

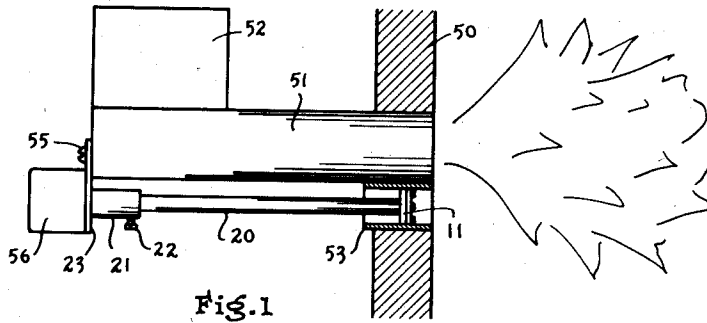
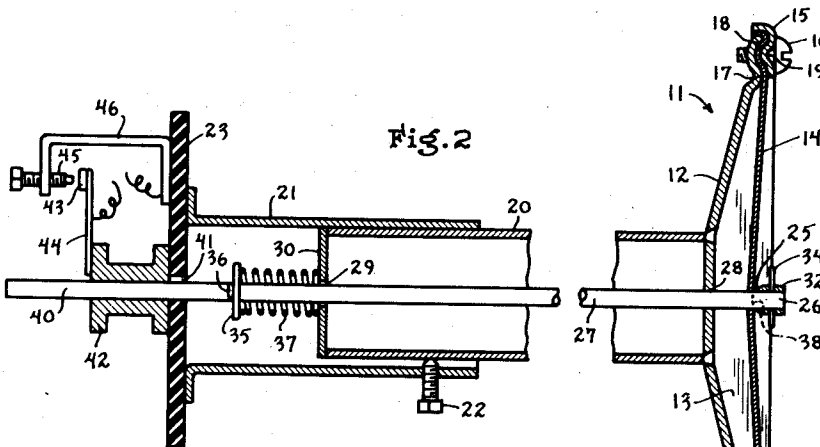
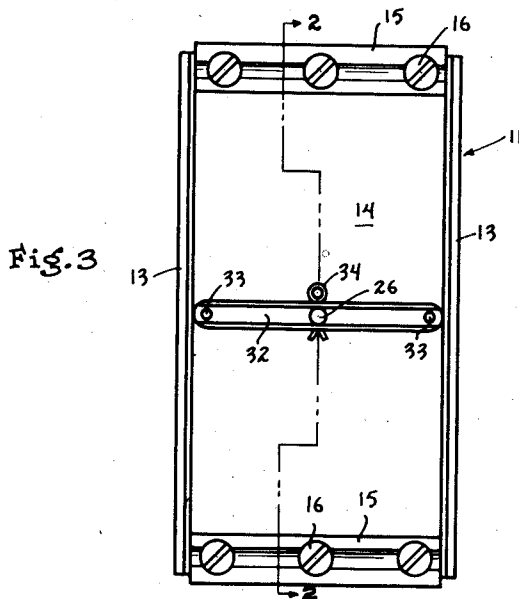
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RADIANT HEAT RESPONSIVE DEVICE

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RADIANT HEAT RESPONSIVE DEVICE

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3 Claims. (Cl. 200-137)

This invention relates broadly to heat sensitive devices and more particularly to devices responsive to radiant heat and which are adapted to respond to the appearance and disappearance of combustion in a furnace.

One of the main objects of this invention is to improve prior art devices of this general type and particularly the devices shown in the Lewis L. Cunningham Patents 1,763,093, 1,763,094, and 1,765,056.

Another object of this invention is to provide a radiant heat responsive device of the metallic diaphragm type wherein the diaphragm is mounted in an open ended substantially rectangular support and substantially closes the opening therethrough. The purpose of making the diaphragm rectangular instead of circular as in the last two Cunningham patents mentioned above, is to reduce the stress set up in the diaphragm as it bends upon expanding. The rectangular diaphragm bends on only one line whereas the circular diaphragm assumes a conical shape which sets up stresses in the diaphragm.

Another object of the invention is to provide a radiant heat responsive device of the rectangular diaphragm type in which the diaphragm is stretched across supports having rounded edges so that the diaphragm will be supported evenly and will not wrinkle.

A further object is to provide a bearing member which biases the diaphragm for bending in one direction and which extends transversely across the diaphragm so as to exert an even pull on the diaphragm throughout its width.

A still further object is to provide a device of the above type which tends to compensate itself against a reverse movement of the diaphragm due to expansion of the support as it heats up.

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 plan view of an oil burner showing a typical mounting for a device incorporating the present invention,

Figure 2 is a section taken along the line 2-2 of Figure 3, and

Figure 3 is a front elevation showing the rectangular diaphragm and biasing member.

Referring first to Figures 2 and 3, the reference numeral 11 generally indicates a supporting member which has a generally concave rear portion 12 and straight sides 13. A rectangular elongated expansive metal strip 14 is stretched

across the open end of the supporting member 11 and is clamped by means of the clamps 15 and the screws 16 against the rounded surfaces 17 of the supporting member 11. Preferably the support 11 should be formed of a metal having a lower temperature coefficient of expansion than the diaphragm 14. The metal should have a reasonably uniform expansion curve throughout the temperature range for which this instrument is designed. The ends of the supporting member 11 are provided with depressions 18 in which the complementary projections 19 on the clamping members 15 are adapted to seat in order to firmly clamp the ends of the diaphragm 14. It will be noted with reference to Figure 3 that the clamps 15 are of the same width as the diaphragm 14 so that the ends of the diaphragm will be securely and evenly clamped against the supporting member 11 thereby preventing the diaphragm from forming wrinkles.

Connected to the back 12 of the supporting member 11 is a rearwardly extending tube 20 which is adjustably supported in the sleeve 21 by means of the screw 22. The sleeve 21 is in turn connected to the bracket 23.

The diaphragm 14 is provided with a central hole 25 through which extends one end 26 of an actuating rod 27 which extends rearwardly through a hole 28 in the support 11 and also through a hole 29 in a guide plate 30 suitably connected to the open end of the tube 20. Connected to the end 26 of the actuating rod 27 is a bearing member 32 which extends transversely across the diaphragm 14 and is riveted thereto as indicated at 33. A pin 34 extends through the bearing member and actuating rod 27 to connect them for movement together. A washer 35 is retained on the actuating rod 27 by means of the pin 36 and a compression spring 37 is retained around the actuating rod 27 between the guide plate 30 and the washer 35. This spring biases the actuating rod 27 for movement toward the left as seen in Figure 2 and hence holds the bearing member 32 against the diaphragm 14 tending to cause it to bend toward the left. It will be noted that the bearing member 32 has a rounded surface indicated in dotted lines in Figure 2 as shown at 38 and that this bearing member extends the entire width of the diaphragm 14 thereby exerting an even force on all portions of the diaphragm so that the tension will be uniform throughout.

The inner end 40 of the actuating rod 27 extends through a hole 41 in the bracket 23 and carries a member 42 which has a slip frictional

engagement with the rod. The member 42 carries a movable contact 43 by means of the blade 44, and as the rod goes toward the left it is adapted to engage the electrical contact 45 which is adjustably positioned in the conducting bracket 46 mounted on the bracket 23.

In Figure 1 is shown one manner in which the device just described may be mounted. A section of the wall of a furnace is shown at 50 in which is mounted the conventional type of gun oil burner 51 having a motor 52. Mounted in the furnace wall 50 along side of the burner 51 is a sleeve 53 into which the support 11 snugly fits. It will be seen that the bracket 23 is secured to the rear of the burner 51 by some suitable means such as the screw 55 and that a cover 56 is placed over the switching mechanism shown in Figure 2. The tube 20 is adjustable within the sleeve 21 by means of the screw 22 so that the support 11 may be moved back and forth within the sleeve 53 as desired.

When the oil burner is in operation the flame will be so located that the radiant heat therefrom will pass directly to the outer surface of the diaphragm 14 indicated in Figure 1 and this surface is blackened in order that it may more readily absorb this radiant heat and therefore be more sensitive.

When the parts are in their cold position as indicated in Figure 2, the diaphragm 14 will be straight or very nearly straight. The reason for this is that with the diaphragm straight a predetermined expansion will cause a much greater relative movement of the actuating rod 27 than if the diaphragm were bent considerably to the left. When combustion is obtained the radiant heat will be absorbed by the diaphragm 14 thereby raising its temperature. It will be noted that the diaphragm 14 protects practically all of the support 11 from the radiant heat and therefore the support will remain cool for a longer period than the diaphragm 14. Thus as the diaphragm first starts to heat the center of the diaphragm which is spaced from the support will increase rapidly in temperature whereas the ends of the diaphragm which are directly in contact with the support will remain at the same temperature as the support. There is therefore a temperature gradient from the center of the diaphragm to its ends with the result that the center of the diaphragm will expand considerably and the ends will remain substantially the same. This will result in an elongation of the diaphragm and due to the bias of the spring 37 the actuating rod 27 will move toward the left carrying with it the slip friction element 42 which will cause the contacts 43 and 45 to move into engagement with each other. Any further movement of the actuating rod 27 toward the left will be taken care of by the slip friction connection between the rod and the element 42. As the radiant heat from the fire continues to be absorbed by diaphragm 14, the support 11 will start to heat up and as a result will expand although to a slighter degree than the diaphragm 14 because it is of a lower expansion metal. As the support increases in temperature, the diaphragm as a whole and particularly the ends thereof will also increase in temperature and therefore the diaphragm will expand further at the same time that the support expands. It will be clear that expansion of the support will move the clamps 15 further apart which will tend to cause the diaphragm 14 to straighten which would of course move the actuating rod 27 toward the right. This is obviously

an undesirable function. To offset this, the ends of the diaphragm 14, and to some extent the center portion, will expand which will tend to move the actuating rod toward the left. In this manner it is seen that the effect of the heating up of the support is compensated by the further heating up of the diaphragm 14 and the resultant effect upon the actuating rod 27 is a further small movement to the left as seen in Figure 2. In other words, as combustion is obtained in the furnace the initial heating of the center of the diaphragm 14 moves the actuating rod to the left to close the switch contacts 43 and 44 and the continued heating of the diaphragm and the support 11 will have substantially no further effect upon the movement of the rod 27 other than causing a slight further movement toward the left.

When the operation of the oil burner is stopped, the amount of heat radiated to the diaphragm 14 will be greatly reduced and its temperature will immediately begin to decrease. The center of the diaphragm will first begin to cool and the ends of the diaphragm will remain hot for a while due to the heat storage capacity of the support which maintains them at a relatively high temperature. The reduction in temperature of the center of the diaphragm causes the diaphragm to contract in length and hence straighten and pull the actuating rod 27 toward the right which will return the slip friction element 42 to the position shown in Figure 2 and open the switch contacts 43 and 45. On continued cooling of the device, the support 11 will decrease in temperature, contract, and hence the clamps 15 will move closer together. This would tend to move the actuating rod to the left again but this effect is compensated for by the cooling of the ends of the diaphragm 14 which causes it to contract and maintain the diaphragm in its straightened position.

It will be noted that in this device the diaphragm 14 substantially closes the open end of the support 11 thereby reducing the possibility of hot gases flowing past the diaphragm and out into the room as the furnace pressure builds up when combustion is first obtained and also preventing the cool air from the room flowing past the diaphragm and into the furnace as the furnace pressure is reduced on continued operation of the oil burner. The flow of these gases past the diaphragm would obviously materially affect its operation and render the device unsatisfactory for the purpose for which it is intended.

Another advantage of this device is that the diaphragm is rectangular in shape and supported at its two opposite ends. On expansion the diaphragm need only bend about a single line which extends transversely across the center of the diaphragm. In the case of circular diaphragms stresses are set up within the diaphragm itself as it expands due to the fact that it must bend about a number of different lines as it takes the form of a cone upon expansion. As a result, the rectangular diaphragm is capable of doing a great deal more work than a circular diaphragm of comparable size.

As certain changes and modifications in this invention may occur to those who are skilled in the art, it is to be understood that I intend to be limited by the scope of the appended claims rather than by the specific embodiment disclosed.

I claim as my invention:

1. A temperature responsive device comprising a support including a pair of corrugated bearing

surfaces, an elongated substantially rectangular sheet of expansible metal stretched across said surfaces, screw means extending through said metal sheet for clamping it so that it is held in firm engagement with said corrugated surfaces, 5 an elongated bearing member separate from and extending transversely across said metal sheet at a point intermediate its length, said bearing member having a rounded surface which engages said metal sheet, and means exerting a force on 10 said bearing member whereby said metal sheet will always bend in the same direction upon an increase in temperature.

2. A temperature responsive device comprising in combination, relatively non-expansible supporting means providing a pair of spaced, rounded, supporting surfaces, a relatively expansible metallic ribbon stretched across said surfaces whereby said ribbon is free to bend in the middle on changes in temperature, a hole in 15 said ribbon at an intermediate point, an actuating member extending through said hole, an elongated bearing member disconnected from and extending transversely across said ribbon and connected to said actuating member, and means 20 biasing said actuating member in a direction to hold said bearing member into forcible engagement with said ribbon.

3. A radiant heat responsive device comprising in combination, a relatively low expansion metallic support, an elongated sheet of relatively expansible metal, the ends of said metal sheet being in heat conductive relation with and carried by 5 said support, means for mounting said support so that said metal sheet may absorb radiant heat from a source of heat, said metal sheet at least partially shielding said support from direct radiations from said source of radiant heat, activation 10 of said source of radiant heat first causing the mid portion of said metal sheet to heat up and expand, the ends of said metal sheet remaining at substantially the same temperature as said support due to their heat conductive relation 15 therewith, and means to bias the mid portion of said metal sheet for movement in one direction as it expands, continued radiation of heat from said source increasing the temperature of said support 20 and the ends of said metal sheets at substantially the same rate whereby the resultant expansion of the ends of said metal sheet tends to compensate for the expansion of said support thereby preventing a reversal of movement of the mid 25 portion of said metal sheet upon continued heating of said sheet and support.

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