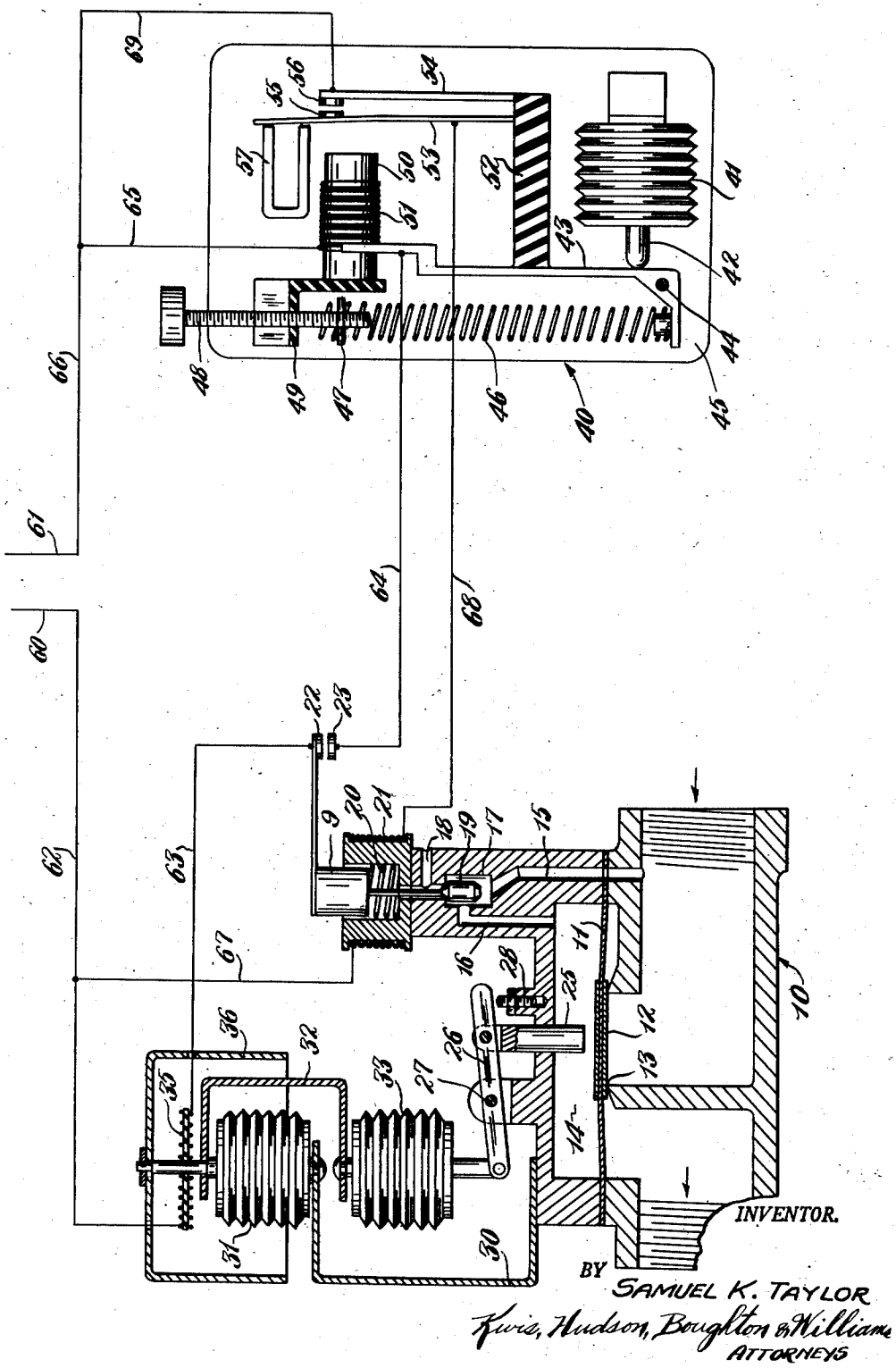
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MODULATING VALVE

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MODULATING VALVE

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9 Claims. (Cl. 236—80)

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This invention relates to improvements in modulating valves for fluid fuel burners in space heaters. The system consists of a standard fuel valve with control appurtenances such that fluid fuel flow may be modulated by a potentiometer thermostat. By this means the rate of operation of the burner is increased or decreased in accordance with the change of temperature of the air in the space to be heated, providing a substantially continuous supply of heat as required rather than the "off and on" operation conventionally employed.

One of the objects of the invention is the provision of simple means for accomplishing the modulation of a fluid fuel burner.

Another object is the provision of modulating means by combining with a conventional valve a movable stop the position of which is automatically controlled in accordance with the heat demand.

A further object is the provision of means for causing such a stop to be withdrawn when the burner closes, in order that when the fuel is again turned on there shall be full flow to the burner to insure ignition from the pilot, the movement of the stop for limiting fuel flow taking place thereafter.

Other objects and features of novelty will appear as I proceed with the description of that embodiment of the invention which, for the purposes of the present application, I have illustrated in the accompanying drawing, in which the single figure is a diagrammatic illustration of apparatus and wiring embodying the invention as applied to a gas burner.

In the drawing 10 represents a gas valve of the diaphragm type in which there is a diaphragm 11 carrying a valve piece 12 which cooperates with a valve seat 13. 14 is a pressure chamber above the diaphragm into which line pressure may be introduced by way of passages 15 and 16 and an intercommunicating valve chamber 17. Above the latter chamber a passage 18 leads to atmosphere. A double ended valve piece 19 in chamber 17 is adapted to close either the passage 15 or the passage 18. When the valve piece 19 is in the illustrated position, pressure builds up in chamber 14. When the valve piece 19 is down to close off passage 15 the passage 16, 17, 18 constitutes a bleed passage for reducing the pressure in chamber 14 to atmospheric and permitting the diaphragm to rise and open the main valve 10. Valve piece 19 is arranged to be actuated upwardly by a coil spring 20 and downwardly by a solenoid 21 the

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action of which is sufficiently powerful to overcome spring 20 and lower valve piece 19 to its seat at the top of passage 15. The armature 9 of the solenoid carries a movable electric contact 22 which is adapted to engage a fixed contact 23 when the solenoid is energized.

25 is an elongated stop which is slidably disposed in an opening through the casing of valve 10 above the center of valve piece 12. At its upper end stop 25 is pivoted to a lever 26 which has its fulcrum at 27 in a boss on the casing. Movement of the lever clockwise is limited by a pin 28 which is adjustably threaded into another boss on the casing.

A bracket 30 attached to the casing of valve 10 supports the lower end of a metal bellows 31, the upper end of which carries a C-shaped arm 32 which is attached to the upper end of a second metal bellows 33 identical in form and size with bellows 31 and partially filled with the same kind of low boiling point fluid, ether for example. The lower end of bellows 33 is pivotally connected with the power end of lever 26. An electric heating coil 35 is mounted above bellows 31 and a hood 36 encloses the coil and the major part of the bellows in order that the fluid within the bellows may respond quickly to heat emanating from the coil. The double bellows arrangement illustrated compensates for changes in ambient temperature, as will be obvious to those skilled in the art.

At the right hand side of the drawing I have illustrated a potentiometer room thermostat indicated generally at 40. It comprises a metal bellows 41 responsive to temperature changes and having an operating ram 42 which presses against the long arm of a bell crank lever 43 pivotally mounted at 44 on an insulation panel 45. Lever 44 is biased clockwise by a tension spring 46, the tension of which may be varied more or less by a pin 47 mounted in an adjusting screw 48 which is threadably mounted in a bracket 49 attached to the panel 45. By turning screw 48, pin 47 is caused to travel up or down in the convolutions of the spring, thereby varying the force of the spring.

Bracket 49 also carries a cylinder 50 of insulation material upon which is wound a coil of resistance wire 51. The upper end of bell crank 43 runs over coil 51 as the pressure in bellows 41 changes. Bell crank lever 43 carries a block 52 of insulation upon which are mounted two spring fingers 53 and 54 which carry electric contacts 55 and 56. Finger 53 tends to swing toward the right to bring these contacts into

engagement, but as illustrated in the drawing it is flexed out of contacting position by the action of a permanent magnet 57.

60 and 61 represent line wires. From line wire 60 a conductor 62 leads to heating coil 35, and from that coil a conductor 63 leads to contact 22. From contact 23 a conductor 64 leads to bell crank lever 43 and from one end of resistance coil 51 conductors 65 and 66 lead to line wire 61.

From conductor 62 a further conductor 67 extends to solenoid 21, while a conductor 68 runs from the opposite end of the solenoid to spring finger 53. Spring finger 54 and its contact 56 are connected by a conductor 69 with conductor 66 and line wire 61.

Operation.—The parts are shown in the burner "off" condition with the circuit through solenoid 21 broken at the contacts 55, 56, and the valve piece 19 raised by the coil spring 20. Line pressure of gas is therefore present in chamber 14, which holds the diaphragm down in valve closing position. At this time also the circuit through heating coil 35 is broken at the contacts 22, 23, so that the operating bellows 31 is cool and therefore contracted. C-shaped arm 32 is thus lowered and lever 26 is disposed as shown, with stop 25 raised.

Now when the temperature in the room in which thermostat 40 is located drops below the point for which the thermostat is set, the bellows 41 will have contracted, permitting spring 46 to swing bell crank 43 clockwise. As soon as this movement has progressed far enough the effect of magnet 57 will be overcome and spring 53 will swing over to the right, causing contact 55 to engage contact 56. This will close the circuit through solenoid 21, which will then operate to lower valve piece 19, closing off the passage 15 and opening the bleed passage 16, 17, 18. Pressure in chamber 14 will thereby be relieved and the valve will open fully.

As soon as solenoid 21 is energized armature 9 will be pulled down and the contact 22 will be caused to engage fixed contact 23. The circuit through heating coil 35 will then be established with more or less resistance from coil 51. In most cases this resistance will be low, so that coil 35 will throw off heat rapidly, expanding bellows 31 and depressing stop 25 to the limit permitted by pin 28. If the limited flow of gas is not sufficient to raise the room temperature to the desired point and maintain it there, bell crank lever 43 will swing clockwise further, introducing more resistance into the heater circuit, whereupon the lever 26 will swing counter clockwise and stop 25 wil rise permitting the gas pressure in the line to lift the diaphragm and open the main valve to a greater extent.

A limited gas flow is thereby maintained and the burner operates continuously over considerable periods of time with variations in gas flow taking place to maintain room temperature with a minimum degree of variation. As room temperature rises resistance 51 decreases, current through heating coil 35 increases and bellows 31 expands lowering stop 25 as far as pin 28 will permit. If room temperature continues to rise bell crank lever 43 will swing counterclockwise far enough to permit magnet 57 to attract finger 53, breaking the circuit through solenoid 21 and closing the main valve.

It will be observed therefore that the controls in the system provide an "off and on" operation of the main valve with the "on" position regulated by the movements of stop 25 to modulate the flow. The system has all of the safety features of one employing a conventional diaphragm valve. In case of power failure the valve closes immediately. On the first call for heat the valve opens fully, providing good ignition from the pilot. The adjustable limit pin 28 puts a low limit on the valve opening such as will support combustion in the burner.

While I have illustrated the system as applied to a diaphragm type of valve, it will be appreciated that the invention is not so limited, as a different type of valve could be substituted.

Having thus described my invention, I claim:

1. In combination, a fluid valve comprising a valve seat and a valve piece adapted to assume closed position and a series of different open positions providing modulated fluid flow, a room thermostat, means responsive thereto for causing said valve piece to move toward or away from said seat, a movable stop in the path of movement of said valve piece, and means responsive to said room thermostat for moving said stop progressively toward said seat in proportion to the rise in room temperature.

2. In combination, a fluid valve comprising a valve seat and a valve piece adapted to assume closed position and a series of different open positions providing modulated fluid flow, a room thermostat, means responsive thereto for causing said valve piece to move toward or away from said seat, a movable stop in the path of movement of said valve piece, an electric heater, means responsive to a gradual unidirectional change in heat emitted by said heater for moving said stop progressively toward said seat, and potentiometer means also responsive to said room thermostat for controlling the flow of current through said heater.

3. In combination, a fluid valve comprising a valve seat and a valve piece adapted to assume closed position and a series of different open positions providing modulated fluid flow, a room thermostat, means responsive thereto for causing said valve piece to move toward or away from said seat, a movable stop in the path of movement of said valve piece, an electric heater, an electric circuit therefor, a switch in said circuit, means responsive to a gradual unidirectional change in heat emitted by said heater for moving said stop progressively toward said seat, potentiometer means also responsive to said room thermostat for controlling the flow of current through said heater circuit, said means for causing the operation of said valve piece functioning simultaneously with the closing of the valve to open said switch.

4. In combination, a fluid valve comprising a valve seat and a valve piece, said valve piece being adapted to assume fully closed position and a series of open positions of different degrees providing modulated flow, off and on means for opening and closing said valve, a room thermostat controlling said off and on means, a stop movable in the path of said valve piece and biased away from said valve seat, means for advancing said stop toward said valve seat, and potentiometer means actuated by said thermostat for controlling said stop advancing means, said stop in any of its advanced positions being adapted to limit the opening movement of said valve piece.

5. In combination, a fluid valve comprising a valve seat and a valve piece, said valve piece being adapted to assume fully closed position and a series of open positions of different degrees providing modulated flow, off and on means for

opening and closing said valve, a room thermostat controlling said off and on means, a stop movable in the path of said valve piece and biased away from said valve seat, means for advancing said stop toward said valve seat, potentiometer means actuated by said thermostat for controlling said stop advancing means, said stop in any of its advanced positions being adapted to limit the opening movement of said valve piece, and means acting simultaneously with the closing of said valve for disabling said stop advancing means.

6. In combination, a diaphragm gas valve having a control chamber above the diaphragm and a valve seat therebelow, said valve having a bypass from the intake side of the valve to the control chamber and a bleed passage from said chamber, solenoid valve means for opening or closing said bleed passage, a movable stop projecting into said chamber terminating concentric with said diaphragm and biased away from the diaphragm, means for advancing said stop toward said seat, said last named means being adapted to overpower gas pressure on the lower side of said diaphragm when said bleed passage is open, a room thermostat, means responsive thereto for operating said soleond valve and a potentiometer also responsive to said room thermostat for controlling the action of said stop advancing means.

7. In combination, a diaphragm gas valve having a control chamber above the diaphragm and a valve seat therebelow, said valve having a bypass from the intake side of the valve to the control chamber and a bleed passage from said chamber, solenoid valve means for opening or closing said bleed passage, a movable stop projecting into said chamber terminating concentric with said diaphragm and biased away from the diaphragm, means for advancing said stop toward said seat, said last named means being adapted to overpower gas pressure on the lower side of said diaphragm when said bleed passage is open, a room thermostat, means responsive thereto for operating said solenoid valve, a potentiometer also responsive to said room thermostat for controlling the action of said stop advancing means, and means for disabling said stop advancing means, said disabling means acting

upon the movement of said solenoid valve to close said bleed passage.

8. In combination, a diaphragm gas valve having a control chamber above the diaphragm and a valve seat therebelow, said valve having a bypass from the intake side of the valve to the control chamber and a bleed passage from said chamber, solenoid valve means for opening or closing said bleed passage, a movable stop projecting into said chamber terminating concentric with said diaphragm and biased away from the diaphragm, an electric heater, means responsive to a gradual unidirectional change in heat emitted by said heater for moving said stop means progressively toward said seat, said last named means being adapted to overpower gas pressure on the lower side of said diaphragm when said bleed passage is open, a room thermostat, means responsive thereto for operating said solenoid valve and a potentiometer also responsive to said room thermostat for controlling current through said heater.

9. In combination, a fluid valve comprising a valve seat and a valve piece adapted to assume closed position and a series of different open positions providing modulated fluid flow, a room thermostat, means responsive thereto for causing said valve piece to move either to fully open or fully closed position, a movable stop in the path of movement of said valve piece, and means responsive to said room thermostat after the said valve piece moves to open position for moving said stop progressively toward said seat in proportion to the rise in room temperature.

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