Jan. 6, 1959 G. KOSLOW 2,867,703

PHOTOTHERMIC RELAY AND CONTROL SYSTEM

Filed March 25, 1957 2 Sheets-Sheet 1

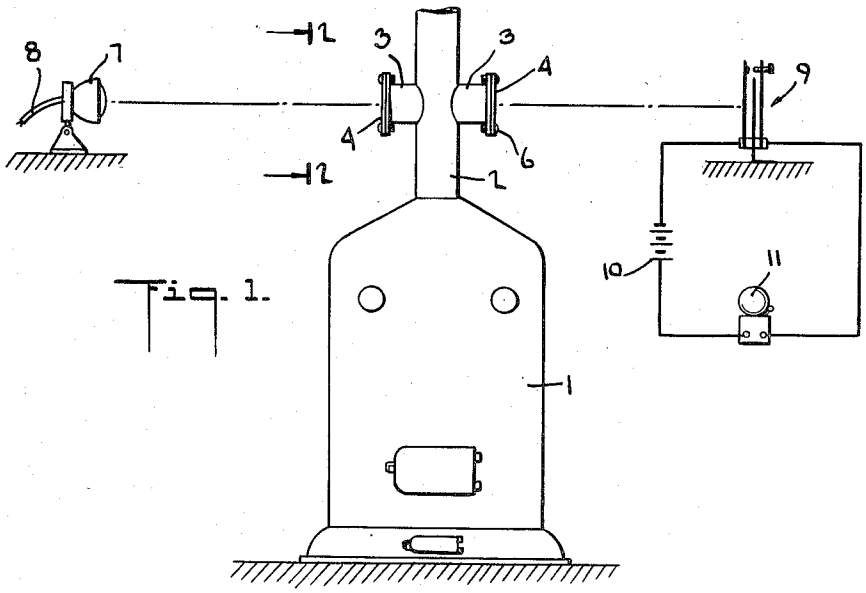
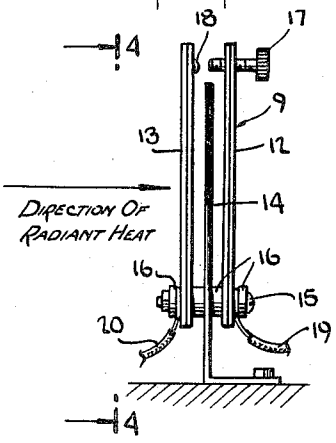


Fig. 1.

Fig. 3.



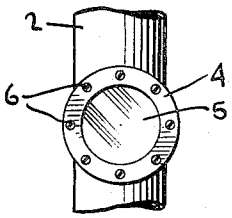
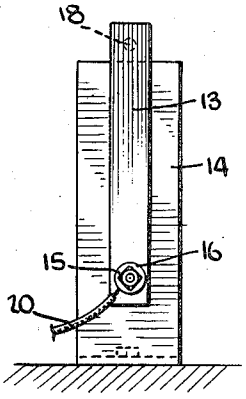


Fig. 2.

Fig. 4.



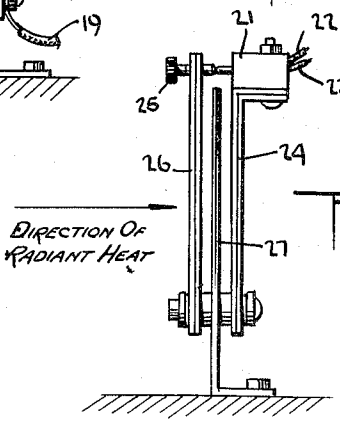


Fig. 5.

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PHOTOTHERMIC RELAY AND CONTROL SYSTEM

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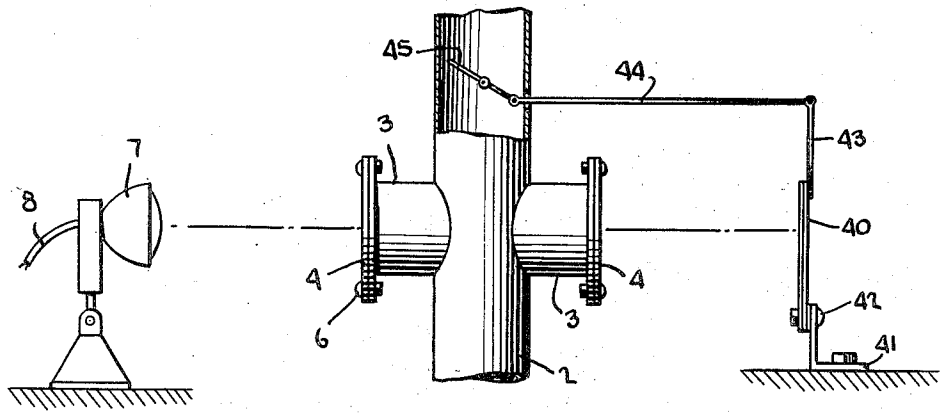


Fig. 7.

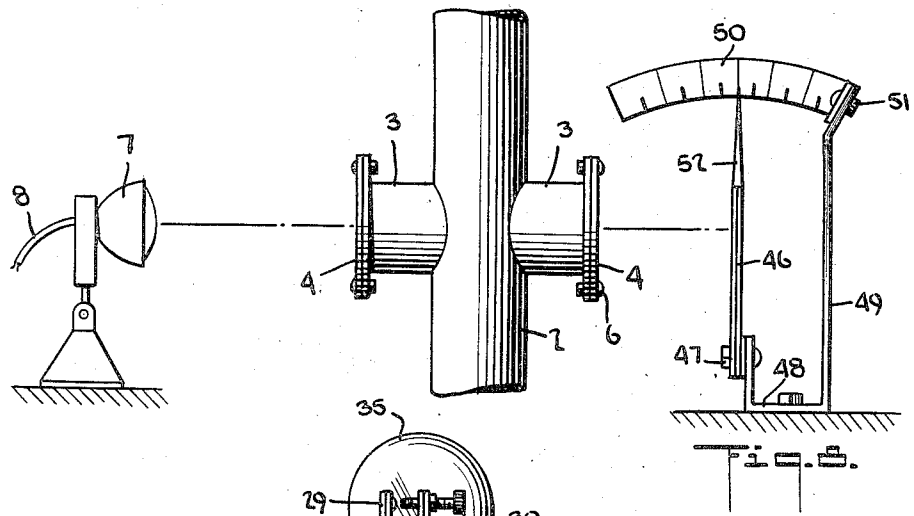


Fig. 8.

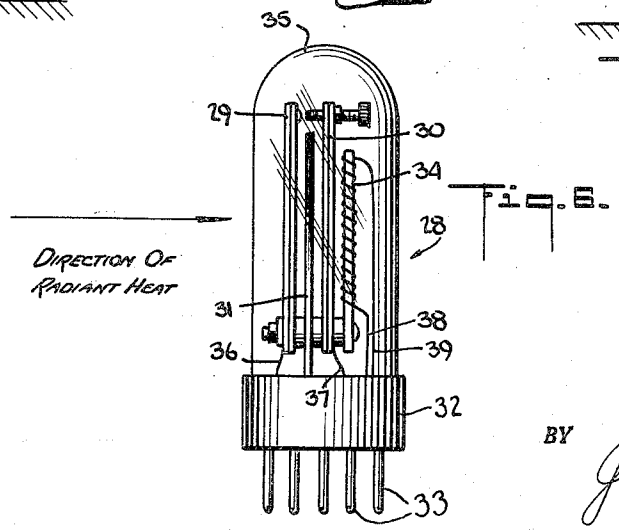


Fig. 6.

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PHOTOTHERMIC RELAY AND CONTROL SYSTEM

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6 Claims. (Cl. 200—138)

This invention relates to a thermally actuated apparatus which may be utilized for system control and alarm purposes and has particular application in those situations where time delay in actuating the mechanism is not an important factor or where such time delay is desired.

The apparatus of the present invention employs a conventional heat detector or sensing element toward which is directed a source of high fixed intensity radiant energy whereby under normal conditions the apparatus is inoperative, but upon total or partial interruption of said radiation for sufficient time the heat sensing element operates to actuate an electric switch, set off an alarm, or otherwise relay or record the detected interruption of radiant energy, or mechanically operate a suitable control device. For example, the detector may be of the uni- or bimetallic type in which case, if desired, the metallic element may be arranged to operate as an inverse thermoswitch under the foregoing conditions whereby to break an electric circuit and shut down an electrically operated mechanism.

One such arrangement is in connection with a conveyor system wherein the interruption of the radiant energy for a preselected length of time by the jamming up of conveyed objects actuates an alarm or shuts down the conveyor system, or both.

Another use, as illustrated in the accompanying drawings, is as a smoke alarm or control system for oil and coal burners wherein the emitted smoke in the breech, stack or flue interrupts or absorbs the radiant energy and accordingly actuates a bimetallic switch, damper or indicator. In such cases, the delayed response of the present apparatus is desirable in that such delay prevents false signals, as when smoke is temporarily given off upon starting up an oil burner or adding fresh coal or fuel to a furnace. This arrangement can be used to signal or indicate malfunction of the furnace, improper combustion, fuel waste, and, more importantly, a violation of laws respecting smoke control and air pollution. In the last-mentioned application, the apparatus may be arranged to automatically shut down an oil burner as well as ring an alarm if smoking persists beyond the legal limit.

The nature of the invention and its advantages will be more readily understood from the following description of several embodiments thereof with reference to the accompanying drawings wherein:

Fig. 1 is a diagrammatic view of one form of the invention arranged in connection with a smoke alarm system for a coal fired furnace;

Fig. 2 is an enlarged elevation of the smoke stack of the furnace of Fig. 1, taken on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged elevation of the bimetallic switch of Fig. 1 as used with the present invention;

Fig. 4 is a side view of the switch taken on the line 4—4 of Fig. 3;

Fig. 5 is an elevation of another type of bimetallic relay embodying a microswitch.

Fig. 6 is an elevation of still another type of bimetallic relay embodying a heating element for line voltage correction;

Fig. 7 is a diagrammatic view, partly in section, of the invention arranged in connection with a smoke damper control system; and

Fig. 8 is a diagrammatic view of the invention arranged in connection with a smoke indicator or meter.

In the drawing, 1 represents a conventional coal fired furnace having the usual flue or smoke stack 2. The stack 2 is provided with a pair of transverse, axially alined, flanged tubular extensions or openings 3. A companion flange 4 having a plate glass window 5 is secured or mounted on each extension 3 by any suitable means such as bolt and nut assemblies 6. This arrangement provides a transparent transverse opening in the stack 2 for a purpose to be described hereinafter. In cases where forced or mechanical draft systems are not used, windowed companion flanges 4 may be omitted.

A conventional electric reflector spot lamp 7, connected by cable 8 to a source of current (not shown), is so mounted that its light beam is directed through the transverse openings 3 of the furnace stack 2 toward a radiant heat detector such as the bimetallic switch or relay 9 connected in series with a battery 10 which provides the operating voltage for an alarm bell 11. In this particular arrangement, the contacts of the bimetallic switch remain open as long as the spot lamp 7 is lit and the light beam is not interrupted by smoke. Since the source of radiant energy is of fixed intensity, it is obvious that barring interruption of the path between the lamp 7 and bimetallic switch 9, the contacts of the latter will remain open thus rendering the alarm circuit inoperative. However, should the furnace begin to emit smoke through its stack 2, said smoke will create a relatively opaque or dense medium in the path of the radiant heat, thereby absorbing a portion of said radiant energy and resulting in a drop in temperature at the bimetallic switch 9. This will cause the switch contacts to close and energize the alarm circuit. The switch 9 is so constructed that there is an appreciable time delay during the interruption of the radiant energy directed thereto before the contacts are closed, thereby insuring that the alarm will be actuated only upon a prolonged smoking condition of the furnace. This obviates the possibility of setting off the alarm during the brief period of smoke emission which often ensues upon stoking the furnace.

Referring to Figs. 3 and 4, there is shown one form of bimetallic switch or relay usable with the present invention. The switch comprises a pair of bimetallic plates or elements 12 and 13, each being composed of two thin strips of metal having disparate thermal coefficients. The plates are supported at their lower ends from a bracket 14 by means of a bolt and nut assembly 15, said bolt and nut being suitably insulated from the metal members of the switch 9 by any suitable means, such as an insulating sleeve (not shown). Spacing and insulating washers 16 insulate the elements from one another and from the support bracket 14. Switch element 12 is provided with an adjustable screw type contact 17, and element 13 is provided with a contact bead 18. The lower ends of the elements 12 and 13 are provided with leads 19 and 20 respectively, for connection to the alarm circuit or other circuit to be controlled.

The bracket 14 extends upwardly between the switch elements 12 and 13, thereby shielding element 12 from the source of radiant energy and the energy radiated by the heated element 13. Both switch elements are arranged to bend to the left, as viewed, upon a rise in temperature. Due to the shielding action of the bracket 14, only element 13 is exposed to the radiant heat and

consequently is the only element bent to the left, thereby causing contacts 17 and 18 to remain open. Upon interruption of the source of radiant heat as described previously, element 13 will cool and bend to the right, thereby closing the switch contacts 17 and 18 and energizing the alarm circuit. Both switch elements 12 and 13 are made of the same bimetallic materials whereby variation in ambient temperature is automatically compensated for, thus limiting the actuation of the switch solely to conditions of lessened intensity of the radiant energy directed toward element 13. As stated, element 12 is shielded from the source of radiant energy by bracket 14. The receiving surface of element 13 may be blackened or coated with other heat absorbing material to increase its efficiency. The other surface of element 13, the adjacent surface of element 12, and both surfaces of bracket 14 are preferably coated with a bright aluminized or other reflective material. The outer surface of element 12 is preferably blackened to help radiate any heat that may leak in through conduction.

The speed of response of the switch can be altered by changing such variables as the receiving area of element 13, the operating temperature of lamp 7, the mass of the switch elements 12 and 13, and by various other modifications well known in the art. In addition, the radiant energy source may be any type of electrically heated element, such as the filament of an infra-red lamp or of an ordinary incandescent lamp 7 as illustrated. Additionally, other reflective or refractive means may be employed for more accurate direction and concentration of the radiant energy.

In the modified form of the switch shown in Fig. 5, a microswitch 21 is utilized as the circuit closing member, the microswitch being provided with leads 22 and 23 for connection to the alarm circuit. The switch is mounted on bimetallic element 24 and is actuated by the adjustable contact screw 25 of bimetallic element 26. Elements 24 and 26 and supporting and shielding bracket 27 are constructed and arranged to cooperate as in the previously described embodiment of the invention. Of course, elements 24 and 26 and bracket 27 need only be thermally insulated since they are not incorporated in the electric circuit. The advantage of the microswitch is its ability to handle heavy currents and high voltages, permitting it to turn off an oil burner directly and simultaneously ring an alarm through the optional use of a double-throw switch.

Fig. 6 shows a conventional heat detector 28 as modified to provide additional advantages when embodied in the present invention. The detector 28 is one of the several types in wide application as electrically operated thermal time-delay relays. As shown, two bimetallic elements 29 and 30 are provided, element 30 serving as an ambient correction. The elements 29 and 30 are mounted on a shielding support bracket 31 fixedly secured in an octyl base 32 provided with male plug fittings 33 for insertion into the receptacle of an electric circuit, in this case preferably the same circuit supplying the source of radiant energy. A wire wound ceramic heating element 34 is mounted adjacent element 30 as shown for a purpose to be described. A glass dome or bulb 35 suitably encloses the various elements. Current is supplied to bimetallic switch elements 29 and 30 and to heating element 34 through lead wires 36, 37, 38 and 39 which pass through the base member 32 and are appropriately connected to plugs 33.

As embodied in the photothermic relay system of the present invention, the heater 34 provides line voltage correction and a means for externally adjusting the temperature at which the switch contacts operate. When used as a smoke alarm, the contacts may be adjusted to operate at the desired smoke density. The output of energy from the radiant source depends on the same line voltage as does the heating element 34, and since cooling or heating both bimetallic elements 29 and 30 causes them to move in the same direction under simultaneous changes in the operating temperature of the radiant source and the heating element 34, line voltage changes will have negligible effect upon the operation of the switch. The temperature of the heater 34 can be adjusted with a rheostat, variable transformer, or other means to regulate the operating range of the switch contacts. Otherwise, the heating element may be an externally located lamp or the like connected directly to the line, the adjustment being accomplished by varying the distance of the lamp from the switch elements.

Some advantages of the foregoing arrangement are freedom from chilling by sudden drafts, contact protection, line voltage and ambient correction, external adjustment of sealed components, and plug-in for easy replacement. The glass dome 35 may be eliminated. Many other variations will become obvious to those skilled in the art of existing equipment.

Numerous variations in the types of heat sensing elements will be obvious to those skilled in the art. For example, the sensing elements may be unimetallic, and the element for ambient correction may be dispensed with. A liquid filled bulb may be used as the heat detecting or sensing element. These elements enable heat to be converted into mechanical movement to operate a switch, tip a mercury switch, or directly operate a valve, damper, pointer or indicator, recording pen, etc. A thermocouple is another suitable element, the electrical output of which may be used to operate a meter, relay or recorder.

Fig. 7 shows how the present invention may be used to directly and mechanically control the damper setting in a furnace stack or flue. As illustrated, furnace flue 2, transverse flanged openings 3, windowed companion flanges 4 and spot lamp 7 are constructed and arranged to cooperate as in the previously described embodiment of the invention. The heat sensing element 40 is of the simple bimetallic or thermostatic type. The thermostat 40 is suitably supported on a bracket 41 by means of bolt and nut assembly 42 and is mechanically coupled at its upper end through suitable linkages, as by linking rods 43 and 44, to a damper 45 pivotally supported in the flue 2 in the conventional manner. By this means the movement of the thermostat 40 during excessive smoking in the flue is mechanically communicated to the damper 45 and actuates or opens said damper to permit increased flue draft.

Fig. 8 shows the invention utilized in connection with a smoke or opacity indicator. The furnace flue 2, openings 3, windowed flanges 4 and spot lamp 7 are cooperatively arranged as previously described. A simple bimetallic element 46 is utilized as the heat sensing element. Element 46 is supported from a bracket 48 by means of bolt and nut assembly 47. The bracket 48 is provided with an upright arm 49 to which is secured a graduated scale 50 by means of bolt and nut assembly 51. The scale may be calibrated in degrees of smoke density in the flue 2. A pointer 52 brazed or otherwise connected to thermostatic element 46 is arranged and adapted to traverse the scale 50 as the element 46 bends to and fro under varying conditions of smoke density in the flue.

The embodiments of Figs. 7 and 8 may be refined by including additional bimetallic elements or the equivalents thereof for ambient correction.

It is thus seen that there is provided a relatively simple and inexpensive apparatus for system control and alarm purposes which requires no special skills to install and operate.

While there has been described above the principles of the invention in connection with specific apparatus, it is to be understood that this description is made only by way of example and not as a limitation of the scope of the invention as set forth in the accompanying claims.

What is claimed is:

1. A smoke detecting apparatus for a furnace provided with a smoke stack having a pair of diametrically opposed openings therein, comprising, in combination, a source of radiant heat of fixed intensity directed through the openings of said stack, a heat responsive bimetallic relay exposed to said directed heat, said relay being responsive to an increase in the opacity of the heat transmitting medium upon the emission of smoke through said stack, and mechanical means connected to and operated by said relay for positively communicating the movement thereof.

2. The apparatus according to claim 1, wherein the communicating means includes a pointer mounted on the relay, said pointer being associated with a scale.

3. The apparatus according to claim 1, wherein the communicating means includes a link element connecting the relay to a damper in the furnace stack.

4. A thermally actuated control or alarm apparatus comprising, in combination, a source of radiant heat of fixed intensity, a heat responsive relay exposed in the direction of said source of radiant heat and responsive to variation in the opacity of the heat transmitting medium, said relay including a bimetallic plate composed of strips of metal having disparate thermal coefficients,

a second bimetallic plate having the same thermal characteristics as the bimetallic plate of the relay, said second plate being in spaced confronting relation to said relay plate, a shielding plate disposed between said bimetallic plates whereby said second bimetallic plate is shielded from the source of radiant heat, a device mounted on said second plate and mechanically actuated by the movement of the relay to communicate said movement in response to variation in opacity of the heat transmitting medium.

5. The apparatus according to claim 4, wherein the device actuated by the relay is a switch which controls a source of electrical energy.

6. The apparatus according to claim 5, wherein the switch is a "microswitch."

References Cited in the file of this patent

UNITED STATES PATENTS

878,456	Darwin	Feb. 4, 1908
1,167,045	Cade et al.	Jan. 4, 1916
2,063,997	Godsey	Dec. 15, 1936
2,159,392	McCabe	May 23, 1939
2,371,590	Brooke et al.	Mar. 13, 1945
2,441,025	Logan	May 4, 1948
2,502,844	Hildreth	Apr. 4, 1950