

Jan. 10, 1939.

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2,143,277

MEANS FOR AUTOMATICALLY ELECTRICALLY CONTROLLING A FUEL OIL BURNING SYSTEM

Filed June 1, 1936

3 Sheets-Sheet 1

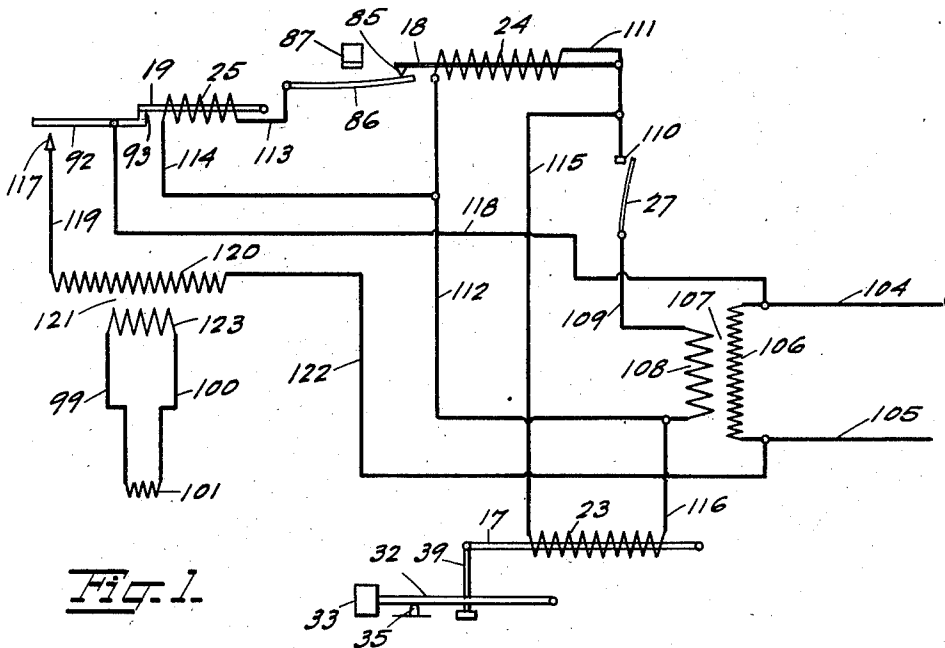


Fig. 1.

Fig. 2.

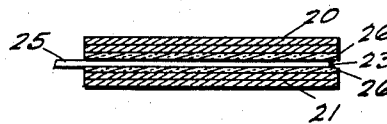
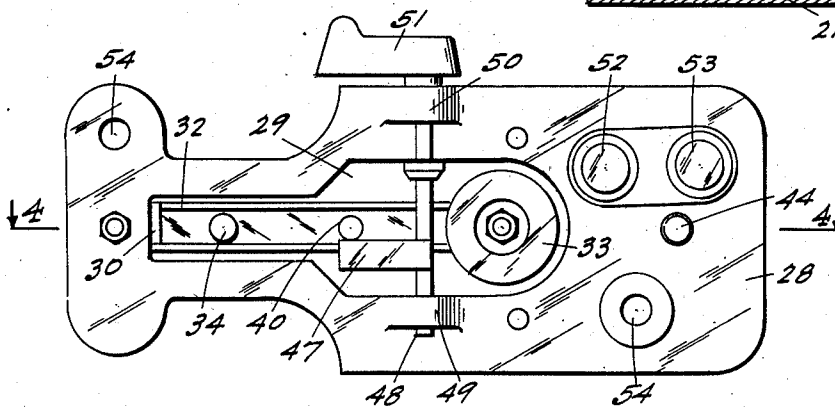


Fig. 3.

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3 Sheets-Sheet 2

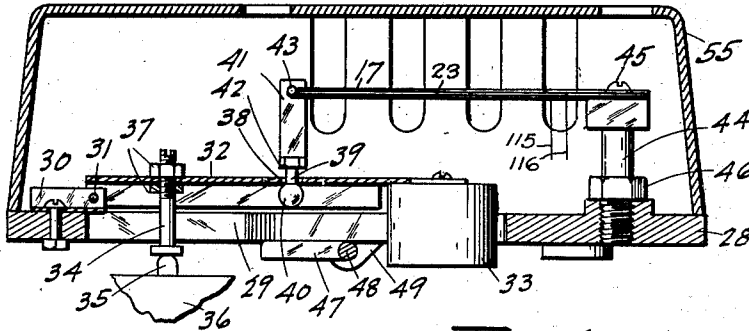


Fig. 4.

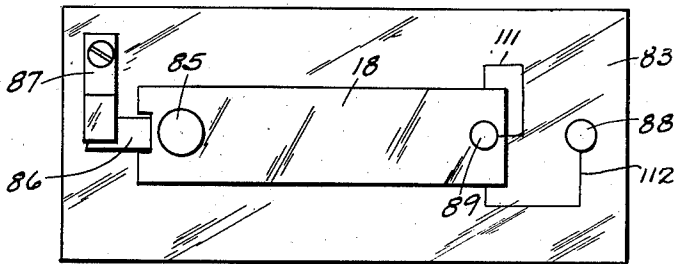


Fig. 5.

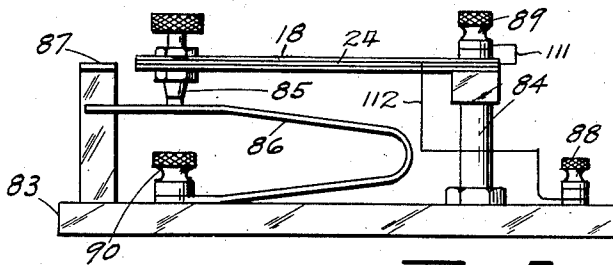


Fig. 6.

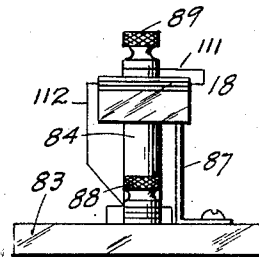


Fig. 7.

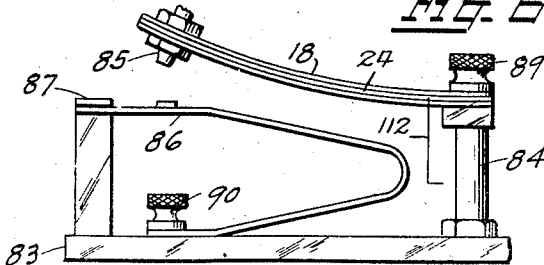


Fig. 8.

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3 Sheets-Sheet 3

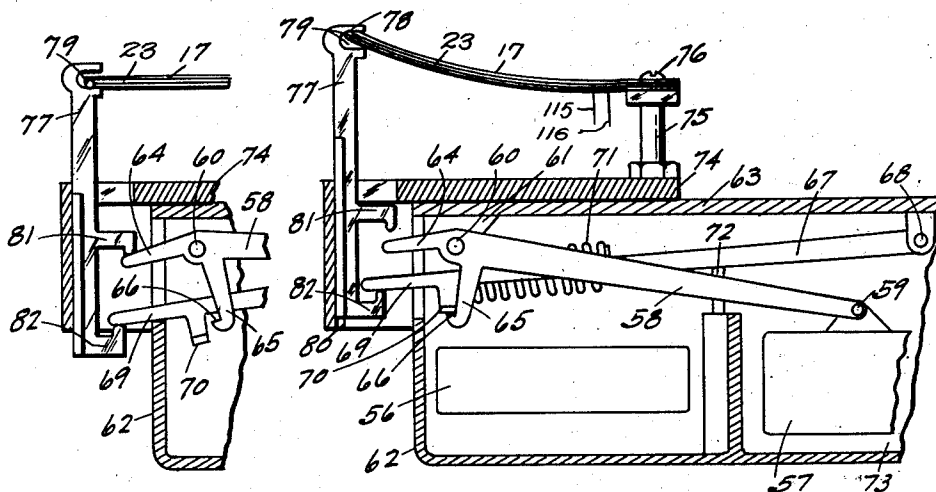


Fig. 10.

Fig. 9.

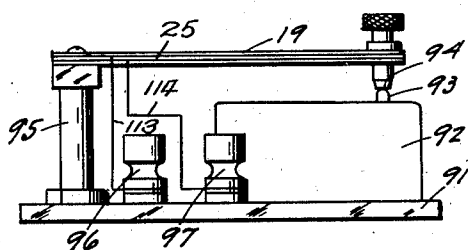


Fig. 11.

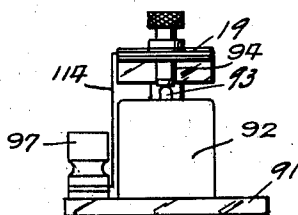


Fig. 12.

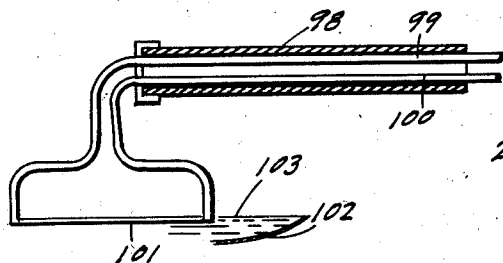


Fig. 13.

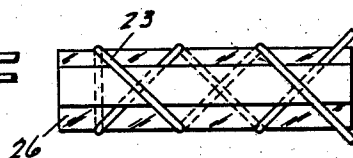


Fig. 14.

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UNITED STATES PATENT OFFICE

2,143,277

MEANS FOR AUTOMATICALLY ELECTRICAL- LY CONTROLLING A FUEL OIL BURNING SYSTEM

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tion of California

Application June 1, 1936, Serial No. 82,869

8 Claims. (Cl. 158—28)

This invention, a means for automatically electrically controlling a fuel oil burning system, relates to a new process and apparatus for controlling the fuel supply and its ignition and extinguishment in gravity type oil burners, and provides a positive, simple, non-magnetically-actuated control system, which is controlled and operated throughout, through the agency of electro-thermostatic means.

The usual type of electrical control for oil burning systems utilizes electromagnets and mechanical devices for operation and control of the various elements, and certain of these elements require manual resetting under predetermined conditions, while this invention provides automatic resetting under all conditions.

It is a known fact that the fuel oil burner known to the art as the gravity type burner, is comparatively less expensive to produce and simpler to install than other types, in standard types of house-heating equipment. However, its application has been somewhat restricted due to the fact that an inexpensive, dependable fuel control system, which is entirely automatic, has not been made available.

To those familiar with the art, it is obviously known that in the gravity type of burner, the liquid fuel flows from storage by gravity to an oil level control, or container controlled by a constant level valve mechanism, which maintains a constant level or head of fuel in relation to the burner inlet. A metering valve is usually included in the oil level control or placed in circuit between this control and the burner for regulating the supply of fuel to the burner.

It is also common practice to use a hot wire igniter in the burner for igniting the fuel, and which usually consists of a suitable length of resistance wire energized by a suitable source of potential.

When electrical ignition means of this type is used, it is most advisable to maintain the ignition device at an ignition temperature over a sufficiently prolonged period previous to admission of fuel, and thereafter for a sufficient period to insure efficient ignition and combustion within the chamber, and also to supply the fuel only after the ignition means is thoroughly heated to ignition temperature for the fuel, and then, to supply the fuel primarily at a rate which can be efficiently handled by the igniting means and by the fuel already in process of combustion, so as to provide more efficient and rapid ignition and obviate smoky combustion due to too rapid supply of fuel.

As the burner heats up and combustion is in-

creased, the rate of vaporization increases, and the fuel supply to the burner should be correspondingly increased, gradually, to the full metered value.

Retention of the fuel until the igniter is heated to incandescence or full ignition temperature insures quick ignition of the fuel. If cold oil is admitted coincidently with energization of the igniter, the cold oil will conduct the heat from the igniter, and additional time will be required for the igniter to reach the ignition temperature.

Slow or sluggish ignition and combustion will result providing a prolonged period of smoky or sooty flame which fills the fire box with soot, wasting fuel and producing an undesirable heat insulating coating, which reduces the economy of operation, as also, undesirable smoky fumes from the chimney.

The objects and advantages of the invention are as follows;

First; to provide electro-thermostatically actuated auxiliary metering means attachable to standard forms of fluid control devices, which will control the initial flow of fuel to the burner at a gradually increasing rate from zero to maximum metered flow as combustion in the burner increases.

Second; to provide means as outlined which will permit normal functioning of the standard metering means from the time said auxiliary metering means has attained its maximum flow position until such time as current is interrupted thereto.

Third; to provide a system including a device as outlined, which upon electrical de-energization will seal fuel against admission to the standard fluid level control device, and again permit passage of fuel thereto after a predetermined period following re-energization.

Fourth; to provide a system as outlined with a series of actuating and control devices, each of which includes a pair of cooperative bimetal plates with interposed electrical heating element, which mechanically actuate devices employed in carrying out the method outlined.

Fifth; to provide an attachment for a standard oil level control, and a series of warp actuators and a warp element actuated switch in conjunction with a room thermostat, which will, upon the closing of the room thermostat circuit or completion of the circuit by other means, energize the igniter, and, after a predetermined period, gradually release a flow of oil to a burner, increasing from zero to full metered flow, and after a second predetermined period will break the igniter cir-

cuit, and which will seal off the fuel supply upon failure of power or opening of the room thermostat circuit.

Sixth; to provide a system of burner and oil control which is controlled in its entirety through the medium of electrothermostatic devices, and which system is devoid of electro-magnets and motors.

Seventh; to provide a system as outlined which automatically resets itself for operation at the time when a cycle of operations is started by the closing of an electric circuit.

Eighth; to provide a system in which the oil is positively sealed off at its source following each cycle of operations, and in which the oil is maintained sealed until the ignition device has attained an ignition temperature for the oil, after which the oil is gradually released from minute to full flow in direct ratio to the instant capacity of the burner to burn the oil in a substantially smokeless condition.

Other objects and advantages of the invention will become apparent as the following description is read on the drawings forming a part of this specification, and in which similar reference characters are used to designate similar parts throughout the several views, of which;

Fig. 1 is a wiring diagram of the invention.

Fig. 2 is an enlarged transverse section through the warp type thermostat used in all of the control devices.

Fig. 3 is a bottom view of the auxiliary oil control attachment.

Fig. 4 is a sectional elevation of the auxiliary oil control attachment, taken on line 4-4 of Fig. 3, and shown attached to the usual type of oil level control.

Fig. 5 is a plan view of the igniter control.

Fig. 6 is a side elevation of Fig. 5 showing the igniter circuit closed.

Fig. 7 is a rear view of the igniter control.

Fig. 8 is a view similar to Fig. 6 except showing the igniter circuit open.

Fig. 9 is a sectional elevation through a modified form of auxiliary oil control attachment applied to a type of oil control using a trigger and float arrangement of valve cut-off, and shows the valve in released position.

Fig. 10 is a fragmentary view corresponding to Fig. 9, showing the auxiliary control in valve sealing position.

Fig. 11 is a side elevation of the igniter circuit switch control.

Fig. 12 is a front elevation of Fig. 11.

Fig. 13 is a sectional elevation through the igniter.

Fig. 14 is a plan view of the heating element for the warp thermostats.

The system includes the usual oil level control and metering valve, a delayed action auxiliary oil control and oil seal, a room thermostat provided with a dial and a circuit breaking switch, an igniter control with delayed circuit breaking action and an igniter control switch, in conjunction with a supply of oil and an oil burning device.

Bi-metals, which are well known in the art, are used for all warp elements. Each warp element, respectively 17, 18 and 19, consists of two cooperative bi-metal plates 20 and 21 with interposed heating elements 22 consisting of the respective resistance elements 23, 24 and 25 insulated by means of sheet mica 26 or other suitable insulating material, each resistance element having suitable terminals. The warp elements are specifically described and claimed in co-pending ap-

plication, Serial No. 614,412, filed May 1, 1932, for Electric valve.

The room thermostat may be of any standard make and therefore requires no description, since the different types are well known in the art. The room thermostat is indicated at 27 in the wiring diagram.

The auxiliary oil control attachment in one form, consists of a base 28 having a slot 29 formed therethrough, and a hinge member 30 formed or secured at one end of the slot as shown. Hingedly connected at 31 to member 30, is a counterweight lever 32 having a counterweight 33 secured to its free end.

Adjustably secured in the lever 32 is a valve plunger 34, which cooperates with the needle valve stem 35 of an oil level control 36, nuts 37 permitting most advantageous adjustment of this plunger relative to the stem 35.

Slidably and adjustably mounted through an aperture 38 formed through lever 32 is a time-delay lever-actuating connection 39 terminating at its lower end in a ball joint 40, the connection proper being threadedly adjustable in the connection head 41 and locked in adjusted position by means of the nut 42. The adjusted space between nut 42 and ball 40 determines the time delay period.

Hingedly connected at one end to the connection head 41 as shown at 43 is a thermo-warp element 17 constructed as previously described, the other end of this element being secured to a pillar 44 as shown at 45, this pillar being adjustably secured in base 28 and locked in adjusted position by means of the nut 46.

A release cam 47 is fixed on a shaft 48, which shaft is mounted in bearings 49 and 50, and a finger lever 51 is fixed on the projecting end of the shaft 48 to permit manual release of the valve 35 at will.

Suitable binding posts 52 and 53 are provided for the terminals of the resistance element of warp element 17, and suitable mounting holes 54 are provided for mounting the attachment on the oil level control 36. A ventilated cover 55 is provided for the unit.

The operation of this device is as follows; When the resistance element 23 is cut in circuit, the heat generated in the resistance element 23 causes the warp member 17 to flex upwardly. This heating is accomplished very slowly through the use of a properly designed resistance element and proper application of potential. The warped position of this type of member is shown in Fig. 8.

During the initial warp period, the connection 39 moves freely in the aperture without lifting lever 32, until the ball 40 cooperates with the undersurface of lever 32. This is the time delay period, since the counterweight 33 maintains the needle valve stem 35 depressed.

After the ball 40 contacts lever 32, further flexing of element 17 (which is very slowly accomplished), very slowly releases the needle valve by raising lever 32 to release stem 35, allowing the oil to enter the control unit 36 in a minute flow, gradually increasing to the metered adjustment of the unit 36. So long as the circuit remains unbroken through the heating element 23, the member 17 remains fully flexed with the plunger 34 clearing the now free end of needle valve stem 35.

When the circuit through 23 is broken the member 17 cools, permitting lever 32 to lower, plunger 34 contacting and depressing pin 35 and sealing the needle valve. Thus any interruption

of current will cause the needle valve to be sealed.

A modification of the auxiliary control is shown in Figs. 9 and 10, applied to a float operated trigger-type valve seal. This type of control consists of the usual float 56 and a flood-actuated float 57, to which is pivotally connected at one of its ends, the trigger lever 58 as shown at 59, this lever being pivotally mounted adjacent its other end as shown at 60, in a bearing 61 integral with the housing 62 or cover 63. A finger extension 64 is formed integrally with this lever and projects from the housing as shown. A trigger 65 is also formed integrally with this lever and terminates in a catch 66.

A plunger lever 67 has one end pivoted to the housing 62 or cover 63 as indicated at 68, the other end extending from the housing as a finger actuating lever 69, and integral with this portion of the lever is a retainer 70 which is cooperatively related to the trigger. A spring 71 cooperates with lever 67, forcing it down when released by the trigger 65.

In operation, the needle valve 72 may be sealed by depressing finger lever 64 which releases the catch 66 from retainer 70, and spring 71 then snaps the lever 67, 69 to the position shown in Fig. 10, depressing needle valve stem 72.

If chamber 73 becomes flooded, the float 57 is raised and accomplishes the same result. To reset the valve, it is necessary to manually raise the finger lever 69 until retainer 70 is caught by catch 66.

To provide these adjustments automatically, an attachment is provided, consisting of a base 74 which is attachable to the oil control unit just described.

A pillar 75 is adjustably mounted in the base and the warp element 17 is affixed at one of its ends to the pillar as shown at 76, the other end cooperating with a slide or plunger 77 as shown at 78, the slot 79 forming another method of obtaining time delay.

This slide is made sufficiently heavy to act by itself to keep the valve closed, and is mounted in some suitable manner, such as in gibways 80 in the base 74, and has two inwardly projecting fingers 81 and 82 which respectively cooperate selectively with opposite sides of finger release levers 64 and 69.

Thus, when the member 17 is electrically heated, the member is flexed as shown in Fig. 9, this flexing being conducted slowly, the initial warp not in any degree releasing the valve 72, further warp raising lever 69 and releasing 64 until trigger 65 catches retainer 70, thus gradually opening the valve after a predetermined time delay, from zero to a completely free valve.

When current is interrupted to the resistance element 23, the warp element 17 cools and returns to the position shown in Fig. 10, gradually depressing lever 64 until member 70 is released, spring 71 then snapping lever 69 to closing position as shown in Fig. 10. Thus any interruption of current to heating element 23 will cause the valve 72 to be closed tightly. This device will work positively without the aid of a counterweight, and can be so used. Although the method of application has been described for only two units, any type of level control can be similarly controlled by this invention.

The time delay control for the igniter consists of a base 83, on which is mounted a pillar 84, to which is secured by one of its ends, the warp element 18, its other end being provided with

an adjustable contact point 85, by means of which the time delay period is adjusted.

Also mounted on the base is a follower contact and conductor 86 which is formed of resilient material, and a stop 87 is fixed to the base and limits the opening movement of the member 86. Suitable binding posts 88, 89 and 90 are provided respectively for one side of the warp element resistance and warp member in parallel, for the other side of the resistance, and for the time delay element 86.

In Figs. 6 and 7, the control is shown in its cold position, with the circuit completed through 89, 18, 85, 86 and 90.

Now, if the circuit is completed through 88 and 15 89, the resistance 24 will heat the element 18 slowly, flexing member 18 slowly while the circuit through 85, 86 remains complete, until 86 is stopped by the travel limiting means 87, the member 18 continuing to warp, breaking circuit 20 between 85 and 86.

When current is interrupted through 88, 89, the warp member 18 cools and returns to the position shown in Fig. 6, again closing the circuit through 89, 18, 85, 86 and 90.

The igniter control consists of a base 91, on which is mounted a standard pin switch 92 having a plunger 93, which upon depression opens the switch, and on release closes the switch. This switch does not form a part of the invention, 30 and any other similar type of switch can be substituted.

A warp element 19 has an adjustable screw 94 mounted at one of its ends for cooperation with the plunger 93, and has its other end affixed to the pillar 95, which in turn is affixed to the base 91. Suitable binding posts 96 and 97 are provided for the resistance element 25, and other binding posts (not shown) are provided for the switch 92.

When member 19 is heated, it flexes upwardly, releasing pin 93 and switch 92 closes. When member 19 cools off, it depresses pin 93, opening the switch.

The igniter is of standard construction and 45 consists of a section of metal conduit 98 carrying insulated conductors 99 and 100 to the resistance or heater wire 101, which is heated by a suitable supply of current, and is installed in the furnace 102 in cooperative relation to 50 admitted oil 103 which it ignites.

The wiring diagram Fig. 1 illustrates the system in its entirety and includes the apparatus described.

A suitable source of potential is supplied 55 through main line conductors 104 and 105, which are connected directly to the primary 106 of a step-down transformer 107. The room thermostat 27 is connected to one side of the secondary 108 of this transformer through a conductor 109, 60 this thermostat normally maintaining a broken circuit above a predetermined temperature in the room. When the temperature drops, the thermostat closes a switch, completing a circuit through contact 110, through wire 111, resistance 65 element 23 of warp member 18, wire 112 to the other side of the secondary 108 of transformer 107, coincidentally making circuit through member 18, contact 85, follow member 86, wire 113, 70 resistance 25 of warp member 19, through wire 114 to conductor 112 to secondary 108, and, coincidentally making circuit from contact 110 through wire 115 to resistance element 23 of warp member 17 thence through wire 116 to secondary 108. 75

Thus all warp members are simultaneously heated, but at different rates.

The initial heating of warp member 19 releases pin 93, permitting switch 92 to close to contact 117, closing a circuit from line 104 through wire 118, switch 92, contact 117, wire 119 to primary 120 of step-down transformer 121, thence through wire 122 to line 105.

The closing of this last circuit energizes the secondary 123 of transformer 121, the terminals of this secondary being connected to the respective terminals 99 and 100 of the igniter resistor 101, heating this resistor.

During this period, all warp elements are heating and flexing slowly. The initial warp of element 19 has permitted switch 92 to close. The initial warp of member 17 has not in the least opened valve 35, but further warp very slowly releases the valve, permitting a minute flow of oil 103 to burner 102, which is gradually increased. By this time, the igniter is heated to ignition temperature for the oil, and this small quantity of oil is ignited, and as the furnace or stove heats up, an increasing flow of oil is supplied by further warp of member 17 and can be handled efficiently by the burner, until finally the valve stem is completely freed and the maximum metered flow of oil is delivered to the burner.

By this time, the oil is burning efficiently and the igniter is no longer required. Also, the warp element 18 has flexed sufficiently to clear the contact 86 after the opening of this member has been stopped by stop 87. The circuit is therefore broken through resistance 25 at contact 85, and element 19 cools, and after the element is sufficiently cooled, it depresses plunger 93, opening switch 92, 117, breaking the circuit to primary 120 of transformer 121, while elements 18 and 17, being constantly heated, remain in their maximum flexed position.

Should the temperature in the room rise above a predetermined value, or in the event of power failure, the circuit will be interrupted, allowing both elements 18 and 17 to cool, closing circuit 85 and 86 and closing valve 35 or 72. Thus all contingencies are guarded against.

It will be understood that variations in the method, system, or construction and arrangement of parts, which variations are consistent with the appended claims, may be resorted to without detracting from the spirit or scope of the invention or sacrificing any of the advantages thereof.

I claim:

1. In a fuel-burning system having a heat-regulating thermostat and an electric igniter for igniting fuel; a mechanical switch controlling said igniter; a first warp element controlled by said thermostat; a second warp element controlled by said first warp element and controlling said mechanical switch, said second warp element being constructed for closing said switch upon initial actuation and opening said switch after a predetermined time delay period independently of the control of said first warp element by said thermostat.

2. A system as claimed in claim 1; a fuel-flow control valve; a third warp element controlled by said thermostat and controlling said valve, releasing said valve to open after a predetermined time delay period, whereby said igniter and said valve are actuated in sequential time-delay relation, and said igniter is actuated through a predetermined period of time independently of said thermostat, while said valve

is maintained released until the condition of the thermostat is changed by change in temperature.

3. In a fuel burning system, fuel ignition means and a circuit therefor; a mechanical switch controlling said circuit; a first warp element normally maintaining said switch in circuit-breaking position, a first heating resistance for said first warp element and a first circuit therefor; a second warp element normally maintaining said first circuit closed through said first heating resistance, and a second heating resistance for said second warp element and a second circuit therefor; a heat-regulating thermostat controlling said first and second circuits for initial operation; means breaking circuit through said second warp element and said first heating resistance after a predetermined degree of warping of said second warp element, whereby said first warp element will open said mechanical switch after a predetermined period of time independently of the circuit control of said heat-regulating thermostat.

4. In a fuel burning system, fuel ignition means and a circuit therefor; a gravitationally closed switch controlling said circuit; a first warp element normally maintaining said switch in open position; a first heating resistance for said first warp element and a first circuit therefor; a second warp element normally maintaining said first circuit closed through said first heating resistance, and a second heating resistance for said second warp element and a second circuit for said second heating resistance; a heat regulating thermostatic switch controlling said first circuit for closing and opening and said second circuit for closing only; a resilient conductive follower in circuit with said first heating resistance and normally in circuit-making contact with said second warp element; and means limiting the travel of said follower, whereby, after a predetermined degree of warping of said second warp element said first circuit will be broken and said first warp element will release said gravitationally-closed switch to open after a predetermined time delay period irrespective of the control of said circuits by said heat-regulating thermostatic switch.

5. A system as claimed in claim 4, and including a fuel-flow control valve, a third warp element having a third heating resistance controlled by said thermostatic switch, said third warp element controlling said valve, releasing said valve to open after a predetermined degree of warping of said third warp element, whereby said ignition means and said valve are actuated in sequential time delay relation, with the valve released during the entire closed period of said thermostatic switch.

6. In a fuel burning system, a mechanical switch for controlling an ignition circuit; a first warp element normally maintaining said switch open and a first heating resistance for said first warp element; a resilient follower connected in series with said first heating resistance and stop means limiting the movement of said follower in one direction; a second warp element normally completing a first circuit through said follower and maintaining said follower in depressed position relative to said stop means, and a second heating resistance for said second warp element and a second circuit for said second heating resistance; and a heat-regulating thermostatic switch controlling said second circuit, and controlling said first circuit to said second warp element, whereby, upon closing of said thermostatic switch, said first and second circuits will be si-

multaneously completed, said mechanical switch will be closed upon initial flexing of said first warp element, said first circuit will be broken upon cooperation of said follower with said stop means and said mechanical switch opened by said first warp element after a predetermined period of time irrespective of the control of circuits by said thermostatic switch.

7. A system as claimed in claim 6 and including; a fuel-flow control valve; means normally maintaining said valve closed, a third warp element and a heating resistance therefor controlled by said thermostatic switch; and an operative connection between said means and said third warp element effecting release of said valve to open only after a predetermined degree of flexing of said third warp element, whereby, with simultaneous closing of all circuits by said thermostatic switch, said mechanical switch will be closed a predetermined period of time in advance of the release of said valve.

8. An oil-burning system comprising; a first circuit including a first transformer secondary and an ignition resistance; a second circuit including a source of potential, a normally-open mechanical switch and the primary of said first transformer; a third circuit including the secondary of a second transformer, a first heating resistance, a follower, a first warp element, and a room thermostatic switch; a fourth circuit in-

cluding said secondary of said second transformer, said thermostatic switch, and a second heating resistance for said first warp element; a fifth circuit including said secondary of said second transformer, said thermostatic switch, and a third heating resistance; the primary of said second transformer being connected across said source of potential; a second warp element for said first heating resistance flexing upon heating to release said mechanical switch for closing said second circuit to heat said ignition resistance and upon cooling to open said mechanical switch to terminate heating of said ignition resistance; a stop element for said follower causing said first warp element to break circuit there- with after a predetermined degree of flexing of said first warp element; and a third warp element for said third heating resistance; means normally maintaining said fuel-supply valve closed and having an operative connection with said third warp element releasing said valve to open only after a predetermined degree of flexing of said third warp element, whereby, upon closing of said thermostat switch, all warp elements are coincidentally heated, the ignition resistance is heated for a predetermined period of time before release of said valve, and for a total predetermined period of time independently of the closed or open position of said thermostatic switch.

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