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R. D. SMITH

1,767,709

ELECTRIC SWITCH

Filed July 20, 1922

Fig. 2.

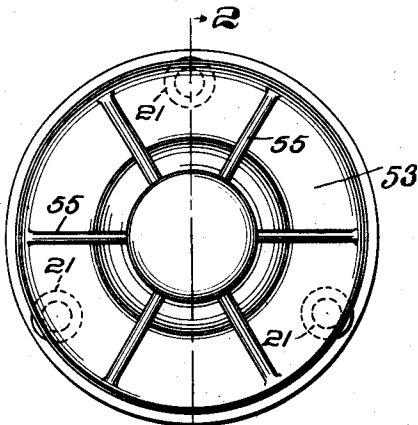


Fig. 1.

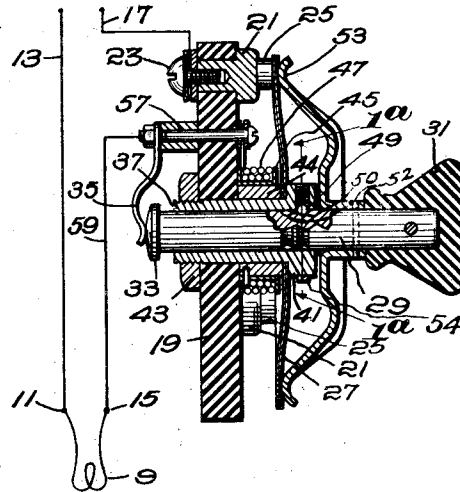


Fig. 1a

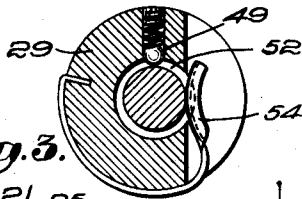


Fig. 3.

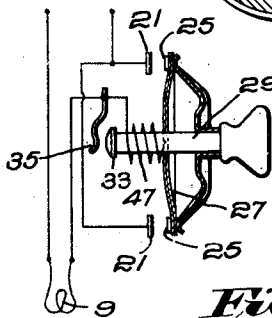


Fig. 4.

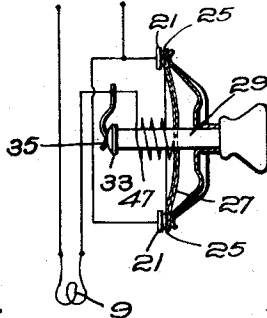


Fig. 5.

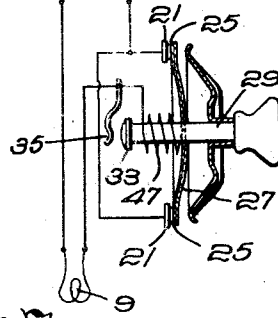


Fig. 6.

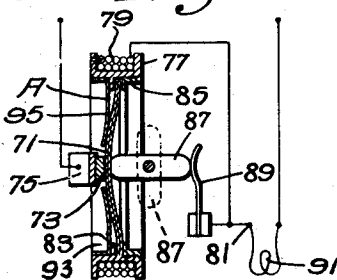
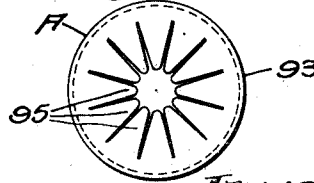


Fig. 7.



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UNITED STATES PATENT OFFICE

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ELECTRIC SWITCH

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This invention relates to thermostatic mechanism for actuating devices including valves and electric switches, and more particularly to those wherein a time interval is provided preliminary to an automatic actuation of the device.

The invention is herein shown for illustrative purposes as embodied in an electric lamp switch, wherein a switch controller may be manually moved to close the circuit to light the lamp, but, when subsequently moved to break the circuit, there are brought into action thermodynamically controlled devices, which herein include a bimetallic thermostat, acting to delay the breaking of the circuit and the extinguishment of the lamp until after a substantial interval of time has elapsed. The invention, however, may have various other uses and applications and is susceptible of embodiment in widely different mechanical forms and in various other circuiting arrangements.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration showing one specific embodiment thereof, while its scope will be more particularly pointed out in the appended claims.

In the drawings,—

Fig. 1 is a longitudinal sectional elevation of a switch embodying one form of the invention, the connected lamp and circuiting being shown diagrammatically;

Fig. 1^a is an elevational cross-section, on an enlarged scale, taken on the line 1^a—1^a in Fig. 1;

Fig. 2 is an end elevation of the switch shown in Fig. 1 viewed from the right;

Fig. 3 is a diagrammatic view showing the parts of the switch in their "off" or open position;

Fig. 4 is a similar diagrammatic view showing the parts in the "on" or closed position of the switch;

Fig. 5 is a similar view showing the parts in the relative positions assumed after the switch controller has been given its manual opening movement and before the auto-

matic breaking of the lamp circuit has taken place;

Fig. 6 is a longitudinal sectional view partly in diagram showing a modified form of switch; and

Fig. 7 is a detail in perspective showing the spring-finger, heating conductor for the switch shown in Fig. 6.

Referring to the drawings, I have shown in Fig. 1, as one illustrative embodiment of the invention, a switch adapted to control an electric load, herein consisting of the incandescent lamp represented at 9, one terminal 11 of the lamp being connected to one side 13 of the supply circuit and the remaining terminal 15 being connected through the switch to the other side 17 of the supply circuit. The controlling switch is herein shown as mounted upon an insulating base 19 and carries one or more suitably disposed main contacts 21 (herein three in number) which are connected each by a suitable binding post 23 to the main line circuit 17. The main contacts 21 are cooperatively related to opposed contacts 25, which latter are carried by the approximately disc-shaped, bimetallic thermostatic member 27 near its periphery. The latter is so constructed, as will be hereinafter described, as to be capable of being moved by the manual switch controller 29 to bring the contacts 25 into contacting relation with the contacts 21 (as represented in Figs. 1 and 4) and to be automatically moved by thermodynamic means to separate these contacts and thereby open the circuit, as is represented in the diagrammatic view in Fig. 3.

The manual controlling means for the switch or other device to be operated by the thermostat may be of any of the numerous types in use, such as the pull-chain type, push-button, rocking beam type, continuous direction rotary type, turn key type or others, but here comprises a plunger or slide rod 29 of conductive material, one end of which is provided with an insulating handle 31 and the opposite end with a contact piece 33, the latter adapted to engage an auxiliary contact 35 when pressed in one direction (as shown in Figs. 1 and 4), or to withdraw

therefrom when moved in the opposite direction (as shown in Figs. 3 and 5). The controlling plunger is mounted to slide longitudinally in a sleeve 37 of conductive material, which latter at one end is provided with an enlargement 41, while the opposite end is threaded and clamped to the insulating base 19 by the nut 43. Surrounding the sleeve 37 is a metallic collar 44 between which and the sleeve enlargement 41 the thermostatic member 27 is tightly clamped at its central portion leaving the member free and unrestrained outside of this confined central portion. Surrounding the collar 44 and between the thermostatic member and the base 19 is a small spool 45 of insulating material, the latter carrying a heating coil 47.

Means are preferably provided, such as the small spring pressed ball 49, cooperating with two circumferential grooves 50 and 52 in the surface of the plunger to position the switch controlling plunger in its respective "on" and "off" positions.

The plunger 29 is maintained in good electrical contact with the sleeve 37 by any suitable means such, for example, as the contact wiper 54 (see Fig. 1^a) having one end secured to the sleeve and the opposite end bent inwardly and located in a transverse slot in the sleeve where it is adapted to contact with the plunger, seating itself in either one or the other of the two grooves 50 and 52.

Between the handle 31 and the sleeve enlargement 41, the plunger has pinned or otherwise secured thereto the hub of an impelling member adapted to engage the peripheral edges of the thermostatic member and to force the latter into a contact making position when the plunger is pushed in, but to withdraw when the plunger is reversely moved leaving the thermostatic member externally free and unrestrained. Such impelling member herein consists of a concave or dish-shaped plate 53, the peripheral edges of which overlie the disc 27, such plate being preferably stiffened, as by the ribs 55, to enable it to act unyieldingly against the edges of the thermostatic member.

The auxiliary contact 35 is carried by a binding post 57 mounted on the insulating base, which binding post is connected to the lamp terminal 15 by the conductor 59. One end of the heating coil 47 is electrically connected to the binding post 57, the other end being connected to the conductive collar 44.

With the switch parts in the position shown in Figs. 1 and 4, the circuit 17 is connected to the lamp terminal 15 through the contacts 21 and 25, the body of the thermostatic member 27, the sleeve 37 with which it is in conductive contact, the plunger 29, contact piece 33, contact 35, binding post 57 and

conductor 59. The circuit through the lamp is then complete. When the plunger is withdrawn or moved to the right, as viewed in the drawings, the auxiliary contacts 33—35 are separated but the contacts 21—25 still remain closed (as will be explained). The current then passes through the lamp through the heating coil 47, which is in shunt circuit around the auxiliary contacts 33—35, and thus receives the entire lamp current on the breaking of the auxiliary contact.

Referring now to the bimetallic thermostatic member 27, it will be observed that in the illustrative embodiment of the invention this member acts both as a conductor and a contact carrying member. This element is herein formed of two united discs of sheet metal pressed into a dish or concave form, the composite piece being capable of being sprung from either one to the other of two opposite, reversely flexed conditions without any intermediate position of stability.

Metals are selected, such for instance as steel and brass, having different coefficients of heat expansion, and the two parts are proportioned and related, and the member is so shaped, that within a range of normal temperature, such as that to which the switch is likely to be subjected in ordinary use, the composite thermostatic member will remain sprung in the position to which it has been moved, while on the other hand, by the application of extraneous force, so applied as to cause it to pass an intermediate or neutral position, it may be caused to reverse its condition of flexure and made to snap quickly to its reversed position.

When unrestrained and free from external influences, within this range of normal temperature, the thermostatic member tends to retain the flexed position to which it has been moved, but when the temperature imparted to it rises above a certain upper limit or falls below a certain lower limit, and the expansive or contractive change of the metal on its one side sufficiently exceeds that of the metal on its opposite side, it will, if unimpeded, automatically move by a quick snap action from one position of flexure to the opposite position. Thus, when its temperature reaches a certain upper limit, it will, if unrestrained, automatically move from the flexed position illustrated in Figs. 1, 4 and 5, where the contacts carried by its peripheral edges engage the stationary main contacts 21, to the oppositely flexed position shown in Fig. 3, where its contacts are separated from the main contacts 21 and the circuit is broken.

While, for illustrative purposes, I have shown the thermostatic member as of a disc formation flexing along all diameters and (in Fig. 1) held at its center, it may be of rectangular, elongated or of any other de-

sired shape or formation and supported and flexing in any desired way, as for example, along parallel lines only, so long as it provides the two opposite conditions of flexure and for its quick movement from one position to the other, either under the influence of temperature change or when forced from its position of rest, as herein described.

The thermostatic member is readily forced from one position of flexure to the other by extraneous means, and in the illustrative embodiment of the invention is caused to snap from the open circuit position to the closed position by the impelling member 53 plus its own in-built characteristic so to snap whenever it is forced to pass from one to the other of its opposite conditions of stability. Although the impeller is herein shown as having a movement coextensive with that of the thermostatic member, this is not essential, for the latter, when engaged by the impelling member and moved beyond a certain neutral or critical position, will of itself automatically complete a quick movement to the closed circuit position. The latter position it will retain until the impelling member has been withdrawn and the upper limit of temperature reached, whereupon it will automatically reverse its flexure. It will be understood that this reversal could at any time be manually effected without waiting for the action of temperature change if pressure is applied to disc 27 opposite to that which closed the contacts if the before described normal range of temperature maintains.

With the preceding explanation, the operation of the switch is as follows: Starting with the parts in their "off" position, the manual switch controller is in its extreme right-hand position and the thermostatic member is flexed to present a convex surface on the side toward the contacts 21, the contacts 25 being thus separated therefrom and the main line circuit being broken. By pushing the handle 31 of the switch controller inwardly, or to the left, the main line circuit is closed at the main contacts 21—25 and also at the auxiliary contacts 33—35. This engagement of the main contacts is effected by the action of the impeller 53 which is brought against the peripheral edges of the thermostatic member and causes the latter to snap quickly from the position shown in Fig. 3 to the position of contrary or opposite flexure shown in Figs. 1, 4 and 5, where its relation to the switch base 19 is changed from convex to concave.

This completes the circuit through the lamp and the latter continues to burn until the switch controller is given a subsequent reverse movement, the heating coil meanwhile receiving no substantial current since it constitutes a shunt of relatively high resistance about the contacts 35—33.

When it is desired to extinguish the lamp, the switch controller is moved to the right (as viewed in Fig. 1) from the position shown in Fig. 4 to that shown in Fig. 5, withdrawing the impeller from the peripheral edges of the thermostatic member and leaving the latter free and unrestrained for subsequent automatic action. The thermostatic member, however, will retain its assumed position under these circumstances until it becomes heated to the temperature limit at which it reverses its condition of flexure. The movement of the switch controller to the right not only withdraws the impeller 53 but also separates the auxiliary contacts 33—35, compelling the lamp current to pass through the heating coil 47. This gradually raises the temperature of the contiguous parts, including that of the thermostatic member 27, and, when the temperature of the latter exceeds the required limit, the thermostatic member will quickly move from the position shown in Fig. 5 to that shown in Fig. 3, separating the main line contacts and opening the circuit and extinguishing the lamp.

The heating coil and the thermostat may be designed to provide any suitable time interval lapsing between the manual actuation of the handle 31 and the actual breaking of the circuit. Since the natural shape of the thermostatic member is that of a concaved disc it jumps quickly from one condition of concavity to the reverse condition and thus acts to separate the contacts and break the circuit instantaneously.

Among the advantages which arise from the use of a thermostatic member of the described characteristics is the compactness of the resulting switch mechanism which leaves more than the usual room for associated switch parts, such as binding post screws for leading-in wires, thermostatic heating coils, etc. This is particularly the case because of the common use of parts standardized as to dimensions, forms and proportions. The disc form of thermostatic member, while not essential, also has the advantage of adapting itself to switch housings of cylindrical shape, such as lamp socket switches, etc.

In the illustrative embodiment of the invention it will be observed that the heating coil is shown as in series with the load,—herein the incandescent lamp. Other circuiting arrangements, however, may be employed if desired wherein the heating coil is arranged in shunt to the load.

In Fig. 1 the thermostatic member is held near its center and its peripheral edges move automatically from one condition of flexure to the reverse condition. In Figs. 6 and 7 there is shown a similar form of switch wherein the thermostatic member, therein designated as 71, is supported at its edges, while the central portion thereof carries the

main line contact 73 cooperating with the fixed but preferably resilient contact 75. In this form of switch the thermostatic member is supported at its preiphery by the interiorly grooved spool holder 77 of conductive material which carries the insulated heating coil 79, one terminal of the heating coil being connected to the holder 77 and the other to the lamp circuit 81. The edges of the thermostatic member have conductive contact with the spool holder 77 but may, though not necessarily have a slight freedom of movement between the flange 83 on said holder and the walls of a threaded collar 85. A manually operable hand control key 87 is employed and, when turned to the full line position shown in Fig. 6, engages the auxiliary contact 89 at one end and at the opposite end presses against the central portion of the thermostatic member, forcing it to the left to bring its contact 73 into engagement with the main line contact 75. This closes the circuit from the main line contact 75 through the contact 73, thermostatic member 71, control key 87, contact 89, circuit 81 and the lamp 91. When the control key is turned to the dotted line position shown it is withdrawn from the thermostatic member, leaving the latter free and unrestrained, and also opens the circuit at the auxiliary contact 89. The lamp current thereupon passes through the contacts 75 and 73, through the thermostatic member to the spool holder 77 and thence through the heating coil 79 and lamp circuit 81.

In connection with key 87, Fig. 6, it should be observed that same may be turned repeatedly in the same direction to alternately effect the manual circuit closing and thermostatic circuit breaking operations. Thus two separate motions of key 87 are not necessary if it be desired by a single motion simultaneously to turn the switch on and leave the switch subject to thermostatic control automatically to turn it off. This latter mode of operation would be particularly convenient in such uses as a heat action delayed, overload protective switch wherein a single, half-turn of key 87 each time the circuit is automatically broken following a predetermined duration of overload would restore the circuit closed and render the switch operative to automatically act again upon the subsequent occurrence of an overload of designed duration through the resistance 79 thus serving the purpose of protecting the winding of motors and any other purpose served by protective overload circuit breakers.

To facilitate the conduction of heat from the spool holder 77 to the thermostatic member, suitable conductive devices may be employed, such as the spring-finger, heat-conductor herein shown, which consists of a bushing 93 fitting closely the inside of the

spool 77 and carrying a series of resilient, radial fingers 95 which bear lightly against the thermostatic member when the latter is moved to its closed circuit position by the key controller 87. These fingers are adapted to increase the conduction of heat to the thermostatic member, but preferably press against the latter so lightly as to increase by no substantial amount the tendency to reverse its position of flexure which will occur when it has had imparted to it a sufficiently high temperature.

From the foregoing description it will be appreciated that it is only for the particular purposes of the herein illustrated application of my invention, that the automatic heat caused action of the thermostat is made to result from a rise in temperature rather than from a decline in temperature. There are equally useful applications of the present improvements, wherein the cooling of the thermostat instead of its warming, should be made to effect the automatic action. The disposition of the metals of different expansion and the formation given them when they are "cupped" or "dished" in their manufacture will determine this characteristic of action.

While I have herein shown for purposes of illustration one specific embodiment of the invention, it is to be understood that extensive deviations therefrom may be made and various other useful applications thereof utilized, all without departing from the spirit of the invention.

For example, as the thermostat 27 may be responsive to changes in temperature of the air or other medium surrounding same and without depending, of necessity, on a heating unit such as 47 to effect its operative changes in temperature, it will be understood that an electrical application has been selected merely to illustrate a useful purpose that may be served by my improved thermostatic operating mechanism, and that the latter can as readily and without modification outside a mechanic's skill be connected to motivate any device in place of the contact 25 adapted to function by passing back and forth between two different positions as, for instance, a valve for controlling gas or fluids. The following claims will therefore, be interpreted as contemplating and referring to any such useful equivalent of an electric contact in the combinations defined.

Claims.

1. A circuit breaker embodying in combination, a circuit governing contact, means to store up and liberate a force for impelling said contact including a thermostatic plate adapted to impel said contact by passing abruptly from one to the other of two oppositely flexed conditions responsive to change in temperature, and a circuit control handle

arranged to operate said contact by acting mechanically upon said plate.

2. A circuit breaker embodying in combination, a circuit governing contact, means to store up and liberate a force for impelling said contact including a thermostatic plate adapted to impel said contact by passing abruptly from one to the other of two oppositely flexed conditions responsive to change in temperature, a mounting for said plate, and a heating unit carried by said mounting in thermal relation to said plate but mechanically independent of the movement thereof.

3. A circuit breaker embodying in combination, a circuit governing contact, means to store up and liberate a force for impelling said contact including a thermostatic plate adapted to impel said contact by passing abruptly from one to the other of two oppositely flexed conditions responsive to change in temperature, a mounting for said plate, and a winding of electrical resistance wire carried by said mounting in a position to furnish heat to said plate and to be mechanically remote from the movement thereof.

4. A switch for an electric circuit having a switch controller movable to open or close the circuit, and means automatically to provide a time interval between the circuit breaking movement of said controller and the corresponding breaking of the circuit, including a main line contact, a thermostatic member adapted to close the main line contact and form therewith a part of the main line conducting circuit, means controlled by said switch controller to move said thermostatic member to close said circuit, said member being itself capable independent of extraneous influences of retaining the closed circuit position to which it is moved by said switch controller, a heating circuit, and a contact controlled by the switch controller for energizing said heating circuit when said controller is moved to a circuit breaking position, said thermostatic member under the effect of said heating circuit being adapted to move automatically to a circuit breaking position.

5. A switch for an electric circuit having a contact controller movable to open or close the circuit, and automatic means to provide a time interval between the circuit breaking movement of said controller and the corresponding breaking of the circuit, said means comprising a thermodynamic contact impelling member capable of passing quickly from one to the other of two opposite flexed positions dependent on having imparted thereto a critical temperature, and also capable of being moved to a contact making position by said controller and of maintaining said position automatically after being released by said controller until said critical temperature is reached, said means compris-

ing also devices to automatically change the temperature of said member when said contact controller is moved to break the circuit.

6. A switch for an electric circuit having a contact controller, and automatic means to provide a time interval between the movement of said controller and the corresponding circuit change, said means comprising a thermodynamic contact impelling member normally distorted into one or another of two oppositely flexed positions, means carried by said contact controller for moving said member from one flexed position to the opposite position, said member when unrestrained being capable of automatic movement to its oppositely flexed position on having imparted thereto a sufficiently high temperature, and said switch controller when subsequently moved to a further circuit changing position leaving said member free and unrestrained, a heating circuit for heating said member energized by said subsequent movement of said switch controller to provide for said automatic reverse movement of said member, and said heating circuit being also deenergized by said reverse movement of said member.

7. A switch for an electric circuit having a thermodynamically-actuated, contact-impelling member adapted, when unrestrained, automatically through flexure to maintain itself in contact-making position at one temperature and to move itself to contact-opening position at another temperature, but adapted, itself independent of extraneous influences, also to maintain the position to which it may be moved at intermediate temperatures, a switch controller provided with means operable, when said controller is moved to actuate the switch, to move the member to one position, and auxiliary heating means, with means to render the same effective to raise the temperature of the contact-controlling member after an interval of time following the movement of said switch controller to reversely actuate the switch, thereby, when said switch is reversely actuated, a substantial interval of time elapses before the contact-controlling member automatically changes its position.

8. In a flow controller motivating mechanism, in combination a switch controlling thermostat of composite material for motivating said flow controller, a portion of which is confined against free change of shape, thereby setting up internal stresses the magnitude of which change upon changes of temperature, the material being so shaped that change of its shape is a discontinuous function of the temperature in one direction of flexure and no function of temperature in the opposite direction of flexure; and a handle for operating said flow controller connected to cause said material to change its

shape in the direction which is no function of temperature.

9. A flow control actuating mechanism embodying in combination, a buckled thermostatic plate adapted to pass with a snap action from one to the other of its oppositely related stable conditions of flexure, so shaped and conditioned that heat effects may overcome its stability in only one of said conditions of flexure, and mechanical control means to restore said plate to its said one condition of flexure.

10. In a flow controller motivating mechanism, in combination, a bi-metallic sheet of thermostatic metal, the terminal portions of the sheet forcing the intermediate portions normally to remain concave or dished on the side having the higher thermal coefficient of expansion and preventing free expansion of said inner portion when heated, said intermediate portion when heated tending to pass abruptly and automatically to a position of opposite curvature, and passing abruptly and automatically to said position at a predetermined temperature, said sheet being so formed and supported that it will not return to its said normally dished condition upon subsequent changes of temperature, and a handle for operating said flow controller connected to force said inner portion from one to the other of its positions of opposite curvature without temperature change in said thermostatic metal.

11. In a flow controller motivating mechanism, in combination, a composite thermostatic material a part of which is movable for motivating said flow controller, and means for confining at least a portion of said material against free expansion, thereby setting up internal stresses the magnitude of which changes upon changes of temperature, the thermostat reaching a condition of instability when it is heated to a predetermined temperature, the material then abruptly changing its shape due to release of internal stresses theretofore stored up in the material but not again becoming instable upon subsequent cooling, and a handle for operating said flow controller connected to force said material to abruptly assume its original shape independently of temperature change.

12. In a flow controller motivating mechanism, in combination, a thermostat comprising a composite thermostatic sheet having a non-developable depression adapted to change its shape suddenly on reaching a predetermined temperature but not capable of reversing its shape upon subsequent cooling, a working part of said flow controller arranged to be movable by changes of shape of said sheet, and a handle for operating said flow controller and operative to mechanically effect said changes of shape with-

out the medium of temperature change therein.

13. In a flow controller motivating mechanism, in combination, a thermostat comprising a composite thermostatic sheet having at least a part of its surface in the form of a dent of such depth and shape that upon reaching a pre-determined temperature the dent reaches a condition of instability and thereupon suddenly alters its shape due to release of internal stresses caused by rise of temperature but not by subsequent fall of temperature, a working part of said controller arranged to be operable by the change of shape of said dent, and means to change the dent shape without a corresponding change of temperature in said sheet.

14. In a flow controller motivating mechanism, in combination, a thermostat having a composite thermostatic sheet portion and a second portion which is stressed by the expansion or contraction of the first portion with change of temperature and which opposes said expansion or contraction, the first portion when it attains a predetermined temperature tending to pass abruptly and automatically to another shape but not capable of resuming its original shape upon subsequent cooling, a working part of said controller arranged to be movable by the passing of said first portion to another shape, and a handle for operating said controller and arranged to force said first portion to receive its original shape without the medium of temperature change.

In testimony whereof, I have signed my name to this specification.

RAYMOND D. SMITH.