March 7, 1944. G. I. HOLMES 2,343,670

STOKER CONTROL

Filed Oct. 31, 1940

Fig. 1

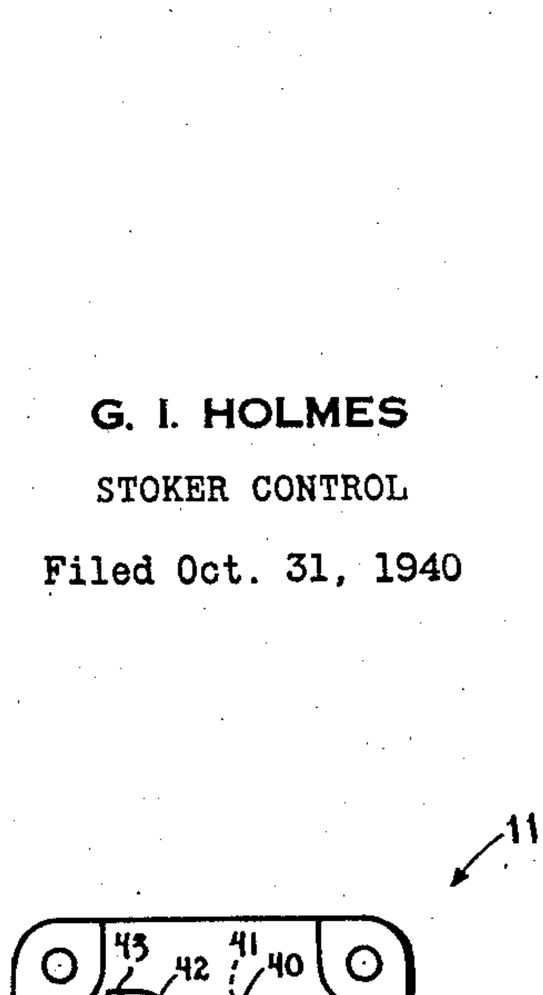
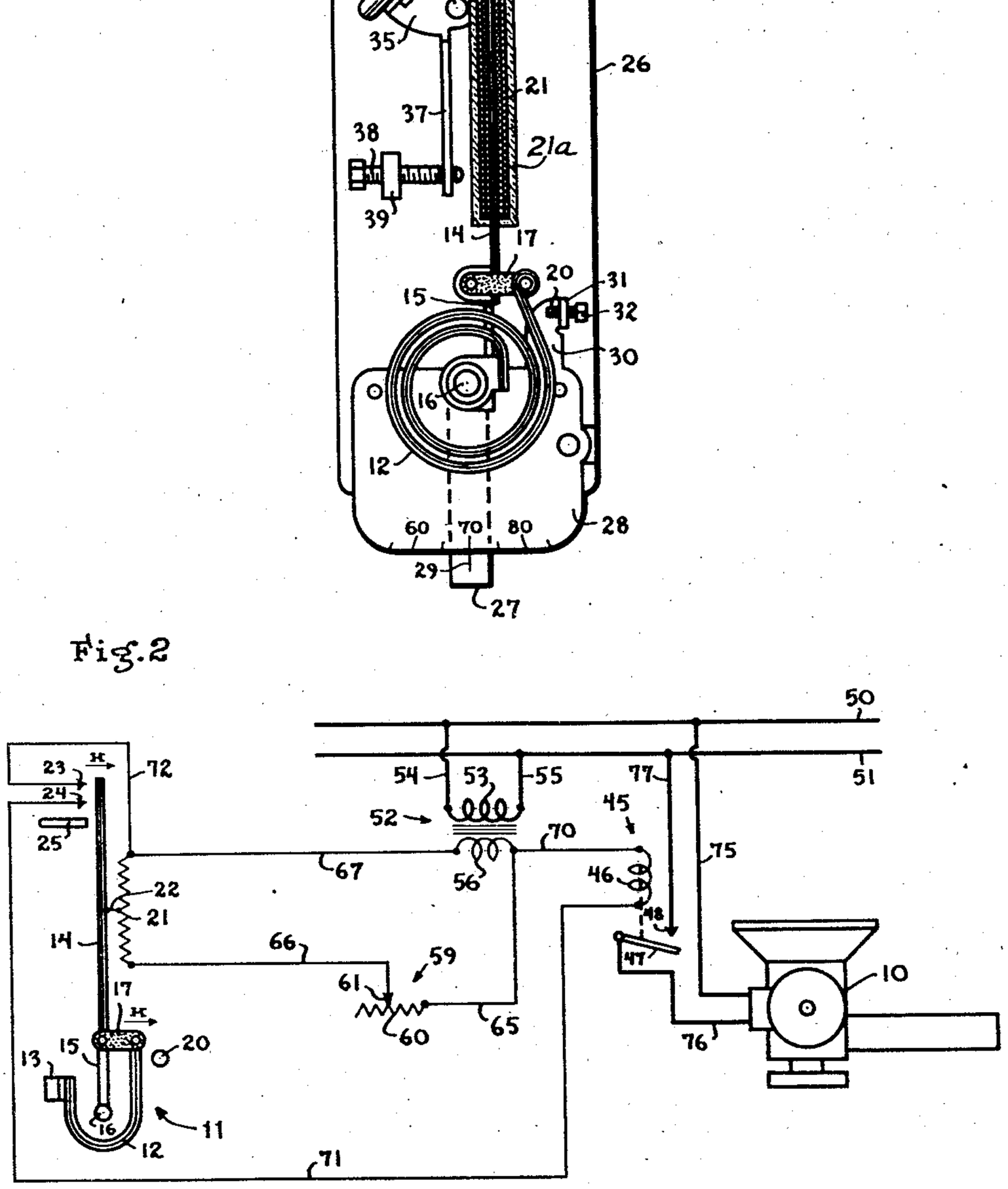


Fig. 2



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STOKER CONTROL

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7 Claims. (Cl. 236—46)

The present invention relates to improvements in control apparatus for fuel feeding devices, primarily stokers, wherein the device is to be controlled by a thermostat and also operated periodically under low heat requirement conditions when there are no calls for heat from the thermostat.

It is the object of my invention to provide a unitary control instrument for fuel feeding devices such as stokers, the instrument being arranged to function both as a thermostat and a timer.

Another object of my invention is to provide a heat actuated timing device for controlling a stoker, the device being responsive to space temperature as well and operable to control the stoker in accordance therewith.

Another object is to provide a control instrument for fuel feeding devices comprising a heat actuated bimetal timer and a temperature responsive element for adjusting the timer in accordance with space temperature.

Figure 1 is a view of the control instrument of my invention.

Figure 2 is a diagrammatic illustration of the instrument in combination with a stoker system.

Referring to the drawing in Figure 2 I have shown a stoker system including my improved control instrument which is shown in diagrammatic form in this figure. The stoker is designated by the numeral 10 and the control instrument by the numeral 11.

The instrument 11 comprises a generally U-shaped bimetallic temperature responsive element 12 which is rigidly mounted as at 13. Numeral 14 designates a second bimetal element responsive to heat which is mounted on the end of an arm 15 pivoted on a pivot 16. The lower end of the bimetal element 14 is attached to the free end of the bimetal element 12 by a link 17. The instrument 11 is disposed in the space being heated by the stoker and the bimetal element 12 is relatively sensitive so as to respond to changes in the space temperature. Upon increase in space temperature the free end of the element 12 moves to the right toward a fixed stop 20, thereby moving the bimetal element 14 in a clockwise direction about the pivot 16. The free end of the element 12 moves to the left upon decrease in space temperature.

Adjacent the bimetal element 14 is an electrical heating resistance 21, the mid point of which is connected to the bimetal element 14 by a wire 22. The upper end of the bimetal element 14 cooperates with a pair of fixed electrical contacts 23 and 24 and bridges these contacts when the upper end of element 14 is moved to the left far enough so as to engage them. Adjacent the upper end of element 14 is a permanent magnet 25 which cooperates with an armature carried by element 14 as may be seen on Figure 1 so that the element 14 engages with and disengages from the contacts 23 and 24 with a snap action.

The details of the control instrument 11 may be more readily ascertained by inspecting Figure 1 wherein a preferred form of the instrument is shown. In Figure 1 the instrument 11 comprises a base member 26 which may be fastened to a wall. The bimetal element 12 is shown as a coiled element mounted on pivot 16 which is journalled in the base 11. Attached to the pivot 16 is an adjusting arm 27 which can be moved to the right or left so as to bodily adjust the position of the element 12. Numeral 28 designates a plate attached to the lower portion of the base 26, the lower edge of the plate 28 having temperature graduations as shown. The adjusting arm 27 has an index marker 29 which cooperates with the graduations on plate 28. With the parts in the position shown on Figure 1, the index 29 is opposite 70 on the plate 28.

The plate 28 has an ear 30 having a bent-over portion 31 through which extends a screw 32 which forms the stop 20 described in connection with Figure 2. The screw 32 limits movement to the right of the free end of the element 12.

In the improved form of the instrument shown in Figure 1 the permanent magnet 25 is carried on a bracket 35 which is pivoted on a pivot 36 and which has a downwardly extending arm 37 attached to the end of an adjusting screw 38 which extends through a bracket 39. The permanent magnet 25 cooperates with an armature 40 at the upper end of element 14 and by adjusting the screw 38 the bracket 35 can be moved to the right or left about its pivot, thus adjusting the position of magnet 25 with respect to armature 40. The element 14 also carries a contact 41 at its upper end which cooperates with a contact screw 42 carried by a bracket 43. If desired, the upper end of the element 14 may carry an element arranged to bridge a pair of fixed contacts as shown diagrammatically on Figure 2. Whenever the armature 40 is brought within the field of the magnet 25 the contact 41 is snapped into engagement with contact screw 42. By adjusting the position of the magnet 25 the position at which element 14 will snap to the left can be adjusted. In Figure 1 the heating element 21 is shown as being disposed in intimate thermal

contact with the element 14 and if desired insulation 21a may be placed about the heating element.

From the foregoing it is to be seen that the element 12 is operable to bodily adjust the position of element 14 with respect to the contact screw 42 upon rise and fall in space temperature and that the amount which element 12 can adjust element 14 to the right about pivot 16 is limited by contact screw 20.

Referring now again to Figure 2, numeral 45 designates a relay for controlling the stoker 10, the relay comprising a winding 46 having an armature attached to a switch blade 47, the armature moving in a direction to bring switch blade 47 into engagement with a fixed electrical contact 48 when the winding 46 is energized. Power for the control system is supplied through line conductors 50 and 51 and a step-down transformer 52 having a primary winding 53 connected to line conductors 50 and 51 by wires 54 and 55 and a secondary winding 56 having a fewer number of turns than the primary winding.

Numeral 59 designates a manually adjustable resistance comprising a resistance element 60 and a manually slidable contact 61.

With the parts in the position shown, the resistance 21 is connected across the secondary 56 of transformer 52 through the variable resistance 59, the circuit being as follows: from secondary 56 through wire 65, part of resistance 60, contact 61, wire 66, resistance 21 and wire 67 back to secondary 56. The resistance 21 is of such a value that when the circuit just described is complete it produces only a negligible amount of heat and under these circumstances the element 14 slowly cools and warps to the left until its upper end is brought into the field of magnet 25 whereupon it snaps into engagement with contacts 23 and 24, bridging these contacts. As soon as these contacts are bridged a circuit is completed for the winding 46 of relay 45 as follows: From secondary 56 through wire 70, winding 46, wire 71, contacts 24 and 23, wire 72, and wire 67 back to secondary 56. As soon as relay 45 is thus energized switch blade 47 engages contact 48 completing a circuit for the stoker 10 as follows: from line conductor 50 through wire 75, stoker 10, wire 76, switch blade 47, contact 48, and wire 77 back to line conductor 51. The stoker remains energized as long as the relay 45 is energized. At the same time as the relay is energized as described above a separate circuit is completed for the lower half of resistance 21, which circuit is in parallel with the circuit through relay coil 46 and which shunts the upper half of resistance 21. This circuit is as follows: from secondary 56 through wire 65, part of resistance 60, contact 61, wire 66, the lower half of resistance 21, wire 22, element 14, contacts 24 and 23, wire 72, and wire 67 back to secondary 56. The resistance in this circuit is considerably lower than the circuit which includes all of resistance 21 and the heat produced by the lower half of resistance 21 is now sufficient to cause element 14 to warp to the right, that is, in a direction tending to move away from contacts 23 and 24. After a given period of time during which the circuit through the lower half of resistance 21 is complete, element 14 snaps away from contacts 23 and 24, interrupting the said circuit and also deenergizing the relay. After the circuit through the lower half of resistance 21 is interrupted the amount of heating is again substantially reduced and element 14 again slowly warps towards contacts 23 and 24. In this manner contacts 23 and 24 are periodically bridged for a short interval of time, for example, from two to four minutes. The characteristics of the element 14 are such that after it has moved away from contacts 23 and 24 approximately thirty minutes elapse before it warps to the left sufficiently to rebridge contacts 23 and 24. Element 14 is relatively insensitive to space temperature inasmuch as changes in space temperature are normally not great enough to produce an appreciable amount of movement of the single bimetal strip of which element 14 is comprised.

The operation just described takes place when the space temperature is at 70°, the thermostat with the parts in the position shown being set for 70° as shown in Figure 1. Under these circumstances the free end of element 12 stays in substantially the same position and so the element 14 remains in substantially the same angular position on the pivot 16. The operation as described under these circumstances, that is, periods of energization of relay 45 of substantially two minutes and periods of deenergization of approximately thirty minutes are for the purpose of maintaining a fire in the furnace or boiler by the stoker 10.

If the space temperature should fall below 70° causing the element 12 to contract its free end moves to the left an amount corresponding to the fall of temperature, thereby moving element 14 angularly about its pivot in a counter-clockwise direction. This brings the upper end of element 14 closer to the contacts 23 and 24 and the result is that element 14 tends to keep contacts 23 and 24 bridged for a longer period of time and to leave them unbridged for a shorter period of time depending upon the magnitude in the fall in temperature below 70°. In other words, when element 14 has a position closer to the contacts 23 and 24 it has a shorter distance to warp to the left before bridging the contacts when the relay 45 is deenergized. Thus it is to be seen that as the space temperature decreases below 70° the operating periods of the stoker are proportionately lengthened and the intervals between operations are proportionately shortened. As the space temperature falls below 70° to a predetermined low temperature the element 12 will position the element 14 within the field of magnet 25 so that the contacts 23 and 24 remain continuously bridged until the space temperature again rises. The temperature value at which contacts 23 and 24 will be continuously bridged may be 65° to 67° for example, depending upon the characteristics of the bimetal elements and their relative positions of mounting.

Due to the length and sensitivity of element 12, relatively small changes in space temperature cause it to impart appreciable movements to element 14.

As the space temperature rises element 12 expands, its free end moving to the right and at a space temperature of 71° or 72°, for example, its free end will engage the stop 20 preventing it from moving the element 14 any further angularly in a clockwise direction. When the free end of element 12 engages stop 20, element 14 is in such a position on its pivot that the operating periods of the stoker produced by element 14 and heater 21 are of minimum duration and the intervals between operations are of maximum length. Under these circumstances the

intermittent operation of the stoker is the minimum amount required to maintain a fire in the boiler or furnace satisfactorily by the stoker. The purpose of the stop 20 is of course to prevent element 12 from moving element 14 so far to the right that the operating periods of the stoker are reduced in length below the minimum required for maintenance of the fire.

As pointed out above, the element 12 is relatively sensitive, moving its free end to the right or left in response to changes in the space temperature. The element 14 is even more sensitive but responds primarily to the heater 21. If desired insulation may be placed about the heater 21 as described in connection with Figure 1 to prevent this heat from affecting the element 12. It is to be recognized that the element 14 and heater 21 act primarily as a timer to provide for intermittent operating periods of the stoker. The operation of the timer is varied by the temperature responsive element 12 so as to increase the amount of operation of the stoker in accordance with the space temperature so as to maintain it at the desired value. It is to be seen therefore that I have provided a single instrument having both a timing function for maintaining the fire and also serving as a thermostat so as to provide for sufficient operation of the stoker so as to maintain a uniform temperature under various heating requirements.

While my disclosure constitutes a preferred form of my invention, various other forms of it are comprehended as being within its scope, the principle of the invention being that of forming a single instrument in such a manner as to act as a timer as well as a thermostat for controlling a device requiring intermittent operation when there are no demands from the thermostat. My invention is to be limited therefore not in accordance with my disclosure which is representative but only in accordance with the claims appended hereto.

I claim as my invention:

1. An intermittently operable switch comprising in combination, a base having a pivot, an elongated bimetal pivoted adjacent one end thereon, a movable contact on the other end of said bimetal, a stationary contact cooperable with said movable contact, said contacts being closed upon movement of said bimetal in cooling direction and opened when said bimetal is heated; a magnet adjacent said contacts to render them snap acting and to establish a temperature differential between opening and closing operations; a heater for said bimetal, said heater being controlled by said contacts so as to supply a higher degree of heat to said bimetal when said contacts are closed than when they are opened; an ambient temperature responsive thermostat secured at one end, the second end thereof being free to move upon temperature changes, a link connecting said second end to said bimetal whereby said thermostat may adjust the position of said bimetal to vary the operation thereof, and to a stop to prevent said thermostat from varying the position of said bimetal beyond a predetermined position.

2. In combination, a pair of temperature responsive members mounted with relationship to each other so that both move in substantially the same directions on heating and cooling, one of said members being pivotally mounted and responsive substantially only to relatively great variations of heating and cooling, mechanical connecting means between said one member and an active portion of said other member whereby said other member bodily positions said one member, control means operated by an active portion of said one member, and means responsive to operation of said control means for intermittently heating and cooling said one member to cause said member to intermittently operate said control means, the length of time of the intermittent operations being determined by the position of said one member.

3. In combination, a pair of temperature responsive members mounted with relationship to each other so that both move in substantially the same directions on heating and cooling, one of said members being pivotally mounted and responsive substantially only to relatively great variations of heating and cooling, mechanical connecting means between said one member and an active portion of said other member whereby said other member bodily positions said one member, control means operated by an active portion of said one member, means responsive to operation of said control means for intermittently heating and cooling said one member to cause said member to intermittently operate said control means, the length of time of the intermittent operations being determined by the position of said one member, and means for limiting the amount that said one member may be positioned to prevent said operations from decreasing below a predetermined minimum length of time.

4. In combination, a thermostat comprising a first temperature responsive member, control means operated by an active portion thereof, heating means for said first temperature responsive member controlled by said control means, said heating means being wholly energized when said control means is in an active position and partially energized when said control means is in an inactive position, said heating means being adapted to cause said first temperature responsive member to move through a predetermined range of movement; a second temperature responsive member responsive to ambient temperature variations and movable through a predetermined range of movement in response thereto, and mechanical connecting means between said temperature responsive members whereby said second temperature responsive member in different places of its range of movement causes said first temperature responsive member to operate in different portions of its range of movement to thereby vary the control characteristics of said thermostat.

5. In combination, a thermostat comprising a first temperature responsive member, control means operated by an active portion thereof, heating means for said first temperature responsive member controlled by said control means, said heating means being wholly energized when said control means is in an active position and partially energized when said control means is in an inactive position, said heating means being adapted to cause said first temperature responsive member to move through a predetermined range of movement; a second temperature responsive member responsive to ambient temperature variations and movable through a predetermined range of movement in response thereto, mechanical connecting means between said temperature responsive members whereby said second temperature responsive member in different places of its range of movement causes said first temperature responsive

member to operate in different portions of its range of movement to thereby vary the control characteristics of said thermostat, and means for limiting the movement of said second temperature responsive member to prevent said first temperature responsive member from being positioned beyond a predetermined range of movement.

6. In a temperature control device, in combination, a thermal timer including switching means and a temperature responsive element deformable on changes in temperature in a first direction to actuate said switching means, means responsive to changes in space temperature and thermally insulated from said thermal timer for positioning said temperature responsive element bodily to actuate said switching means or to render said switching means ineffective, and means for limiting the bodily movement of said temperature responsive element by said space temperature responsive means in a direction tending to render said switching means ineffective, whereby said temperature responsive element is capable of actuating said switching means regardless of space temperature.

7. In apparatus of the character described, in combination, a stoker, control apparatus for the stoker comprising a thermal timer including electrical switching means for causing operation of said stoker when actuated and a temperature responsive element deformable on changes in temperature in a first direction to actuate said switching means, means responsive to the temperature of the space being heated and thermally insulated from said temperature responsive element for positioning said temperature responsive element bodily to actuate said switching means, and means for limiting the bodily movement of said temperature responsive element by said space temperature responsive means in a direction tending to render said switching means ineffective, whereby said temperature responsive element is capable of actuating said switching means periodically to operate said stoker regardless of space temperature.

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