Feb. 16, 1932. D. C. IGOU 1,845,278

THERMOSTATIC SWITCH

Filed March 12, 1930

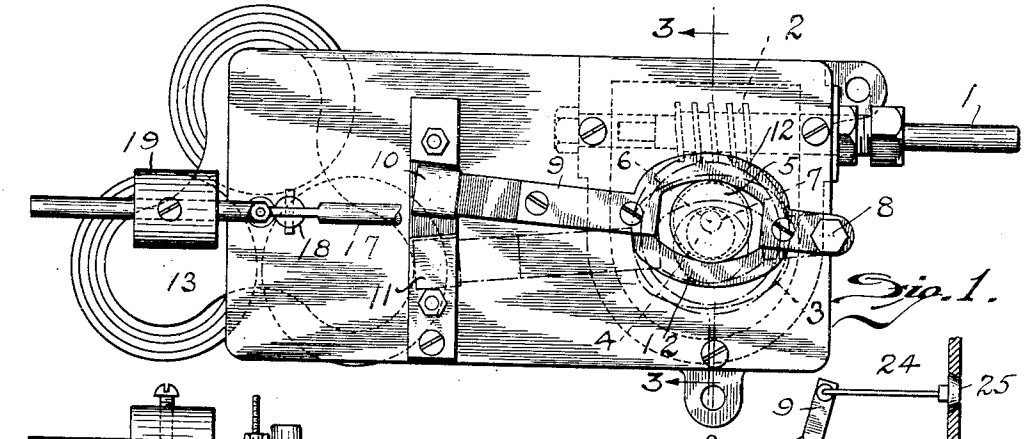


Fig. 1.

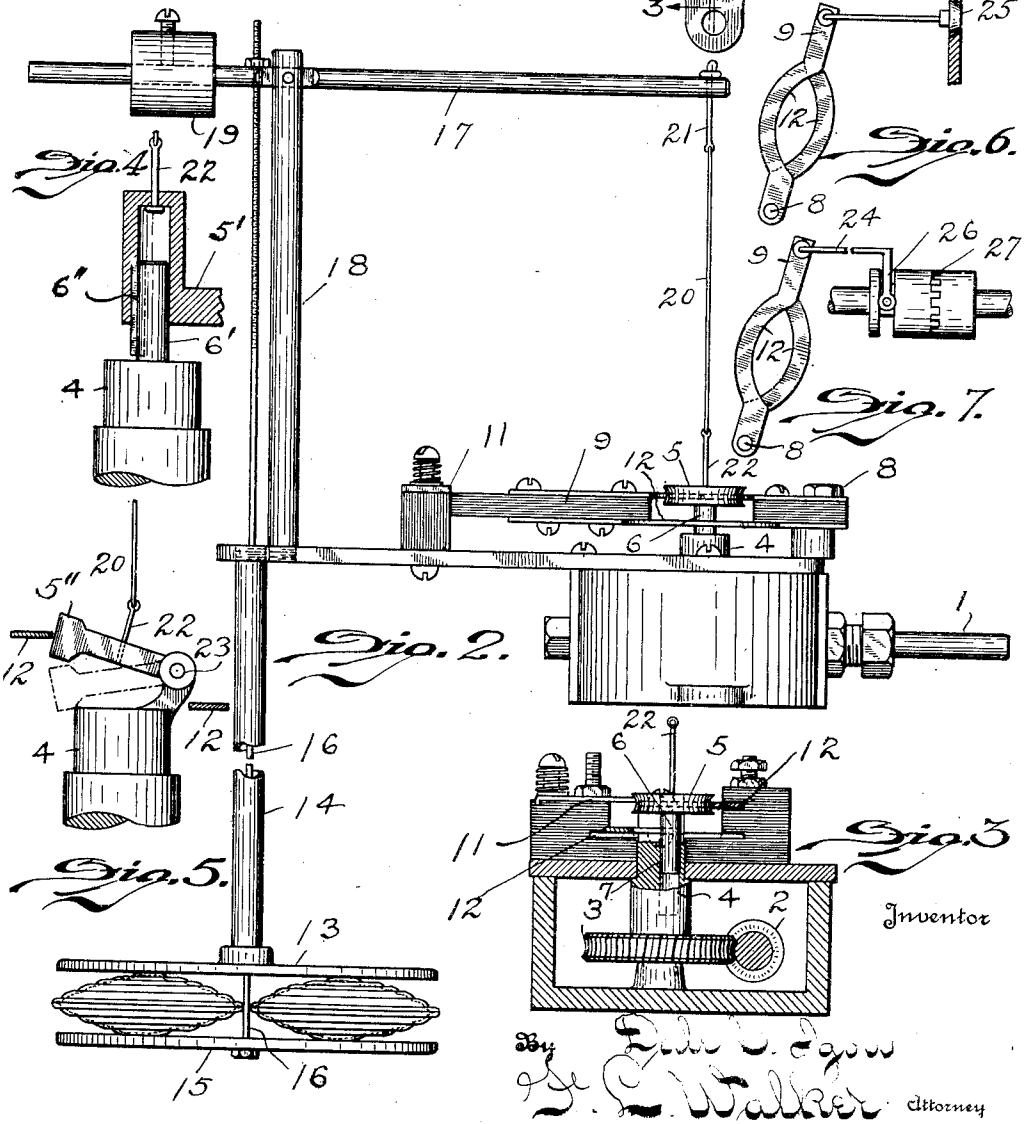


Fig. 2.



Fig. 5.



Fig. 3



Fig. 4



Fig. 6.



Fig. 7.

Inventor

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## THERMOSTATIC SWITCH

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My invention relates to a thermally controlled, automatic reversing mechanism applicable to electric switches, valve or clutch operating means and analogous purposes, and particularly to an apparatus wherein a thermostatic control means is employed for setting the mechanism in condition for operation by other power driven actuating means.

For illustrative purposes, the invention is shown and described in its application to an electric switch to be intermittently opened and closed in accordance with temperature fluctuation. Such automatic switch is especially desirable for controlling the temperature conditions of incubators or for regulating furnaces or heating plants of houses, for controlling ventilating apparatus and the like. In such installations there is ordinarily employed an electric motor or other source of driving power which in the present instance is employed to drive a rotary actuator carrying a cam or tappet. The electric switch arm is pivoted for to and fro oscillatory motion into and out of engagement with its contact. Such switch arm is provided with a yoke extending on opposite sides of the rotary actuator and adapted to be engaged by the cam or tappet during its rotation to shift the yoke and arm first in one direction and then in the other. The contact surfaces upon the yoke to be engaged by the cam or tappet are relatively offset in different parallel planes. The cam or tappet for engagement therewith is movable relative to the yoke and switch arm out of the plane of one contact surface into that of the other and vice versa. Such adjustment of the tappet or cam is effected by a thermostatically controlled mechanism operatively connected with the cam or tappet and adapted to vary the position thereof in accordance with temperature fluctuation, whereby it is moved automatically into and out of operating relation with the yoke of the switch arm.

The object of the invention is to simplify the structure as well as the means and mode of operation of such thermally controlled automatic reversing mechanism whereby it will not only be cheapened in construction but will be more efficient in use, positive in operation, uniform in action, accurately controlled and unlikely to get out of order.

A further object of the invention is to provide such a mechanism having a minimum number of operating parts and in which the motion will be directly transmitted giving definition to the movement of the switch arm or other operated element causing the make and break action of the switch to be fully and quickly effected, thus avoiding any tendency of the contact surfaces to arc and burn and in the case of valve or clutch operating mechanism to effect a full stroke operation.

A further object of the invention is to provide a thormostatic control for a power operated reversing mechanism.

With the above primary and other incidental objects in view, as will more fully appear in the specification, the invention consists of the features of construction, the parts and combinations thereof and the mode of operation or their equivalents as hereinafter described and set forth in the claims.

Referring to the accompanying drawings wherein is shown the preferred, but obviously not necessarily the only form of embodiment of the invention, Fig. 1 is a top plan view of the assembled reversing mechanism forming the subject matter hereof embodied in an automatic electric switch.

Fig. 2 is a side elevation thereof, and Fig. 3 is a transverse sectional view on line 3—3 of Fig. 1.

Figs. 4 and 5 are detail views illustrating modifications of the actuator cam or tappet for shifting the oscillatory lever.

Figs. 6 and 7 are detail views illustrating the application of the reversing mechanism to a valve and to a clutch shifting means respectively.

Like parts are indicated by similar characters of reference throughout the several views.

Referring to the drawings, 1 is the power driving shaft to be connected with an electric motor or any other source of driving power. The shaft 1 carries a worm gear 2 meshing with a worm wheel 3, the shaft 4 of which comprises the actuator and carries an

actuating cam or tappet 5. As illustrated in Figs. 1 to 3, this actuating cam or tappet 5 comprises a disc or roller having a concentric stem or shaft 6 engaged for both revoluble and axial adjustment within an eccentric bore 7 in the shaft 4 of the worm gear. Thus as the worm wheel 3 rotates, the actuating cam or tappet 5 describes a planetary motion about the axis of the actuator shaft 4 and is capable of simultaneous rotation about its own axis.

An oscillatory switch lever 9 is pivoted at 8 and at its opposite end is provided with a contact head 10 for electrical engagement with a complementary contact 11. The switch is closed and opened by the oscillatory movement of the switch arm, thereby bringing the contact head 10 into and out of engagement with the electrical terminal 11. The oscillatory arm is medially enlarged to form a frame or yoke 12 extending on opposite sides of the actuator and so relatively spaced that when one side of such yoke or frame is pushed beyond the field of operation of the actuator tappet by contact therewith, the opposite side of such yoke or frame 12 is projected into the field of operation or path of the actuator tappet or cam 5. The sides of the contact frame or yoke 12 of the oscillatory lever are relatively offset into different parallel planes. When the actuator cam or tappet 5 is poistioned for engagement with one side of the frame or yoke 12 of the oscillatory lever, it will be positioned out of the plane of the opposite side thereof and hence will engage with only one side of the yoke 12 to shift the lever 9 in one direction. When the direction of movement of the lever is to be reversed, the actuator cam or tappet 5 is shifted relative thereto to bring it into the plane of the opposite side of the yoke 12 which at such time has been projected into the field of operation of the actuator tappet or cam by the previous movement of the lever. As the actuator rotates, the tappet or cam engaging with such side of the yoke 12 pushes the yoke out of its path of travel thereby oscillating the lever 9 in reverse direction. This movement of the lever 9 is positively effected under the power driving influence of the shaft 1, thereby effecting a quick and complete make and break engagement of the contact heads 10 and 11.

To automatically shift the actuator tappet or cam 5 from the plane of one side of the yoke 12 to that of the other to effect the movement of the yoke first in one direction and then in the other, a thermostat is provided which may be of any suitable or desirable type. Merely for illustrative purposes and without intent to limit the invention, this thermostat has been shown as of the hollow wafer type consisting of thin flexible metallic containers filled with a volatile material, usually ether and highly susceptible to temperature change. One or more of these thermostatic wafers or expansible and contractible elements are interposed between a relatively fixed head or spider 13 suspended upon a tubular support 14 and a corresponding movable head or spider 15. The latter head or spider 15 is connected by a link or wire 16 with an oscillatory lever 17 pivoted upon a standard 18. This lever 17 carries a counterbalance weight 19 at one side of its pivotal connection, and at its opposite side it is connected by a suspension wire 20 with the actuator cam or tappet 5. The suspension wire 20 is coupled by swivel connections 21 and 22 with the extremity of the lever 17 and with the actuator cam or tappet 5 and affords minimum resistance to the rotation of the cam or disc 5.

As the temperature to which the thermostatic elements are subjected increases, such thermostatic elements expand, thereby exerting a downward pressure upon the movable spider or head 15, placing the connecting link or wire 16 under tension and oscillating the lever 17 to elevate the actuator cam or tappet 5. The actuator continues to rotate, and as the actuator cam or tappet 5 is raised into the plane of the uppermost side of the yoke 12, it engages such yoke during its rotation, and pushing the yoke aside, effects the oscillation of the lever 9. This opens the switch contact between the elements 10 and 11. As the temperature decreases, the thermostatic wafers contract, thereby releasing the tension upon the connecting wire or link 16, permitting the lever 17 to oscillate in the opposite direction and thus lower the actuator cam or tappet 5 out of the plane of the upper side of the yoke 12 into that of the lower side of such yoke, which, extending on the opposite side of the actuator is engaged thereby during its rotation to shift the pivoted lever in reverse direction.

The actuator cam or tappet 5 being provided with a shaft or stem 6 slidable axially within its journal bearing in the actuating shaft 4 is readily adjusted alternately into the planes of the opposite sides of the yoke 12 by the oscillation of the lever 17 under the influence of the thermostatic elements, while maintaining its driving engagement with the actuator shaft 4. In order to reduce friction the actuator cam or tappet 5 is revoluble independently of the carrying shaft 4. Thus during its contact engagement with one side or the other of the yoke 12, it effects a rolling motion.

In lieu of mounting the cam or disc 5 fixedly upon the stem 6, and mounting such stem for revoluble and axial movement within the actuator shaft 4, this relation may be reversed and a stud 6′ may be fixedly mounted in either concentric or eccentric position in the end of the actuator shaft 4 and the tappet 5′ may be

slidably mounted upon said stud 6′ on which it is held against rotation by a key 6″ as is shown in detail in Fig. 4. In such construction the contact cam or tappet 5′ is provided with a hub or sleeve 22 of sufficient length to clear the end of the stud 6′ when the tappet is in its lowermost position. To this extension sleeve or hub is connected the swivel 21 of the suspension wire 19 by which such contact element or tappet is supported upon the oscillatory lever 17 for vertical movement into alternate operating positions.

In Fig. 5 there is shown a further modification wherein the tappet 5″ is hinged at 23 to the top of the revoluble actuator 4 for vertical swinging movement into and out of the planes of the respective sides of the yoke 12. This tappet 5″ is weighted and is suspended upon the wire 19 and swivel connections 21 and 22 in the manner before described. This tappet projects beyond the actuator 4 and in its lowermost position rotates in the plane of the lower side of the yoke 12 engaging such yoke to push the yoke aside and thereby oscillate the main switch arm in one direction. When the tappet 5″ is elevated about its hinge connection 23 by the tilting action of the lever 17 influenced by the thermostatic element, it extends into the plane of the upper side of the yoke 12 and engages therewith to move the yoke and switch arm in the opposite direction. The action and result are the same as before described.

Instead of providing an electrical contact 10 upon the extremity of the arm 9 for engagement with the corresponding electrical terminal 11, such lever 9 may be connected by a link 24 as shown in Fig. 6 with a valve member 25 to open and close the valve. As an alternative construction, such link 24 may be connected to a shift collar 26 having operative engagement with a slidable clutch 27 to move such clutch into and out of driving engagement with its companion member.

The construction is such that the rotary tappet and balance weight carried upon the lever 17 are maintained in an approximate state of equilibrium and subject to the slightest influence of the thermostat which governs the position of the tappet. The result is an extremely sensitive mechanism effecting reversal upon a temperature change of less than one-fourth of a degree of variation. The thermostat is not subject to strain or motive effort in moving the switch or other operated device and therefore meets with little or no resistance. The thermostat merely influences the balance of the lever 17 which by its movement in one direction or the other sets the tappet in position for operation of the lever in one direction or the other. The movement of the device from one position to the other is positively effected by applied power independent of the thermostat which only determines the setting of the tappet in operative position.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific details shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described my invention, I claim:

1. A temperature controlled reversing mechanism including a constantly rotating driving member, a tappet element operatively connected therewith and movable into different planes while maintaining its connection with the driven member, a movable member extending on opposite sides of the tappet element, the portions thereof at opposite sides of the tappet element being disposed in different relatively offset planes, a thermostat and means actuated by the thermostat for shifting the tappet element into and out of the planes of the side portions of the movable member, whereby the said portions are alternately engaged to move said member first in one direction and then in the other.

2. A temperature controlled reversing mechanism including a movable member having an opening therein, the opposite margins of the opening being offset into different planes, an axially movable rotary actuator located within the opening and engageable first with one margin and then with the other thereof to shift the member, and thermostatic means for axially moving the actuator from the plane of one margin into the plane of the other margin of the opening.

3. A temperature controlled reversing mechanism including an actuator roller mounted for rotation about an eccentric axis, movable spaced bearing faces at opposite sides of the roller and relatively offset in different planes, thermostatically controlled means for axially shifting the actuator roller out of the plane of one bearing face and into that of the other for operative engagement therewith whereby the bearing faces will be moved, and a reversible member operatively connected with the contacts.

4. A temperature controlled reversing mechanism including a continuously rotating axially movable actuator, a movable yoke extending on opposite sides of the actuator, the portions of the yoke with which the actuator is engageable at opposite sides of the actuator being located in different planes, and thermostatically controlled means for shifting the actuator out of one such plane and into the other to effect actuation of the yoke first in one direction and then in the other, and a member to be operatively connected with the yoke.

5. A temperature controlled reversing mechanism, a reversible member to be operated, a rotary actuator therefor, reversely disposed spaced contact surfaces upon the reversible member for engagement of the actuator, and thermostatically controlled means for shifting the rotary actuator axially out of operative relation with one of the surfaces and into such relation with the other under influence of temperature change.

6. A temperature controlled reversing mechanism including a reversible element to be operated, a power driven actuator therefor having alternate points of engagement with the reversible element, and thermostatically controlled means for bodily shifting the actuator into operative relation with first one and then the other point of engagement with the reversible member.

7. In a thermostatically controlled switch, a movable switch element having reversely disposed engagement surfaces located in different planes, a rotary actuating element axially movable out of the plane of one surface into that of the other and vice versa, and thermostatically controlled means for automatically shifting the rotary actuating element into operative relation with first one engagement surface and then the other to effect alternating movement of the switch in accordance with fluctuations of temperature.

8. In a thermostatically controlled switch, a movable switch member, an actuating cam therefor axially movable into engagement with the switch member in each of two alternate positions to operate the switch member in alternate directions, and thermostatically operated means for shifting the actuating cam relative to the switch.

9. In a thermostatically controlled switch, a movable switch element, a constantly rotating actuator therefor, and thermostatically controlled means for shifting the actuator in an axial direction relative to the switch member with which it engages in alternate positions to operate the switch first in one direction and then in the other.

10. In a thermostatically controlled switch, a switch member movable alternately into open and closed positions, an adjustable rotary actuator therefor adapted when in one operative position to move the switch member in one direction and when shifted to an alternate operative position adapted to move the switch in reverse direction, and thermostatically operated means for shifting the actuator to alternate operative positions.

11. In a temperature controlled apparatus, a rotating driving member, an actuating element operatively connected therewith and movable into different planes of operation while maintaining its driving connection with said driving member, a movable member to be actuated, and thermostatic means for moving the actuator into and out of the plane of said movable member to be actuated for engagement therewith.

12. In a temperature controlled reversing mechanism, a pivoted arm mounted for to and fro oscillatory motion, said arm having a medially disposed opening therein, the opposite margins of which are relatively offset into different planes, a rotary drive shaft, an actuator member carried by the drive shaft and movable relative thereto into and out of the planes of the opposite margins of said arm opening, an oscillatory lever, a suspension link connecting the oscillatory lever and said actuator, and a thermostat connected with said lever for actuating the lever to shift the actuator out of the plane of one margin of the arm opening and into that of the opposite margin.

13. A temperature controlled mechanism including a movable member to be actuated, an adjustable rotary actuator therefor across the field of operation of which the movable member extends, and thermostatically controlled means for shifting the actuator into and out of the plane of the movable member with which the actuator contacts to move the said member out of the field of operation of the actuator.

14. In an apparatus of the character described, a switch member movable into and out of closed position, a continuously traveling actuator therefor operating in different parallel planes and movable relative to the switch member into and out of the plane of operation thereof, and thermostatically controlled means for shifting the actuator into and out of the plane of the switch member.

15. In a construction of the character described, the combination with a reversible member, of a power driven actuator therefor including a rotary tappet capable of axial adjustment independently of its rotary motion, and a thermostatic governor for axially shifting the tappet into different planes of operation in one of which it is operative to move the reversible member in one direction and in the other of which it is operative to move the reversible member in the opposite direction.

16. In a construction of the character described, the combination with a reversible member, of a power driven actuator there-

for including a rotary tappet capable of axial adjustment independently of its rotary motion, a balanced support for the tappet and a thermostat connected with the balanced support to disturb the balance thereof to effect a change of position of the tappet in an axial direction into different planes of operation in which it is operative to move the reversible member in alternate directions.

17. In a construction of the character described, a rotary tappet capable of adjustment in an axial direction independently of its rotary motion, a movable yoke extending on opposite sides of the tappet, the sides of the yoke being disposed in different planes, and a thermostatic governor for shifting the tappet in an axial direction out of the plane of one side of the yoke and into that of the other for operative engagement with first one side and then the other side thereof to move the yoke in alternating directions.

18. The combination with a mechanism to be actuated, of a rotary actuating cam therefor, said cam being adjustable in an axial direction into alternative positions of operation simultaneously with its rotation, and governor means for automatically adjusting the cam.

19. The combination with a reversible member to be actuated of an actuator therefor operable in different planes of movement, in one of which it engages with the reversible member to move it in one direction and in the other of which it engages therewith to move said member in the opposite direction, and thermostatically controlled means for automatically shifting the actuator from one plane of operation into the other.

20. The combination with an electric switch movable into on and off positions, of a traveling operator therefor capable of bodily movement from one operative position to another, in one of which it operates the switch into on position and in the other of which it operates the switch to off position, and automatically controlled means for bodily shifting the traveling operator from one operative position to the other.

21. The combination with a swinging lever, of a constantly rotating cam, said cam being axially movable from one plane of rotation into another, contact surfaces on said swinging lever in different planes corresponding with the planes of rotation of the cam, said cam operatively engaging with one contact surface when in the corresponding plane to move the lever in one direction and operatively engaging the other contact surface when in the corresponding plane to move the lever in reverse direction and actuating means for shifting the cam axially from one plane to the other.

In testimony whereof, I have hereunto set my hand this 1st day of March, A. D. 1930.

DALE C. IGOU.