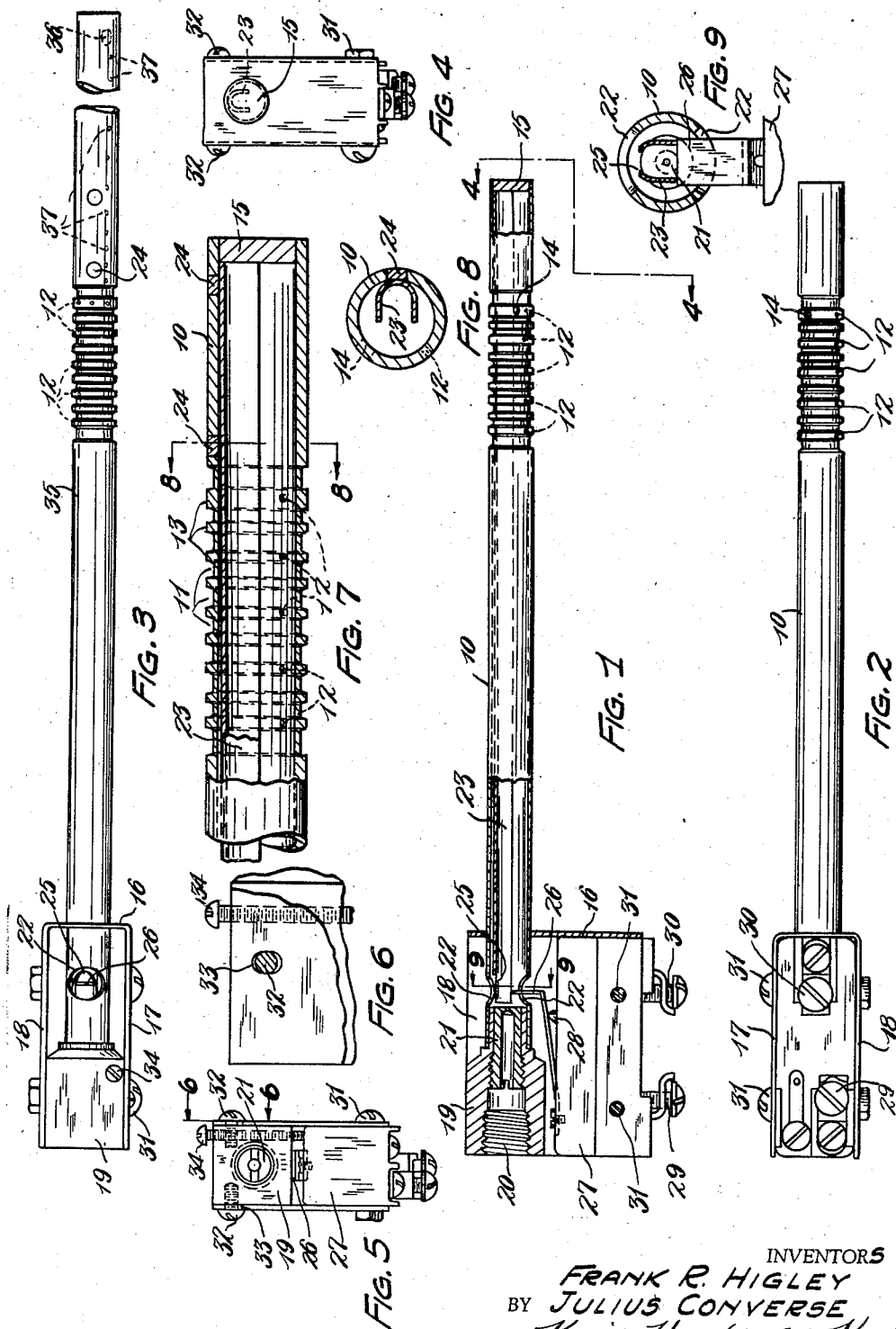


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THERMAL CONTROL DEVICE

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THERMAL CONTROL DEVICE

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This invention relates to improvements in thermal control devices, that is to say, devices of the compensated type, and more especially devices of this character which may be utilized in a novel manner for safety pilots.

An object of the invention is the provision of a compensated thermal control device of great simplicity and low cost, but one which, nevertheless, is more sensitive thermally than other devices now in wide commercial use.

Another object of the invention is the provision of a thermal control device which itself shall function as a pilot tube.

A further object is the provision of a thermally responsive device in the form of a pilot tube with a tongue mounted inside the tube for communicating motion therefrom to a suitable control.

Another object is the provision of a tongue of special form having special advantages.

Still another object is the provision of means for providing a Bunsen burner effect in a combined pilot tube and thermal control device, and, further, for utilizing one of the air intake ports in such a burner as an opening through which motion may be communicated from the internal tongue to external control apparatus.

Other objects and features of novelty will appear as we proceed with the description of that embodiment of the invention which, for the purposes of the present application, we have illustrated in the accompanying drawing in which:

Fig. 1 is a plan view partly in horizontal section of a device embodying the invention.

Fig. 2 is a side elevational view of the same;

Fig. 3 is an elevational view of a slightly modified form of the invention looking in the direction opposite that of Fig. 2;

Fig. 4 is an end view looking in the direction of the arrows 4—4 of Fig. 1;

Fig. 5 is a view of the opposite end of the device;

Fig. 6 is a fragmental elevational view looking in the direction indicated by arrows 6—6 of Fig. 5;

Fig. 7 is a fragmental central sectional view of a portion of the device on a larger scale;

Fig. 8 is a detail cross-sectional view taken substantially on the line 8—8 of Fig. 7; and

Fig. 9 is a detail sectional view on the same scale as Fig. 8, the view being taken substantially on the line 9—9 of Fig. 1.

The thermally responsive element of the invention consists primarily of an elongated tube 10 of material responsive to heat and not subject to rapid deterioration because of heat, preferably a steel alloy. While a tube of uniformly thin wall

throughout may be used, we prefer to employ one of fairly heavy gauge and to machine a series of grooves 11 in a short length of the tube to increase its flexibility at that point and for other reasons, as will presently appear. The tube is caused to flex for effecting the operation of suitable control apparatus, as, for example, a gas valve, and this flexure is brought about by the application of heat to one side only of the tube, whereby that side expands throughout the heated portion and causes more or less bowing of the tube. The air within the tube, of course, forms effective insulation against the transfer of heat in a straight course from the hot side of the tube to the cold side, and while some leakage takes place through the wall of the tube, the section through which it passes is relatively thin and cuts down the flow of heat to such an extent that it becomes of relatively little importance.

While heat may be applied by the application of a flame from a burner outside the tube we prefer to utilize the tube itself as the gas conductor and to form a series of small ports 12 in some or all of the ribs 13 between grooves 11, these ports being in alignment longitudinally of the tube. This arrangement of the ports in the ribs 13 is advantageous from the standpoint of entraining secondary air, while the ribs themselves provide additional metal for the absorption of heat. In a horizontally arranged tube, as herein illustrated, the ports 12 are located in the lower half of the tube somewhat to one side of the vertical median plane so that flame resulting from gas issuing from these ports will wipe one side of the tube and not tend to flow under the tube to the other side thereof. 14 is an igniting port that is adapted to light a burner (not shown) with which the tube 10 may be associated as a pilot tube. After the gas from port 14 is ignited, that from the nearest port 12 will flow upward and be ignited from the first flame and the remaining ports 12 are arranged close enough together so that the flame quickly spreads to all of them, it being understood that these flames are quite small as compared to that of the igniting port 14. When the tube is arranged vertically or otherwise than horizontal, it will be convenient oftentimes to have the igniter port in the end of the tube, but in the present instance the tube is shown closed at this end by a plug 15.

In the illustrated embodiment, the tube is supported near its opposite end by being extended through a round opening of suitable size in the intermediate wall 16 of a three-sided sheet metal frame. Between the other walls 17 and 18 of this

frame there is mounted a block 19 having a bore therethrough threaded at 20 for connection with gas tubing. The opposite end of the block is turned down to cylindrical form of a size to fit tightly within the tube 10. A spud 21, threadably mounted in the block 19, has the usual constricted exit opening for delivering a stream of gas centrally into the tube 10. Just beyond the spud 21 we provide air ports 22 through which primary air may flow to be entrained by the gas issuing from spud 21. In effect, therefore, the tube 10, with its gas and air intake openings, constitutes a Bunsen burner.

It is possible to utilize the flexure of tube 10 in various ways to effect the operation of control apparatus. One means which we have discovered for doing so is to mount a tongue within the tube attached to the tube and adapted to communicate movement back away from the point of attachment and the area of flexure. The tongue which we prefer to employ is a tongue 23 of U-shaped cross-section, the curved back of which is attached to the tube 10 by brazing or welding, as indicated at 24. The free end of the tongue 23 terminates in the vicinity of the air ports 22. In order to interpose no interference with the entrance of air, the curved back of the tongue may be cut away at this point, as indicated at 25. Means for transmitting the movement of the free end of the tongue in response to flexure of the tube may extend through one of the ports 22, and this is done in the illustrated case by having a spring finger 26 of a microswitch 27 project through this port. The details of the microswitch are of no importance in this case, it being essential merely that a very small movement shall suffice to open or close the switch. As shown herein, the switch includes a plunger 28 which, when moved inwardly, makes a contact. It comprises two binding posts 29 and 30 for connection with conductors of an electric circuit. When the tube is heated by flames from ports 12, the resulting flexure of the tube causes the free end of tongue 23 to press finger 26 and thereby push on plunger 28 for closing the electric circuit. The latter may be arranged to operate a control such as an electrically actuated valve in a gas conductor leading to the burner with which the present pilot is associated.

The body of switch 27 is preferably fixed in the frame members 17, 18 by means of bolts 31. Screws 32 extend loosely through holes 33 in the frame members 17 and 18 and are threaded into the block 19, permitting the block to be locked in different positions of adjustment within small limits. An adjusting screw 34 threaded in the block 19 bears against the body of switch 27. When the screws 32 have been loosened, screw 34 may be turned one way or the other to separate block 19 and switch 27 more or less, whereby the tube 10 is tilted one way or the other in its bearing in frame member 16, which effects adjustment of the tongue 23 with respect to the finger 26, thereby regulating the speed of operation of the device after heat is applied to the tube. The adjustment may be secured by other means, however.

In Fig. 3 we have shown a pilot tube 35 of greater length than that in the other figures of the drawing, that is to say, one which extends considerably beyond the points of attachment 24 of the tongue 23 to the tube, these points of attachment being more or less distant from the extreme end of the tube where the igniting port 36 is located. Ports 12 may be connected with port 36

by small intervening ports 37, the purpose of which is solely to carry igniting flame from port 36 to ports 12. These ports 37 are in the top of the tube in line with port 36, and therefore have no heating effect.

To those skilled in the art, the operation of the device, it is believed, will be apparent from the foregoing description. While we have necessarily gone somewhat into detail in order to explain fully the particular embodiment of the invention herein illustrated, we desire it to be understood that such detailed disclosures are not to be construed as amounting to limitations except as they may be included in the appended claims.

Having thus described our invention, we claim:

1. In a device of the character described, a pilot tube constituting a laterally flexing thermal element of the compensated type, said tube being fixed at its inlet end only and being closed at its free end, and having an exit port in its side wall the flame from which is adapted to heat the tube on one side and cause flexure thereof, and means for utilizing said flexure to operate a control.

2. In a device of the character described, a pilot tube supported near one end, means for admitting gas to the tube at that end, said tube having a gas exit port in a side wall thereof the flame from which is adapted to heat the tube on one side and cause flexure thereof, a tongue arranged internally of the tube and attached at one end thereto remote from the supported end of the tube, said tube having an air intake opening therethrough near its supported end, and control apparatus operatively connected with said tongue through said opening.

3. In apparatus of the class described, a thermal control device of the compensated type comprising a tube, said tube having in a portion of its length a series of peripheral grooves for increasing flexibility, means for heating the grooved portion of the tube along one side of the latter to cause flexure, and means for utilizing said flexure to operate a control.

4. In a device of the character described, a pilot tube, said tube having in a portion of its length a series of peripheral grooves for increasing flexibility and having gas exit ports in said grooved portion between the grooves thereof arranged in longitudinal alignment for heating the tube on one side and causing flexure thereof, and means for utilizing said flexure to operate a control.

5. In a device of the character described, a pilot tube supported at one end, a tongue attached to the tube near the opposite end of the latter and extending therefrom toward the supported end, said tube having a gas exit port intermediate the ends of the tongue the flame from which port is adapted to heat the tube to cause flexure thereof, and control apparatus arranged to take movement from the free end of the tongue.

6. In apparatus of the character described, a thermally responsive device comprising a tube, means for heating the tube on one side to cause flexure thereof, mounting means disposed endwise of the tube one way from the point of application of heat, and a tongue within the tube secured at one end to the side thereof opposite the heated side at a point disposed the other way from said point of heat application, said tube having an opening through which the effects of the movements of said tongue may be transmit-

ted for the control of apparatus external to the tube.

7. In apparatus of the character described, a thermally responsive device, comprising a tube mounted at one end, means for heating said tube on one side to cause flexure thereof, and a tongue within the tube of channel-shaped cross-section with its back attached at one end to the tube opposite the heated side of the latter, whereby radiant heat transfer is minimized, said tube having an opening through which the effects of the movements of said tongue may be transmitted for the control of apparatus external to the tube.

8. In a device of the character stated, a pilot tube having a gas exit port in a side wall thereof, the flame from which is adapted to heat the tube on one side and cause flexure thereof, a tongue disposed internally of the tube and attached at one end to the tube, said gas port being located intermediate the free and attached ends of the tongue, and means responsive to the motion of said tongue.

9. In a device of the character stated, a pilot tube having an exit port in one side thereof, the flame from which is adapted to heat the tube on that side and cause flexure of the tube, a tongue of channel shape disposed within the tube with its back attached at one end to the tube opposite the heated side of the latter, said

port being located intermediate the free and attached ends of the tongue, said tube having an intake port therein near the free end of said tongue disposed to direct fluid between the side walls of the channel-shaped tongue, whereby said fluid may flow into and along the channel of said tongue, and means responsive to the motion of said tongue.

10. In a device of the character stated, a pilot tube having an exit port in one side thereof, the flame from which is adapted to heat the tube on that side and cause flexure of the tube, a tongue of channel-shape disposed within the tube with its back attached at one end to the tube opposite the heated side of the latter, said port being located intermediate the free and attached ends of the tongue, means for mounting said tube at a point near the free end of said tongue, a gas spud in the tube beyond the free end of said tongue arranged to deliver a stream of gas into the channel of said channel-shaped tongue directed along the tube toward said exit port, said tube having a side port arranged to deliver air between the side walls of the channel-shaped tongue into the path of said gas stream, and means responsive to the motion of said tongue.

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