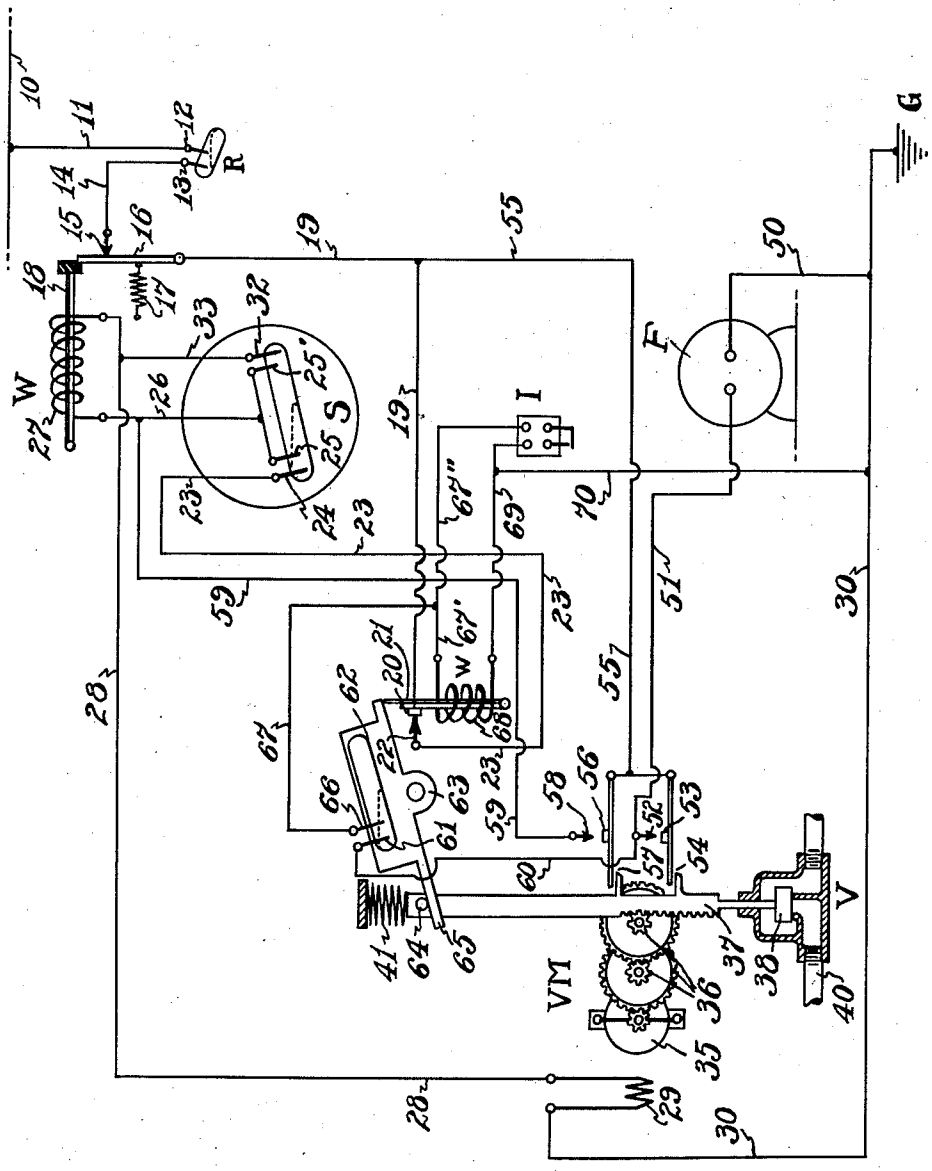
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OIL BURNING CONTROL SYSTEM

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OIL-BURNING-CONTROL SYSTEM.

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The object of my invention is to provide a control system for oil burners of such character that upon an automatic call for heat a delivery of fuel, and ignition means therefor will be initiated, the fuel delivering means comprising an electric motor and an electrically actuated valve in the fuel delivery line; initial fuel delivery will be maintained throughout the heat calling period provided initial ignition is accomplished and combustion is maintained; fuel delivery will be discontinued upon cessation of demand for heat or upon cessation of combustion, or, within a predetermined time, in case of failure of initial ignition fuel; the fuel igniting means will be automatically discontinued at the end of the predetermined time; and initiation of fuel delivery may not be accomplished unless the apparatus is at a predetermined low temperature and the temperature affecting element within immediate influence of fuel combustion is in proper operative condition.

It is common practice at the present time to deliver fuel oil to a suitable burner, properly arranged in conjunction with a combustion chamber and heating element such as a furnace or boiler, by means of an electric motor, said motor being commonly called the fuel motor and forcibly delivering either the oil or the necessary air or both to the fuel nozzle. It is also common practice in apparatus of the kind under consideration to control the flow of oil by means of a valve the controlling element of which is biased to closed position by a spring and moved to open position by an electric motor of the type capable of being stalled without injury in order to hold the valve in open position for substantial periods of time. It is also common practice in apparatus of this kind to utilize mercury switches and warp switches comprising bimetallic blades and means for electrically heating the same. It is also common practice to utilize a thermostat controlled circuit controller arranged within the immediate influence of the heat of the combustion chamber and this element, in my construction, I shall for convenience designate as a "stack thermostat" because a convenient position for its arrangement in the system is within the outlet stack of the combustion chamber although it may be arranged at any one of a number of other convenient positions.

The precise details of the various elements mentioned above, and which are utilized in my controlling device form no part of my present invention and consequently I have illustrated my invention diagrammatically, the drawing being a diagrammatic illustration of the various elements and their electrical and mechanical relations and connections.

Referring to the diagram 10 indicates a power wire connected by wire 11 with terminal 12 of the room thermostat R. The associated terminal 13 of room thermostat R is connected by wire 14 with a fixed terminal 15 contacted by a movable blade 16 biased away from such contact by a spring 17 and held in said contact by the movable element 18 of the safety warp switch W. Blade 16 is connected by wire 19 with a contact 20 carried by the bimetallic element 21 of the ignition warp switch w said contact 20 being normally in contact with the terminal 22 connected by wire 23 with terminal 24 of the stack thermostat S said thermostat comprising a terminal 25 companion to terminal 24 at the cold side of the stack thermostat. Terminal 25 is electrically integral with a terminal 25′ at the hot end of the stack thermostat and these two terminals (they may be a single terminal in certain constructions) are connected by a wire 26 with one end of the heating coil 27 of the warp switch W the other end of said warp switch being connected by wire 28 to one end of the field coil 29 of a fuel control valve motor VM, the other end of said field coil 29 being connected by wire 30 to ground (or to the power line companion to line 10).

The hot end of the stack thermostat S also comprises a terminal 32 companion to the terminal 25′ and connected by wire 33 with wire 28.

The motor VM comprises a rotor 35 con-

nected by a suitable train of gears 36 with the stem 37 of the movable valve element 38 of the fuel control valve V which is arranged in the fuel conduit 40 leading from a suitable source of supply either directly to the fuel nozzle or to a pump controlled by the fuel motor.

The valve stem 37 is biased to cold position by a spring 41 and the motor VM is of a type which will permit stalling and electrical maintenance in stalled position without harm.

The energizing circuit of the fuel motor F comprises a wire 50 connected to ground and a wire 51 connected to a fixed terminal 52 arranged to be contacted by a swinging terminal 53 under the control of valve stem 37 as indicated at 52, the contact 53 being biased normally open. Contact 53 is connected by a wire 55 with wire 19 and wire 55 is also connected to a swinging contact 56 normally biased to open position and under the control of valve stem 37 as indicated at 57. Contact 56 coacts with a fixed terminal 58 connected by wire 59 with wire 26.

Terminal 52 is connected by wire 60 with a terminal 61 in the mercury switch 62 which is carried by a tilting carrier 63 which is biased to circuit opening position, most conveniently by over-balanced weight, and is normally held in circuit closing position by a pin 64 carried by a valve stem 37 and having a one way engagement with an extension 65 of carrier 63. The terminal 66 of tube 62 is companion to terminal 61 and is connected by a wire 67 and branch wires 67′ and 67″ respectively with the heating coil 68, of warp switch *w*, and the primary of the electrical ignition means I.

Coil 68 and the primary ignition means are also connected by wire 69 and this wire is connected by wire 70 to ground.

The blade 21 of the warp switch *w* is so spaced that, when cold and contact 20 is in contact with terminal 22, the tube carrier 63 will be supported in circuit closing position, against its bias, by blade 21 even though said carrier be released by withdrawal of pin 63.

The diagram shows the parts in what may be termed the normal positions, i. e., a condition of no fuel delivery and no call for fuel delivery.

Upon the call for heat the room thermostat will swing to circuit closing position thus closing the circuit 10, 11, 12, 13, 14, 15, 16, 19, 20, 22, 23, 24, 25, 26, 27, 28, 29, 30 to ground thereby energizing the fuel valve motor VM and raising and temporarily maintaining valve 38 from its seat. The upward movement of valve stem 37 will release tube carrier 63 so that it is then only supported by blade 21, and will also bring contacts 53 and 56 into contact with terminals 52 and 58 respectively thereby closing the fuel motor circuit 11, 12, 13, 14, 15, 16, 19, 55, 53, 52, 51, 50 to ground; and also closing the ignition circuit 11, 12, 13, 14, 15, 16, 19, 55, 53, 52, 60, 61, 66, 67, 67′ through 68, and 67″ through the ignition primary, 69, 70 to ground.

The flow of current through coil 27 will heat blade 18 of warp switch W and, if maintained a sufficient length of time, will release blade 16 and thus break all circuits at 15 and stop further operation of the apparatus until the device is re-set by hand; the fuel motor stopping delivery of fuel and the fuel valve motor element 38 moving to fuel blocking position under the action of spring 41 and withdrawing contacts 53 and 56 from contact with the respective terminals 52 and 58.

Flow of current through the heating coil 68 for a predetermined time, which will be the time estimated to insure proper ignition of the fuel under normal conditions, will cause a warping of blade 21 so as to release tube carrier 63 and thus break the ignition circuit at 61—66 so that there will be no loss of current due to necessity of maintaining current in the heating coil of the warp switch 20 after a fuel has been properly ignited.

If combustion is properly initiated the stack thermostat S will be thermally actuated to cause, within a predetermined time, a break of the fuel valve motor circuit at 24—25 but to concurrently make a circuit at 25′—32 thus providing a maintaining circuit 11, 12, 13, 14, 15, 16, 19, 55, 56, 58, 59, 26, 25′, 32, 33, 28, 29, 30 to ground for the fuel valve motor which shunts the heating coil 27 of the safety warp switch W.

When a sufficient amount of heat has been delivered the room thermostat will return to normal open position thus breaking all circuits at 12—13, stop the fuel delivery motor and releasing the fuel valve motor so that spring 41 will serve to return element 38 to fuel blocking position and permitting 53 and 56 to move away from their associated terminals, and returning tube 62 to circuit closing position, blade 21 snapping under carrier 62.

It will be noted that any failure of circuit closing function of the room thermostat, for any reason, renders the apparatus incapable of delivering fuel; that any failure of circuit closing function of the stack thermostat at terminals 24—25 will render the apparatus incapable of delivering fuel because the fuel valve motor will not be actuated and flow of fuel will be blocked at 38; that any failure of circuit making capacity of the stack thermostat at 25′—32 will result in discontinuance of fuel delivery because no maintaining circuit for the fuel valve motor will be produced and the pre-

ceding break at 24—25 will release stem 37 and permit spring 41 to drive the element 38 to fuel blocking position and at the same time break the fuel motor circuit at 52—53. If, for any reason, the stack thermostat should become stuck so as to fail to respond freely to temperature variations undesirable fuel delivery would be prevented within a safe time because, if the stack thermostat fails to respond to increased temperature the circuit at 24—25 will be maintained and there will be a consequent sufficient flow through coil 27 to actuate warp switch W; and if the stack thermostat sticks in the hot position the fuel delivery will be discontinued, as already described, when the room thermostat moves to heated position and, when it returns to cold or heat-demand position the fuel valve motor will not be actuated because the initiating circuit is only through terminals 24—25.

For the sake of brevity in the claims the following terms will be used:

"Fuel motor" designates an electric motor which actuates means for positively delivering fluid fuel, as for instance oil and air, either or both, to a suitable burner; "fuel valve" designates a movable fuel flow controlling element; a "valve motor" an electrically energized element capable of acting upon the fuel valve to move to and hold it in position against the action of a normal bias acting upon the fuel valve to move the fuel valve to closed position; "combustion control" a thermostat, or equivalent element comprising an element sensitive to combustion conditions in or reasonably closely adjacent the combustion chamber of the furnace to be controlled and also comprising a circuit-controlling element moved into and out of circuit-making position by reason of the response of the thermostatic element to combustion conditions. The thermostatic element of this structure might be an element not strictly a thermostat but responsive to variations in intensity of light due to combustion conditions or responsive to variations in temperature due to combustion conditions; "timed switch" an electric circuit controlling element (most conveniently what is known as a warp switch) capable of maintaining or breaking an electric circuit and responsive at the end of a predetermined time interval to electrical conditions established in an element thereof to modify the circuit controlled by the switch.

I claim as my invention:

1. A controller for fluid fuel burners comprising; a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control.

2. A controller for fluid fuel burners comprising, a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position and non-automatic in resetting, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control.

3. A controller for fluid fuel burners comprising a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position and non-automatic in resetting, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control; a fuel motor; an energizing circuit for the fuel motor comprising the starting switch, the first-mentioned timed

switch and a biased-open switch closed by movement of the fuel valve to open position.

4. A controller for fluid fuel burners comprising a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position and non-automatic in resetting, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control; a fuel motor; an energizing circuit for the fuel motor comprising the starting switch, the first-mentioned timed switch and a biased-open switch closed by movement of the fuel valve to open position; electric ignition means; and an energizing circuit for said electrical ignition means, comprising a timed electrical element affecting the second-mentioned timed switch.

5. A controller for fluid fuel burners comprising a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position and non-automatic in resetting, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control; a fuel motor, an energizing circuit for the fuel motor comprising the starting switch, the first-mentioned timed switch and a biased-open switch closed by movement of the fuel valve to open position; electric ignition means; and an energizing circuit for said electrical ignition means comprising a timed electrical element affecting the second-mentioned timed switch and also comprising a circuit breaker biased to open position, a movable element of the second timed switch being arranged to hold said last-mentioned circuit breaker against its bias; and means actuated by the fuel valve, in its closing movement, to move said last-mentioned circuit breaker against its bias to circuit-closing position.

6. A controller for fluid fuel burners comprising, a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control; a fuel motor; an energizing circuit for the fuel motor comprising the starting switch, the first-mentioned timed switch and a biased-open switch closed by movement of the fuel valve to open position.

7. A controller for fluid fuel burners comprising a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control; a fuel motor; an energizing circuit for the fuel motor comprising the starting switch, the first-mentioned timed switch and a biased-open switch closed by movement of the fuel valve to open position; electric ignition means; and an energizing circuit for said electrical ignition means,

comprising a timed electrical element affecting the second-mentioned timed switch.

8. A controller for fluid fuel burners comprising, a fuel valve biased to closed position; a valve motor connected to said fuel valve to open the same; a combustion control comprising two oppositely set circuit breakers, one in circuit-making position in the absence of combustion and one in circuit-making position in the presence of combustion; an energizing circuit for the valve motor comprising in series a starting switch, a timed switch normally biased to open position and non-automatic in resetting, an automatically resetting timed switch, the cold-closed circuit breaker of the combustion control and the electrical timed element of the first-mentioned timed switch; a shunt circuit for shunting the electrical timed element of the first-mentioned timed switch, said shunt being connected to the energizing circuit of the valve motor and comprising a switch biased-open and closed by opening movement of the fuel valve and also comprising the hot-closed circuit breaker of the combustion control; electrical ignition means; and an energizing circuit for said electrical ignition means, comprising a timed electrical element affecting the second-mentioned timed switch.

9. A controller for fluid fuel burners comprising, electric ignition means, an energizing circuit for said ignition means comprising a biased-open circuit breaker, an electrically-timed element normally holding said circuit breaker closed, an electric circuit including said timed element in parallel with the ignition means and beyond the circuit breaker, a starting switch, and means controlled by said starting switch to move the circuit breaker to closed position against its bias.

In witness whereof, I have hereunto set my hand at Minneapolis, Minnesota, this 6th day of March, A. D. one thousand nine hundred and twenty eight.

DANIEL G. TAYLOR.