

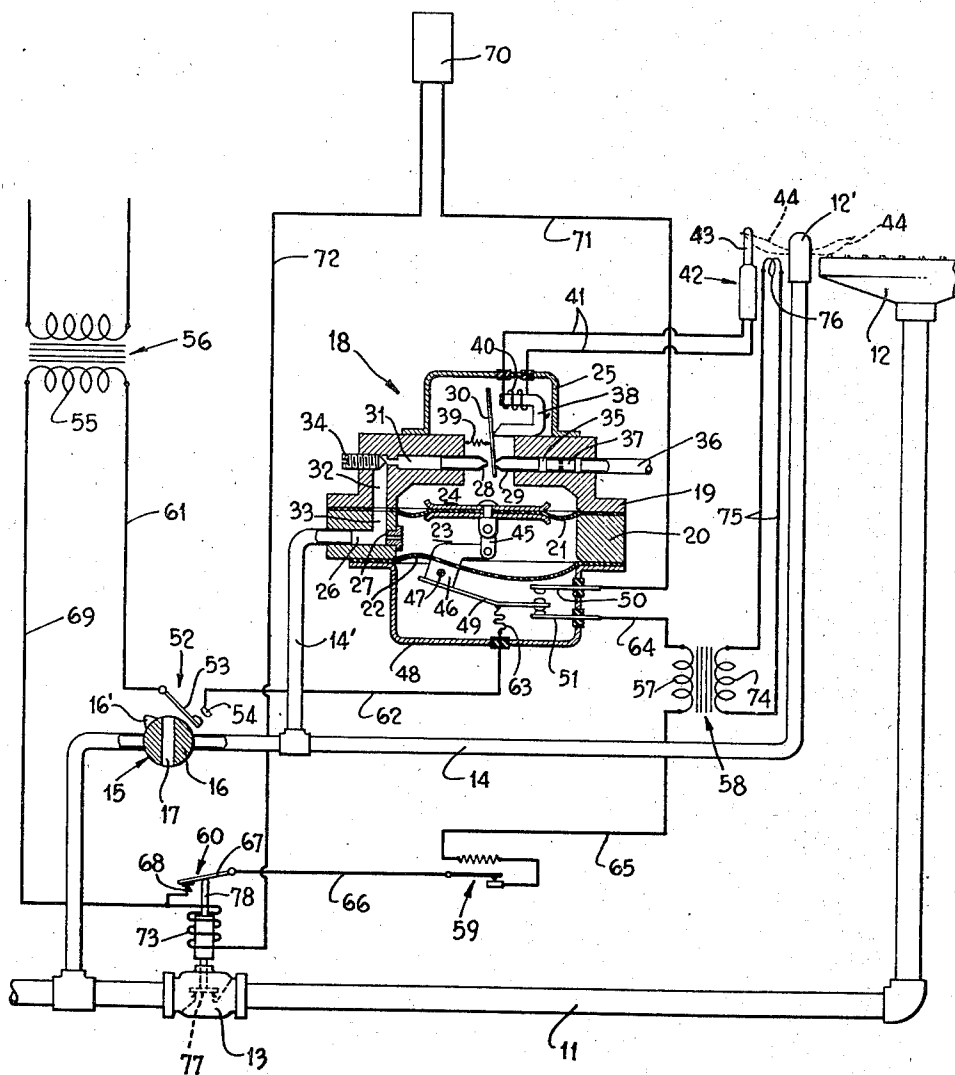
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BURNER CONTROL SYSTEM

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BURNER CONTROL SYSTEM

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My present invention relates to means for controlling the operation of a fluid-fuel burner system of the type which includes a main burner, a pilot burner for the main burner, an electric igniter for the pilot burner, and an electrically operated valve for controlling supply of fuel to the main burner.

An object of this invention is to provide, in a system of the character described, improved means for delaying opening of the main-burner valve until the pilot burner is safely ignited.

Another object is to provide means for preventing energization of the igniting means for a predetermined interval following closing of the main-burner valve.

Another object is to provide means responsive to the flame of the pilot burner, which means is activated and deactivated relatively slowly upon respective establishment and extinction of the flame, for effecting the delay referred to in the preceding objects.

Another object is to provide, for effecting the delay, a motor, operated by the pressure of the fuel in the system, for actuating switching means controlling energization of the igniting means and the main-burner valve; the motor being so constructed that its operation in alternate directions is relatively slow.

Another object is to provide means responsive to the condition of the main-burner valve for controlling energization of the igniting means.

Other objects and advantages of the invention will be found in the description, the drawing, and the claims; and, for full understanding of the invention, reference is to be had to the following detailed description and accompanying drawing, the single figure of which is a view, mainly in diagram, of a gas-burner control system embodying the invention.

In the drawing, the numeral 11 indicates a conduit through which gas from a source (not shown) is supplied to a main burner 12 under the control of an electromagnetically-operated main valve 13. Branching from conduit 11, ahead of the main valve 13, is a pipe 14 to the end of which is connected a pilot burner 12' for igniting the main burner. Controlling flow through pipe 14 is a valve 15 comprising a manually-rotatable plug 16 having a passage 17.

Connected to pipe 14 at the outlet side of valve 15, by another pipe 14', is a fluid-pressure-operated switch generally indicated at 18 and comprising a pair of hollow casing sections 19 and 20 between which is clamped at its margin a main flexible diaphragm 21. The open bottom

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end of the lower section 20 is closed by another flexible diaphragm 22 to form a pressure chamber 23 below the main diaphragm 21; another pressure chamber 24, above the main diaphragm, being formed by the upper section 19, the apertured top end of which is closed by a housing 25. While the valve 15 is open, the lower pressure chamber 23 is constantly subjected to the gas pressure through a horizontal inlet passage 26 in the section 20; a flow-restricting or orifice member 27 being provided at the inner end of this passage. Controlling fluid pressure in the upper chamber 24 is a three-way pilot valve comprising a pair of jets 28 and 29 with which a movable blade-like closure 30 cooperates. The jet 28 is fitted in a horizontal passage 31 in the upper section 19, which passage is in communication with the inlet passage 26 through aligned vertical passages 32 and 33 in sections 19 and 20, respectively. Cooperating with a reduced section of passage 31 is a conically-pointed screw 34 whereby the rate of flow of gas to the jet 28 can be adjusted. The jet 29 fits in another horizontal passage 35 which leads through a pipe 36, in series with a flow-restricting member 37, to the atmosphere; the pipe 36, in practice, being extended to a point adjacent the main burner 12.

The pilot closure 30 is of magnetizable material and is fulcrumed on the lower arm of a U-shaped electromagnet core 38 mounted on the top surface of section 19; a compression spring 39 biasing the closure-armature 30 away from the upper arm of the core and into engagement with jet 29. Around the upper arm of core 38 is an energizing coil 40 which is connected by wires 41, sealingly and insulatingly extending through the top wall of housing 25, to a thermoelectric generating device generally indicated at 42 and comprising one or more thermocouples, contained within a shell 43, having hot junctions adapted to be heated by the flame 44 of pilot burner 12'. Thermoelectric generating devices of the type commonly employed in gas-burner control systems may be so constructed that their heating and cooling (and the resultant growth and decay of generated current) are either relatively slow or fast. Examples of such thermoelectric generating devices are disclosed in the Ray Patent No. 2,340,899. In the device of Fig. 1 of that patent, the elements are relatively light and their hot junctions (enclosed in thin stainless steel protective sleeves) are exposed to the flame or to the atmosphere and therefore heat or cool rapidly; whereas as shown in Fig. 6, the elements are relatively massive, and are surrounded

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by insulating material and a relatively-thick metal jacket, so that they heat or cool slowly. To effect delay of operation of the system herein disclosed (in addition to such delay as may be produced by the operation of the fluid-pressure motor of switch 18) the thermoelectric generating device 42 may be so constructed that it heats and cools relatively slowly.

Connected, by a link 45, to stiffening plates arranged on opposite sides of the main diaphragm 21 is a switch member 46 rockably mounted on a pin 47 secured to a housing 48 which is attached to the lower section 20 below diaphragm 22; the member 46 being in two sections joined together with diaphragm 22 therebetween. Carried by the switch member 46 is a contact arm 49 which cooperates with a pair of contact blades 50 and 51 insulatingly mounted on housing 48.

Indicated at 52 is a switch comprising a contact arm 53 which is moved into engagement with a fixed contact 54, when the valve 15 is opened, by means of a cam 16' projecting from the valve plug 16. When switch 52 is closed, the three-way switch constituted by arm 49 and blades 50 and 51 serves to selectively control energization of two electrical circuits. With arm 49 in engagement with blade 51, as shown, a first circuit is completed which comprises the secondary 55 of a conventional A. C. service transformer 56, the primary 57 of an ignition transformer 58, a thermal cut-out 59, and a switch 60 operated by the valve 13; the circuit being traced from the right-hand side of the transformer secondary 55 through wire 61, switch arm 53, fixed contact 54, wire 62 and flexible extension 63, switch arm 49, contact blade 51, wire 64, primary 57 of ignition transformer 58, wire 65, thermal cut-out 59, wire 66, movable arm 67 and fixed contact 68 of switch 60, and wire 69 back to the other side of transformer secondary 55.

When, as will be described hereinafter, the switch arm 49 is moved into engagement with contact blade 50, a second electrical circuit is completed which comprises a thermostat 70, the electrically-operated valve 13, transformer secondary 55 and switch 52—this circuit being traced from contact blade 50, through wire 71, thermostat 70, wire 72, energizing coil 73 of solenoid valve 13, and wire 69 back to the left-hand side of transformer secondary 55; the portion of the second circuit from the right-hand side of the transformer secondary to contact arm 49 being common with that of the first circuit. The secondary 74 of the ignition transformer 58 is connected by wires 75 to a heating coil 76 for igniting gas at the pilot burner 12'.

In describing the operation of the system it will be assumed that the main burner 12 is arranged to supply heat to a room or space wherein the thermostat 70 is located. With the parts in the positions shown in the drawing the system is out of operation, as during a period when no heating is required. To initiate operation of the system, the plug 16 of valve 15 is manually rotated to open position so that gas issues from the pilot burner. Since by the opening movement of valve 15 the switch 52 is closed, the "first" or igniting circuit is completed as described above and, normally, after a brief interval the gas issuing from the pilot burner is ignited. With the opening of valve 15 the pressure of the gas is applied to both of the chambers 23 and 24 of the pressure-operated switch 18 (the pilot jet 28 being uncovered) so that no movement

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of diaphragm 21 occurs and the position of switch arm 49 is unaltered; this arm being biased to its shown position mainly by the weight of the stiffening plates on opposite sides of main diaphragm 21. The flow-restricting member 27 prevents the possibility of upward surge of the diaphragm 21 upon initial application of gas pressure. The pressure of the gas acting on the lower diaphragm 22 is ineffective to move the switch member 46 due to the pivotal arrangement of the same.

After a predetermined interval, determined by the specific construction of thermoelectric generating device 42, the same becomes heated to a degree such that electricity is thereby generated in an amount sufficient to so energize the core 38 that the armature-closure 30 is attracted out of engagement with jet 29 and into engagement with the other jet 28. When this occurs, the gas compressed in the upper chamber 24 is slowly vented to the atmosphere, through jet 29, restriction 37 and pipe 36; the pressure in the lower chamber then being effective to raise the main diaphragm 21 and thereby rock the contact arm 49 into engagement with the upper blade 50. In this position of arm 49 the "second" circuit, including winding 73, is completed as described hereinabove (it being assumed that thermostat 70 is in circuit-closing condition) so that the closure 77 of valve 13 is raised and gas then passes to the main burner where it is ignited by the flame of the pilot burner. In the opening movement of valve 13, the arm 67 of switch 60 is moved (by an extension 78 of the solenoid plunger) out of engagement with contact 68 so that the igniting circuit is additionally interrupted at this point. During existence of flame at the pilot burner, the pressure-operated switch is maintained in its "second" circuit-connecting position; the main-burner valve 13 then being opened and closed in accordance with the demand of thermostat 70.

If the pilot-burner flame is extinguished accidentally, or by closing of manual valve 15, upon resultant cooling of the thermoelectric generating device the electromagnet core 38 is de-energized so that the armature-closure 30 is released and assumes the position shown in the drawing. Gas can then pass through the open jet 28 into chamber 24 and, since this chamber is now closed with respect to the atmosphere, the fluid pressure therein gradually becomes the same as that in chamber 23 below the main diaphragm so that that diaphragm falls under the force of gravity, and the switch arm 49 is brought into engagement with the lower contact blade 51 to reestablish the "first" electrical circuit. If the extinguishment of the pilot-burner were due to accidental causes, (other than failure of gas or electric supply), the pilot burner would be immediately reignited since switch 52 is still in closed condition. It follows that after a temporary interruption of electrical service the burner system would automatically become operative. Obviously, if extinguishment of the pilot burner were due to the closing of valve 15 (and resultant opening of switch 52), the system would remain inoperative until valve 15 were again closed.

Due to the flow restrictions provided by members 27 and 37, and the restriction controlled by screw 34, the movement of the main diaphragm 21 in both directions is relatively slow; and, further, the contact blades 50 and 51 are spaced apart by a distance such that there is an appreciable interval between the disengage-

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ment of arm 49 from one of the blades and its engagement with the other.

The thermal cut-out 59 is of conventional design and operates to open the ignition circuit only in the event of failure of ignition due to a defect in the transformer 58 or heating coil 76, or in the event that the proper amount of gas fails to issue from the pilot burner when valve 15 is opened.

The manual valve or gas-cock 15 is preferably located at a point remote from the burner or furnace to avoid the possibility of injury of the person operating it if an explosion should occur. It will be observed that, to place the burner system into or out of operation, the manual valve 15 is the only control device requiring attention; however, for seasonal shut-off it is customary to provide a main valve ahead of the system illustrated.

The embodiment of my invention herein shown and described is susceptible of modification without departing from the spirit of the invention, and I intend therefore to be limited only by the scope of the appended claims.

I claim as my invention:

1. In a gas-burner control system: a main burner; a pilot burner for said main burner; a manually operable valve for controlling supply of fuel to said pilot burner; a first electrical circuit; electrical means in said first circuit for igniting the fuel at said pilot burner; a second electrical circuit; an electrically operated valve in said second circuit for controlling supply of fuel to said main burner and biased to closed position; a first switch adapted to control a source of electrical energy for said circuits and actuated to circuit-closing position by movement of said manually operated valve to open position; a second switch in circuit with said first switch and adapted, when the first switch is closed, to connect said circuits individually to said source, the second switch having two circuit-connecting positions and being biased to first-circuit-connecting position; a motor, operable slowly in opposite directions by the pressure of the fuel, for actuating said second switch between said two positions; valve means for controlling the operation of said motor; and means responsive to the flame of the pilot burner for controlling the operation of said valve means.

2. In a gas-burner control system: a main burner; a pilot burner for said main burner; a manually operable valve for controlling supply of fuel to said pilot burner; a first electrical circuit; electrical means in said first circuit for igniting the fuel at said pilot burner; a second electrical circuit; an electrically operated valve in said second circuit for controlling supply of fuel to said main burner and biased to closed position; a first switch adapted to control a source of electrical energy for said circuits and actuated to circuit-closing position by movement of said manually operated valve to open position; a second switch in circuit with said first switch and adapted, when the first switch is closed, to connect said circuits individually to said source, the second switch having two circuit-connecting positions and being biased to first-circuit-connecting position; a motor, operable slowly in opposite directions by the pressure of the fuel, for actuating said second switch between said two positions; a pilot valve for controlling operation of said motor; and means, responsive to the flame of the pilot burner, effective only after a predetermined interval following establishment of the flame to operate said pilot valve to a position such that the second switch is actuated to second-circuit-connecting position by the motor.

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3. In a gas-burner control system: a main burner; a pilot burner for said main burner; a manually operable valve for controlling supply of fuel to said pilot burner; a first electrical circuit; electrical means in said first circuit for igniting the fuel at said pilot burner; a second electrical circuit; an electrically operated valve in said second circuit for controlling supply of fuel to said main burner and biased to closed position; a first switch adapted to control a source of electrical energy for said circuits and actuated to circuit-closing position by movement of said manually operated valve to open position; a second switch in circuit with said first switch and adapted when the first switch is closed, to connect said circuits individually to said source, the second switch having two circuit-connecting positions and being biased to first-circuit-connecting position; a motor, operable by the pressure of the fuel, for actuating said second switch between said two positions; a pilot valve for controlling operation of said motor; means responsive to the flame of the pilot burner for operating said pilot valve upon establishment of the flame to a position such that the second switch is actuated to second-circuit-connecting position by the motor; and means operatively associated with said motor for so restricting flow of fuel with respect thereto that actuation of the second switch is delayed for a predetermined interval following the establishment and the extinction of the flame.

4. In a gas-burner control system: a main burner; a pilot burner for said main burner; a manually operable valve for controlling supply of fuel to said pilot burner; a first electrical circuit; electrical means in said first circuit for igniting the fuel at said pilot burner; a second electrical circuit; an electrically operated valve in said second circuit for controlling supply of fuel to said main burner and biased to closed position; a first switch adapted to control a source of electrical energy for said circuits and actuated to circuit-closing position by movement of said manually operated valve to open position; a second switch in circuit with said first switch and adapted, when the first switch is closed, to connect said circuits individually to said source, the second switch having two circuit-connecting positions and being biased to first-circuit-connecting position; a motor for actuating said second switch between said two positions and comprising means forming a pair of pressure chambers separated by a movable partition; means operatively connecting said partition to said second switch; means under the control of said manually operated valve for subjecting both of said chambers to the pressure of the fuel when the manually operated valve is opened so that the second switch remains temporarily in its biased position; a pilot valve for venting one of the chambers so that the pressure of the fuel in the other of the chambers is effective to move the partition slowly in a direction such that the second switch is actuated to second-circuit-connecting position; and means responsive to the flame of the pilot burner for operating said pilot valve.

5. A system, as defined in claim 4, including means for so restricting flow of fuel with respect to the motor that actuation of the second switch is delayed for a predetermined interval following the establishment and the extinction of the pilot-burner flame.

6. In a gas-burner control system: a main burner; a pilot burner for said main burner; a manually operable valve for controlling supply

of fuel to said pilot burner; a first electrical circuit; electrical means in said first circuit for igniting the fuel at said pilot burner; a second electrical circuit; an electrically operated valve in said second circuit for controlling supply of fuel to said main burner and biased to closed position; a first switch adapted to control a source of electrical energy for said circuits and actuated to circuit-closing position by movement of said manually operated valve to open position; a second switch in circuit with said first switch and adapted, when the first switch is closed, to connect said circuits individually to said source, the second switch having two circuit-connecting positions and being biased to first-circuit-connecting position; a motor, operable slowly in opposite directions by the pressure of the fuel, for actuating said second switch between said two positions; a pilot valve for controlling operation of said motor; an electromagnetic device for operating said pilot valve; and a thermoelectric generating device, arranged for heating by the flame of the pilot burner, for energizing said electromagnetic device, the thermoelectric generating device being so constructed that it heats and cools slowly so that operation of the pilot valve is delayed for a predetermined interval following the establishment and the extinction of the flame.

7. In a gas-burner control system: a main burner; a pilot burner for said main burner; a manually operable valve for controlling supply of fuel to said pilot burner; a first electrical circuit; electrical means in said first circuit for igniting the fuel at said pilot burner; a second electrical circuit; an electrically operated valve in said second circuit for controlling supply of fuel to said main burner and biased to closed position;

a first switch adapted to control a source of electrical energy for said circuits and actuated to circuit-closing position by movement of said manually operated valve to open position; a second switch in circuit with said first switch and adapted, when the first switch is closed, to connect said circuits individually to said source, the second switch having two circuit-connecting positions and being biased to first-circuit-connecting position; a motor for actuating said second switch between said two positions and comprising means forming a pair of pressure chambers separated by a movable partition; means operatively connecting said partition to said second switch; means under the control of said manually operated valve for subjecting both of said chambers to the pressure of the fuel when the manually operated valve is opened so that the second switch remains temporarily in its biased position; a pilot valve for controlling fuel pressure in one of the chambers; an electromagnetic device for operating said pilot valve and effective when energized to operate the pilot valve to a position wherein said one of the chambers is vented, so that the pressure of the fuel in the other of the chambers can move the partition slowly in a direction to actuate said second switch to second-circuit-connecting position; and a thermoelectric generating device for energizing said electromagnetic device, the thermoelectric generating device being so constructed that it heats and cools slowly so that operation of the pilot valve is delayed for a predetermined interval following the establishment and the extinction of the flame.

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