

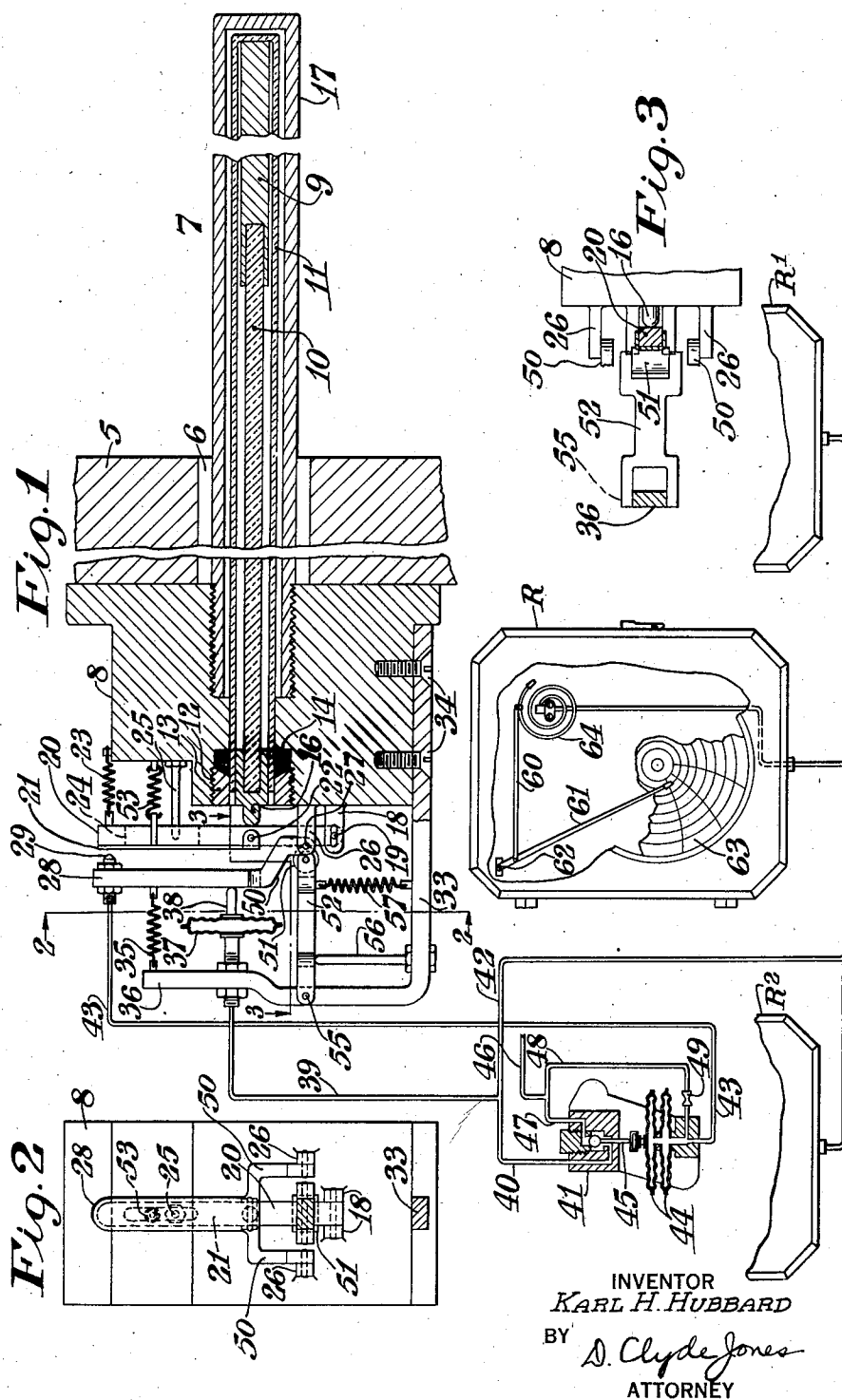
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TEMPERATURE RESPONSIVE DEVICE

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TEMPERATURE RESPONSIVE DEVICE

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This invention relates to temperature responsive devices.

Prior temperature responsive devices such as thermometers for use at temperatures as high as 1800° have been fragile, have been ill-adapted for recording at a plurality of remotely located stations and have not been arranged for checking at room temperatures.

The main feature of the present invention is the provision of a high temperature thermometer which is rugged in construction, which is designed for multiple recording, which is self-checking, which is relatively inexpensive to make and which is accurate.

Other features of the invention will appear from the detailed description and claims when taken with the drawing in which Fig. 1 illustrates a multiple recording thermometer of which the temperature responsive stem is shown in longitudinal section and one of the recorders is shown in elevation with a portion of its front broken away to disclose the operating mechanism thereof and two other recorders are indicated by fragments of their cases; Fig. 2 is a vertical section taken on the lines 2—2 of Fig. 1; and Fig. 3 is a horizontal section taken on the line 3—3 of Fig. 1.

Referring especially to Fig. 1, 5 designates a furnace wall through an opening 6 in which there extends into the interior of the furnace the expanding stem section 7 of the thermometer of the present invention. This stem section, which is supported by a head 8 mounted on the outside of the wall of the furnace, includes a relatively short central rod 9 made of high expanding alloy with a relatively inert transmission rod 10 and an outer tube 11 having one closed end and one open end. The rod 9 may be made of "Allegany metal 44", while the transmission rod 10 and the tube 11 may be made of low expanding material preferably quartz for high temperatures (1000° F. to 1800° F.), and invar for lower temperatures, that is, below 1000° F. The open end of the quartz tube 11 is rigidly mounted in the head 8 in any suitable manner, but as herein shown it extends through an opening 12 in the head which opening communicates with a threaded recess in the front of the head. A threaded bushing 13 is screwed into the recess to compress packing material 14 so that it clamps the quartz tube 11 rigidly to the head. The rod 9 at one end engages the closed end of the quartz tube, while in its other end there is mounted the transmitting rod 10 which serves to transmit longitudinal expansive movement of the rod 9 to a plug 16. This plug is slidably mounted with-

in the open end of the quartz tube 10 and is provided with a stud projecting beyond the front surface of the head 8. A sleeve 17, screw-threaded into the head, encases the expanding stem section 7 to provide a protective covering therefor.

The head 8 is provided with a pair of spaced lugs 18 having elongated slots therein in which the pivot 19 of a baffle support 20 is swingingly mounted. This support has a baffle plate 21 pivotally mounted thereon at 22. A coil spring 23 having one end attached to the head and the other end attached to the upper part of the baffle support 20 tends to hold this support against the lug on the plug 16, while a second coil spring 53, passing through an opening 24 in the support and having its ends respectively connected to the head 8 and to the baffle plate 21, tends to hold this baffle plate against the baffle support until displaced therefrom as will be hereinafter set forth. A pin 25 is mounted on the head 8 in a position to pass through the opening 24 in the baffle support and to engage the baffle plate 21 for a purpose to be described. A second pair of spaced lugs 26 which are provided on the head 8 adjacent the lugs 18, carries a nozzle support 28 on which a nozzle 29 is mounted in operative relation to the baffle plate 21 on the baffle support 20.

There is attached to the head by screws 34, a bracket 33 made of low expanding alloy with the upper end of its vertical arm 36 serving as an anchorage for a coil spring 35. This spring is connected to the nozzle support 28 so that it tends to move the nozzle 29 away from the baffle plate 21. The vertical bracket arm 36 also provides a mounting for a capsular diaphragm 37, shown in cross-section in Fig. 1. This diaphragm is provided on its free surface with a stud 38 against which the nozzle support 28 rests as a result of the tension exerted thereon by the spring 35. The interior of the capsular diaphragm 37 communicates with a pressure fluid conduit 39 connected, in turn, to the branch conduits 40 and 42. Branch conduit 40 extends to the air relay or pilot valve 41, while branch conduit 42 communicates with the Bourdon spring 23 of a recording device or a combined recording and regulating device R. The opening in the nozzle 29 communicates with the pressure fluid conduit 43 terminating in capsular diaphragm 44 which diaphragm operates the stem 45 of the ball valve of the air relay 41. A source of pressure fluid such as compressed air, is supplied through the conduit 46 and the branch conduit

47 to the air relay 41, while the branch conduit 48 connects the supply conduit 46 through a constriction 49 to the conduit 43.

Since the temperature of the head will vary greatly in accordance with surrounding temperature conditions, it is necessary to provide temperature compensation for certain of the parts supported on the head. The diaphragm 37 is most susceptible to temperature changes since its modulus of elasticity will decrease roughly 10% for a temperature change from 0° C. to 300° C., the variation being practically related to the temperature change. Since the need for compensation arises chiefly from the fact that the elastic constant of the material of diaphragm 37 changes with temperature in such a manner that there is an increased deflection due to a temperature increase that is approximately proportional to the product of the pressure in the diaphragm and the temperature change, the compensation may be effected by varying the ratio of the lever arms of the support 20 in proportion to the temperature change. This means that if the instrument temperature is low, the support 20 moves less than if the instrument temperature is high, for a given temperature change at the sensitive element 9. This corresponds to the change in the motion of diaphragm 37 for a definite pressure change corresponding to the temperature change, with the result that the compensating action is satisfactory. The specific construction for effecting this result includes an arm 52 which is pivoted at one end at 55 on the vertical bracket arm 36, while the other end of the arm 52 is provided with a roller 51 which contacts with the lower portion of the baffle support 20. The arm 52 rests on the upper end of the pin 56 of high expanding alloy, which pin is mounted in the bracket 33. Since the bracket 33 is made of low expanding alloy, as the temperature of the head increases, the pin 56 will expand and thereby lift the free end of the arm 52 moving the roller 51 thereon, upward on the baffle support 20. This movement of the roller 51 upward on the support 20 will shorten the lower lever arm of the support (that is, the portion of the support between roller 51 and the lug on plug 16) as the temperature of the head increases. Conversely, the mentioned parts will cause the roller 51 to move downward on the support 20, to lengthen its lower lever arm as the temperature of the head drops. If the material of the bracket 33 and the pin 56 are properly selected and if the parts are properly proportioned, the mentioned temperature effect of the parts supported on the head will be compensated for.

The operation of the thermometer of the present invention is as follows: If the stem section 7 is subjected to an increase in temperature, the rod 9 of high expanding alloy will expand, while the relatively inert quartz tube 11 will expand only a negligible amount. As the rod 9 expands, since its free end engages the closed end of the quartz tube, the expansion effect of the rod 9 will be transmitted by the quartz transmission rod 10 to the plug 16. The lug on this plug will engage the baffle support 20 and move it counterclockwise so that the baffle plate 21 approaches the nozzle 29. It will be understood that compressed air from a source (not shown) is normally supplied through the conduit 46, branch conduit 48, constriction 49 and conduit 43 opening into the nozzle 29. Therefore a stream of compressed air continuously leaks out through the nozzle except as its flow is impeded by the baffle

plate 21. As the baffle plate approaches the nozzle 29, the pressure in the conduit 43 increases causing the capsular diaphragm 44 to expand. On expansion of this diaphragm it forces the valve stem 45 of the ball valve upward, tending to stop the flow of compressed air through the air relay 41. Therefore the pressure in conduits 39 and 42 decreases. The Bourdon coil 64 in response to this reduction in pressure will tend to wind up and through the link 60 will swing the pen arm 61 counterclockwise about its pivot 62. This movement of the pen arm will record the temperature change on the chart 63 which is rotated by any suitable timing mechanism (not shown). As the pressure in the conduit 39 decreases, the diaphragm 37 will tend to contract thereby permitting the spring 35 to withdraw the nozzle support 28 and the nozzle 29 slowly away from the baffle plate 21. The action of the diaphragm 37 tends to compensate for variations in pressure of the supply of compressed air and for "sticking" of the air relay 41 so that this diaphragm forms a part of a very efficient transmission system between the stem section and the Bourdon spring.

On a drop in temperature about the stem section 7, the high expanding alloy rod 9 will contract and by means of its transmitting rod 10 will withdraw the plug 16 toward the right of Fig. 1. Springs 23 and 53 will cause the baffle support 20 and the baffle plate 21 to recede from the nozzle 29 in following the movement of the plug. This will result in a drop in the air pressure in the conduit 43 with the result that the diaphragm 44 will contract tending to open the air relay 41. The remaining operations are the reverse of those just described in the case of a rise in temperature.

It is important in a thermometer designed for use at high temperatures to provide an arrangement by which it is self-checking, that is, it becomes possible to check the accuracy of the thermometer at room temperature. This self-checking is effected in the present thermometer by means of the pin 25 and its cooperation with the baffle plate 21 in modifying the action of the device. Thus as the temperature falls to the lower portion of the range of the thermometer, the baffle support 20 moves in a clockwise direction away from the nozzle 29 so that the baffle plate 21 will finally engage the pin 25. The continued movement of the baffle support after pin 25 engages the baffle plate, will cause counterclockwise movement of this plate about its pivot 22. As the baffle plate recedes from the nozzle, prior to its engagement with pin 25, the air pressure in the conduit 43 will drop causing the diaphragm 44 to contract. This contraction of the diaphragm will tend to open air relay 41 so that air pressure from branch conduit 47 will build up in conduit 39 causing diaphragm 37 to expand. As this diaphragm expands, its stud 38 moves the nozzle support 28 and the nozzle 29 clockwise to their extreme right-hand position. The baffle plate in the course of its counterclockwise movement due to its engagement with pin 25 eventually approaches near to the nozzle, now resting in its extreme right-hand position, so that the air stream emerging from the nozzle and the pressure in the conduit 43 is now varied in accordance with room temperatures. This variation in pressure actuates the air relay valve 41 as previously described to vary, in turn, the air pressure in diaphragm 37 and in Bourdon spring 64. This spring operates through the link

60 to cause the pen arm 61 to record the room temperature on chart 63 in the manner already set forth.

It will be seen that the conduit 42, in addition to being connected to the Bourdon spring 64 of the recorder R, is connected to the Bourdon springs of instruments R1 and R2 which are identical with instrument R, these last-mentioned recorders being located at points remote from the recorder R. However, this invention is not limited to the use of multiple recorders but instead, a single recorder may be employed in the device.

I claim:

1. In a device of the class described, a mounting structure, a baffle support, a baffle plate, and a nozzle mounted in cooperative relation on said structure, mechanism responsive to changes in temperature in a high temperature range for causing relative movement between said baffle support and said baffle plate as a unit and said nozzle, means supplementing said mechanism and functioning in response to a change in temperature in a low temperature range for moving

said baffle plate relative to said baffle support and to said nozzle, and a pneumatically actuated means responsive to the varying space relation between said nozzle and said baffle.

2. In a device of the class described, a head, a baffle support swingingly mounted on said head, a baffle plate swingingly mounted on said support, a nozzle swingingly mounted on said head to approach and recede from said plate, means responsive to temperature changes in a high temperature range and engaging said baffle support to cause said baffle support and said baffle plate to move as a unit with respect to said nozzle, a projection mounted on said head to engage said baffle plate to stop the movement of the same with respect to said support, as said support is moved by said means in response to a change in temperature in a low temperature range, whereby the relation of said baffle plate with respect to said baffle support and said nozzle is changed, and pneumatically actuated mechanism responsive to the varying space relation between said nozzle and said baffle plate.

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