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OIL BURNER CONTROL SYSTEM

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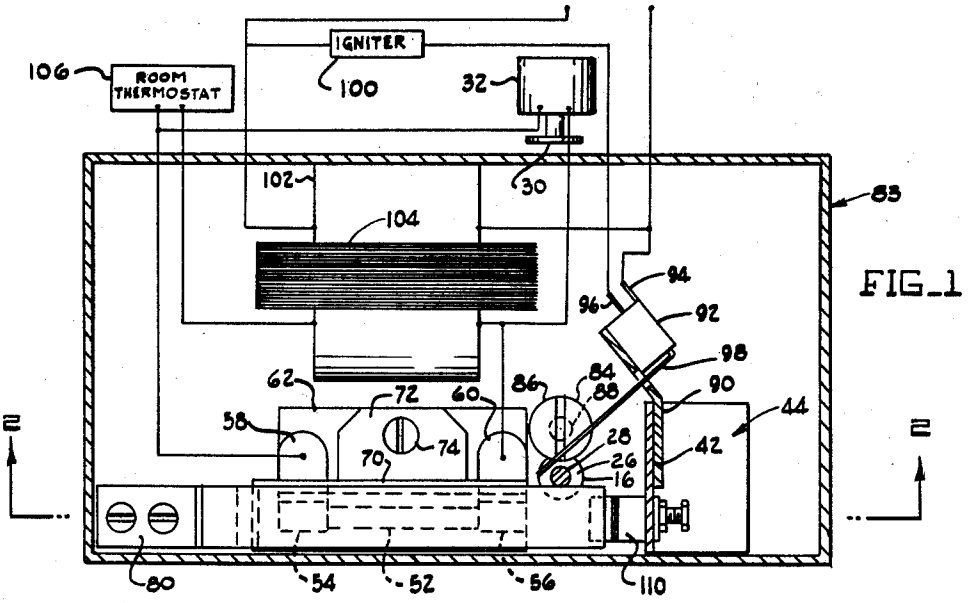


FIG_1

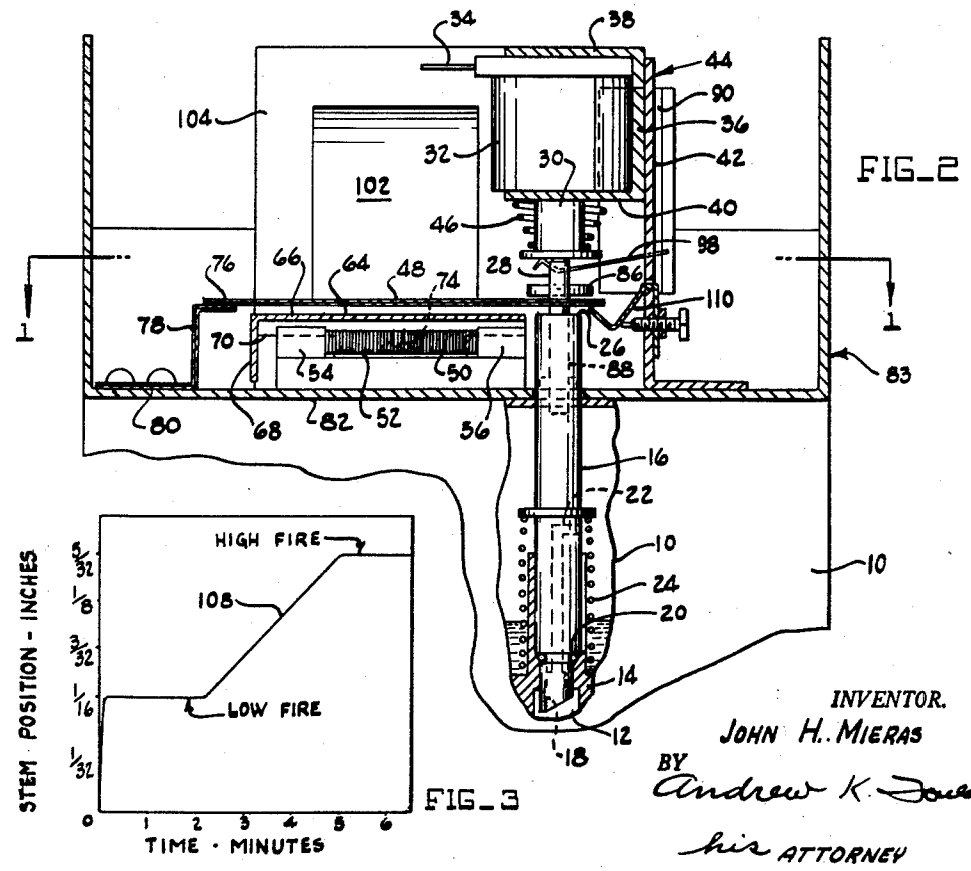


FIG_2

FIG_3

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OIL BURNER CONTROL SYSTEM

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This invention relates to burner control systems.

In one type of liquid fuel burning system the operating burner is ignited by means of an electric igniter rather than a pilot burner such as is conventionally employed. The electric igniter has a limited ability to heat liquid fuel supplied to the burner, and hence it is desirable that during the initial ignition periods the burner be supplied with relatively small amounts of liquid fuel. It is also desirable that as the burner temperature is raised by the ignited fuel the admitted quantities of fuel be gradually increased. The desired cycle is one wherein the thermostat's call for heat causes the metering valve to initially deliver a relatively small quantity of liquid fuel to the burner for a short time period, as for example two minutes, and to then gradually increase the supply of fuel to the burner until a high fire condition is reached. The high fire condition is preferably reached after a fairly short time interval, as for example five minutes after the call for heat, and the return of the metering valve to a fully closed position is preferably effected rapidly after satisfaction of the thermostat.

One object of the present invention is to provide a mechanism for supplying liquid fuel to a burner in accordance with the above-mentioned cycle.

More particularly, it is an object of the invention to provide a metering valve which is movable between a first fully closed position, a second partially opened low-fire position, and a third fully open high-fire position, the cycle of valve movement being such that the valve moves rapidly from its first position to its second position, then slowly from its second position to its third position, and rapidly from its third position to its first position.

A further object of the invention is to provide a fuel metering mechanism in which ambient temperature variations do not unduly interfere with the operating cycle.

An additional object of the invention is to provide a bimetal control arrangement wherein ambient temperature variations are ineffective to vary the bimetal performance.

Other objects of this invention will appear from the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

FIGURE 1 is a sectional view taken on line 1—1 in FIG. 2, but with solenoid 32 removed, and illustrating certain features of one embodiment of the invention;

FIG. 2 is a sectional view taken on line 2—2 in FIG. 1;

FIG. 3 is a chart illustrating the performance of the FIG. 1 device during a portion of its operating cycle.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to the drawings, there is shown therein a liquid fuel burner supply mechanism comprising a conventional liquid fuel chamber 10 having an outlet 12 defined by an upstanding wall structure 14. Slidably arranged within wall structure 14 is a cylindrical fuel metering valve stem 16 having a slot 18 in its lower wall portion such that when the stem is raised from its illustrated position liquid fuel can flow from chamber 10 through slot 18 and into the outlet chamber 12, from whence it is delivered to the liquid fuel burner (not shown). The metering stem may be provided with an O-ring type seal 20 to seal against flow of liquid when the stem is in its illustrated position. Further, a vent passage 22 may be provided to promote satisfactory flow when the valve is raised from its illustrated position. Raising of the valve stem is accomplished by means of a compression coil spring 24, as is conventional in the art. A novel control mechanism (to be described hereinafter) is provided so that the call for heat by room thermostat 106 causes stem 16 to immediately move upwardly to permit a small low fire liquid flow through slot 18, and to thereafter slowly move upwardly to permit an increasing liquid flow through slot 18. The rate of flow is of course proportional to the length of slot exposed to the liquid in chamber 10, and the effective slot length is in turn proportional to the distance through which stem 16 is raised. In one embodiment of the invention a total stem 16 stroke of about 5/32 inch is sufficient to provide full liquid flow.

It will be seen that in the illustrated embodiment the upper end of stem 16 is of reduced diameter to form a shoulder 26 and a pin-like extension 28. When the stem is in its illustrated lower position extension 28 abuts against the lower surface of the armature 30 for the electric solenoid 32, said solenoid having two terminals, one of which is shown at 34. The solenoid is suitably mounted within a C-shaped frame having a web wall 36, upper flange 38, and lower flange 40, said web wall being suitably secured to the upstanding wall portion 42 of a mounting bracket designated generally by numeral 44. As shown in FIG. 2 the solenoid is provided with a compression spring 46 so that when the solenoid is de-energized armature 30 is powered downwardly by gravity and by spring 46, to thus overcome the biasing effect of spring 24 and maintain stem 16 in its lowered illustrated position.

When the solenoid is energized armature 30 is raised and stem 16 is powered upwardly by spring 24 until shoulder 26 strikes the underside of an upwardly warpable bimetal strip 48, said strip acting at low temepratures as a rigid stop to limit the stem in its upward movement. The bimetal strip is arranged above an electric heater which may conveniently comprise a length of resistance wire 50 wound on a cylindrical rod-like support element 52, said support element having its opposite ends disposed within the curled-around portions 54 and 56 of the two terminals 58 and 60. The terminals are suitably mounted on a di-electric block 62, as by means of rivets or the like (not shown).

Preferably the heat which is generated by heater 50 does not immediately cause movement of bimetal strip 48. There is therefore provided an intermediate heat absorbing element 64, said element being preferably metallic and including a horizontal wall portion 66 disposed between the heater 50 and strip 48. The heat-absorbing element also preferably includes an end wall 68, a downwardly extending side wall 70 and a horizontally directed flange 72 which seats on the upper surface of block 62. A screw 74 may be utilized to secure the element 64 in a fixed location.

As shown in FIG. 2, the left end of strip 48 is attached to the flange portion 76 of a temperature compensating bimetallic arm 78, said arm having a base flange 80 for its securement on the bottom wall 82 of the casing structure generally designated by numeral 83. Strip 48 is ar-

ranged so that increasing temperatures are effective to warp its right end upwardly. Bimetal arm 78 is arranged so that increasing temperatures tend to move it clockwise around its base flange 80; therefore when the ambient temperature is high arm 78 causes the right end of strip 48 to apply a relatively high force load on the stop member 110 (i.e., higher than would be the case if member 78 were completely rigid, and when the ambient temperature is low arm 78 causes the right end of strip 48 to apply a relatively low force load on member 110 (i.e., lower than would be the case if member 78 were completely rigid or stationary). The upwardly facing disposition of heater 50 and the provision of wall 68 are such that heater 50 does not adversely affect the position of arm 78, i.e., the position of arm 78 is affected to a great extent by the general ambient temperature condition in the atmosphere. If arm 78 were not of bimetal construction, in the presence of the very low ambient temperature conditions the heat from heater 50 would be dissipated into the atmosphere without warping strip 48 sufficiently to enable a full upward stroke of stem 16. However when arm 78 is made as a bimetal element, low ambient temperature conditions tend to reduce the pre-load force of strip 48 on member 110 so that when member 78 is formed as a bimetal member it takes a lesser temperature change from heater 50 to raise the strip to a position corresponding to a full upstroke of stem 16. Viewed in another way, at low ambients bimetal 78 helps heater 50 to move strip 48 off of stop 110.

In operation, when solenoid 32 and heater 50 are energized spring 24 moves stem 16 upwardly until shoulder 26 strikes strip 48, after which there is a short time delay before the heater 50 heat can pass through shield 64 to strip 48. This time delay is preferably about two minutes. After the time delay, strip 48 slowly warps upwardly so that stem 16 gradually moves upwardly under the influence of spring 24. The upward motion is limited by a stop screw 84 having a head 86 and a shank 88 extending downwardly from the head to threaded mounting in bottom wall or floor 82 of the casing 83. As will be seen from FIG. 1, a portion of head 86 overlies shoulder 26 so that the screw becomes effective as a stop to limit upward movement of stem 16.

It will be noted that bracket 44 carries an auxiliary bracket 90 which in turn carries a conventional snap switch 92 having terminals 94 and 96. The illustrated switch is provided with a wire arm operator 98 which is arranged to extend through an opening in bracket 90 and thence into engagement with the undersurface of armature 30. When the armature is in its lowered position wire operator 98 is depressed so that current is prevented from flowing through terminals 94 and 96. When armature 30 is in its raised position the internal springing in snap switch 92 causes the switch blade therein to close the circuit between terminals 94 and 96 and to raise the operator 98. Switch 92 is arranged in the energizing circuit for an electric fuel igniter 100 which is located in the 115 volt supply circuit for the step-down transformer coil 102. The coil secondary supplies low voltage current to the conventional room thermostat 106, solenoid 32, and heater 50.

As previously described, metering stem 16 has three positions, namely the illustrated fully closed position, an intermediate low-fire position in which shoulder 26 engages strip 48, and a fully raised high-fire position in which shoulder 26 engages the fixed stop 86. In overall operation, when room thermostat 106 calls for heat the solenoid 32 and heater 50 are immediately energized. Stem 16 immediately moves upwardly to its low-fire position engaged with strip 48, and switch 92 closes to energize igniter 100. The heat generated by heater 50 is initially absorbed in element 64, and stem 16 therefore maintains its low-fire position for a suitable time delay period, shown in FIG. 3 as about two minutes. During this time delay period igniter 100 has an opportunity to vaporize and ignite the small low-fire quantities of liquid fuel supplied to the burner, and to raise the burner temperature toward a value sufficient to satisfactorily support high-fire combustion. Gradually the heat which has been supplied to element 64 is radiated onto strip 48, and the right end portion of the strip begins to warp upwardly. During the upward warping of strip 48 stem 16 slowly moves upwardly toward its high-fire position; this slow movement is denoted by portion 108 of the operating curve in FIG. 3.

When room thermostat 106 has been satisfied, solenoid 32 and heater 52 are de-energized, and spring 46 is effective in conjunction with gravity forces to rapidly move stem 16 downwardly to its illustrated fully closed position. During the downward movement of stem 16 the wire operator 98 is actuated to open the circuit through terminals 94 and 96. If desired, switch 92 may be located in the same circuit as a combustion switch, not shown, in which case the circuit through terminals 94 and 96 will be opened in advance of downward movement of operator 98. In any case, heater 50 is in the circuit controlled by thermostat 106, and when the thermostat is satisfied the heater is de-energized so that bimetal strip 48 returns to its illustrated position in which its right end rests on the adjustable stop formed by sheet metal element 110.

As previously noted, during initial ignition conditions bimetal arm 78 functions as a temperature compensating device to vary the load of member 48 on stop 110 in accordance with variations in ambient temperature. The general arrangement is such that very low ambients are ineffective to prevent proper cycling of the mechanism, i.e., to prevent attainment of a high-fire condition within a satisfactory time interval. Briefly, arm 78 tends to decrease the starting temperature for strip 48 movement when the ambient is low so that even though a good deal of the heater 50 heat fails to reach strip 48 there is still a sufficient upward warpage of the strip to permit stem 16 to reach the high fire position within a satisfactory time interval.

As will be noted the illustrated device comprehends a metering stem which moves between a first closed position, a second low-fire position, and a third high-fire position, said metering stem movement being accomplished by the interacting influences of four separate power devices, namely spring 24, solenoid 32, thermostatic strip 48, and spring 46. It is contemplated that some variation in construction and arrangement of the power devices can be resorted to without departing from the spirit of the invention as set forth in the appended claims.

I claim:

1. In an oil burner control system comprising an oil burner igniter, room thermostat switch, and a burner supply unit which includes an oil chamber means, an outlet port for the chamber means adapted to communicate with the burner, a vertically movable metering stem arranged within the chamber means to move upwardly from a first position fully closing the outlet port to a second partially open low fire position and then to a third fully open high fire position, spring means tending to move the metering stem upwardly from its fully closed position toward its fully open position, a solenoid-armature assembly effective when the solenoid is energized to permit the stem to move under the influence of the spring means, a thermostatic strip having a portion thereof arranged to limit upward movement of the stem to the low fire position when the solenoid is energized, and an electric heater arranged to thermally warp the thermostatic strip for thereby allowing the spring means to raise the stem from its low fire position to its fully open high fire position: the improvement comprising a unitary control casing structure positioned atop the chamber means and defining a floor; said solenoid armature assembly, thermostatic strip, and electric heater being located in said control casing structure with the upper end portion of the metering stem

extending into said structure; a single step-down transformer located within the control casing structure; an energizing circuit for the solenoid and electric heater connected to the secondary of the transformer, said circuit including said thermostat switch to constitute a control for the solenoid and heater; the armature comprising a plunger located on the solenoid axis directly above the metering stem with its lower face arranged to engage the stem upper end; a control circuit for the igniter including a source of line voltage and a snap switch mechanism located in the control casing structure and having a hinged operator arm extending into engagement with the plunger lower face; said thermostatic strip being located substantially directly above the heater and parallel thereto, a heat shield interposed between the heater and thermostatic strip, and a mount for the thermostatic strip comprising a bimetal arm extending upwardly from the aforementioned floor at one end of the strip; said bimetal arm being positioned so that ambient temperature decrease tends to cause it to exert an upwardly acting force on said portion of the thermostatic strip such that low ambient temperatures are ineffective to prevent the heater from warping the strip upwardly.

2. In an oil burner supply unit which includes an oil chamber means, an outlet port for the chamber means adapted to communicate with the burner, a vertically movable metering stem arranged within the chamber means and being biased by a spring means to move upwardly from a first position fully closing the outlet port to a second partially open low fire position and then to a third fully open high fire position, a solenoid-armature assembly effective when the solenoid is energized to permit the stem to move from its fully closed position under

the influence of the spring means, a thermostatic element having a portion thereof arranged to limit upward movement of the stem to the low fire position when the solenoid is energized, and an electric heater arranged to thermally warp the thermostatic element for thereby allowing the spring means to raise the stem from its low fire position to its fully open high fire position: the improvement comprising a unitary control casing structure positioned atop the chamber means and defining a floor; said solenoid-armature assembly, thermostatic element, and electric heater being located in said control casing structure with the upper end portion of the metering stem extending into said structure; said thermostatic element comprising an elongated thermostatic strip located adjacent the heater, and said heater being disposed adjacent the aforementioned floor; a heat shield interposed between the heater and thermostatic strip; and a mount for the thermostatic strip comprising a bimetal arm located at one end of the strip; said bimetal arm being positioned so that ambient temperature decrease tends to cause it to exert an upward force on said portion of the thermostatic strip such that low ambient temperatures are ineffective to prevent the heater from warping the strip.

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