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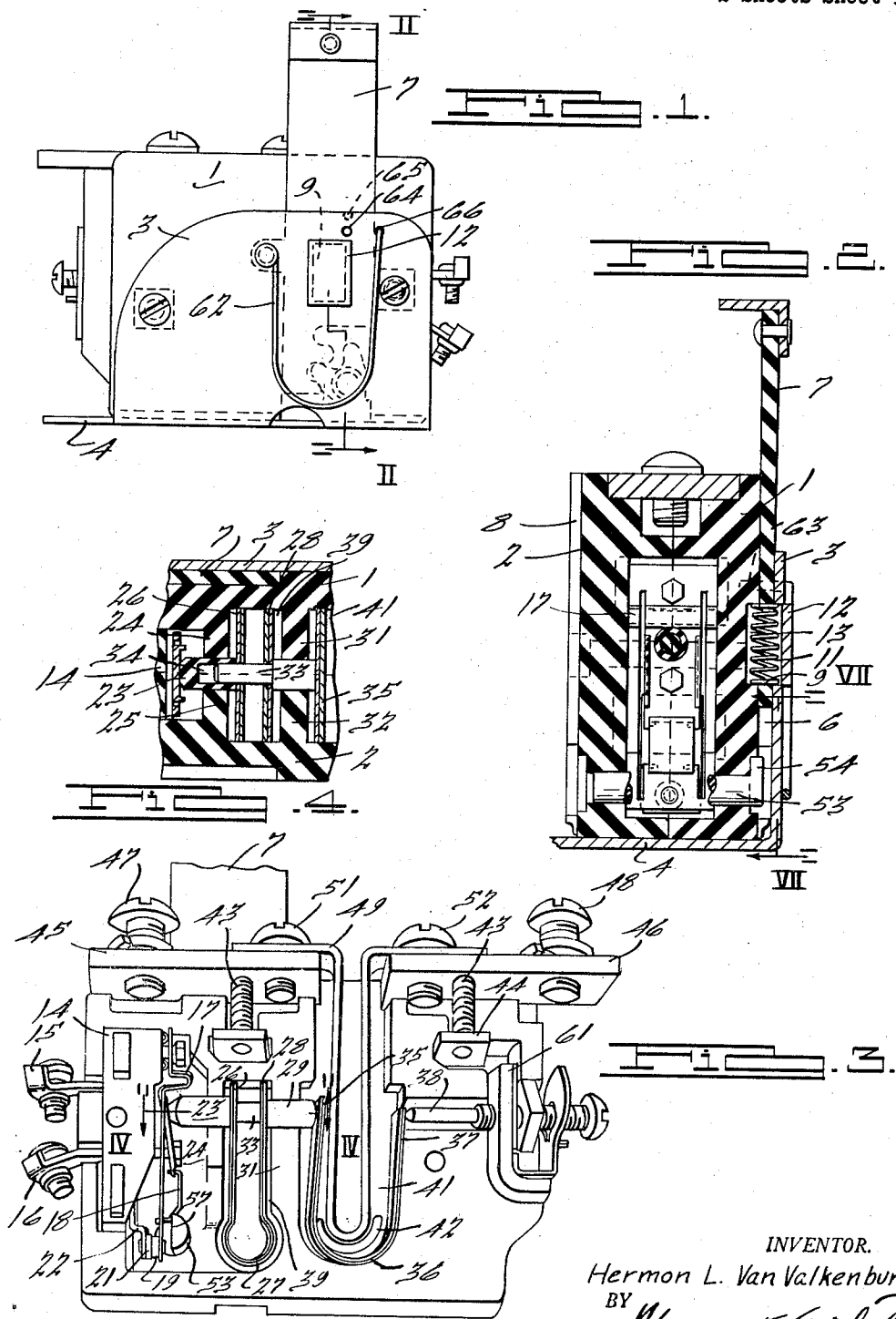
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AMBIENT TEMPERATURE COMPENSATED RELAY

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2 Sheets-Sheet 1



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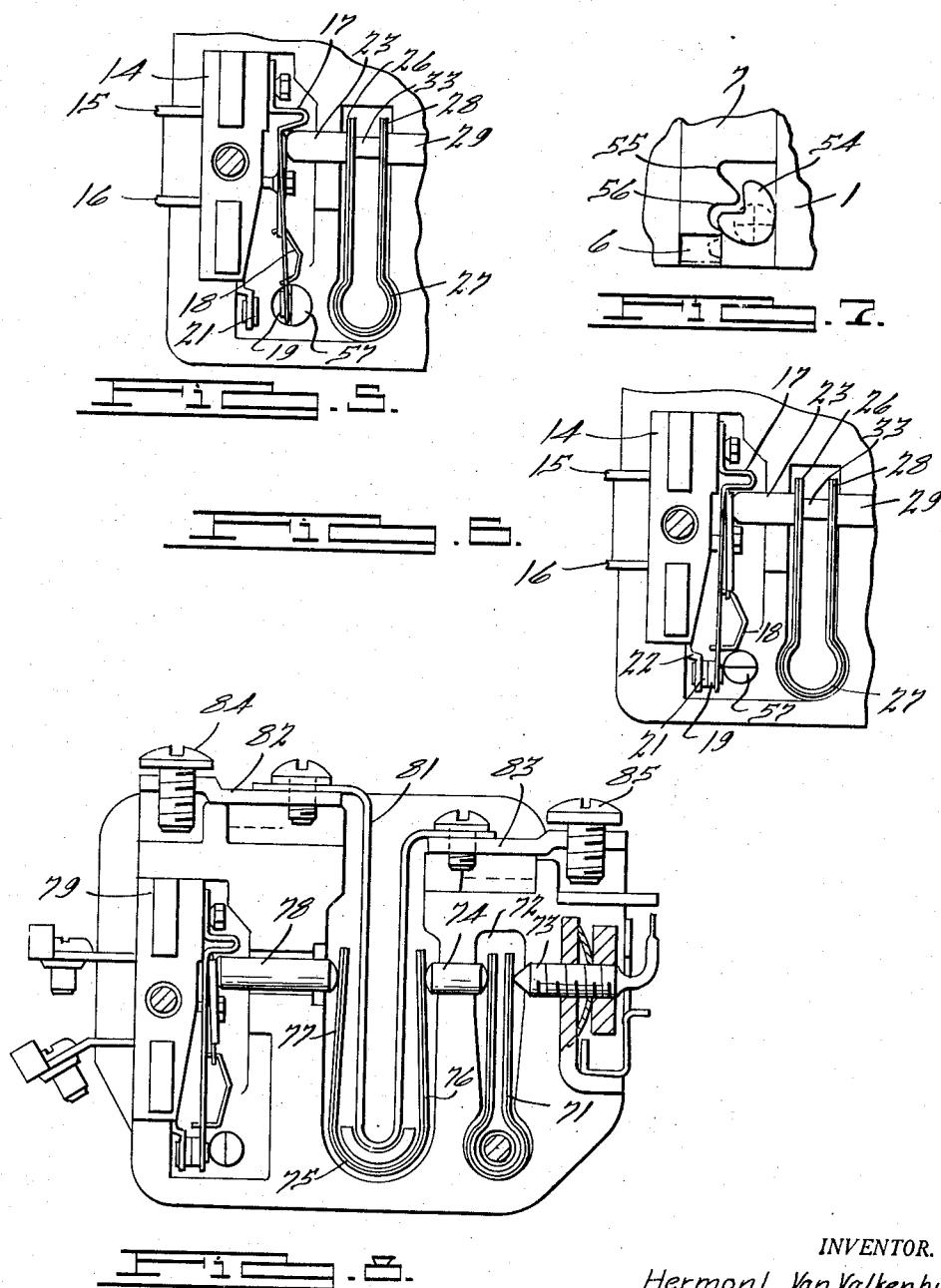
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AMBIENT TEMPERATURE COMPENSATED RELAY

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10 Claims. (Cl. 200—122)

This invention relates to electrical switches and more particularly to electrical relays automatically operable to open circuit upon the occurrence of a current overload.

One object of the invention is to provide an electrical overload relay with an improved form of internal operating mechanism.

Another object of the invention is to provide an ambient temperature compensating mechanism within an electrical overload relay.

A further object of the invention is to provide a floating ambient temperature compensation mechanism within the internal operating mechanism of an electrical overload relay.

Other objects and features of this invention will be readily apparent to those skilled in the art from the specification and appended drawings illustrating certain preferred embodiments in which:

Figure 1 is a side elevational view of an overload electrical relay according to the present invention.

Figure 2 is a sectional view taken along the lines II—II of Figure 1.

Figure 3 is a side perspective view of the overload electrical relay with one side cover removed.

Figure 4 is a sectional view taken along the lines IV—IV of Figure 3.

Figure 5 is a partial elevational view showing the switching mechanism in tripped position.

Figure 6 is a partial elevational view showing the switch and reset mechanism during reset operation.

Figure 7 is a partial elevational view showing the reset mechanism and taken along the lines VII—VII of Figure 2.

Figure 8 is a side elevational view with one side cover removed of a modification of the overload electrical relay according to the present invention.

The relay, according to the present invention, includes a main body portion made up of two mating sections 1 and 2. On the body section 1 there is mounted a metallic bracket 3 having a foot 4 by means of which the relay may be mechanically supported. The side wall of the body section 1 is provided with a slot at 6 in which is disposed a reset plate 7 maintained within the slot by the metal bracket 3. A similar slot 8 is provided in the body section 2 so that the reset plate 7 may be mounted to either side of the relay with coincident reversal of the metallic bracket 3 for coordinate functioning with the slot 8. The plate 7 is provided with a slot 9 within which is disposed a spring 11 which is also received within an outwardly pressed portion 12 on the metallic bracket 3 and in a depression 13 in body section 1, the spring 11 exerting a bias on the slide 7 tending to move it outwardly to its limiting position as shown in Figures 1 and 2. The pressed out portion 12 and the depression 13, in effect, form a cylindrical housing for the spring 11 within which the spring also functions as a limit for outward movement of the reset plate 7.

The relay is provided with a snap acting switch more particularly shown in Figures 3, 5 and 6. The switch includes an insulating base portion 14 upon which are mounted the terminals 15 and 16 thereof. Terminal 15 is connected to a resilient switching arm 17 which is provided with the conventional overcenter acting resilient link 18 and a movable contact 19. The movable contact 19

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is positioned in cooperating alignment with a stationary contact 21 on conducting strap 22 connected to terminal 16.

An operating rod 23 is provided for the switch 14 and presses upon the arm 17 thereof to effect snap opening movement of the contacts 19. The pin 23 is slidably mounted within an opening in transverse insulating barriers 24 and 25 of the two mating sections 1 and 2, respectively. The opposite end of the rod 23 is adapted to be engaged by the leg 26 of a U-shaped bimetallic element 27 having its second leg 28 engaged by a shoulder of a second rod 29. Rod 29 is slidably mounted within openings in transverse insulating barriers 31 and 32 in the two mating sections 1 and 2, respectively, and at one end has a reduced diameter extension 33 passing through suitable holes in both legs 26 and 28 of the U-shaped bimetallic member 27 and into an excavated central bore 34 in the rod 23. The opposite end of the rod 29 is adapted to be engaged by the leg 35 of a U-shaped bimetallic member 36 having a second leg 37 engaged with an adjustable stationary abutment 38. The two mating sections 1 and 2 making up the body portion of the relay are provided with internal excavations 39 and 41, within which the respective U-shaped bimetallic members 27 and 36 are loosely and floatingly supported, excepting that the U-shaped bimetallic element 27 is additionally slidably supported on the reduced diameter extending portion 33 of the rod 29. An arcuate projection 42 is provided in the excavation 41 so as to provide for the alignment of the U-shaped bimetallic element 36.

Supported on the base sections 1 and 2 at the upper surfaces thereof as by means of bolts 43 cooperating with nuts 44 held in suitable excavations in the sections 1 and 2 are a pair of conducting terminal straps 45 and 46 having terminal screws 47 and 48, respectively. A heating element 49 is disposed between the legs 35 and 37 of the bimetallic element 36 and electrically interconnects the terminals 45 and 46 and is secured thereto respectively by screws 51 and 52.

Pivotaly mounted in the sections of the base is a shaft 53 disposed, as shown more particularly in Figures 2, 3, 5 and 6, in a position to be engaged by the contact end of the resilient plate 17. Upon one end of the shaft 53, there is mounted an arcuate plate 54 having its end portions cooperating with a pair of spaced slots 55 and 56 at the interior end of the reset plate 7. The actions of the parts is such that movement of the plate inwardly from the position shown in solid lines in Figure 7 will effect a rotation of the plate 54 and the shaft 53 in a counterclockwise direction while movement of the plate 7 upwardly will effect movement of the plate 54 and shaft 53 in a clockwise direction. With the shaft 53 shown in the position of Figure 3, the contact carrying end of the resilient switch blade 17 will move outwardly a sufficient distance, as the actuating rod 23 is moved to the right, so that the snap switch will not recover; or, in other words into the position shown in Figure 5 wherein release of the pin 23 will not be accompanied by return movement of the resilient arm 17 to close contacts 19 and 21. However, rotation of the shaft 53 will move the point 57 thereof into engagement with the resilient switching arm 17, thus moving it in a counterclockwise position, a sufficient distance for the resilient force thereof to pass overcenter and effect snap operation of the contact to engaged position. This occurs upon a manual depression of the reset plate 7 after an automatic operation has opened the contacts 19 and 21.

In the operation of the device, a circuit in response to overload in which the switch is designed to open its contacts, is connected through the main terminals 45 and 46 so that the current will pass through the element 49. On the occurrence of a predetermined overload current, as

determined by the value of the resistance in the heating element and the setting of the adjustable abutment 38, the bimetal 36 will become heated and will tend to straighten out due to the difference in coefficient of expansion of the material from which it is formed. The arm 37 of the bimetal is engaged with the stationary abutment 38 and is positioned by threading movement of the abutment 38 into a stationary block 61, supported in the two mating sections 1 and 2. Since the arm 37 will have its position determined by the position of the abutment 38, all of the force and movement generated within both legs of the bimetal will be reflected by movement of the leg 35 which will not only have movement due to its own flexure, but that movement which would otherwise have been afforded to the leg 37, this, since the bimetal is loosely and floatingly mounted within the base. As the arm 35 moves toward the left, as viewed in Figure 3, it will engage the head of rod 29 to move the same to the left. As the rod 29 is moved to the left, the interconnection between this rod and rod 23 afforded by means of the U-shaped bimetallic member 27 will cause coincident movement of the rod 23 toward the left until the resilient arm has passed through its overcenter position at which time the contacts 19 and 21 will be snapped into open circuit position as shown in Figure 5. Upon the occurrence of this contact opening, circuit components forming no part of this invention but actuated by the circuit through contacts 19-21 will deenergize the circuits being fed through terminal straps 45 and 46 to remove the heating current from the heater 49. As the bimetallic member 36 cools, the force exerted by the arm 23 will be removed, but the switch will remain in the position of Figure 4 since, as previously explained, the contact arm 17 and contact 19 are moved sufficiently so that a stable open position is reached. To effect a re-engagement of the contacts 19 and 21, the reset plate 7 is moved inwardly rotating shaft 53 to move contact arm 17 to the right until the bias produced in arm 17 is sufficient to overcome the toggle action at which point there is a further snap movement of the contact to its engaged position.

In addition to the mechanism provided for manual reset of the device, provision is also made for automatic reset wherein as the bimetal 36 cools after an automatic operation the contacts 19 and 21 will be automatically closed without the necessity of a manual manipulation. To effect this automatic reset, the reset plate 7 is maintained in its inward position so that the point 57 on the shaft 53 is always in a position to prevent the movement of the contact 21 to its stable open position. On the metallic bracket 3 there is provided a spring wire 62 having an inward projection 63 upon its free end. In the position of Figures 1 and 2, the projecting end portion 63 is disposed out of the path of the reset plate 7 in a hole 66 in the bracket 3, which is then free to move outwardly under the bias of spring 11 to the position determined by the limiting alignment of spring 11 within slots 13 and 12. To maintain the reset plate 7 in its inward or automatic reset position, the projection 63 on the spring wire 62 is moved to the alternative opening 64 in the bracket 3 where it will be placed in cooperating alignment with a similar opening 65 in the reset bracket 7 and, with the reset bracket 7 depressed into reset position, will maintain the bracket and shaft 53 with projection 57 in permanent automatic reset position. Hence, the disposition of the movable end of the spring wire in either the opening 66 as shown in Figure 1, or in the opening 64 in the metallic bracket 3 will determine whether the operation of the relay will be such as to effect automatic resetting or whether a manual operation of the sliding plate 7 is necessary to reclose the contacts after they have been opened.

Ambient temperature compensation is provided in the relay of the present invention by means of the U-shaped bimetallic member 27 which is freely and slidably sup-

ported on the reduced diameter extension 33 of the rod 27. The bimetallic element 27 is so constructed that upon increase in ambient temperature condition the legs 26 and 28 thereof will be moved toward each other due to the different coefficient of expansion of the material from which the bimetal 27 is formed so as to operate oppositely to the movement of legs 35 and 37 of bimetallic member 36. The leg 28 of the bimetallic member 27 will have its position determined by the position of the leg 35 of the bimetallic member 36; consequently, all force and movement generated within both legs of the bimetallic member 36 will be reflected by movement of the leg 26 which will have combined movements due to its own flexure, and due to flexure of the bimetallic member 36. Movement of the leg 26 toward the snap switch will cause coincident movement of the rod 23 and therewith movement of the arm 17 of the snap switch. With this construction, the effect of ambient temperature on the relay of the present invention will be such that the same value of current flowing through the relay will cause the relay to operate regardless of the temperature surrounding the device; that is, when the surrounding temperature is high, the bimetallic member 36 will tend to separate its legs 35 and 37 and the bimetallic member 27 will tend to move its legs 26 and 28 closer together. The relationship of the legs 26 and 28 will determine the overall length of the combined rods 23 and 29 so that the effect of ambient temperature is to adjust the relay operating mechanism to each ambient temperature condition. With the operating mechanism adjusted for ambient temperature, the relay now requires the same current responsive movement of the main bimetallic member 36 at all times to effect operation of the snap switch. The bimetallic member 27 will likewise function under conditions of reduced ambient temperature conditions to increase the effective length of the combined rods 23 and 29 to maintain a constant heating requirement within the relay due to current flow through the heating element 49.

In Figure 8 is illustrated a modification of the ambient temperature compensated relay mechanism of the present invention. In this modification, a completely free floating ambient temperature compensating element is provided in the U-shaped bimetallic element 71 floatingly supported within an excavation 72 in a two-part relay supporting body made up of mating sections similar to the sections 1 and 2 of the relay illustrated in Figure 1. The bimetallic element 71 operates at one end against an adjustable abutment 73 having a calibration function and at its other end against a connecting rod 74 which is slidably mounted within the complementary openings in transverse insulating barriers within the mating cover sections of the relay housing. The main overload current responsive bimetallic member 75 is supported within an excavation in the mating section of the relay housing having legs 76 and 77 disposed for operation respectively by the rod 74 and upon a rod 78 slidably mounted within an opening in transverse insulating barriers in the relay housing. The end of rod 78 opposite to that end engaged by the leg 77 of the U-shaped bimetallic member 75 is in abutting engagement with a resilient contact arm of an overcenter acting snap switch 79 to function in the same manner as does rod 23 against resilient arm 17 of the relay embodiment shown in Figures 1 and 3. A heating element 81 is interconnected between the terminal straps 82 and 83 provided with terminal screws 84 and 85, through which the load current for operation of the relay passes.

The operation of the device shown in this modification is substantially the same as that shown in the relay of Figure 3 and differs primarily only in the physical positioning of the ambient temperature compensating bimetallic elements within the relay switch; that is, increased ambient temperature will cause opening movement of the legs 76 and 77 of the bimetallic member 75 and closing movement of the legs of the bimetallic element 71 to

maintain a substantially constant overall length of the operating elements including the rods 74 and 78 and the bimetal 71 and 75 between the adjustable abutment 73 and the resilient arm of the snap switch.

While certain preferred embodiments of the invention have been specifically disclosed, it is understood that the invention is not limited thereto, as many variations will be readily apparent to those skilled in the art and the invention is to be given its broadest possible interpretation within the terms of the following claims.

What is claimed is:

1. In an automatic electric switch, separable contacts, current responsive means for automatically effecting separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U shape, means operated by said bimetallic strip to effect separation of said contacts, and a U-shaped ambient temperature compensating means, a discrete enclosure for said ambient temperature means thermally insulating said ambient temperature means from said current responsive means, said ambient temperature means being operable upon said operated means for modifying the control of said bimetallic strip.

2. In an automatic electric switch, separable contacts, current responsive means for automatically effecting the separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U shape, means floatingly mounting said bimetallic strip within said electric switch, an operating rod operably interconnecting said bimetallic strip and said separable contacts, ambient temperature compensating means interposed between said bimetallic strip and said separable contacts, and means controlled by said ambient temperature compensating means for adjusting the length of said interconnecting rod in response to ambient temperature.

3. In an automatic electric switch, separable contacts, current responsive means for automatically effecting the separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U shape, an operating rod interposed between said bimetallic strip and said separable contacts, a bimetallic loop having both legs thereof supported on said rod intermediate the ends thereof, and said loop being operative to adjust the length of said operating rod in response to ambient temperature.

4. In an automatic electric switch, separable contacts, current responsive means for automatically effecting the separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U shape, an operating rod interposed between said bimetallic strip and said separable contacts, a U-shaped bimetallic member having both legs thereof supported on said rod and being operative upon said rod for modifying the control of said bimetallic strip in response to ambient temperature, and an adjustable abutment operative upon said bimetallic strip for calibrating said electric switch.

5. In an automatic electric switch, separable contacts, current responsive means for automatically effecting the separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U shape, an operating rod interposed between said strip and said separable contacts, a second U-shaped bimetallic member having both legs thereof supported on said operating rod and being operable thereupon for modifying the control of said bimetallic strip in response to ambient temperature, and means external of said switch and operative upon one of said separable contacts to effect resetting of said contacts after separation by said bimetallic strip.

6. In an automatic electric switch, separable contacts, current responsive means for automatically effecting separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U

shape, an operating rod between said bimetallic strip and said separable contacts, an adjustable abutment, a second operating rod, a second U-shaped bimetallic member operative at one leg against said adjustable abutment and at the other leg against said second rod, said second rod being operative upon one leg of said bimetallic strip, whereby said second bimetallic member compensates said bimetallic strip for ambient temperatures.

7. In an automatic electric switch, separable contacts, current responsive means for automatically effecting separation of said contacts and including a bimetallic strip bent about a transverse axis into substantially U shape, an operating rod interposed between said bimetallic strip and said separable contacts, a second operating rod operable upon said bimetallic strip, and a second U-shaped bimetallic member operative upon said second rod for modifying the control of said bimetallic strip in response to ambient temperature.

8. In an automatic electric switch, an enclosure comprised of complementary discrete parts cooperating to form a plurality of individual cavities within the enclosure, separable contacts, current responsive means for automatically effecting separation of said contacts, including a first bimetallic strip and a second bimetallic strip for modifying the control of said first bimetallic strip, said separable contacts, first bimetallic strip and second bimetallic strip being supported one each in said cavities, and operating means passing between said cavities for effecting said automatic separation of said contacts.

9. In an automatic electric switch, an enclosure comprised of complementary discrete parts cooperating to form a plurality of individual cavities within the enclosure, separable contacts, current responsive means for automatically effecting the separation of said contacts and including a bimetallic strip bent about a transverse axis into a substantially U shape, said bimetallic strip being floatingly mounted in one of said cavities, said separable contacts being supported in a second of said cavities, an operating mechanism passing between said strip and contact supporting cavities for effecting separation of said contacts, a bimetallic member having a substantially U shape and being floatingly supported in a third of said cavities, and means for modifying the control of said operating mechanism by said bimetallic member.

10. In an automatic electric switch, an enclosure comprised of complementary discrete parts cooperating to form a plurality of individual cavities within the enclosure, separable contacts, current responsive means for automatically effecting the separation of said contacts and including a bimetallic strip bent about a transverse axis into a substantially U shape, said bimetallic strip being floatingly mounted in one of said cavities, said separable contacts being supported in a second of said cavities, an operating mechanism passing between said strip and contact supporting cavities for effecting separation of said contacts, a bimetallic member having a substantially U shape, means floatingly supporting said member in a third of said cavities and including a portion of said operating mechanism, and means for modifying the control of said operating mechanism by said member.

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