Sept. 3, 1929. H. I. MORRIS 1,726,675

ELECTRIC SWITCH

Filed May 9, 1924 2 Sheets-Sheet 1

Fig. 7

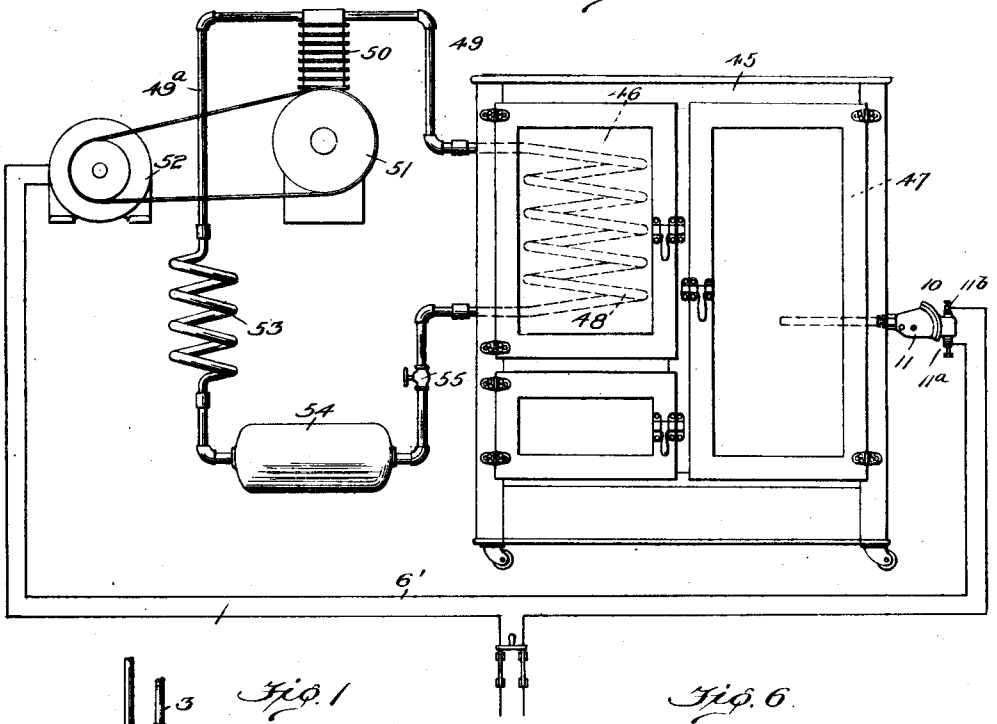


Fig. 1

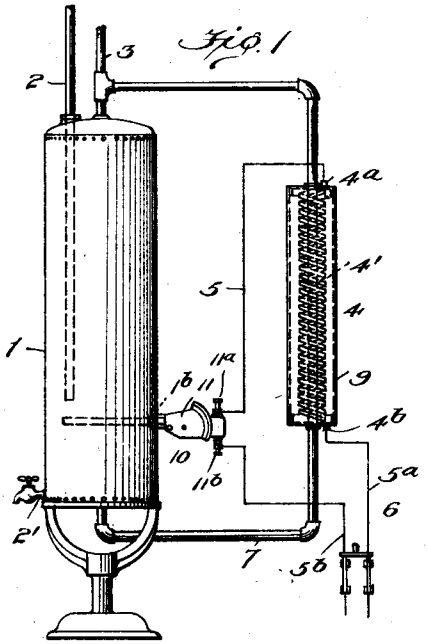
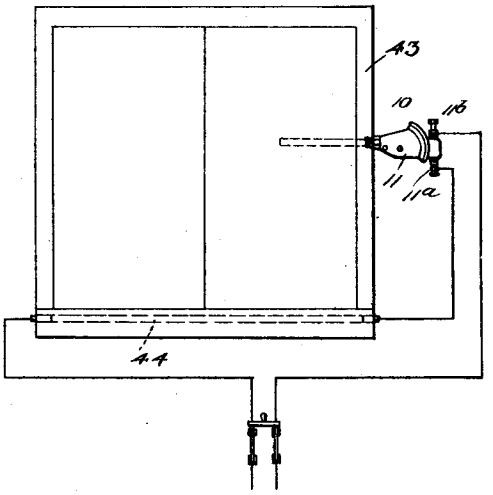


Fig. 6



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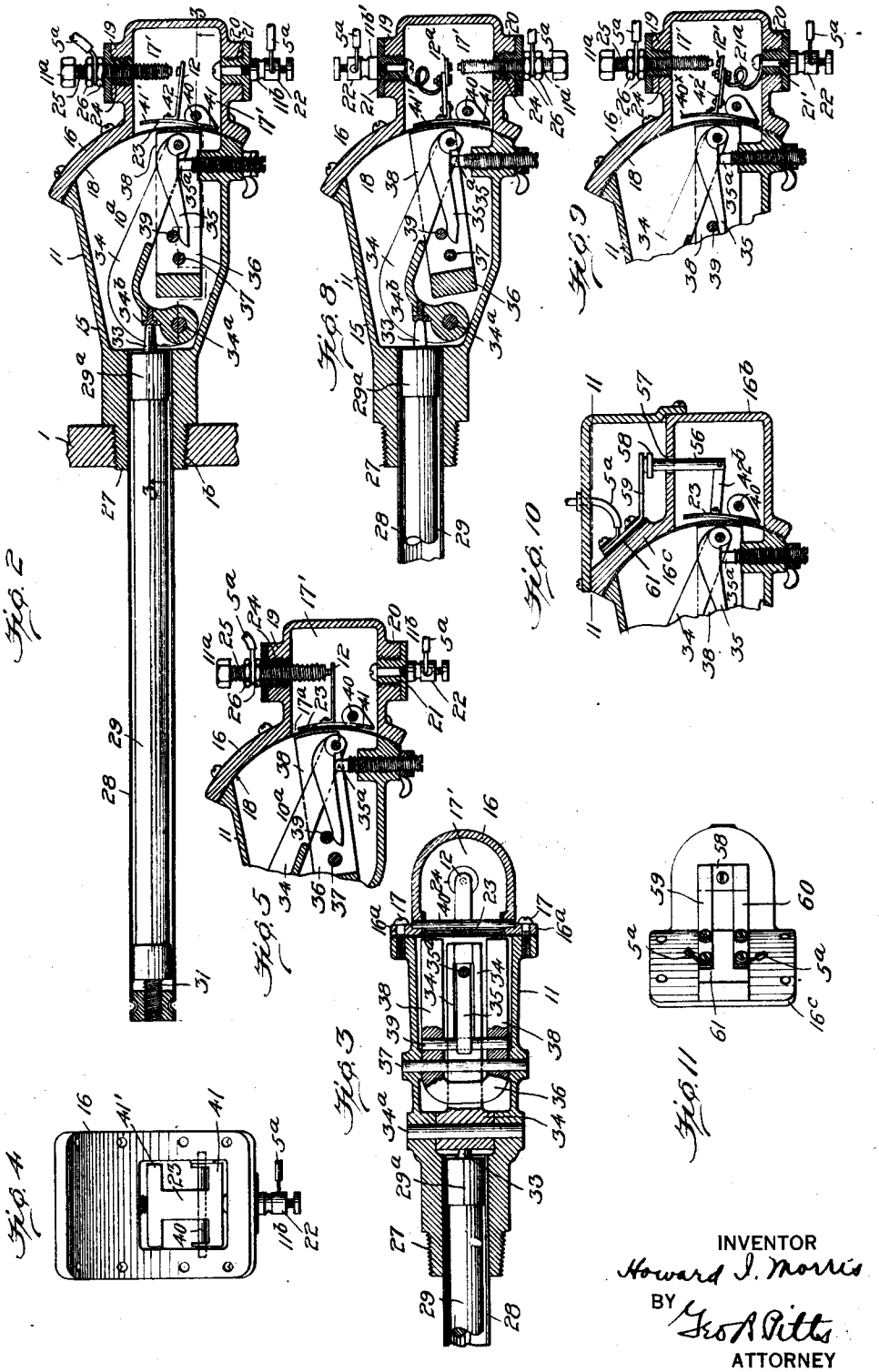


Fig. 2

Fig. 8

Fig. 9

Fig. 10

Fig. 5

Fig. 3

Fig. 4

Fig. 11

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UNITED STATES PATENT OFFICE.

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ELECTRIC SWITCH.

Application filed May 9, 1924. Serial No. 712,113.

This invention relates to an electric switch mechanism wherein a circuit through one or more leads is opened and closed automatically. In the preferred application of the invention, the switch mechanism opens and closes a circuit to an element, such as a heater or motor, but the invention may be applied to open and close a master circuit, which in turn controls magnetically operated switches for one or more circuits that are to be opened and closed. My invention is associated with a thermostat which is actuated by the rise and fall of the temperature of a medium (air, gas or water) that surrounds the thermostat, and the latter in turn effects the operation of the switch mechanism.

One object of the invention is to provide a switch mechanism which is simple in construction and positive in operation.

Another object of the invention is to construct an electric switch in which the movable contact element is actuated in a relatively quick manner in either direction.

Another object of the invention is to construct an improved electric switch mechanism, which is actuated by a thermostat, to control the operation of means that directly or indirectly maintain the medium surrounding the thermostat at substantially any desired temperature, so that by reason of the change in temperature of the medium, the thermostat will automatically effect operation of the switch mechanism to close an electric circuit to set in motion or action or to stop the means which act to return the temperature of the medium to the desired degree.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings.

In the drawings Fig. 1 is an elevational view, partly broken away, illustrating a switch mechanism embodying my invention as applied to a water heating apparatus.

Fig. 2 is a longitudinal sectional view through the switch mechanism.

Fig. 3 is a section on the line 3—3 of Fig. 2.

Fig. 4 is an elevational view of one of the casing members.

Fig. 5 is a fragmentary view, similar to Fig. 2, but showing the position of the elements when the switch mechanism has operated and the electric circuit is closed.

Fig. 6 is a view of a modification showing the switch mechanism arranged to control an electrically heated oven.

Fig. 7 is a view, partly in elevation and partly diagrammatic, of a refrigerator and system therefor, wherein the temperature of the refrigerator is controlled and maintained at substantially any desired degree by a switch mechanism embodying my invention.

Fig. 8 is a fragmentary sectional view of a switch mechanism arranged to control the circuit for a motor in a refrigerating system as shown in Fig. 7.

Fig. 9 is a slightly modified form of switch mechanism embodying my invention.

Fig. 10 is a further modified form of construction embodying my invention.

Fig. 11 is a fragmentary section on the line 11—11 of Fig. 10.

Referring to Figs. 1 to 5, inclusive, wherein I have illustrated the application of my invention for use in connection with thermostatic elements which control the heating of water or other liquid in a tank and maintaining it at any desired temperature, 1 indicates a tank adapted to contain water or other liquid. 2 indicates a water supply pipe, which is connected to the tank 1 in any suitable manner. 3 indicates a pipe leading from the tank 1 to points where the heated water is desired for use. 4 indicates an electric heater, which preferably comprises a coiled heating element 4′ of suitable material having terminals 4^a, 4^b, to which are connected the ends of leads 5, 5^a, included in an electric circuit 6. The heating element 4′ surrounds a pipe 7 connected to the lower end of the tank 1 and to its upper end or to the pipe 3. The leads 5^a, 5^b, are connected to the terminals of a switch 8, which opens and closes the circuit leading from a source of supply (not shown). The heating element 4′ is preferably enclosed in a casing 9 to protect it as well as to prevent radiation of the heat. The casing 9 may be constructed in sections to permit its assembly and access to the heating element. The arrangement of the heating element herein shown is merely for illustrative purposes, since so far as my invention is concerned it may be arranged in any desired manner.

2′ indicates a pipe connected to the bottom of the tank 1, whereby it may be drained, when desired. The pipe 2′ is provided with a suitable valve or cock as shown in the drawing. It will be understood that

the pipe connections to and from the tank 1 may be arranged in any manner other than that shown in the drawings when desired.

10 indicates as an entirety a switch mechanism interposed in the lead 5^a and controlling the opening and closing of the circuit 6 therethrough.

Of this switch mechanism 10, 11 indicates a casing which houses the electric terminals 11^a, 11^b, the switch element 12 that has electrical connection with one of the terminals and engages and disengages the other terminal and an operating mechanism indicated as an entirety at 10^a. The walls of the casing 11 are formed with openings in which are supported the terminals 11^a, 11^b. The casing 11 preferably comprises two members 15, 16, suitably shaped to facilitate their assembly for correlation with each other and assembly of the operating elements therein, as will later be apparent. To permit ready assembly the casing member 16 is provided with a curved end wall and a curved flange wall 16^a to which the casing member 15 is secured in a well known manner, for example, by screws 17. The casing member 16 is shaped to provide a chamber 17′ in which the inner end of the terminal 11^a and switch member 12 are mounted. The side of the chamber 17′ is open as shown at 17^a, but in connecting the casing member 16 to the walls of the casing member 15, I interpose between the two casing members a relatively thin plate 18, formed from suitable non-magnetic material, for a purpose which will later appear. As the plate 18 extends from side edge to side edge of the casing 16 (see Fig. 3), it serves to close the inner side of the chamber 17′ and therefore divides the casing 11 into two chambers one for the inner end of the terminal 11^a, the switch element 12 and the device to which the latter is connected and the other for the switch operating mechanism 10^a.

By preference the upper and lower walls of the chamber 17′ are provided with bosses 19, 20, in which are formed screw threaded openings to receive supporting devices for the terminals 11^a 11^b. The supporting device for the terminal 11^b preferably comprises a plug 21 screw threaded in the opening through the boss 20. The plug 21 is formed with an opening through it to receive the bolt of a binding post 22, to which the lead 5^a is connected. The plug 21 is formed of conductive material so that the circuit from the lead 5^a is grounded to the casing member 16 and leads through the latter to the switch element 12 through a rocker 23, (to be later referred to) to which the switch element is connected. The supporting device for the terminal 11^a comprises a plug 24 formed from insulating material and screw threaded in the opening formed in the boss 19. The plug 24 is provided with a screw threaded opening in which a screw 25 is mounted. 26 indicates nuts mounted on the screw 25 and adapted to lock the screw 25 in the plug 24 and also to clamp between them the end of the lead 5^a. As shown, the screw 25 extends inwardly into the chamber 17′ into position to be engaged by the switch element 12 when the latter is operated. The contacting end of the screw 25 and the switch element 12, may be provided with platinum contact devices, if desired. By loosening the nuts 26, the screw 25 may be rotated to adjust its contact end closer to or farther away from the switch element 12.

27 indicates a hollow boss provided on the inner end of the casing member 15 The boss 27 is provided with external screw threads adapting it for connection with the walls of an opening 1^b formed in the side wall of the tank 1.

28, 29, indicate thermostatic elements extending into the tank 1. The element 28 preferably comprises a section of tubing formed from copper or other material capable of readily expanding under the influence of heat. The outer end of the element 28 is closed in any suitable manner. The inner end of the tube fits tightly within the boss 27, the connection therewith being of a liquid tight character to prevent leakage of the water in the tank 1 into the casing member 15. The thermostatic element 29 is preferably formed from some material, such as porcelain, which is not to any substantial extent affected by temperature changes. The element 29 is arranged within the section of tubing 28 being connected at its outer end to the adjacent end of the tube 28 by any suitable device, such as a screw 31, which permits adjustment of the elements relative to each other when desired. The inner end of the thermostatic element 29 is, by preference provided with an enlarged portion 29^a which fits the inner end of the tube 28. The inner end of the element 29 is preferably provided with an extension, which serves as a thrust element 33, extending in an axial direction.

Since the inner end of the thermostatic element 28 is fixed to the casing 11 and its outer end is connected to the outer end of the thermostatic element 29, it will be understood that upon the rise in temperature of the medium surrounding the element 28, the latter expands and moves the element 29 endwise, or toward the left, as viewed in the drawings, and when the temperature of the medium falls, the element 28 contracts and moves the element 29 endwise in the opposite direction, thereby serving to control the operation of the operating mechanism 10^a as will be later set forth.

Of the operating mechanism 10^a, 34 indicates a lever pivoted upon a cross shaft or

pivot 34ª mounted at its opposite ends in suitable openings formed in the side walls of the casing member 15. 35 indicates a supplemental lever pivoted to the free end of the lever 34 and engaging a fulcrum 35ª about which it rocks during movement of the lever 34. 36 indicates a magnet, preferably of the horse-shoe type, pivoted at or near its inner end upon a shaft or pivot pin 37, supported at its opposite ends in the walls of the casing member 15. 39 indicates a bar or rod connected to and extending across the gap between the two legs 38 of the magnet 36 and arranged to be engaged by the free end of the supplemental lever 35, to swing the magnet about its pivotal support 37. As shown in the drawings, the horse-shoe type of magnet provides a space between its legs for the free end of the lever 34 to move in; and by bifurcating the free end of the lever 34, provision is made for the reception of the supplemental lever 35 whereby the lever 34, supplemental lever 35 and magnet 36 co-operate and move freely relative to each other in a relaively small confined space or chamber, so that compacness and reduced cost of manufacture are insured. The lever 34 is provided with an abutment 34ᵇ with which the thrust member 33 engages. When the thermostatic element 28 contracts due to fall in temperature of the water in the tank 1, it will move the thermostatic element 29 endwise toward the right as viewed in the drawings, and it in turn will act through the levers 34 and 35 to swing the magnet 36 about its pivot 37 upwardly; likewise, when the temperature of the water rises, these elements move in the opposite direction and permit the magnet to move downwardly. The operating elements just described are preferably arranged so that when the water in the tank 1 is at the desired temperature, the magnet 36 is in a substantially horizontal position as shown in Fig. 2. 40 indicates a shaft extending transversely across the chamber 17′ and secured at its opposite ends in the said walls thereof and supporting the rocker 23. The rocker is provided with a pair of wings 41, 41′, of magnetic material extending to either side of the shaft 40. 42 indicates an arm fixed to the rocker 23 and constituting at its outer end the switch element 12 already referred to. The shaft 40 is arranged so that when the magnet 36 moves in either direction, its influence or attraction decreases with respect to one wing and increases with respect to the other wing so that a rocking of the rocker 23 on its shaft 40 takes place to operate the element 12, such operation serving to hold the rocker in one position until the influence of the magnet effects its rocking.

From the foregoing description, it will be seen that the rocker 23 constitutes an armature pivoted intermediate its ends, whereby movement of the magnet in opposite directions toward its ends will cause the armature to rock to either positively open or close the circuit through the lead 5ª with a relatively quick motion.

In operation—assuming that the water in the tank 1 is at the desired temperature—the elements of the operating mechanism 10ª will be substantially in the position shown in Fig. 2, with the switch element 12 out of engagement with the terminal 11ª. If the water in the tank 1 is allowed to cool or cooling takes place by reason of the discharge of the hot water therefrom, the cooling effect will cause a contraction of the thermostatic element 28 and movement of the element 29 toward the right; such movement will in turn operate the levers 34 and 35 and they in turn will swing the magnet 36 upwardly to the position shown in Fig. 5. As such movement of the magnet continues, it will attract the armature 41′, causing the rocker to rock about its pivot and close the circuit with a relatively quick movement, as shown; that is, it will move the switch element 12 into engagement with the terminal 11ª, thereby closing the circuit 6 through the heating element 4′; heating of the water will then take place. When the water has reached the desired, predetermined temperature, the heat thereof will cause the expansion of the tubing 28 and it will move the thermostatic element 29 endwise toward the left. As the thermostatic element 29 moves in this direction the levers 34, 35, will operate in the reverse direction, due to their weight and the weight of the magnet 36, which will then move downwardly to the position shown in Fig. 2. As the magnet moves downwardly, it will move away from the armature 41′ and toward the armature 41. As this movement continues, the influence of the magnet 36 on the armature 41′ gradually decreases, while its influence on the armature 41 gradually increases, until its influence on the latter is greater, at which time the rocker will swing about its pivot with a relatively quick movement and open the circuit, as shown in Figure 2.

It will be seen that the magnet 36 is movable, and operates to both open and close the circuit with relatively quick actions and these operations are effected by movement of the magnet relative to two armatures which being connected together and mounted upon a common pivot are positively and alternately operated to open and close the circuit 12 by a single movement of the magnet relative to the pivot about which the armatures swing.

The construction is particularly advantageous for the further reason that the magnetic influence between the magnet and one end of the rocker serves to maintain the rocker 23 in either position until it is posi-

tively moved to its other position; for example in Fig. 2 the magnet 36 is shown at substantially its lowest position and attracting the armature end 41. Due to the magnetic influence upon the armature end 41, the latter will be maintained in that position (and the circuit open) while the magnet 36 is moving upwardly to the position shown in Fig. 5 until its influence on the armature end 41′ is greater than its influence on the armature 41, whereupon the rocker will rock. As a result of this movement there will be a rapid decrease in the influence on the armature end 41 and a rapid increase in the influence on the armature end 41′, the effect of which is to complete the operation of the rocker with a relatively quick movement. As the switch element is connected to the rocker, it is moved to the circuit closing position quickly and positively.

From the foregoing description it will be seen that I have provided a relatively simple form of construction, consisting of few parts. Furthermore, it will be seen that I have provided a construction in which the use of springs for operating or controlling any of the elements or parts or their relative movements are entirely eliminated.

It will also be seen that I have provided two separate closed chambers in each of which are mounted certain of the operating elements, the armature or armatures and contact elements being mounted in one chamber and the lever and magnet being mounted in another chamber. By reason of this arrangement a separate chamber is provided for the electric contact devices so that in the event that arcing takes place the heat thereof will not affect the elements of the operating mechanism or the bearings in which they are mounted. Furthermore, it prevents the medium, which surrounds the thermostatic elements, from entering the chamber in which the electric contact devices are mounted. In carrying out this arrangement, the joint between the casing members 15, 16, is of a liquid tight character. The plate 18 being disposed between the casing members 15, 16, it maintains the magnet and armatures 41, 41′ out of contact at all times, so that they will not stick together; the plate also forms a stop to limit the swinging of the rocker in one direction, namely, when operating to move the switch element out of contact with the terminal 11^a.

Since magnetic attraction is relied upon to operate the armatures 41, 41′, there is no mechanical connection between them and the switch element 12 is operated in a positive manner and with a relatively quick movement in either direction without the provision of a loose pivot and slot connection or a spring control connection between any of the operating elements and such switch element to insure a quick or snap action of the latter.

The fulcrum 35^a preferably comprises a rod provided with screw threads which fit a screw-threaded opening in the lower portion of the casing member 15. This construction and arrangement permits the rod to be rotated and thereby adjusted endwise so that the engagement of the supplemental lever 35 with the cross rod 39 can be controlled to regulate the operation of the magnet 36 relative to the armatures 41, 41′, whereby the water in the tank 1 can be maintained at a relatively higher or lower temperature, as desired.

Where it is desired to connect the switch element 12 directly with the terminal 11^b, the plug 21 may be formed of insulating material as shown at 21′ in Fig. 9. In this construction the inner end of the binding post is connected by a lead 21^a with the switch element 12′ which is connected to but preferably insulated from the arm 42′ of the rocker 40^x.

Fig. 6 illustrates the application of my invention to an oven indicated at 43. In this form of construction the hollow boss 27 is screw threaded into an opening in one wall of the oven and the thermostatic elements 28, 29, extend into the latter so as to be affected by the rise and fall of the temperature therein. In this form of construction the heating element is disposed in the lower portion of the oven, as shown at 44.

Fig. 7 illustrates the application of my invention to an apparatus wherein the switch mechanism controls a circuit to an electric motor which in turn operates a mechanism incident to such apparatus. As illustrative of this application of the invention I have shown a refrigerating system adapted to effect refrigeration in a refrigerator. In this view 45 indicates a refrigerator of any desired construction having a refrigerated chamber 46 and storage chamber 47. 48 indicates the coil for the refrigerant. One end of the coil is connected by a pipe 49 with a compressor 50 the driven member 51 of which is operated from an electric motor 52. From the other side of the compressor the pipe 49^a leads through a cooling coil 53, then to a tank 54, then through an expansion valve to the other end of the coil 48. As shown, the switch mechanism 10 is mounted in one wall of the refrigerator 47, similar to that described in connection with the heating oven in Fig. 6 so that the thermostatic elements 28, 29, thereof will be disposed in the storage chamber of the refrigerator and at the point at which the desired temperature is to be maintained. Due to the rise and fall of temperature in such chamber, the thermostatic elements 28, 29, will open and close the circuit 6′ for the motor which in turn will drive the compressor 50 to effect circulation of the refrigerant and thereby to maintain the temperature in the refrigerator

at the desired degree. Where the switch mechanism is applied to a refrigerator or a refrigerating system, the electric terminals $11^{a'}$, $11^{b'}$, are reversed (see Fig. 8), since it is necessary to effect operation of the motor due to rise in temperature of the medium instead of the drop in temperature as is the case where it is desired to heat or maintain in heated condition a body of gas or liquid. This construction is illustrated in Fig. 8 where the magnet 36 is shown acting upon the armature 41' when the storage chamber in the refrigerator is at the desired temperature, with the thermostatic element 28 contracted. If the temperature in the storage chamber rises, the thermostatic element 28 will expand and thus permit the magnet 36 to swing downwardly and attract the armature 41, thereby swinging the switch element 12^a into engagement with the terminal $11^{a'}$.

Fig. 10 illustrates a further modified form of construction embodying my invention. In this form of construction the arm 42^b carries a plunger 56, which projects through an opening 57 formed in the casing member 16^b and carries at its open end a contact plate 58. 59, 60 indicate contact elements connected to the wall 16^c of the casing member 16^b. The connection also includes a block of insulating material 61. The contact elements 59, 60 project laterally into the path of movement of the contact plate 58 so that when the plunger 56 is moved upwardly due to the swinging of the magnet 36 from its lower position (like that shown in Fig. 2) to its upper position (like that shown in Fig. 5) the contact plate will engage the contact elements 59, 60 and complete the circuit therethrough. The inner ends of the plates 59, 60 are provided with binding devices to which the ends of the leads 5^a are connected as shown in Fig. 11. Where this form of construction is applied to a refrigerating system or for maintaining a liquid, and air and gas at a relatively low temperature, the normal position of the rocker is opposite to that shown in Fig. 10, and the contact elements 59, 60 are disposed below the contact plate 58, so that upon the movement of the plunger 56 downwardly the circuit will be completed across the contact plate 58.

I have not thought it necessary to illustrate other applications of my invention, but the same could be applied to control the temperature in a room or storage space where such temperature was maintained by a supply of heated or cooled air. In such application the switch mechanism embodying my invention would control a circuit to a motor which in turn operated or controlled the operation of the valves, ventilators or devices which permitted or cut off the flow of air to the room or space.

It will also be understood that the magnet 36 may be an electro-magnet having one or more windings that are energized from a suitable source of energy. Furthermore, instead of providing two armatures mounted to rock about an intermediate pivot or trunnion, a single movable armature may be used. In this latter form of construction, the weight of the switch element or a spring is utilized to move the armature in one direction.

To those skilled in the art of making mechanisms of the class described, many alterations in construction and widely differing embodiments and applications of my invention will suggest themselves, without departing from the spirit and scope thereof. My disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

What I claim is:

1. In apparatus of the class described, a support, an electric terminal mounted on said support, an armature trunnioned on said support and carrying a contact arranged to engage said terminal to close a circuit, a permanent magnet pivotally mounted on said support whereby its pole swings relative to the opposing face of said armature toward its end portions to either side of a plane cutting the axes of the magnet pivot and armature trunnion, and means for moving the magnet from one end portion of the armature to the other end portion thereof, whereby the latter is rocked to open and close the circuit.

2. In apparatus of the class described, a support having a pair of chambers therein, terminals within one of said chambers, one of said terminals being movable to engage and disengage the other terminal, a magnet pivoted in the other chamber whereby its pole is swingable, an armature connected to the movable terminal and trunnioned in the chamber therefor at a point adjacent the path of movement of the magnet pole and intermediate the ends of movement thereof, means for moving the magnet to swing its pole relative to the armature trunnion toward either end of said trunnion relative to the opposing face thereof, whereby said magnet pole holds said armature in one position until it swings to a point on the opposite side of the amature trunnion and then rocks said armature to effect a snap action thereof, and a wall of non-magnetic material carried by said support and extending between the magnet pole and said armature.

3. In apparatus of the class described, the combination with a support shaped to form a pair of chambers, of a terminal for one side of an electric circuit mounted on the wall of one of said chambers, an armature trunnioned in the last mentioned chamber and electrically connected with the other side of the circuit and carrying a switch element arranged to engage and disengage said

terminal, a magnet mounted in the other chamber to move relative to the opposing face of said armature toward its ends at either side of its trunnion, whereby said magnet pole holds said armature in one position until it swings to a point on the opposite side of the armature trunnion and then rocks said armature to effect a snap action thereof, a thermostat element, and operative connections between said thermostat element and said magnet for operating the latter.

4. An apparatus as claimed in claim 1 in which is provided a thermostat for controlling the magnet moving means.

In testimony whereof, I have hereunto subscribed my name.

HOWARD I. MORRIS.