April 18, 1939. F. M. COWAN ET AL 2,155,344

TEMPERATURE-RESPONSIVE CONTROL SYSTEM

Filed Sept. 17, 1937

Fig. 2.

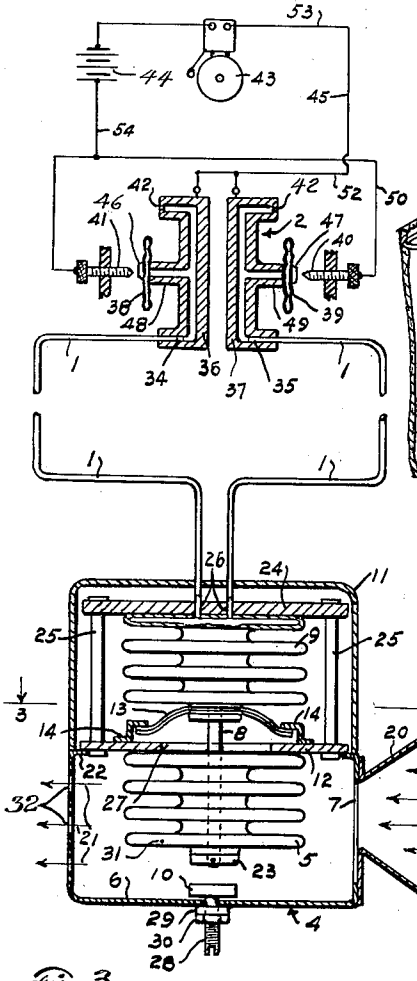


Fig. 1.

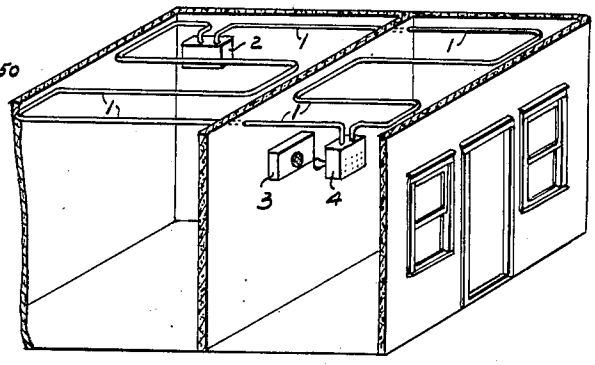


Fig. 4.

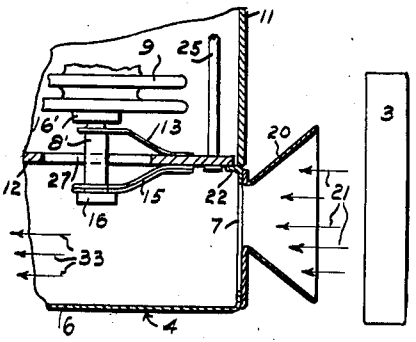
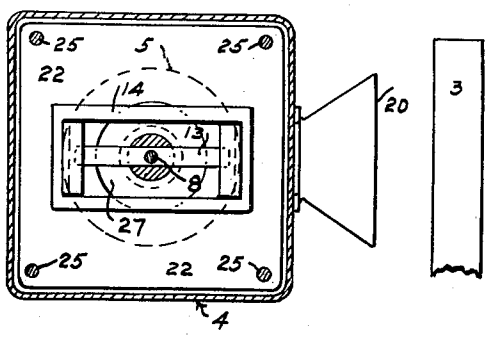


Fig. 3.



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TEMPERATURE-RESPONSIVE CONTROL SYSTEM

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10 Claims. (Cl. 177—355)

This invention relates to temperature-responsive alarm or control systems responsive to fire conditions and more particularly to systems of this character which are sufficiently sensitive to be affected by ordinary fluctuations of temperature in the enclosure where the temperature-responsive apparatus is located.

In certain installations of this character, for example for the protection of rooms or enclosures where unit heaters or blower heater systems are employed, difficulty has been experienced in preventing false alarms because of the rapid rise of temperature produced by this type of heating system in the area adjacent the temperature-responsive apparatus.

Heretofore this difficulty has been obviated by decreasing the sensitivity of the temperature-responsive apparatus, for instance, by increasing the spacing of the electrical contacts in the aero-tube system. This reduces the effectiveness of the system to a considerable extent and is therefore undesirable.

It has also been proposed to obviate this difficulty with respect to the production of false alarms by disabling the alarm system for a considerable period or until the general rise in temperature has abated, such a system being disclosed in the patent to Field No. 976,645, granted November 22, 1910. Such systems are also disadvantageous because of the fact that the alarm system is entirely inoperative for said period and no active protection during such period is provided.

It is an object of the present invention to provide neutralizing or compensating means responsive to the unit heater or other normal heating source which is associated with the temperature-responsive system in such a manner that the fire alarm or control apparatus is substantially unaffected by the temperature changes initiated by the heater or other normal heating source. The compensating device may be arranged to be unaffected by fire or other abnormal conditions so that full protection is secured against such conditions.

Another object of the invention is to provide compensating means for a temperature-responsive system having a fixed rate of rise characteristic whereby the system will be responsive at all times to a rise in temperature produced by the occurrence of fire, irrespective of normal fluctuations of room temperature of sufficient magnitude to operate the temperature-responsive system.

Another object of the invention is to provide means, in an aero-tube system wherein an increase of pressure results from a fire, for decreasing the pressure in one part of the aero-tube system upon the occurrence of a rise in temperature from normal heating conditions that might cause a rise in pressure in the system sufficient to produce a false alarm.

A further object of the invention is to provide means, in connection with a fire alarm system of the character described, for compensating the response of the system when a unit heater, or heaters, are turned on to an extent corresponding to the heating effect produced by said heater or heaters.

A still further object of the invention is to provide means, in connection with a fire alarm system having temperature-responsive means, comprising a length of tubing, for controlling the pressure or volume of the air within the tubing upon the occurrence of sudden normal heating changes to compensate therefor without rendering the system unresponsive, at any period, to fire or other abnormal temperature conditions.

A still further object of the invention is to provide in a system of the character described, compensating means in connection with the aero tube system which obviates the formation of a pressure surge upon the air within the system when the blower heater is turned off, or the supply of heat discontinued, thus to prevent a false alarm.

Other objects and advantages of the invention will appear from the following description of the preferred embodiments thereof shown in the accompanying drawing, wherein

Fig. 1 is a view, in perspective, of an installation embodying the invention and illustrating the relationship of the compensating device for the fire alarm system and a unit heater for heating the enclosure in which the thermo-sensitive apparatus is located;

Fig. 2 is an enlarged detail view, partially in section, of the compensating device shown in Fig. 1;

Fig. 3 is a cross-section taken on line 3—3 of Fig. 2, looking in the direction of the arrows; and

Fig. 4 is an enlarged, fragmentary view, partially in section, of a modification of a compensator.

In accordance with the present invention, the thermo-sensitive part of the fire alarm or control system, for example, the pressure tubing of the aero-tube system, is provided with an alarm preventing compensating means in installations

where normal sources of heat, such as unit heaters, are likely to affect the response of the fire alarm system and in some cases to cause false alarms. The compensating device is preferably arranged adjacent to the unit heater or other normal source of heat and within the heated stream of air and is shielded at least to some extent from changes in surrounding atmospheric temperature changes so that it will not be directly affected by a fire in the enclosure. In the case of the aero-tube system, the compensating unit is arranged to suck sufficient air from the tubing circuit, preferably at about the center of that part of the tubing circuit affected by the unit heater, to reduce the pressure by an amount equivalent to the atmospheric temperature increase due to the operation of the unit heater.

The operation of the compensating device may be effected by a thermo-responsive element exposed to the heat from the unit heater whereby the operation of the compensating device corresponds to any desired extent with the time and magnitude of the temperature change produced by the unit heater. In this manner the pressure developed in the tubing may be precisely counterbalanced by the operation of the compensating device so that the response of the fire alarm or control system and the operativeness of the system are not affected, but on the other hand the system is adapted to respond, at all times, under any of its internal conditions to a fire in the enclosure.

It will be evident that this system posseses outstanding advantages over prior systems in which the sensitivity of the fire alarm system was reduced, or in which the system was rendered wholly inoperative during the period when the pressure surge in the tubing was caused by the unit heater or other source.

If more than one unit heater is employed, additional compensating units may be connected to the tubing circuit in a manner to compensate for the operation of each additional individual heater.

In accordance with the specific embodiment shown on the accompanying drawing for the purpose of diagrammatically illustrating the invention, the system may comprise aero-tubing 1 arranged in the enclosure or space to be protected. It will be understood that the term "enclosure" shall not be limited to mean a room or building but shall include any space or area which is either partially or completely hemmed in by walls, floors or other barriers and which may be suitable for or require a fire protection system of the kind to be described herein. In Fig. 1 this space may include a plurality of connecting rooms and the tubing 1 may be located at the ceilings of the respective rooms. The tubing may be arranged and supported in any usual manner and is shown as forming a loop or circuit connected at the ends to a detector unit 2 having pressure operated electrical contacts and vents to permit passage of air slowly into or out of the tubing to compensate for normal variations of temperature such as take place between night and day or seasonal variations, the vents serving to restrict the air emission and discharge from the tubing sufficiently so that pressure surges cannot be rapidly released. Thus whenever a fire condition occurs in the enclosure, the resulting increase in temperature in the fire area quickly produces an increased air pressure within the tubing beyond the normal discharge capacity of the vents, whereby the alarm or control contacts are operated, as will be described hereinafter.

In Fig. 1, a unit blower heater 3 is shown mounted in one of the rooms, usually hung from the ceiling, to represent diagrammatically a source of heat which is likely to cause false alarms in the ordinary fire alarm system. In order to neutralize or compensate the effect of the heater unit 3 upon the tubing 1, an aero tube pressure neutralizing or compensating unit 4 is disposed adjacent the heater unit 3 and connected in circuit with the tubing 1. The neutralizing device 4 is located in the aero tube system which at a remote location is connected to a detector unit 2 and is preferably arranged directly in the path of the hot air stream from the heater 3 but is shielded from atmospheric temperature changes and further will not be materially affected by a rise in temperature in the enclosure resulting from an actual fire.

The operation of the system is as follows; When the unit heater 3 operates, a relatively rapid rise in room temperature occurs which produces an increase in pressure in the system 1 just as in the case of the occurrence of a fire. However, the neutralizing unit 4 is connected to the system 1, preferably in the middle of the length of tubing which is most affected by the unit heater 3 and is operated by the heat received from the unit heater. The device 4 is arranged, when operated by heat from the heater 3, to suck a volume of air from the tubing 1 in order to reduce the pressure in the tubing by an amount equivalent to the increase in pressure resulting from the operation of the heater. The operation of the neutralizing or compensating unit 4 is retarded since it is responsive only to the heating effect of the heater 3.

It does not operate at the instant the heater is turned on but may coincide both in time and in effect to the time and magnitude of the pressure surge in the tubing 1. It is unnecessary to have an exact neutralization or compensation of the pressure surge in the system, inasmuch as the usual vents in the alarm device 2 will take care of any slight accumulation of pressure in the tubing. Thus it will be seen that by the use of compensating unit 4 not only is the fire detecting system guarded against false alarms but the setting or sensitivity of the system is practically unchanged by the operation of the heater 3 so that the system may be adjusted to maximum sensitivity to fire at all times. From this it is obvious that the system is in operative condition at all times, even during compensation periods, to supervise the protected premises and cause an alarm during fire conditions. The heater 3 is merely illustrative of various sources of heat such as forges, baking ovens, or furnaces which are able to cause extreme and rapidly changing heat condition.

Furthermore, if there are a number of such sources of heat, a corresponding number of neutralizing units may be provided in the aero tube system to prevent false operation of the alarm system, each neutralizing unit 4 being connected to the portion of the tubing which is affected by said heat source.

There is, diagrammatically disclosed in Fig. 2, a preferred embodiment of a neutralizing or compensating unit, connected into an aero tube alarm circuit in connection with a blower heater unit which comprises an outer protective casing comprising an enclosing lower shell 6 and an upper heat insulating enclosing shell 11 superposed on

the base shell or housing 6 and there held by suitable means, not shown. The shell 6 is provided with an inlet opening 7 which is surrounded by an open-ended funnel member 20 which is located adjacent the heat emission or discharge opening in the heater unit 3, shown in Fig. 1, thereby to receive and direct some of the heated stream from the blower heater into the interior of the shell 6, as indicated by the arrows 21, which stream passes out at the apertures 32 at the rear thereof.

The casing 6—11 is divided into two chambers, vertically as viewed in Fig. 2, by a heat insulating baffle plate 12 which is suitably affixed to a flanged extension 22 which surrounds the upper edge of shell 6. Upper shell 11 may be of a material to thermally insulate bellows 9 from atmospheric temperatures.

To the underface of baffle plate 12 is fixedly located a sylphon bellows 5 which is provided with a small vent 31. At the bottom thereof is attached a collar 23 to which is suitably pinned an interiorly mounted vertical shaft 8 which is connected at its opposite, upper end to the lower end of a second sylphon bellows 9 which is thermally insulated and is mounted in the upper shell 11. The upper sylphon bellows 9 also sealed and is firmly attached at its upper end to the underface of a support plate 24 which in turn is supported on four corner posts 25, Figs. 2 and 3, which are fixedly mounted in baffle plate 12. As thus described, when heat strikes lower bellows 5, it expands and this action expands the upper bellows 9. The aero tubing, as seen in Fig. 2, has its ends connected into the support plate through shell 11 and is thus connected into the interior of the sealed bellows 9. Thus, when bellows 5 expands through the agency of heat from the blower heater unit 3, it draws bellows 9 downwardly by means of the shaft 8 which passes through an aperture 27 in the support plate 12 and upon such downward action of bellows 9, air is drawn from the interior of the tube system 1. This extraction of air from the tube system 1 counteracts the expansion of air in said tube system which is caused by the heat from the heater blower 3.

Means are provided to limit the expansion movement of the initiating sylphon bellows 5 this means comprising a stop plug 10, which has a slotted threaded stem 28, the plug portion 10 being located within the shell 6 adjacent the collar 23, the stem 28 extending exteriorly of the bottom of shell 6 which is bored therefor. Shell 6 at the bored portion is provided with an affixed threaded nut 29 with which stem 28 engages, and a lock nut 30 engages on said stem 28 and is jammed against nut 29 to lock the plug in any adjusted position in which it may be set to control the expansion action of the bellows 5 to any desired degree. In adjusting the plug 10, the nut 30 is loosened and a screw driver is entered in the slot of stem 28, Fig. 2, and the stem is then rotated for position and again locked by nut 30.

As a means for preventing the belows 9 from suddenly collapsing and creating an alarm initiating pressure surge in the aero tube circuit 1 after a prolonged actuation of the heater unit 3, the bellows 9 at its point of connection to shaft 8 is provided with a bimetallic thermostatic metal strip 13 which is firmly connected thereto, Figs. 2 and 3. The ends of the strip 13 are downwardly bent, Fig. 2, and engage under the upper flanged edge of the rectangularly conformed flanged holder 14 which is suitably affixed to the upper face of the baffle plate 12, Figs. 2 and 3, and frames the aperture 27, Fig. 3.

When the heat from the unit 3 is of prolonged duration and is suddenly stopped, the strip 13, which has become heated through aperture 27, is straightened out slightly and locks bellows 9 in expanded position. As this apparatus slowly cools, the strip 13 gradually assumes its normal position and gradually returns the extracted air into the aero tube system, thus restoring normal conditions therein. As the tube system and bellows are gradually restored to normal, air is slowly readmitted into the bellows 5, from atmosphere, through the vent 31 therein.

The aero tube circuit and alarm means, shown in Fig. 2 more or less diagrammatically and in partial section, are of a well known type and will now be briefly described.

The two opposite ends of the aero tube system 1 are each connected to one of the two connections 36 and 37 of an alarm device, generally denoted by 2, Fig. 2, at 34 and 35.

The alarm device 2 comprises two separate, chambered members 36 and 37. The upper opposite portions of the members 36 and 37 are provided with the usual atmospheric vents 42—42, whereby normal breathing of the air in the aero system is permitted to normally vary under normal atmospheric temperature changes.

The members 36 and 37 are provided with open ended tubular extensions 48 and 49, respectively, and the open ends are each closed by a double expansion diaphragm 38 and 39. These diaphragms are provided at their outer faces with electrical contacts 46 and 47. Opposite to the contacts 46 and 47 and adjustably spaced therefrom are suitably supported adjustable contact screws 40 and 41. When a fire initiated surge takes place in the system the diaphragms expand, thus to close with contact points 40 and 41 and thereby close and operate the electrical alarm circuit, now to be described.

The electrical alarm circuit comprises an electrical current source 44, Fig. 2, and an audible alarm 43. These are connected by wiring 45, 52, 53 and 54. Wiring 52 is connected to the two chambered members 36 and 37. Wire 54 is also connected to contact point 41. Wiring 52 is connected to wire 54. Wiring 50 is connected between contact point 40 and wiring 54.

The alternate form of thermo-sensitive apparatus is shown in Fig. 4, in which like parts bear the same indices as shown in Figs. 1, 2 and 3. Only fragments of the coacting parts are shown. This embodiment comprises a housing 6—11, the baffle support 12 located on flange 22 therein, the support uprights 25, the inlet funnel 20 at the aperture 7 and the heater unit 3.

The baffle 12 has an aperture therein in which is mounted a reciprocatory stud 8' which is provided with spaced shoulders 16 and 16' on opposite ends thereof, one end, 16, being located in the chamber of shell 6, the other shoulder 16' being located in the chamber of shell 11. An offset spring 13, preferably of flat metal, is affixed to baffle 12 on its top surface at one end, the free elevated end thereof being caught beneath the shoulder 16' and thereby tending to keep the stud in normally upward position.

On the under surface of baffle 12 is firmly affixed an offset bimetallic thermostatic strip 15 at one of its ends, the free offset end thereof being operatively connected to the upper surface of the shoulder 16.

The upper end of lug 16' is firmly attached to a cylphon bellows 9 which is located above the stud 8' and is operatively mounted and functions as described for upper bellows 9, of Fig. 2.

In operation, in conjunction with a heated air stream passing through the lower chamber 6, and as shown by the arrows 21—33, from the heater unit 3, the strip 15 tends to draw the stud 8' and with it the attached upper bellows and this action extracts air from the aero system 1, as described for Figs. 1 and 2. This action also stresses the spring 13 downwardly.

When the blower heater unit 3 ceases operation, the strip 15 gradually becomes cooler and under the uplift action of spring 13, the extraction sylphon gradually restores the air back into the aero tube system without surging.

The blower heater system herein briefly described in its standard embodiment, is provided with thermostatic controls which, when the atmospheric temperatures drop, initiate the operation of the heater until predetermined temperatures are reached, whereupon the thermostat ceases operation. The thermostatic controls are well known and are not herein shown but are understood.

From the foregoing it will be noted that the neutralizing or compensating means acts as a full time monitor for the aero-tube system and that it controls the air pressures in said system against all tendency to initiate any alarms except alarm conditions set up by a fire within the enclosure said monitoring control supervising the aero-tube system under and during any and all air conditions within the tube, including conditions of sudden surge in the aero-tube due to fire conditions. It also monitors the aero-tube system during a drop in pressure within said tube system to prevent vacuum surges therein and this is all accomplished without any disablement of the constant supervisory alarm initiating means.

It will be obvious from the foregoing that modifications may be made in the structure herein disclosed without departing from the spirit hereof or the appended claims.

It will further be noted that the apparatus herein disclosed is not limited to alarm systems but may be used in connection with other apparatus for other purposes.

We claim:

1. In combination, an enclosure, temperature-responsive means arranged to supervise the temperaure changes in said enclosure and to operate upon the occurrence of a predetermined rise in temperature therein, means responsive to said temperature-responsive means, heating means in said enclosure affecting the temperature-responsive means when the heating means is turned on and off, and compensating means associated with said temperature-responsive means and arranged to be affected by said heating means in a manner to counterbalance the response of said temperature-responsive means, to substantially eliminate the effect of the heating means thereon, upon a rise in temperature in the enclosure from the operation of the heating means.

2. In combination, an enclosure, temperature-responsive means arranged to supervise the temperature changes in said enclosure and to operate upon the occurrence of a predetermined rise in temperature therein, means responsive to said temperature responsive means and compensating means associated with said temperature responsive means and arranged to be affected by normal temperature changes in the enclosure to counterbalance the response of the temperature-responsive means, during changes in temperature which may be expected in point of intensity but unexpected in point of time, whereby the latter will operate substantially uniformly at all times on the occurrence of temperature changes resulting from fire or other abnormal conditions.

3. In combination, an enclosure, temperature-responsive means including an aero-tube system arranged to supervise temperature changes in said enclosure and to operate upon a predetermined increase in the pressure in said aero-tube system means responsive to said temperature responsive means and a compensating pressure controlling device connected to said aero-tube system and arranged to be affected by normal heating conditions in the enclosure whereby the pressure changes in the aero-tube system are substantially unaffected by such conditions.

4. In combination, an enclosure, heating means for said enclosure, temperature-responsive means including an aero-tube and alarm system arranged to supervise fluctuating temperature changes in said enclosure and system and to operate said alarm upon a predetermined increase in pressure in said aero-tube system and compensating means connected to said aero-tube system arranged to decrease pressure variations therein resulting from temperature changes caused by said heating means, said last-named means comprising means to extract air from the aero-tube system operated by heat from said heating means, and means to gradually restore air to said aero-tube system to its normal atmospheric pressures, when the heating means is turned off.

5. In combination with an aero-tube alarm system, a blower heater adjacent to said system comprising a casing, said casing having inlet and outlet apertures therein, a thermo-sensitive means in said casing in line with said apertures adapted to change its condition when heat from the blower heater is passed through said apertures and air extractive means connected to said aero-tube system and operable by said thermo-sensitive means whereby when the latter changes its condition, the extractive means gradually extracts air from said aero-tube system.

6. In combination with an aero tube alarm system, a blower heater adjacent to said system comprising a casing, said casing having inlet and outlet apertures therein, a thermo-sensitive means in said casing in line with said apertures adapted to change its condition, when heat from the blower heater is passed through said apertures, air extractive means connected to said aero-tube system and operable by said thermo-sensitive means whereby when the latter changes its condition the extractive means gradually extracts air from said aero-tube system and a second thermo-sensitive means associated with said first thermo-sensitive and said air extractive means adapted to slowly change its condition to gradually restore air to said aero-tube system to normal atmospheric condition.

7. In combination with an aero-tube alarm system, a blower heater adjacent to said system comprising a casing, said casing having inlet and outlet apertures therein, a thermo-sensitive means in said casing in line with said apertures adapted to change its condition, when heat from the blower heater is passed through said apertures, or turned off and air controlling means connected to said aero-tube system and operable

by said thermo-sensitive means whereby when the latter changes its condition the air controlling means gradually extracts or restores air from or to said aero-tube system.

8. In combination, temperature-responsive means arranged to supervise atmospheric temperature changes and to operate upon the occurrence of a predetermined change in atmospheric temperature, atmospheric heating means affecting the temperature-responsive means when the heating means is turned on and off and compensating means associated with said temperature-responsive means and arranged to be affected by said heating means in a manner to counterbalance the response of said temperature-responsive means, to modify the effect of the heating means thereon, upon a rise in temperature in the atmosphere caused by the operation of the heating means.

9. In combination, an enclosure, temperature responsive means arranged to supervise temperature changes in said enclosure, heating means capable of causing response by said temperature responsive means, means responsive at all times to said temperature responsive means upon the occurrence of temperature variations resulting from fire conditions or other abnormal conditions and compensating means for preventing response by said means responsive to said temperature responsive means during temperature changes resulting from the action of said heating means.

10. In combination, an enclosure, heating means therein, temperature responsive means having a portion thereof directly exposed to said heating means and arranged to supervise temperature changes in said enclosure, means responsive to said temperature responsive means during all changes of temperature resulting from fire conditions or other abnormal conditions and compensating means associated with said temperature responsive means for preventing operation of said means responsive to said temperature responsive means during all normal changes of temperature.

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