and that the invention is not limited to the specific details thereof.

I claim:

1. In combination in a thermostatic snap acting device, two thermostatic bimetal strips lying substantially parallel to each other, a resilient compression spring strip lying approximately parallel to said two bimetal strips, one end of each strip being mounted and the other end thereof being movable, the three movable ends of said bimetal and compression-spring strips being so connected together that they are constrained by the connection to move together and that said compression spring imposes a longitudinal strain on said bimetal strips, whereby each of said bimetal strips has two connections, one at its mounted end and the other at its movable end, one of said two connections of each bimetal member being rigid for the transmission of bending movements therethrough, whereby a change of temperature of either bimetal strip tends to move said connected movable ends.

2. In combination in a thermostatic snap acting device, two bimetal tension members, and a resilient compression member, each so connected to the others at a movable end, that said bimetal tension strips support the compressive stress of said compression member, and each mounted at its other end, whereby each bimetal tension member has a connection at one of its ends to its mounting and a connection at its other end to the other members, one of said connections of each bimetal member being rigid for the transmission of bending moments therethrough, and stops for limiting the motion of said connected movable ends of said three bimetal tension, and resilient compression members.

3. The combination of claim 1 wherein said bimetal members are electrically insulated from each other at least at one end, and wherein there are included electrical circuit connections to one of said bimetal members independent of the other bimetal member, whereby an electrical circuit including said one bimetal element need not pass through the other.

4. In combination in a snap acting thermostatic device, two bimetal tension members and a resilient compression member lying alongside each other and connected together at a movable end rigidly so that each may transmit bending moments through the connection to the others of said members, each of said three members being mounted at its other end, the mountings for said bimetal members being rigid for the transmission of bending moments therethrough, said compression member being shorter than said tension members and pivotally mounted.

5. In combination in a device of the class described, an insulating housing, two bimetal side strips and a resilient center strip lying approxi-

mately parallel and alongside each other in said housing, an insulating cross bar connected to one end of each of said three strips for connecting said three ends together, said connected ends being movable, each of said strips being mounted at its other end in said housing, longitudinal insulating barrier walls in said housing lying between said strips, and insulating barrier fins on the cross bar between said strips, said fins overlapping the ends of said barrier walls.

6. In combination in a device of the class described an insulating housing, two bimetal side strips and a resilient center strip shorter than the side strips all lying alongside each other and approximately parallel to each other in said housing, an insulating cross bar connected to one end of said three strips for connecting said three ends thereof together, said connected ends being movable, each of said three strips being separately mounted in said case as its other end whereby said three strips are electrically insulated from each other, insulating barrier walls extending from the position of said insulating cross bar between said center strip and said side strips, a connecting barrier wall extending beyond said center strip between the mounted ends of said side strips, whereby said housing and barrier walls provide separate cavities for said strips with the width of the cavities for the side strips increased at the mounted ends of those strips to provide increased space for terminal connections, electrical connections for providing a circuit through each bimetal side strip, said connections for each side strip being located entirely within the cavity containing said strip, and an adjustable support for said center strip located in its cavity.

7. The combination of claim 6 wherein there is included a stationary electric contact insulated from said three strips, a movable contact carried by said crossbar for cooperation with said stationary contact for opening and closing an electric circuit through said contacts in response to the movement of said crossbar, and wherein said center strip and its support are included in the circuit through said contacts.

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