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HEAT SENSITIVE SWITCH

2,211,700

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Fig. 1

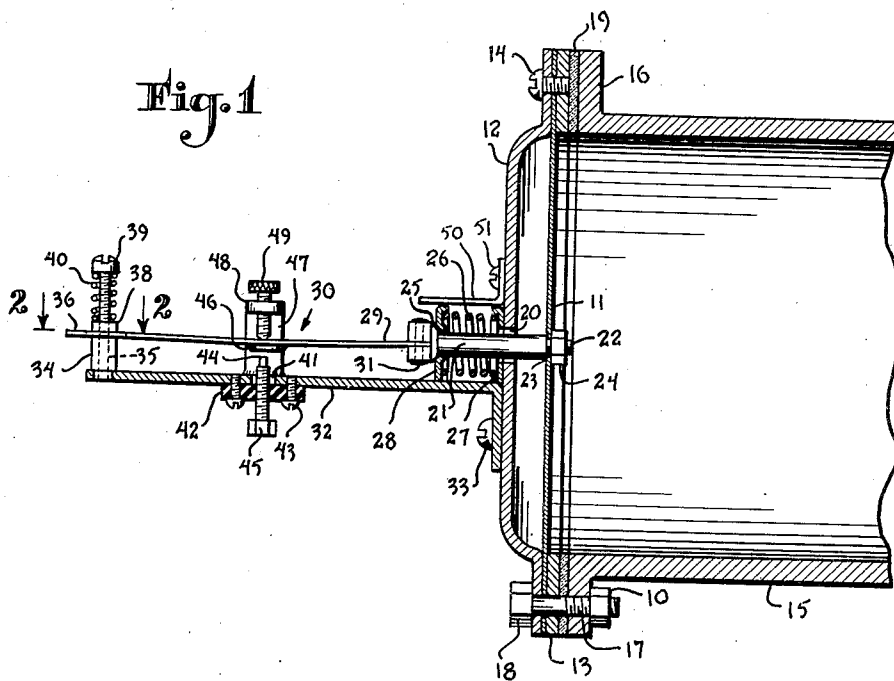


Fig. 2

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## UNITED STATES PATENT OFFICE

2,211,700

## HEAT SENSITIVE SWITCH

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13 Claims. (Cl. 200—137)

This invention relates to the art of thermo-  
static switches, and more particularly to that type  
of thermostatic switch which is adapted to re-  
spond to radiant heat. Switches of this type  
are shown for example in the Cunningham Pat-  
ents 1,163,094 and 1,765,056.

Particularly in the automatic control of an oil  
burner it is desirable to provide a switch which  
will close as soon as combustion occurs and open  
as soon as the flame is extinguished. In order to  
produce such a function it is obvious that the  
switch must operate independently of any definite  
temperature value and respond only to a reversal  
of temperature change over that which caused  
the last switch actuation. It is a further re-  
quisite that the switch be very sensitive to any  
movement of the temperature responsive device.

It is a prime object of this invention to pro-  
vide a switch which will fulfill the above require-  
ments.

A further object is to provide a heat responsive  
device which buckles a member by applying an  
endwise pressure upon it.

A further object is to provide a device of the  
type set forth in the preceding paragraph where-  
in the buckling member is a leaf spring and car-  
ries a switch contact at an intermediate point.

A still further object is to provide a frictional  
mounting for one end of said spring so that  
the switch will be actuated upon a change in  
the direction of movement of the heat responsive  
device.

A still further object is to provide a means for  
adjusting the amount of friction afforded by said  
frictional mounting and adjustable stops for  
limiting the buckling movement of the leaf spring.

Another object of this invention is to provide  
a switch of the above type in which a relative  
movement will occur between the contacts after  
they are made, which will aid in keeping them  
clean.

Although this switch is particularly adapted  
for use in connection with an oil burner control,  
it will readily be understood that it may also be  
used in various other types of systems.

These and other objects will readily become  
apparent as the following specification is read in  
the light of the accompanying drawing, in which

Figure 1 is a cross-section of a device em-  
bodying my invention, and

Figure 2 is a view of one of the details of con-  
struction.

The present switch mechanism is adapted to  
be actuated by means of a metallic diaphragm  
11 which closes the end of a cup-shaped mem-

ber 12. A washer 13 of a soft metal lies adjacent  
the diaphragm 11 and the three members are  
secured together by means of screws, one of  
which is shown at 14. An elongated tube 15 is  
provided with a flange 16 which has a series of  
holes, one of which is shown at 17, through which  
bolts 18 are inserted to clamp an annular piece  
of heat insulating material 19 between the flange  
16 and the washer 13 by means of nuts 10. The  
cup-shaped member 12 is provided with a hole  
20 through which is inserted a connecting rod  
21 which has a reduced end portion 22 which is  
screw-threaded and inserted through a small hole  
23 in the center of the diaphragm 11. The con-  
necting rod 21 is secured to the diaphragm by  
means of a nut 24 threaded on the screw-threads  
22. The connecting rod 21 is provided at its op-  
posite end with an enlarged head 25. A com-  
pression spring 26 surrounds a portion of the  
connecting rod 21 and is confined by two spring  
retainers 27 and 28, 27 lying adjacent the cup-  
shaped member 12 and 28 lying against the  
head 25.

The head 25 is connected to one end 29 of a  
flat leaf spring 30 by means of a pin 31. A  
bracket 32 is secured to the member 12 by means  
of screws 33 and at its distant end supports an  
upstanding sleeve 34 by means of a suitable rigid  
connection. The sleeve 34 has a longitudinal hole  
35 therethrough which is screw-threaded for a  
purpose to be later described. The other end 36  
of the leaf spring 30 is provided with an elongated  
slot 37 as shown in Figure 2, which registers  
with the hole 35 in the sleeve 34. Supported  
on the upper face of the end 36 of the leaf spring  
is a washer 38 and a screw 39 is inserted down-  
wardly through the washer and the slot 37 and  
is screw-threaded in the hole 35 in the sleeve 34.  
The screw 39 confines between its head and the  
washer 38 a compression spring 40. Adjustment  
of the screw 39 in the hole 35 will vary the force  
exerted by the spring 40 on the washer 38, there-  
by varying the force with which the washer 38  
bears against the end 36 of the spring 30. The  
purpose of this arrangement is to provide an ad-  
justment of the resistance to movement of the  
end 36 of the spring 30 by the washer 38 and  
sleeve 34.

The bracket 32 is provided with a hole 41 about  
which is attached a piece of insulating material  
42 by means of screws 43. A stationary contact  
44 is mounted on a screw 45 which is adjustably  
threaded to the insulating material 42 and whose  
stem is smaller in diameter than the hole 41  
so that the contact will be electrically insulated

from the bracket 32. Suitably fastened to the lower face of the spring 30 is a movable contact 46. The bracket 32 is provided with an upstanding arm 47 having a horizontally extending portion 48 through which is adjustably threaded a stop member 49. It will be noted that the stop 49 is so adjusted that the leaf spring 30 can never assume a straight position so that when the diaphragm 11 moves toward the left the spring is bound to buckle so that the movable contact 46 will be moved in a downward direction. It will be noted also that the compression spring 26 so biases the diaphragm 11 that as it expands it will always move toward the left.

The tube 15 is adapted to be positioned in the wall of a furnace, for example, so that the diaphragm 11 will look directly toward a source of radiant heat such as the flame produced by an oil burner. In order that the diaphragm shall be more sensitive to such heat radiations the surface which looks toward the source is blackened.

In Figure 1 the parts are shown in their cold position. Assume now that the source of radiant heat towards which the diaphragm 11 faces increases in temperature so that the diaphragm will absorb an additional amount of heat. This will cause the diaphragm to expand but as the periphery of the diaphragm is prevented from moving the center must buckle and due to the bias of the spring 26 this buckling will move the connecting rod 21 toward the left. The spring retainer 28 moves with the rod 21 and is guided by the bracket 32 and a bracket 50 which is connected to cup 12 by means of screws 51. The spring 40 has been so adjusted as to resist the movement of the end 36 of the spring 30 toward the left so that as the connecting rod 21 moves toward the left the spring 30 will buckle near its center and cause the movable contact 46 to engage the stationary contact 44. This will prevent spring 30 from buckling further and any further movement of the connecting rod to the left will be accommodated by the end 36 of the spring 30 slipping between the sleeve 34 and washer 38 as permitted by means of the elongated slot 37. As long as the diaphragm 11 does not decrease in temperature, the contacts 44 and 46 will remain in engagement, but as soon as the source of radiant heat decreases in temperature the diaphragm 11 will immediately start to move towards the right, causing the connecting rod 21 to pull the end 29 of the spring 30 towards the right. The immediate effect of this movement will be to straighten the spring 30, which will cause an upward movement of the movable contact 46, which movement will continue until the stop 49 is engaged. Further movement of the connecting rod 21 toward the right caused by continued cooling of the diaphragm 11 will now cause the end 36 of the spring 30 to move toward the right by slipping between the sleeve 34 and the washer 38 by means of the elongated slot 37. This returns the parts to the position shown in Figure 1 where they will be ready to repeat the above cycle indefinitely.

From the above it will be seen that the present switch will function to control the circuit not in response to the attainment of any particular temperature value but rather immediately upon the occurrence of a change in temperature in a direction opposite to that which caused the last switch operation. It will also be seen that a decided mechanical advantage is obtained, causing the movable contact 46 to move a relatively large distance in response to

a relatively small movement of the diaphragm 11. This mechanical advantage is of course due to the buckling of the spring 30.

This switch could very easily be made into one which would open the contacts on temperature rise by merely reversing the position of the stop 49 and the stationary contact 45. The screw 39 is very easily and readily capable of adjustment for varying the amount of friction imposed by spring 40 upon the movement of the end 36 of the spring 30 so that it may be adjusted with respect to the type of spring used.

Certain other changes and modifications of this invention may readily occur to those skilled in this art and it is therefore to be understood that I intend to be limited not by the specific embodiment disclosed but rather by the scope of the appended claims.

I claim as my invention:

1. In a device of the character described, an operating member, means for supporting one end of said member and frictionally resisting movement thereof, and a condition responsive device for applying a longitudinal pressure to the opposite end of said member to cause it to first bend laterally and then move longitudinally.

2. In a device of the character described, an operating member, means for supporting one end of said member and frictionally resisting movement thereof, a condition responsive device for applying a longitudinal pressure to the opposite end of said member to cause it to first bend laterally at an intermediate portion and then move longitudinally, and stops for limiting the amount of said lateral movement, one of said stops preventing said member from assuming a straight position after said longitudinal pressure is removed.

3. In a device of the character described, an operating member, means for supporting one end of said member and resisting movement thereof, a condition responsive device for applying a longitudinal pressure to the opposite end of said member to cause it to buckle thereby causing a lateral movement of an intermediate portion, stops for limiting the amount of said lateral movement, one of said stops preventing said member from assuming a straight position after said longitudinal pressure is removed, said means permitting longitudinal movement of said member after it has engaged one of its stops, and control means operated by said intermediate portion.

4. In a device of the character described, an elongated leaf spring, frictional mounting means for one end of said spring, stops on opposite sides of an intermediate portion of said spring, a heat responsive device for applying a longitudinal pressure to the other end of said spring on a variation of the heat in one direction to cause said spring to buckle and move said intermediate portion from engagement with one stop into engagement with the other, further movement of said heat responsive device being permitted by said one end of said spring slipping in said frictional mounting, and means for first moving said intermediate portion into engagement with said one stop and then causing slippage of said one end of said spring in said frictional mounting means upon a reversal in movement of said heat responsive device.

5. In a device of the character described, an elongated leaf spring, frictional mounting means for one end of said spring, stops on opposite sides of an intermediate portion of said spring, a heat

responsive device for applying a longitudinal pressure to the other end of said spring on a variation of the heat in one direction to cause said spring to buckle and move said intermediate portion from engagement with one stop into engagement with the other, further movement of said heat responsive device being permitted by said one end of said spring slipping in said frictional mounting, means for first moving said intermediate portion into engagement with said one stop and then causing slippage of said one end of said spring in said frictional mounting means upon a reversal in movement of said heat responsive device, and an electrical contact carried by said intermediate portion of said spring, one of said stops being adjustable and providing a stationary electrical contact.

6. In a device of the character described, an elongated leaf spring, frictional mounting means for one end of said spring, stops on opposite sides of an intermediate portion of said spring, a heat responsive device for applying a longitudinal pressure to the other end of said spring on a variation of the heat in one direction to cause said spring to buckle and move said intermediate portion from engagement with one stop into engagement with the other, further movement of said heat responsive device being permitted by said one end of said spring slipping in said frictional mounting, means for first moving said intermediate portion into engagement with said one stop and then causing slippage of said one end of said spring in said frictional mounting means upon a reversal in movement of said heat responsive device, and means for varying the amount of friction produced by said frictional mounting.

7. A control device of the character described, comprising in combination, a leaf spring, means for supporting one end of said spring, means resisting longitudinal movement of said one end of said spring, condition responsive means for alternately moving the other end of said spring toward and away from said one end, causing said spring to alternately bow in the middle and straighten out, and a stop for limiting the amount said spring can bow, said resisting means permitting said one end to move longitudinally in one direction after said stop has limited the bowing of said spring, and in the other direction after said spring has been straightened out.

8. In combination, a condition responsive device, a leaf spring having one end attached thereto, a support for the other end, spring means normally resisting but being capable of permitting longitudinal movement of said other end, and stops to limit the movement of the center portion of said spring, whereby said leaf spring first moves laterally to engage one of said stops and then moves longitudinally.

9. In a device of the character described, an

elongated leaf spring, a condition responsive device connected to one end of said spring for causing longitudinal movement thereof, a support for the other end of said leaf spring, means for normally resisting but being capable of permitting longitudinal movement of said other end of said leaf spring including an adjustable spring, adjustable stop means cooperating with an intermediate portion of said leaf spring for keeping it at least partially bowed, a movable contact carried by said intermediate portion, and a stationary contact for cooperation with said movable contact, said stationary contact also limiting the amount which said leaf spring can bow under the influence of said condition responsive device.

10. In a device of the character described, a metallic diaphragm for receiving radiant heat from a source, means for fixing the periphery of said diaphragm, an elongated operating member, means connecting the center of said diaphragm to one end of said member, means biasing said diaphragm for movement toward said member, means for frictionally resisting movement of the other end of said member, means for adjustably limiting the lateral movement of an intermediate portion of said member, and control means operated by said intermediate portion.

11. In a device of the character described, a heat sensitive diaphragm, a movable contact, a stationary contact, and means operated by said diaphragm for actuating said contacts substantially immediately upon reversal of movement of said diaphragm, said means comprising an elongated leaf spring connected at one end to said diaphragm and frictionally mounted at its other end.

12. In a device of the character described comprising in combination, a circuit controlling member, a device for exerting a longitudinal force on said member in response to variations in the value of a variable condition, and friction means for first causing said member to move laterally and perform its circuit controlling function in response to a change in said condition value and thereafter permit longitudinal movement of said member upon further variations of said condition value.

13. In a device of the class described, a flexible circuit controlling member both ends of which are confined against lateral movement, a condition responsive device for placing a longitudinal force on said member to cause it to bend in the middle in response to variations in the value of said condition, means limiting the amount which said member can bend and slip friction means permitting further movement of said condition responsive device after the lateral movement of said member has been stopped.

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