March 5, 1940. V. O. BEAM 2,192,629

CONTROL FOR FUEL BURNING APPARATUS

Filed June 20, 1936 2 Sheets-Sheet 1

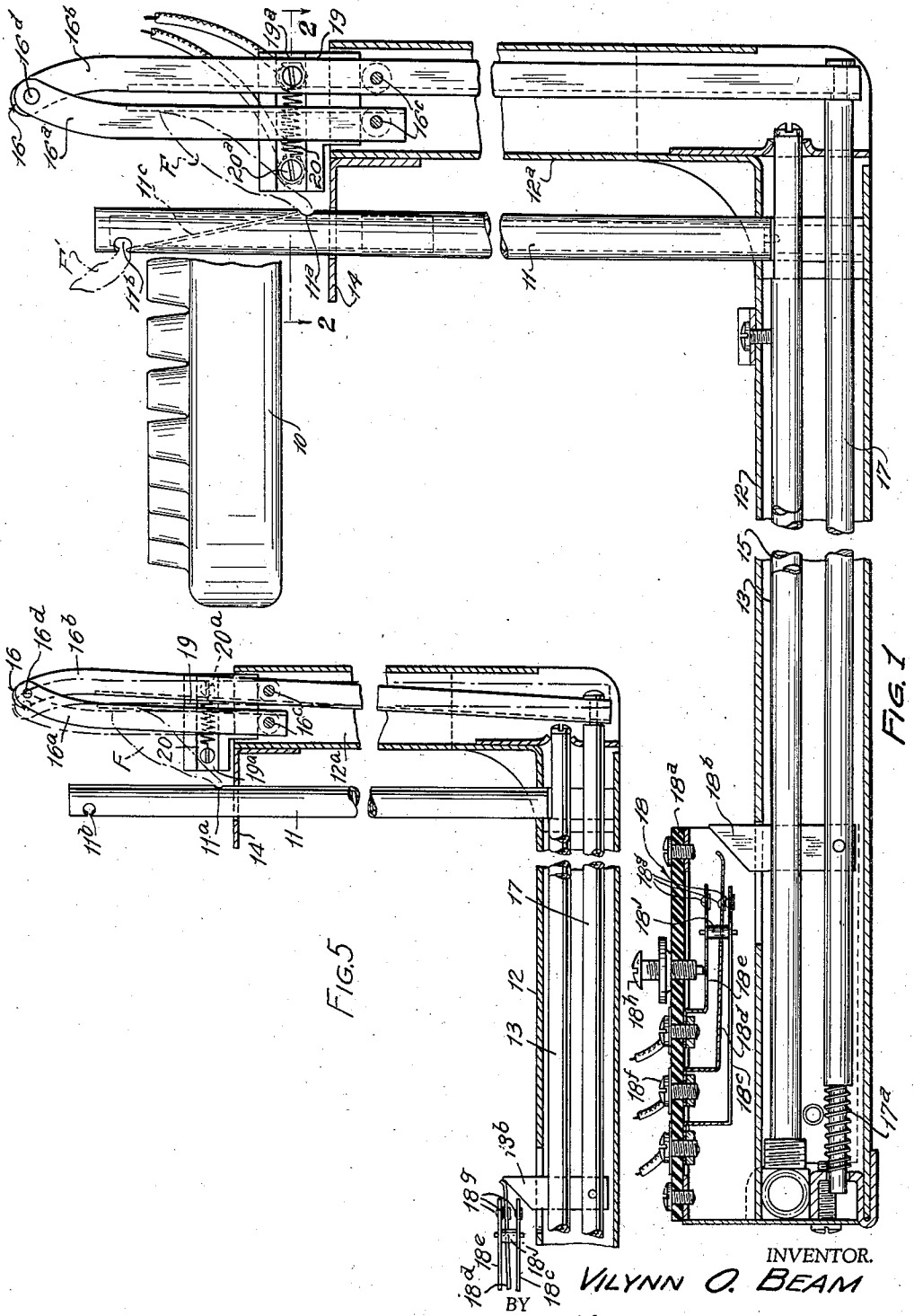


FIG. 1

FIG. 5

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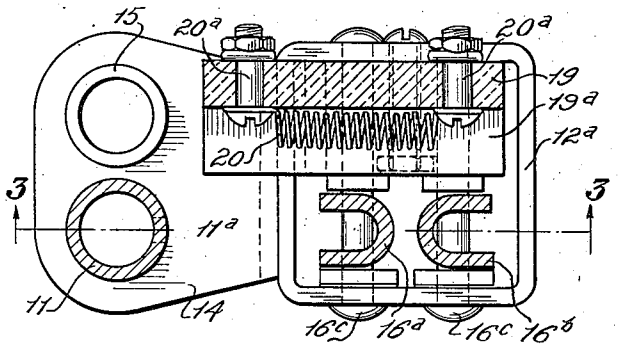


FIG. 2

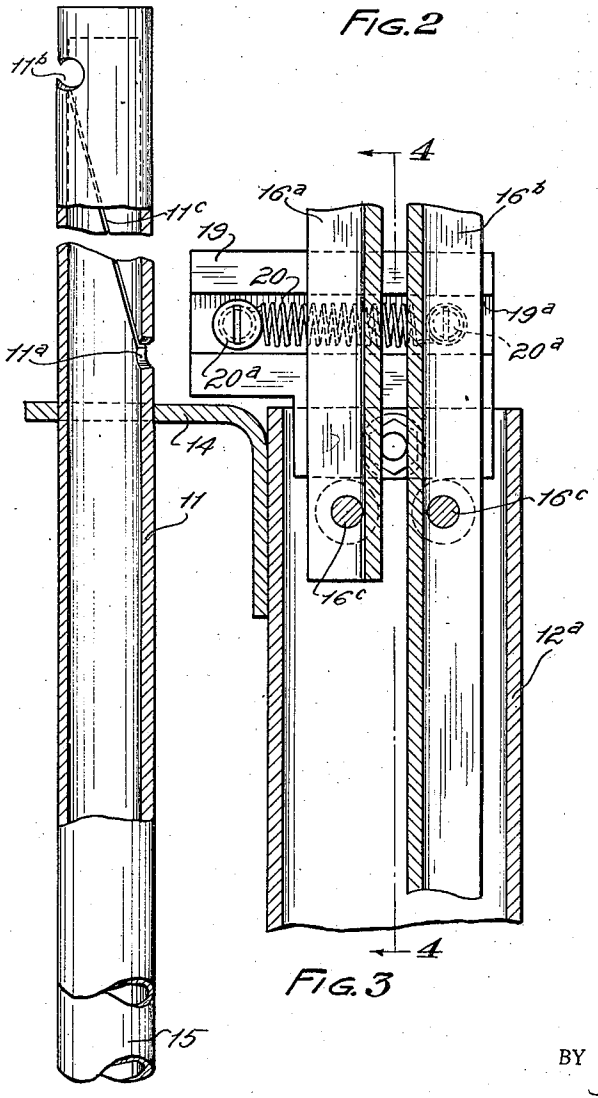


FIG. 3

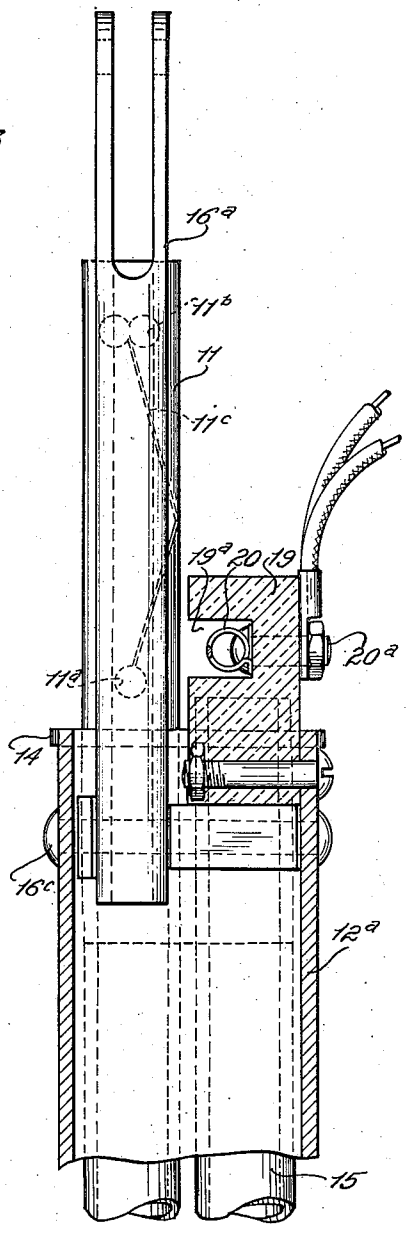


FIG. 4

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2,192,629

CONTROL FOR FUEL BURNING APPARATUS

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Application June 20, 1936, Serial No. 86,381

6 Claims. (Cl. 297—11)

This invention relates to a new and improved thermal device and has particular reference to a thermal device for use in connection with the pilot burner of fluid fuel-consuming systems, such as gas-fired furnaces, boilers, and the like.

The principal object of the invention is to provide a novel form and construction of thermal device which is speedy in action; which is self-compensating as regards ambient temperature; which in its functioning does not necessarily involve any flexure or bending of any member or part thereof; and which is so constructed that it may be used for directly or indirectly controlling the flow of fuel without requiring mechanism to multiply the movement generated or produced in the thermal device itself.

The invention may be briefly summarized as consisting in certain novel combinations and arrangements of parts which will be described in the specification and set forth in the appended claims.

In the accompanying sheets of drawings,

Fig. 1 is a view partly in elevation and partly in section showing the gas control unit including the pilot burner, the thermal device, a pilot igniting coil, and a double-throw switch which is directly actuated by the thermal device, a portion of the main burner being shown adjacent the pilot burner, this view showing the parts of the thermal device in the position which they occupy when the pilot is extinguished and the device is cold, and the corresponding position of the parts of the double-throw switch;

Fig. 2 is a transverse sectional view on an enlarged scale substantially along the line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view substantially along the line 3—3 of Fig. 2;

Fig. 4 is a vertical sectional view substantially along the line 4—4 of Fig. 3;

Fig. 5 is a view showing a portion of the equipment illustrated in Fig. 1 but with the thermal device and the double-throw switch operated thereby in substantially the position which these parts occupy when the thermal device is heated.

Referring now to the drawings, 10 represents the main burner to which gas will be supplied from the usual supply pipe. I wish it to be understood however that the present invention, although useful in connection with gas-fired boilers, furnaces, heaters, and the like, is not necessarily confined thereto. In igniting relation to the main burner is a pilot 11 which, as well as the thermal device to be referred to presently, forms a part of a unit having a tubular casing 12 which may be rectangularly or otherwise shaped in cross-section, this casing having a horizontal main portion and at its inner end an upright or vertical portion 12*a*. Gas is supplied to the pilot 11 by a pipe 13 extending through the horizontal portion of the casing, the pipe 13 being connected to the pilot 11 in a manner such that there will be supplied to the latter a suitable mixture of air and gas. The pilot 11 extends up from the horizontal portion of the casing 12 in front of the upright portion 12*a* thereof and is steadied by the flange of a bracket 14 secured to the upper part of the vertical portion 12*a* of the casing. If a main valve of the diaphragm type is utilized, a bleed pipe is employed to carry the gas from the upper chamber of the valve when the latter is to be opened by gas pressure beneath the diaphragm, and in that case the bleed pipe here indicated at 15 may also extend through the casing 12 alongside the pilot pipe 13 and it may have a vertical extension alongside the pilot 11 but will terminate short of the upper end thereof, as indicated in Fig. 4. However, this bleed pipe forms no part of the present invention and will not be further referred to.

Considering next the thermal device constituting the principal feature of the present invention, it will be observed that this device 16 is composed of two members 16*a* and 16*b* which are pivotally connected by cross-pins 16*c* to the upper part of the vertical portion 12*a* of the casing 12 and project outwardly and upwardly therefrom. At their upper ends these members are pivotally connected together by a pivot pin 16*d*. The member 16*a* is next to the pilot 11 and this member which when compared with the member 16*b* is relatively short, may be termed the "hot" member of the thermal device. The other member 16*b* of the thermal device is relatively remote from and shielded from the pilot flame by the hot member 16*a* and may be termed the "cold" member of the device. This latter member is relatively long and is in the form of a lever which extends down beyond its pivot pin 16*c* and at its lower end is connected to the gas controlling element which it is to operate. From their pivot pins 16*c* to the upper common pivot pin 16*d* the two members 16*a* and 16*b* are normally of equal length, the axes of the three pivot pins forming the corners of an acute isosceles triangle when the element is cold. Though the major portion of the member 16*a* and the major portion of the upper part of the member 16*b* are parallel or substantially parallel, their upper

ends are in this instance curved inwardly and placed in overlapping relation so that they can be conveniently connected together by the pivot pin 16d. As will appear presently, the heat differential between the member 16a and the upper portion of the member 16b causes the member 16a to expand linearly and the two fixed pivot points 16c together with the fact that the members are pivotally coupled together at their ends compel the relatively hot member to rock on its pivot 16c (to the right as the same is viewed in Fig. 1), thus imparting a similar rocking movement to the member 16b which thus acts as a lever to transmit at its lower end to the part to be actuated a movement the extent of which can be made anything desired within reasonable limits by the appropriate selection of the ratio of the lengths of the two lever arms above and below the pivot 16c.

In Fig. 5 I have illustrated the manner in which the thermal element functions by showing in full lines the position of the parts of the thermal element when the same is heated and by dotted lines their positions when the element is cold. In this same figure I have shown how the movement of the lower end of the member 16b of the element shifts the middle contact 18d of the switch 18 from the position shown in Fig. 1 to the position wherein the middle contact engages the upper contact 18e.

Reverting to the thermal device 16, it is to be observed that neither the hot member 16a nor the cold member 16b thereof is designed to be flexed by the action of the pilot flame, in fact they are especially shaped to avoid flexure and to that end they are made quite stiff and rigid by being made channel-shaped, as will best be seen by reference to Fig. 2, but the channel-shape, in addition to its strength-imparting function, aids in the quick cooling and heating of the members and particularly the hot member 16a. Additionally, the channel of the hot member 16a faces the pilot flame or that part thereof which heats it and serves as a trough to receive and guide the flame and prevents its impinging upon the cold member 16b. The hot and cold members 16a and 16b of the device may be formed of precisely the same metal or alloy so as to have the same thermal expansion, and while they have generally the same or substantially the same expansion coefficient, so that the element will be unaffected by ambient temperatures, under some circumstances one of the members, preferably the hot member, may have a somewhat higher thermal expansion than the other, depending upon the surrounding temperature in which the element is designed to work. They are formed of a material or materials having good load carrying characteristics so as to resist without bending or distortion the stresses set up during the functioning of the element and will have high thermal expansion. Nickel-chrome steel has been found quite satisfactory, and if one member is to have a somewhat different thermal expansion than the other, this can be accomplished by varying the proportions of the ingredients of the alloy.

By reference to Figs. 1, 2, 3 and 4, it will be seen that the pilot has a lower orifice 11a for the emission of gas to produce the flame F (shown by dotted lines in Fig. 1) which heats the adjacent member 16a of the thermal element and an upper orifice 11b for the emission of gas for the flame F', also shown by dotted lines in Fig. 1, for igniting the main burner or burners, these two orifices being connected by a spiral slot 11c so that when the gas is ignited at the lower orifice 11a it will travel up the slot and ignite the gas at the upper orifice 11b.

It is desirable that the pilot be lit by a suitable igniter generally electrically actuated, and while different forms of igniters may be employed, I prefer to use an igniter of the hot wire type generally in the form of a coil 20 which on the passage of current therethrough becomes incandescent and therefore sufficiently hot to ignite the gas surrounding it.

On top of the vertical portion 12a of the casing 12 at the side of the two members of the thermal device I mount a block 19 of heat-resisting material having a channel 19a extending horizontally therethrough, this channel being located alongside and facing the members of the thermal element and projecting inwardly beyond the same toward the pilot 11, the inner end of the channel being located adjacent the lower orifice 11a of the pilot 11. In this channel is placed the igniter coil 20 held in place by terminal screws 20a to which current supplying conductors may be connected.

This device functions as follows: The parts are so related that the gas emerging from the lower orifice 11a of the pilot envelops the coil 20, and when current is passed through the coil and the latter becomes incandescent, it ignites this gas and therefore starts flames at the pilot orifices, but as soon as the flame F is established it is caused by convection to curl upwardly into the channel of the hot member 16a of the thermal element and no longer impinges upon the igniter coil so that its life is substantially unaffected by the heat of the flame.

Assuming that the main gas valve is closed and that the pilot is extinguished, in which event the thermal device is of course cold, the parts of the thermal device are in he position shown in Fig. 1 and the middle contact 18d of the double-throw switch 18 engages the lower contact 18c.

When it is desired to start the furnace or other fuel consuming apparatus, the gas to the pilot is turned on and the coil 20 is caused to be energized, after which the pilot will be ignited. As soon as this occurs the flame F rises and instantly after the ignition occurs the flame is out of contact with the igniter coil.

The flame now plays on the hot member 16a of the thermal device, and while the cold member 16b remains relatively cool, the hot member expands and lengthens, changing the distance between its pivot 16c and the upper pivot 16d which pivotally connects the upper ends of the thermal members. As the hot member 16a gradually lengthens, it transmits lateral thrust to the upper end of the cold member 16b, causing the pivot pin 16d to move in a clockwise direction as the same is viewed in Fig. 1 to a position about as shown in full lines in Fig. 5 so that both members rock in a clockwise direction about their respective pivots 16c and move the switch actuating rod 17 to the left. The movement imparted directly by the long arm or member of the thermal device to the switch member 18b is sufficient to move the middle contact 18d from the position shown in Fig. 1, i. e., in engagement with the lower contact 18c, into engagement with the upper contact 18e, as shown in Fig. 5. It might be stated at this point that the time element of this part of the cycle can be varied by adjusting the positions of the two contacts 18e and 18c with reference to the middle contact 18d. This can be done by means of an adjusting screw 18h

which extends through the top of the switch box 18a and engages the upper contact 18e. This contact is connected with the lower contact 18c by an insulating spacer 18f which passes freely through an opening in the middle contact 18d so that by adjusting the screw the two contacts 18e and 18c can be raised or lowered with reference to the middle contact 18d.

The forward end of the rod 17 is reduced and passes through a suitable support at the front of the switch box. A spring 17a surrounding the reduced end of the rod 17 is compressed when the thermal element acts in the manner just explained on being heated, but when the pilot is extinguished and the thermal members are cool or reach equal temperature, the parts are restored to their former positions shown in Fig. 1, the spring 17a assisting this action.

When the thermal element is actuated by the pilot flame in the manner just explained so as to bring the middle contact 18d into engagement with the upper contact 18e of the switch 18, a circuit may be completed through electric apparatus (not shown) for turning on the gas to main burner 10. At the same time the circuit for igniter coil 20, which includes the middle contact 18d and the lower contact 18c of switch 18 is broken.

Various parts of the apparatus disclosed but not claimed herein are claimed in two applications filed as divisions of this application, namely, application Serial No. 145,087, filed May 27, 1937, for Burner control system, and application Serial No. 145,088, filed May 27, 1937, for Fuel burning equipment.

While I have shown somewhat in detail the preferred embodiment of the present invention, I do not desire to be confined to the details or specific members described above as the principle of the invention may be otherwise utilized, and I therefore aim in my claims to cover all modifications which do not involve a departure from the spirit and scope of the invention in its broadest aspects.

Having thus described my invention, I claim:

1. In a pilot flame responsive device, a pair of elongated members arranged alongside each other having separate pivotal mounting connections at closely adjacent locations and connected together remotely from said connections, one of said members having a longitudinal groove adapted to receive and guide a pilot flame and extend it along a substantial length of said member and thereby take maximum heat from the flame.

2. In a pilot flame responsive device, a pair of elongated members arranged alongside each other having separate pivotal mounting connections at closely adjacent locations and connected together remotely from said connections, one of said members having a longitudinal groove facing from the other member adapted to receive and guide a pilot flame and extend it along a substantial length of said member and thereby take maximum heat from the flame substantially to the exclusion of the other member.

3. In a thermally responsive device for use in connection with the pilot burner of a fuel burning system, a support, a pair of pivots on said support spaced apart horizontally a slight distance, two upright elongated members each mounted on one of said pivots, said members being connected together at a point remote from said pivots, one of said members having a longitudinal groove therein on its side remote from the other member, whereby the pilot flame may be caused to enter said groove and travel upwardly therealong for the heating of the grooved member independently of the other member.

4. In a thermally responsive device for use in connection with the pilot burner of a fuel burning system, a support, a pair of pivots on said support spaced apart slightly, two elongated members each mounted on one of said pivots, said members being connected together at a point remote from said pivots, one of said members having an extension beyond its pivot point on the side thereof remote from the point of connection between the members, to which extension a control connection may be attached, and means for subjecting one of said members between its pivot and its connection with the other member to the action of the pilot flame independently of the other member.

5. In a thermally responsive device for use in connection with the pilot burner of a fuel burning system, a support, a pair of pivots on said support spaced apart slightly, and two elongated channel members arranged back to back each mounted upon one of said pivots, said members being connected together at a point remote from said pivots, whereby the pilot flame may be projected into the channel of one of said members and directed therealong and whereby the other member may be protected from the heat of the flame.

6. In a thermally responsive device for use in connection with the pilot burner of a fuel burning system, a tubular support, a pair of pivots carried by said support near one extremity thereof, an elongated hot member mounted on one of said pivots and projecting outwardly beyond the end of the tube, an elongated cold member mounted intermediate its ends on the other of said pivots and connected with the projecting end of the hot member, a portion of one of said members extending toward the other end of the tubular support interiorly of the same, and means associated with the tubular support adjacent the free extremity of said extending portion adapted to be actuated by the latter upon the heating of the hot member independently of the cold member.

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