May 27, 1958 E. A. KATHE 2,836,675

ELECTRIC SWITCH

Filed Sept. 28, 1955 2 Sheets-Sheet 1

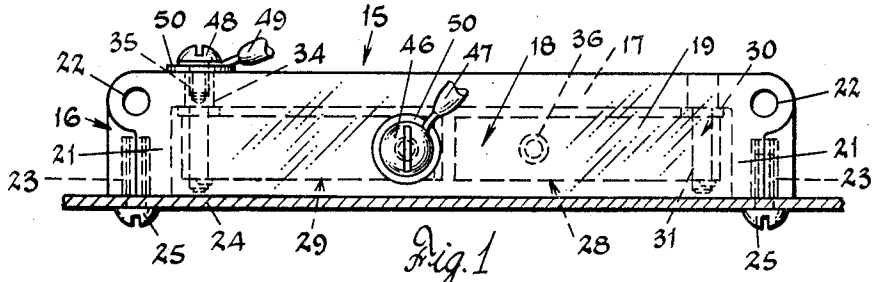

Fig. 1

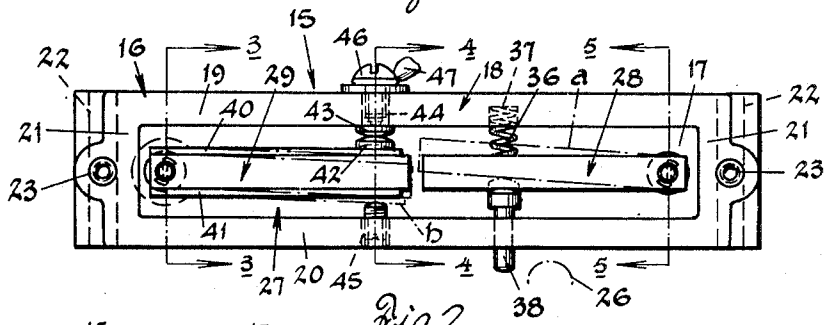

Fig. 2

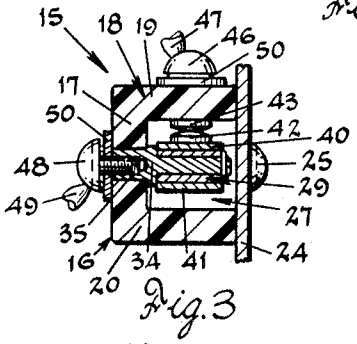

Fig. 3

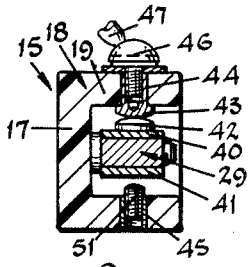

Fig. 4

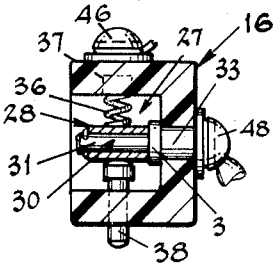

Fig. 5

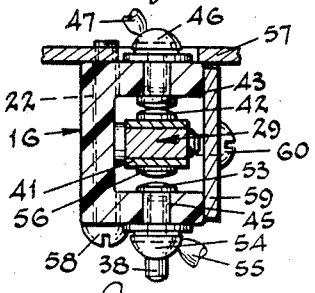

Fig. 6

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May 27, 1958 E. A. KATHE 2,836,675

ELECTRIC SWITCH

Filed Sept. 28, 1955 2 Sheets-Sheet 2

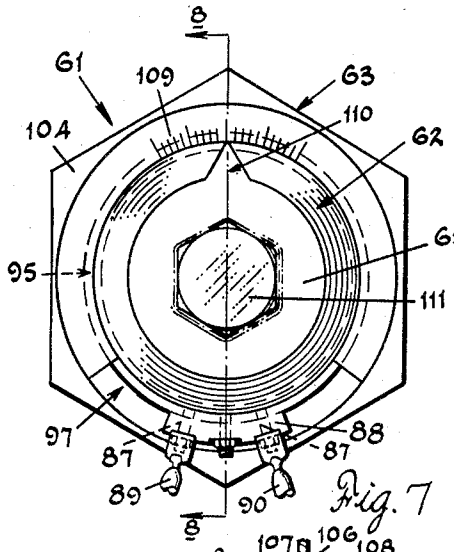

Fig. 7

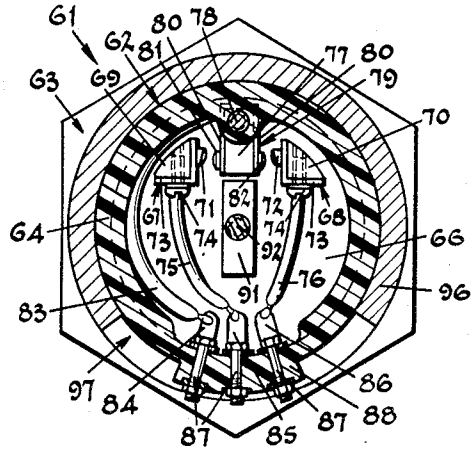

Fig. 9

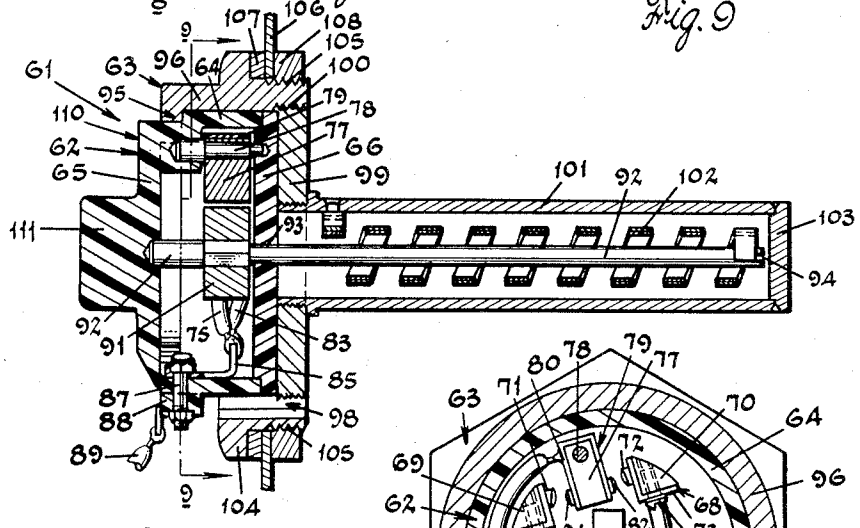

Fig. 8

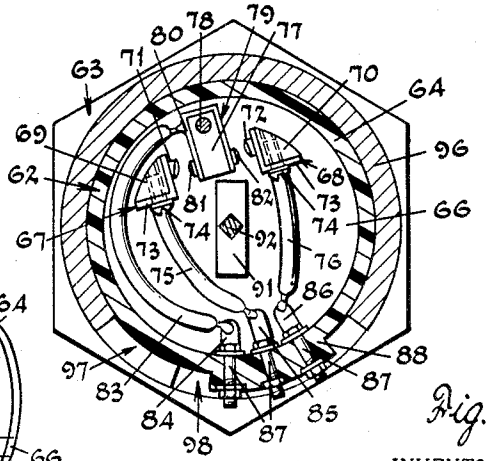

Fig. 10

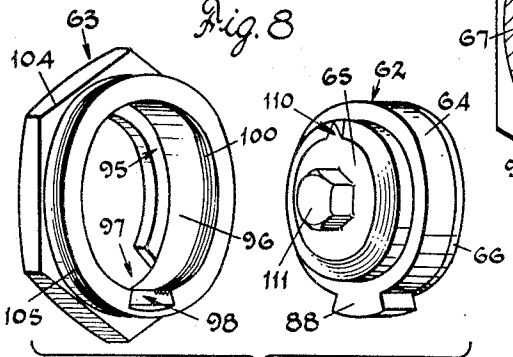

Fig. 11

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ELECTRIC SWITCH

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4 Claims. (Cl. 200—87)

The present invention relates broadly to switch devices for controlling an electric circuit. More particularly, it is concerned with an improved switch construction for producing the temporary termination of an electric circuit and wherein the associated switch elements are movable without actual contact between one another.

The principal object of my invention therefore resides in an improved switch wherein the conduction of electric current is controlled by the operation of elements which respond in operation without actual engagement therebetween.

Another object of the invention is to provide in an improved switch structure movably associated circuit-controlling elements which are moved from one position to another without engagement therebetween which substantially eliminates fatigue or wearing of the elements.

Another object of the invention is to provide in a switch of the above character a circuit-controlling element which is movable between open and closed positions by its magnetic activity in response to magnetic activity induced by an actuatable element.

Another object of the invention is to provide a circuit-controlling switch element and an actuatable element, each of said elements having magnetic characteristics and which are arranged to respond in their movements according to the magnetic force produced therebetween.

A further object of the invention is to provide a circuit-controlling switch element and an actuatable switch element, each of which are permanently magnetized and arranged so that automatically produced motions will be carried out by the directed influence of the magnetized elements to respond to induced movement therebetween.

A still further object of the invention is to provide an improved switch construction wherein fatigue or disruptive wearing of the parts thereof is reduced to a minimum; the parts are formed of relatively sturdy long-wearing structures, and combined in an advantageously compact relation of operation.

Other objects and advantages of the invention will become more apparent during the course of the following description, when read in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

Fig. 1 is a top view of an electric switch constructed in accordance with one embodiment of the invention;

Fig. 2 is a side elevational view of the switch;

Fig. 3 is a vertical transverse section of the switch taken on line 3—3 of Fig. 2;

Fig. 4 is a similar transverse sectional view taken on line 4—4 of Fig. 2;

Fig. 5 is also a transverse sectional view taken on line 5—5 of Fig. 2;

Fig. 6 is a transverse sectional view of the switch when adapted to alternately control two circuits;

Fig. 7 is a front elevational view of a modified form of an electrical switch;

Fig. 8 is a longitudinal vertical sectional view taken on line 8—8 of Fig. 7;

Fig. 9 is a transverse vertical sectional view taken on line 9—9 of Fig. 8;

Fig. 10 is a view similar to Fig. 9 wherein certain of the switch parts have been moved; and

Fig. 11 is an exploded perspective view of certain of the switch parts.

Referring now to Figs. 1 to 6 inclusive, there is shown an electric switch constructed in accordance with one embodiment of my invention and designated in its entirety by the numeral 15. This particular switch is adapted to be operated for the instantaneous opening and/or closing of an electric circuit and is of the general variety known in the art as "limit" switches. These switches are commonly employed at one or more steps in an operation to institute the function of a component part of a machine; to stop the travel of a machine part in one direction or to reverse the travel, and to start the operation of a second machine part when a first associated part has reached a predetermined phase of its individual cycle of work. For these purposes, the switches are adapted to be momentarily engaged and thereby establish a circuit or by their momentarily active condition interrupt a circuit and then allow the circuit controls to resume a closed condition. It is highly desirable therefore that switches of this character be of relatively simple operation and few well-constructed parts in order that they will perform repeatedly for long periods of time and with no more than infrequent inspections during their service.

Accordingly, I have provided a switch wherein the actuated parts respond in their movements to one another without actual contact being made therebetween and without the inclusion of spring members which are susceptible to fatigue or complete breakage. Thus the switch 15 comprises a pair of aligned members which are initially magnetized and then positioned relative to one another so that the magnetic properties of one will repel the like properties of the other. This phenomena of magnetic force is of course well-known and often defined as the repulsion of like magnetic poles.

The operable elements of switch 15 are supported by and contained within an open-sided box 16. This box may be formed of any suitably moldable insulation material such as thermo-setting plastics, resins or like materials. As herein shown, the box has a rear wall 17 and a forwardly directed flange or continuous wall 18 having a top wall 19, bottom wall 20 and end walls 21. For this convenient mounting of the switch, the end walls may have formed therein "through" holes 22 that are disposed in aligned relation to the rear wall 17 and in the opposite end corners thereof. Also the end walls 21 may have anchored therein threaded sleeves 23 that are arranged at substantially right angles to the holes 22. As shown in Figs. 1 and 3, the switch may thus be mounted on a vertically disposed (as shown) support panel 24 by screws 25 or on a horizontally disposed panel according to its intended mode of engagement by a functional machine part such as a lug or boss 26 indicated in phantom line in Fig. 2.

The operable parts of the switch 15 are contained within the chambered area 27 of the box 16 and comprise an actuating member 28 and a switch member 29. As shown particularly in Figs. 3 and 5 in conjunction with Fig. 2, the actuating member 28 is swingably mounted on an especially formed fulcrum pin 30 which has an annular shank 31 on which the body of the member 28 is pivotally received, an enlarged flange 32 abutting the inner surface of rear wall 17 and a second shank 33 that is anchored or otherwise fixedly secured in the said rear wall and

medially between the top and bottom walls **19** and **20** of the box. Preferably also the fulcrum pin **30** is located in the rear wall **17** in close proximity to the adjacent end wall **21**.

In like manner, the switch member **29** is pivotally mounted on a fulcrum pin **34** adjacent the opposite end wall **21**. As shown in Fig. 3, this pin is a duplicate of pin **30** for simplicity of manufacture, but is provided with an outwardly-directed, axial tapped hole **35**. The members **28** and **29** are thus pivotally mounted at their remotely disposed ends and so as to present their opposed ends in close proximity to one another. Now if the members **28** and **29** are of a paramagnetic material—that is to say of an iron or steel that will substantially permanently retain a magnetic force—and their like poles are arranged in this juxtaposition, the swinging movement of one or the actuating member **28** will repel the other or member **29** and cause it to swing in the opposite direction.

The member **28** is biased in an idle position by means of a light coil spring **36** that is received at one end in a socket **37** formed in the top wall **19**. Oppositely disposed with respect to the spring **36** there is a vertically disposed plunger **38** slidably mounted in the wall **20** and in continual engagement with the member **28**. As indicated in Fig. 2, when the lug **26** engages the outwardly disposed end of plunger **38** and thrusts the same inwardly of the box **16**, the member **28** will be swung to a position, such as is indicated by the phantom lines *a*. This will of course produce magnetic repulsion between members **28** and **29** and consequently motion of the member **29** to a position substantially as indicated by the phantom lines *b*.

According to the switch construction shown in Figs. 2 and 4, the member **29** is adapted to maintain a closed circuit condition and will be caused to instantaneously, though momentarily, open the same when swung from its full line position to the position indicated at *b*. For this purpose, the member **29** which comprises a block of suitable magnetized metal has affixed to its upper and lower surfaces strips **40** and **41** of non-ferrous and conducting metal such as copper or the like. In Fig. 3, it will be seen that either strip **40** or **41** is in edgewise contact with the flange **32** of pin **34**. It will also be noted that the strip **40** has secured thereupon a contactor button **42**. The contactor button **42** is nominally in engagement with a fixed contactor **43** that is supported in a threaded sleeve **44**. The sleeve **44** is anchored in the top wall **19** and a like sleeve **45** is similarly disposed in axial alignment in the bottom wall **20**. The contactor **43** is threaded into the lower end of sleeve **44** while a screw **46** is threaded into the outer end of the sleeve to secure the end of a wire **47** thereagainst.

A circuit from wire **47** through sleeve **44**, contactors **42** and **43** and strip **40** is completed through fulcrum pin **34** and by screw **48**, threaded into the tapped hole **35**, of pin **34** to the wire **49** secured thereby. If desired suitable washers **50** can be employed to increase the "grip" of the wires **47** or **49** by the screws **46** and **48**.

In operation, when the plunger **38** is moved inwardly by the engagement of a mechanically movable part such as the lug **26**, the actuating member **28** by reason of its magnetized body will influence the switch member **29** to swing in the opposite direction and thus separate the contactors **42** and **43** momentarily or until the lug disengages from the plunger **38**. If desired, the actual motion of the member **29** can be limited by a stud **51** threaded into the sleeve **45** and having a screw slot **52** whereby it can be turned until properly positioned with reference to the limit of motion of member **29**.

In the event that it is found preferable to momentarily close an electrical circuit through contactors **42** and **43** and wires **47** and **49**, the member **29** can be bodily inverted. The contactor **43** will then replace the stud **51** in lower sleeve **45** and the screw **46** employed to attach the wire **47** at the outer end thereof. Also the stud may be threaded into the upper sleeve **44** and located to limit the motion of the switch member **29** as previously described.

Now, if two control circuits are to be affected by the switch operation, the stud **51** can be removed from the sleeve **45**. This will permit the temporary closure of a second circuit while a first circuit is temporarily opened. For this purpose and as shown in Fig. 6, a contactor **53** is threaded into the inner end of sleeve **45** and a screw **54** employed to secure a wire **55** at the outer end thereof. Also the strip **41** is provided with a contactor **56**. Since the strips **40** and **41** are connected to the wire **49** through the screw **48** and pin **34** they will now both be adapted to complete one side of an electrical circuit. The contactors **42—43** will therefore maintain a circuit from wire **47** to wire **49** until the actuating member **28** is moved to the indicated position *a* of Fig. 2. Then the member **29**, when swung to the position indicated at *b* in Fig. 2, will carry the contactor **56** on strip **41** into active and circuit closing engagement with the contactor **53**. A circuit will now be temporarily completed from wire **49** through pin **34**, strip **41** and contactor **56**, contactor **53** and sleeve **45** to screw **54** to wire **55**.

Also as shown in Fig. 6, the box **16** is secured to a horizontally disposed support plate or structural machine part **57** by screws **58** passed through the holes **22**. When so mounted, the open side of box **16** can conveniently be closed by a plate **59**, screws **60** being threaded into sleeves **23** to firmly position the said plate. This view upon comparison with Figs. 1 or 3, illustrates the simple yet ready adaptability of the switch to mounting according to any of a variety of desired functional positions.

With reference now to Figs. 7 to 11, inclusive, there is shown a second embodiment of my invention which is adapted to automatically operate in response to a change in thermal conditions. That is to say—a switch of the construction herein disclosed may be used to automatically control the heat range of ambient temperatures; it may also be mounted to respond to the temperature of contained gases or liquids and it may, with similar adaptability, be employed as a thermostat switch in the atmosphere of gases that are known to be dangerous in the presence of electrical arcing.

This embodiment of the invention accordingly is adapted to control one or more circuits by the automatic motion of permanently magnetized elements which are substantially sealed from the atmospheres in which they are intended to function. Thus, the switch **61** comprises a hermetically-sealed, annularly-shaped switch receptacle or container generally designated by the numeral **62** that is rotatably mounted within a mounting base **63**.

More particularly, the container **62** comprises an annular side wall **64** and an outward or forwardly directed wall **65**. The container **62** is closed by a panel or rear wall **66** on which the fixed and movable switch elements are mounted and which is sealingly secured to the peripheral edge of the side wall **64** once the switch elements have been installed. The container **62** is thus substantially hermetically sealed from the undesired entry of gases or other dangerous atmospheres.

Referring to Fig. 9, it will be seen that the switch elements include a pair of fixed contacts **67** and **68** that are mounted on lugs **69** and **70** integrally formed with and projecting from the inwardly disposed surface of the wall **66**. The contacts have engagable contact points **71** and **72** carried on one leg of a substantially L-shaped plate **73**. The plate **73** of each contact is secured by its opposite leg to the respective lug **69** or **70** by means of a screw **74** which also serves to fix one end of a wire **75** in one case, and **76** in the other to the associated contact.

Arranged between the lugs **69** and **70**, is a magnetic block **77** that is pivotally mounted on a shaft **78**; the shaft being supported at its ends in suitably socketed portions of the forward wall **65** and the rear wall **66**. The block **77** carries a U-shaped conductive strip **79** that is equipped on each of its downwardly directed legs

80 with contact points 81 and 82. When the block 77 is swung on the shaft 78, the contact point 81 will engage the fixed contact point 71 in one direction of motion and the contact point 82 with the contact point 71 during motion in the opposite direction.

The contacts 67 and 68 are connected by the wires 75 and 76 to an outside source of current. The strip 79 is also connected by a wire 83, that may be soldered or otherwise secured thereto, to the outside current source. For this purpose, the wires 75, 76 and 83 are connected at their opposite ends to suitable clips 84, 85 and 86 that are fixedly mounted by bolts 87 that are passed through holes formed in the container wall 64. To assure a firmly mounted arrangement of the bolts, the wall has an outwardly directed boss 88 integrally formed therewith. The strip 79 by the wire 83 may be connected to a source wire 89 through the clip 84 and associated bolt 87 and the contact 70 by wire 76 to a source wire 90 through the clip 86 and its associated bolt 87.

Here, as shown in Figs. 7 and 9, only one circuit will be controlled as when the contact point 82 of plate 79 is carried to engage the point 72. A circuit therefore will be established from source wire 89, wire 83, plate 79, contact point 82, contact point 72 and wire 76 to the source wire 90. On the other hand, two circuits may be as conveniently controlled by connecting a source wire to the bolt 87 associated with clip 85 and by wire 75 to the contact 69. Controllably produced swinging motion of the block 77 on which the plate or strip 79 is mounted will accordingly close a circuit at points 71 and 81 or points 72 and 82 at each limit of its movement. Likewise the motion of the block, in swinging from one limit to the opposite limit as defined by the fixed points 71 and 72, can serve to open one circuit as between wires 75 and 83 and sequentially close a second circuit between wires 76 and 83 or vice versa.

In order that the swinging movement of the magnetic block 77 can be automatically and effectively carried out, a second magnetized member 91 is arranged in endwise relation to the block 77. As set forth in the first embodiment of my invention, the blocks 77 and 91 are positioned so that their like poles are in endwise relation to one another. Accordingly, upon motion of the block 91, the block 77 will be caused by the repelling influence of the magnetic force to move in an opposite direction. The block 91, if employed as the actuator, may thus be moved in response to changes in temperatures and thereby produce the opening and/or closing of an electric circuit or circuits to control the high/or low range of a desired range of degrees of temperature.

For this purpose, the block 91 is associated with a bimetallic element that is situated so as to be influenced by conditions of heat or cold and, upon contracting or expanding, produce motion of the said block. More particularly, the block 91 is fixedly mounted on a shaft 92 that is journaled at one end in the front wall 65 of the container 62. Rearwardly of the block 91, the shaft passes through the rear wall 66, the hole 93 therein affording a second journal support. The shaft 92 at its extreme end is provided with a slot 94.

In assembling the switch receptacle or container 62, the wires 75, 76 and 83 are connected to their respective contacts 67 and 68 and the strip 79 and clips 84, 85 and 86. The shafts 78 and 92 are then stepped into their journals in the front wall 65. The shaft 92 is passed through the hole 93 in the rear wall 66 after which the shaft 78 is fitted into its journal in the rear wall. This wall is then secured to the peripheral edge of the annular wall 64 and sealed thereagainst by suitable adhesive or other cementious material to render the container substantially hermetically closed.

The container is bodily received in the base 63 by engaging a flange 95 depending from the annular wall 96 thereof. Preferably this flange is interrupted to form an arcuate slot 97 while the wall 96 is provided with a

notch 98 through which the boss 88 may be passed. After properly seating the forward wall 65 of the container against the flange 95, a rear wall plate 99 is positioned so as to close the rear end of the base 63 and thus enclose the container therein. For this purpose, the rear margin of the inner surface of the wall 96 is threaded as at 100 and the periphery of the plate 99 threaded in a like manner.

The wall 96 also carries a tubular sleeve 101 that is concentrically located, and attached by means of a conventional threaded connection. In locating the plate 99, the shaft 92 is inserted into the sleeve and the plate is then turned into the threaded portion 100 of the wall 96. The sleeve 101 at its end adjoining the plate 99 has suitably attached thereto one end of a coil 102 of bimetallic metals. When the plate 99 has been properly located in the base 63, the free or opposite end of the coil 102 is inserted to the slot 94 of shaft 92. Since the sleeve 101 is intended to be located in an atmosphere or liquid the temperature of which is to be controlled, the extreme or open end of the sleeve is preferably closed by a fixedly mounted and sealed plug 103.

In order to conveniently mount the base 63, the outer surface of the annular wall 96 is shaped to form a hexagonal flange or nut 104 and is threaded as at 105. When positioned within an opening provided in a wall 106, as shown in Fig. 8, and being equipped with a suitable washer 107, the base 63 can be fixedly mounted by means of a nut 108, the flange 104 serving as a suitable surface to receive a wrench or other holding tool.

With the associated parts now arranged as shown in Figs. 8 and 9, it will be seen that the distortion of the bimetallic coil 102 in response to temperature changes will effect the rotation of shaft 92 and thus swing the magnetic block 91. As the block 91 is moved relative to the block 77, the repulsion of their like poles will cause the block 77 to swing on its shaft 78 and produce the desired opening or closing of an electrical circuit as above described.

Thus, if the coil 102 is adapted to expand due to an influential heat condition, the shaft 92 will be rotated counter-clockwise, as viewed in Fig. 9, and consequently the block 91 will cause the block 77 to carry the point 82 into engagement with the point 72 of contact 70. This will create a circuit by wire 83 to strip 79 and contact 82 to wire 76 via contact 70. Upon a change in temperature or decrease in the heated condition, the coil 102, in contracting, will move the shaft clockwise with associated movement of the block 91 to swing the block 77 oppositely and disengage the contact points 72 and 82.

Since variation of the degree of temperature at which the switch will respond is a usual adjunct to temperature control devices, the outer surface of the flange 95 is provided with radially disposed lines 109 that may be designated by suitable numerals to indicate a range of temperature. Also the forward wall 65 of container 62 is formed to provide a pointer 110 to register therewith. To conveniently manipulate the container within the base 63, the outer face of wall 65 is provided with a knob 111.

To adjust range of the operating temperature, the container 62 is rotated by the knob 111 and the boss 88 will move within the slot 97. When the desired degree of temperature is indicated by registration of the pointer 110 with the properly denoted line 109, the contacts 67, 68 and the magnetic block 77 will have been carried to a position substantially as shown in Fig. 10. The magnetic lines of force between the opposed ends of blocks 77 and 91 will accordingly be displaced and the block 91 will not effect movement of the block 77 until by expansion of the coil 102, the block 91 has been swung to pass its proximate end past the opposed end of block 77 and thus produce its swinging action to carry the point 82 into engagement with the point 72 of contact 68.

It is to be understood that the forms of the invention herewith shown and described are to be taken as illustrative embodiments only of the same, and that various

changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. An electric switch having a receptacle box, a pin located adjacent each of the opposite ends of said box, each pin having a body portion supported in a wall of the said box, and an integral axle portion of reduced diameter projecting inwardly therefrom, a switch operating member including a magnetic block pivotally mounted at one of its ends on the axle portion of one of said pins, a strip of conductive metal affixed to one side of the magnetic block in surface contact with the body portion of the said pin, means connecting said first pin to one side of an electric circuit, a second electric circuit source mounted in a second wall of the box and adapted to be engaged by the free end of the switch operating member, a switch actuating member including a magnetic block pivotally mounted at one of its ends on the axle portion of the second of said pins and disposed in alignment with the magnetic block of the switch operating member, resilient means engageable with the switch actuating member for normally urging it into a position to hold the conductive strip of said switch operating member in engagement with the said second circuit source during repulsion of magnetic forces between the magnetic blocks of the said switch actuating and switch operating members, separate control means operable to cause said switch actuating member to move against the normal action of the resilient means whereby said switch operating member is moved from a circuit closed to a circuit open position, and means limiting movement of the said switch operating member from a circuit closed position.

2. An electric switch as defined in claim 1, wherein said resilient means includes a coil spring for automatically reversing the repulsing action of the switch actuating member upon release of the said separate control means.

3. An electric switch as defined in claim 1, wherein said separate control means includes a pin slidably supported in a wall of the receptacle box in opposition to said resilient means.

4. An electric switch as defined in claim 1, wherein said limiting means includes a threadably mounted member positioned in a wall of the receptacle box and adapted to adjustably limit the pivotal movement of the switch operating member between the circuit closed and circuit open positions.

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