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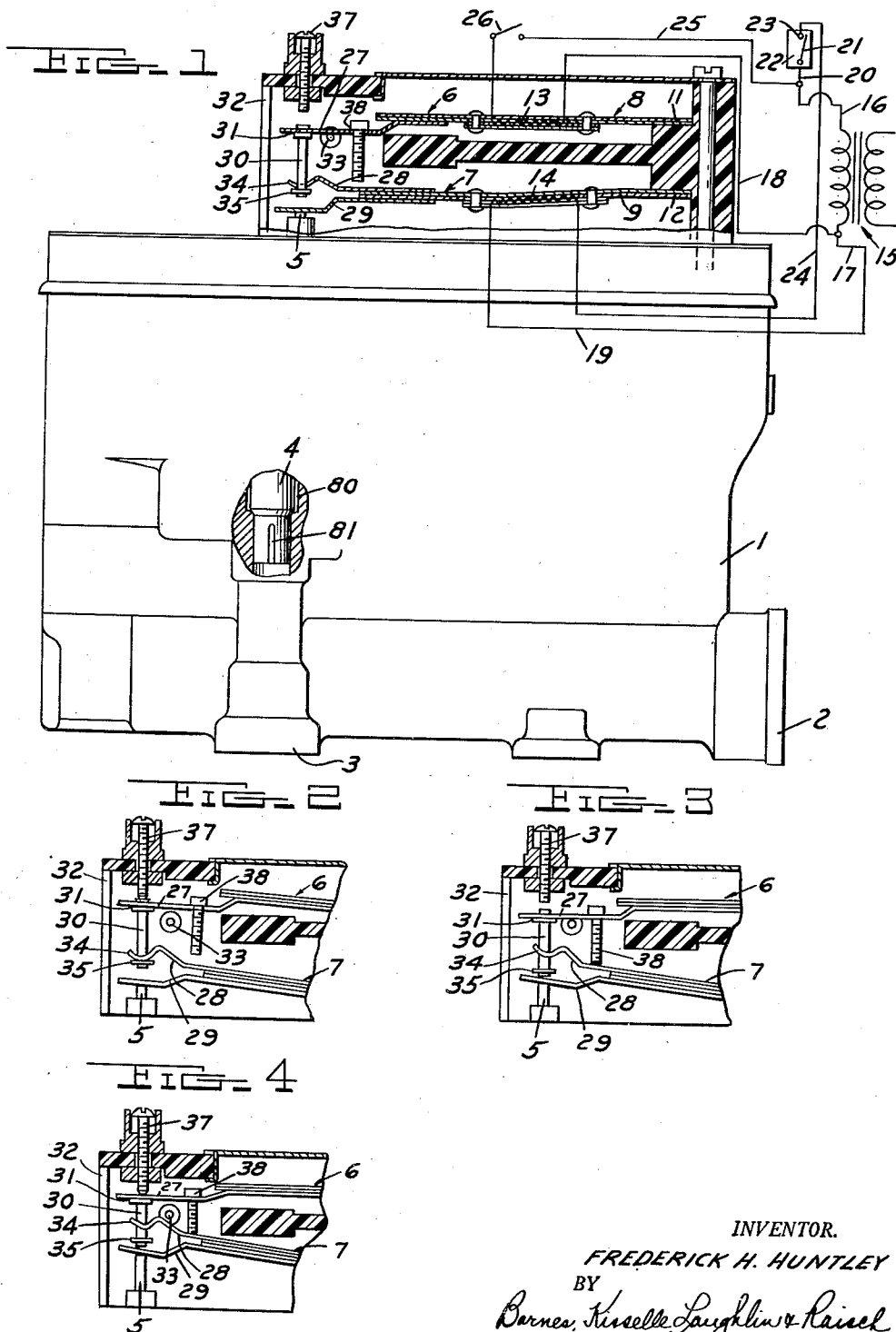
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THERMOSTATIC FUEL CONTROL SYSTEM

Filed Aug. 25, 1949

2 SHEETS—SHEET 1



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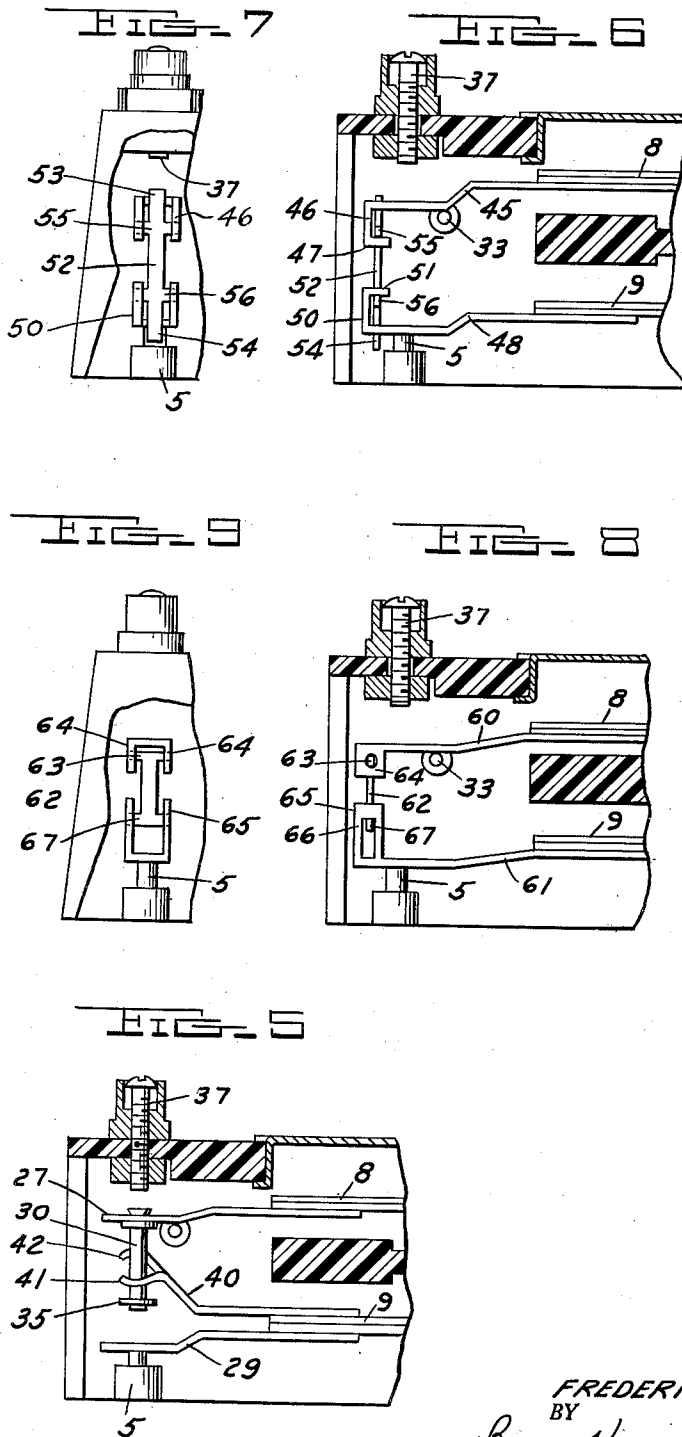
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2 SHEETS—SHEET 2



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THERMOSTATIC FUEL CONTROL SYSTEM

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This invention relates to an oil control device and more particularly to a control device for regulating the supply of liquid fuel to gravity fed oil burners such, for example, as a vaporizing type fuel oil burner.

In a vaporizing type fuel oil burner the oil is vaporized by the heat of the flame preparatory to mixing with air and burning. If the burner is burning, say, for example, with only a low pilot flame and the fuel oil is then fed into the burner at too fast a rate, the heat generated by the low pilot flame will be insufficient to thoroughly vaporize all of the oil flowing into the burner and consequently the oil will tend to pool for a short period, the burner will run inefficiently and the attainment of a high fire will be delayed. In other words, the flame or heat generated by the burner gets out of step temporarily with the increased rate of feed which results in inefficient operation of the burner.

It is an object of this invention to produce an oil control which will keep the rate of oil feed in step with the burner flame, that is, with the ability of the burner to properly vaporize the fuel preparatory to burning the same. Thus, this invention contemplates an oil control which will produce more efficient combustion in a vaporizing type burner and particularly in those periods when the rate of oil feed into the burner is being accelerated or decelerated.

In the drawings:

Fig. 1 is an elevation partly in section showing the oil control which is the subject of this invention.

Fig. 2 is a fragmentary section showing the position of the thermostatic control bars when the burner is burning at low clean fire.

Fig. 3 shows the position of these bars when the burner is burning at medium or intermediate fire.

Fig. 4 shows the position of these bars at high fire.

Fig. 5 shows a modified form of connection between the two control bars.

Figs. 6 and 7 are slide and end elevations respectively showing a second modified form of connection between the control bars.

Figs. 8 and 9 are side and end elevations respectively showing a third form of connection between the control bars.

Referring more particularly to the drawings, there is shown a constant level oil control device comprising a main casing 1 having a liquid supply chamber therein to which liquid is supplied and maintained at a constant level by

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mechanism not shown but well known in the art, see, for example, United States Letters Patent Nos. 2,068,138, 2,120,364, and 2,369,739.

Liquid fuel is supplied to the main casing 1 through inlet 2 and flows out of casing 1 into the burner through outlet 3 which is controlled by valve 4. Valve 4 is controlled by pin 5. As pin 5 rises, valve 4 opens and admits more fuel from casing 1 to outlet 3, and as pin 5 is lowered, valve 4 moves toward closed position and decreases the flow of fuel out of outlet 3.

The opening and closing of pin 5 is controlled by two motors generally designated 6 and 7. Motors 6 and 7 each take the form of laminated thermostatic bimetal bars 8 and 9 respectively, anchored at one end upon support 10 as at 11 and 12 respectively. Bar 8 is energized by electrical resistance heating coil 13 which is in heat exchange relation therewith and bimetal bar 9 is energized by electrical resistance heating coil 14 which is in heat exchange relation therewith.

Energy is supplied to heating elements 13 and 14 from a step down transformer 15. The secondary winding 16 of the step down transformer has one terminal connected by a conductor 17 and branch conductors 18 and 19 with one terminal of each of the heating elements 13 and 14 respectively. The other terminal of the secondary winding 16 is connected by a wire 20 to the movable contact leaf 21 of a room thermostat generally designated 22. The fixed contact 23 of the room thermostat is connected by a wire 24 to the other terminal of the heating element 14 of the heat motor 7. The other terminal of heating element 13 of heat motor 6 can be connected to the other terminal of the secondary winding 16 by a wire 25. The flow of current through wire 25 can be controlled by a conventional mechanism, such as a pilot selector switch or a thermostat positioned without the building being heated. By way of illustration, a pilot selector switch 26 is installed in line 25 and controls the flow of current therethrough.

The free end of bimetal bar 8 is provided with an extension 27 fixed thereto in any conventional manner but preferably by riveting. The free end of bimetal arm 9 is provided with two extensions 28 and 29 fixed thereto in any suitable manner but preferably by riveting. Extensions 27, 28 and 29 preferably are in the form of sheet metal stampings. A pin 30 is fixed at its upper end to extension 27 as at 31. One wall of the housing 32 in which the heat motors 6 and 7 are mounted carries a fixed stop 33 upon which extension 27 rests when motor 6 is denergized,

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The pin 31 projects through the bifurcated or forked end 34 of extension 28. A disc 35 is fixed to the lower end of pin 30. Disc 35 overlaps the arms of fork 34. An adjustable stop screw 37 is mounted in the top of casing 32 and arrests the upward movement or deflection of extension 27 and heat motor 6. An adjustable screw 38 is mounted on arm 27 and extends downwardly toward arm 28 on heat motor 7 for purposes described below.

The operation of my device is as follows: As shown in Fig. 1, thermostatic switch 21 and switch 26 are both open so that heat motors 6 and 7 are deenergized. At this time extension 29, which contacts pin 5, has depressed pin 5 so that valve 4 is in low pilot position, that is, admitting just enough fuel from fuel chamber 30, through slot 31 in the end of the valve 4 and through outlet 3 to maintain a low pilot flame in the burner. Valve 4 is biased toward open position by a coil spring (not shown) in a conventional manner. The lower end of pin 38 is out of contact with arm 28 and arm 27 rests upon stop 33 and out of contact with pin 37.

Heat motors 6 and 7 each flex upwardly about their anchors 11 and 12, respectively, upon a rise in temperature, such as occurs when current flows through heating elements 13 and 14. If switch 26 is closed, then current flows from secondary winding 16 of the transformer through heating element 13 and heat motor 6 is deflected upwardly to the position shown in Fig. 2 wherein the arm 27 abuts the lower end of stop screw 37 to thereby hold arm 27 against any further upward movement. As arm 27 moves upwardly it acts through disc 35 to pick up the forked end 34 of extension 28 and thereby flex heat motor 7 and extension 29 upwardly thereby causing pin 5 and valve 4 to rise to low clean fire position wherein fuel flows through outlet 3 into the burner at about twenty-five percent (25%) of the rate at which it flows through outlet 3 at high fire. Thus, to recapitulate, if thermostat 22 is open and not calling for heat, then with switch 26 open, valve 4 is in low pilot position and with switch 26 closed, valve 4 is in low clean fire position so that the burner is generating about twenty-five percent (25%) of its maximum heat output.

Whenever thermostat 22 calls for heat, switch 21 is closed so that current flows from the secondary coil 16 through heater coil 14 thereby causing heat motor 7 to warp or flex upwardly relieving pin 5 and thereby causing valve 4 (which is biased toward open position by a spring (not shown) to open from its lower position to high fire position, Fig. 4. The lower position of valve 4 may be low pilot, Fig. 1, or low clean fire, Fig. 2, depending upon the position of the bimetal bar 8. When the burner goes from low clean fire, Fig. 2, to high fire, no delay in feeding the oil is necessary because the burner is hot enough to vaporize all the oil admitted to the burner.

If the burner is on low pilot and then goes from low pilot, Fig. 1, to high fire, Fig. 4, too rapidly, the rate of vaporization of the oil will not keep step with the rate of admission of the oil into the burner and the burner will tend to pool for a short period. The net result is that the burner will not reach high fire as quickly and as well as if the rate of oil feeding is rapid up to about thirty percent (30%) of the full rate of feed and then the rate of feed is slowed down from there to full feed. Thus

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controlling and eventual slowing down of the rate of feed when the burner goes from low pilot to high fire is accomplished as follows: When switch 26 is open, bar 8 is in lowered position against stop 33 and if valve 4 is at low pilot position, Fig. 1, then if heat motor 14 is energized, bimetal bar 9 will rise or flex rapidly to the position shown in Fig. 3 until bimetal bar 9 strikes the lower end of screw 38. This permits valve 4 to open to about thirty percent (30%) of full feed position rapidly. Since bar 8, which is not energized, has considerable resilience, an added load is put on bar 9 and the bar 9 in passing from about thirty percent (30%) of maximum feed to full feed position, Fig. 4, is slowed down due to the resilience or resistance to flexing of bar 8. Fig. 4 shows the position of the control at high fire, that is, when valve 4 is wide open and the oil is being fed into the burner at its maximum rate.

Conversely, when switch 26 is open and heating element 13 deenergized, the going from high fire (Fig. 4) to low pilot (Fig. 1) is accelerated when heating element 14 on bar 9 is deenergized. The added stiffness of bar 8, which retards bar 9 going up, accelerates it going down until the point is reached when the connection between bar 8 and bar 9 is discontinued. This action is very desirable as its effect is to prevent "over-run" of room temperature which is a condition which is encountered in milder temperature days.

High fire position of the control, Fig. 4, is reached both when the fire comes up from low pilot position (Fig. 1) and from low clean fire position (Fig. 2) but there is no limiting or retarding effect on the upward flexing of bar 9 as the fire comes from low clean fire position shown in Fig. 2 to high fire shown in Fig. 4 because switch 26 will be closed, heat motor 13 energized, bar 8 flexed upwardly to its top or high fire position with screw 38 clear of bar 9 before heat motor 14 is energized and bar 9 starts its upward travel from low clean fire to high fire position unrestrained by bar 8. The stop 38 is adjustable so that the timing of the movement of bar 9 can be regulated.

The modified form of control shown in Fig. 5 is identical with that shown in Figs. 1 to 4 except that screw 38 has been omitted and extension 40 (which corresponds to extension 28) on bar 9 has its outer end divided into a fork having a lower finger 41 and an upper finger 42 which straddle pin 30. Finger 41 contacts disc 35 when bar 8 is energized and flexed upwardly thereby flexing bar 9 upwardly and permitting valve 4 to rise to low clean fire position, as indicated in Fig. 2. Finger 42 takes the place of screw 38 and serves the same function. Hence, if bar 8 is not energized, then if bar 9 is energized, bar 9 will rise upwardly without restraint from low pilot to about thirty percent (30%) of full fire position whereupon finger 42 contacts extension 27 and bar 8 now yieldably resists or restrains further upward flexing of bar 9 and thus slows down the rate of increase in the feed of fuel into the burner in the same manner as previously described with the principal form of this invention.

Figs. 6 and 7 show a second modified form of the connection between bars 8 and 9. The end of extension 45 on arm 8 is bifurcated as at 46 and turned downwardly and then inwardly as at 47. The end of extension 48 of arm 9 is bifurcated as at 50 and then turned upwardly and inwardly as at 51. A lost motion connection 52 in

the form of a double cross member is mounted upon the bifurcated ends 46 and 50. The ends 53 and 54 of the double cross connection 52 are positioned between the arms of the bifurcated ends 46 and 50 and project beyond extensions 45 and 48 respectively and the cross bars 55 and 56 extend across the arms of the bifurcated ends.

Lost motion connection 52 cooperates with the ends of arms 8 and 9 to perform the same function performed by stop screw 38 and pin 30 in the principal form of this invention. As shown in Figs. 6 and 7, bars 8 and 9 are deenergized and valve 4 is in low pilot position. When bar 8 is energized by closing switch 26, then as bar 8 warps upwardly bifurcated end 47 of extension 45 contacts cross bar 55 and cross bar 56 contacts end 51 of extension 48 so that arm 8 acts through connector 52 to pick up arm 9 and permit valve 4 to open to low clean fire position, Fig. 2. The upward flexing of arm 8 is limited by stop 37. If bar 9 is energized, then it warps or flexes upwardly causing inwardly turned end 51 to move upwardly away from cross bar 56 and cross bar 55 will now be picked up by extension 48 and bar 55 will move away from end 47 thus permitting valve 4 to open rapidly until cross bar 55 contacts the under face of arm 45 whereupon the inherent resilience of arm 8 now acts through bar 52 to retard the speed of arm 9 and thus slow down the rate of opening of valve 4 as it opens from about thirty percent (30%) of the full rate of fuel feed to the full or high fire rate of feed.

In the modified form shown in Figs. 8 and 9, arms 8 and 9 are provided with extensions 60 and 61. A connecting bar 62 is pivoted as at 63 in the downwardly turned ears 64 at the end of extension 60. Extension 61 is provided with a pair of upwardly turned ears 65 each provided with elongated openings 66 into which extend shoulders 67 on the lower end of bar 62. As shown in Figs. 8 and 9, both bars 8 and 9 are deenergized. When bar 8 is energized by closing switch 26, bar 8 warps upwardly and acts through bar 62, shoulders 67 and the upper ends of slots 66 to pick up bar 9 and raise it to the low clean fire position, as illustrated in Fig. 2. If bar 8 is deenergized by opening switch 26 and bar 9 is energized by closing of switch 21, then bar 9 will rise rapidly until shoulder 67 on bar 62 contacts the bottom of slots 66. This occurs when bar 9 and valve 4 reach a position of about thirty percent (30%) of the maximum rate of fuel feed. At about thirty percent (30%) of the full fire position arm 9 contacts the lower end of bar 62 and at this time bar 8, as in the other forms of the invention, acts through connector bar 62 to retard the rate of opening speed of bar 9 from about thirty percent (30%) to high fire position.

I claim:

1. In a control device adapted for regulating the supply of liquid fuel to a liquid fuel burner comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating the flow of fuel through said outlet, a motor operable when energized to shift said metering valve from pilot to high fire position, means for yieldably resisting the action of said first motor and retarding the rate of movement of the valve in an opening direction under the influence of said first motor, and a second motor operable when energized to render said means ineffective to resist the action of the first motor.

2. In a control device adapted for regulating the supply of liquid fuel to a liquid fuel burner

comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating the flow of fuel through said outlet, a motor operable when energized to shift said metering valve from pilot to high fire position, resilient means for yieldably resisting the action of said first motor and retarding the rate of movement of the valve in an opening direction under the influence of said first motor after the first motor has opened the valve substantially beyond pilot fire position, and a second motor operable when energized to render said resilient means ineffective to resist the action of the first motor and to shift said valve to low clean fire position.

3. In a control device adapted for regulating the supply of liquid fuel to a liquid fuel burner comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating flow through said outlet, a heat motor operable when energized to shift said valve from pilot to high fire position, a second heat motor operable when energized for shifting said valve from low pilot to low clean fire position, said second heat motor operable when deenergized into operative contact with the first heat motor to yieldably resist the action of said first heat motor and retard the rate of movement of the valve in opening direction under the influence of the said first heat motor after the valve has opened substantially from pilot fire position.

4. The control device claimed in claim 3 wherein said second heat motor when energized is ineffective to resist the action of said first heat motor as said first heat motor shifts said valve to high fire position.

5. The control device claimed in claim 4 wherein each heat motor comprises a strip of laminated thermostatic metal and an electrical resistance element in heat exchange relation therewith, a lost motion connection between the first and second heat motors whereby the second heat motor when energized acts through said lost motion connection on the first heat motor to shift said valve to low clean fire position, said lost motion connection being such that when the first motor is energized it moves from low clean fire to high fire position without acting upon said second heat motor, and a one way driving connection between said first heat motor and said second heat motor effective when said second heat motor is deenergized and the first heat motor is energized as the first heat motor moves from substantially beyond pilot fire position to high fire position whereby said second heat motor yieldably resists and retards the opening action of said first heat motor.

6. The control device claimed in claim 5 wherein said one way driving connection comprises an abutment carried by one of said heat motors and extending toward the other heat motor, a stop upon which the second heat motor rests when deenergized, the length of said abutment being less than the distance between the first and second heat motors when each are deenergized whereby the first heat motor when energized shifts said valve substantially beyond low pilot position before said abutment on the one motor contacts the other motor.

7. The control device claimed in claim 6 wherein said abutment takes the form of an adjustable set screw extending from said second heat motor toward said first heat motor.

8. In a control device adapted for regulating

the supply of liquid fuel to a liquid fuel burner comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating the flow of fuel through said outlet, first and second heat motors each comprising a warpable laminated thermostatic metal strip and an electric resistance element in heat exchange relation therewith, said first heat motor operable when energized to shift said valve from pilot to high fire position, said second heat motor operable when energized for shifting said valve from low pilot to low clean fire position, a stop against which said second heat motor rests when deenergized, a bar carried by the second heat motor and having a projection underlying the first heat motor, said projection contacting the underside of said first heat motor to flex the first heat motor in valve opening direction when the second heat motor is energized and flexes in valve opening direction, and an abutment carried by the second heat motor and projecting toward said first heat motor, said abutment engaging said first heat motor after the first heat motor has moved substantially from low pilot position when the second heat motor is deenergized and the first motor is energized.

9. In a control device adapted for regulating the supply of liquid fuel to a liquid fuel burner comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating the flow of fuel through said outlet, first and second heat motors each comprising a warpable laminated thermostatic metal strip and an electric resistance element in heat exchange relation therewith, said first heat motor operable when energized to shift said valve from pilot to high fire position, said second heat motor operable when energized for shifting said valve from low pilot to low clean fire position, a stop against which said second heat motor rests when deenergized, said first heat motor having two projections on its free end, a bar fixed on the second heat motor, the lower end of said bar contacting the underside of said first projection when the second heat motor is energized and the first heat motor is deenergized to flex the first heat motor to low clean fire position, the second projection on said first heat motor when the latter is energized contacting the deenergized second heat motor whereby the deenergized second heat motor yieldably resists opening movement of the first heat motor after the first heat motor has moved substantially beyond low pilot position.

10. In a control device adapted for regulating the supply of liquid fuel to a liquid fuel burner comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating the flow of fuel through said outlet, first and second heat motors each com-

prising a warpable laminated thermostatic metal strip and an electric resistance element in heat exchange relation therewith, said first heat motor operable when energized to shift said valve from pilot to high fire position, said second heat motor operable when energized for shifting said valve from low pilot to low clean fire position, a stop against which said second heat motor rests when deenergized, a driving connector pivoted to the end of the one of said heat motors and having a projection which slidably engages a slotted ear in the end of the other heat motor whereby when the first heat motor is energized the deenergized second heat motor acts through the connector to yieldably resist opening movement of the first motor and whereby when the second motor is energized and the first motor deenergized said second motor acts through said connector to flex the first motor to low clean fire position.

11. In a control device adapted for regulating the supply of liquid fuel to a liquid fuel burner comprising a casing having a chamber for liquid fuel and an outlet from said chamber, a metering valve for regulating the flow of fuel through said outlet, first and second heat motors each comprising a warpable laminated thermostatic metal strip and an electric resistance element in heat exchange relation therewith, said first heat motor operable when energized to shift said valve from pilot to high fire position, said second heat motor operable when energized for shifting said valve from low pilot to low clean fire position, a stop against which said second heat motor rests when deenergized, the free ends of each of said motors being of a bifurcated U form, a connector in the form of a double cross extending between the bifurcated ends of said heat motors and having the upper and lower cross members positioned respectively within the U-shaped ends of said motors with a lost motion between the U ends and the cross bars whereby when the first motor is energized and the second motor deenergized the second motor yieldably resists opening movement of the first motor after the first motor has moved substantially beyond low fire position and whereby when the first motor is deenergized and said second motor is energized said second motor flexes said first motor to low clean fire position.

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