Nov. 19, 1957 W. A. BIERMANN ET AL 2,813,579

IGNITION AND FUEL FLOW CONTROL

Filed Oct. 15, 1954 4 Sheets-Sheet 1

Fig. 1

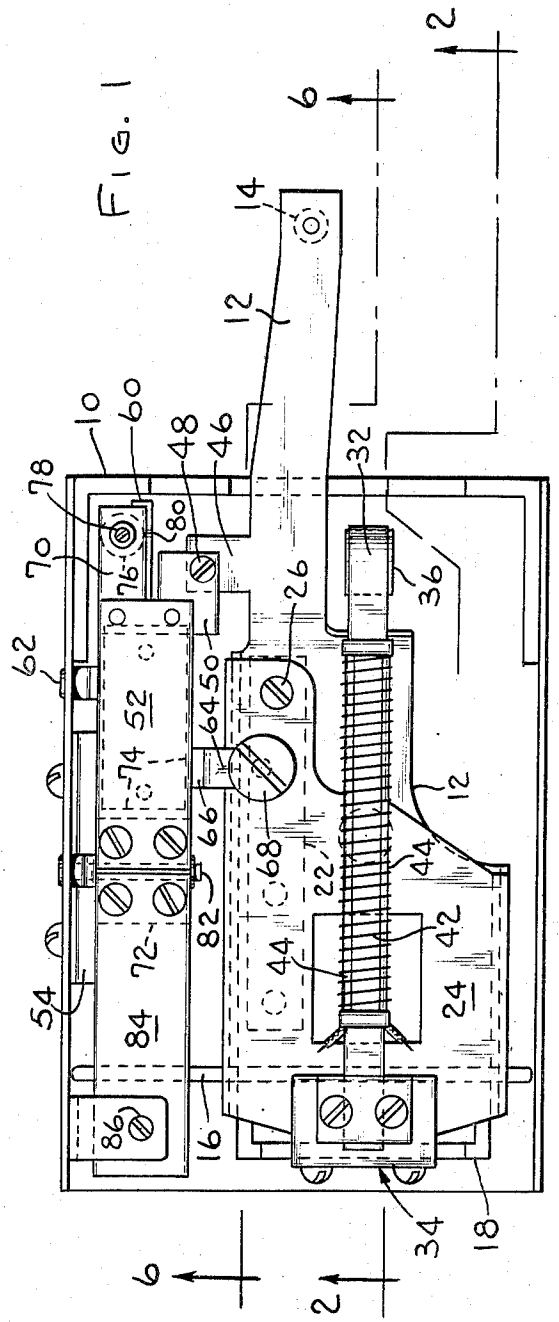
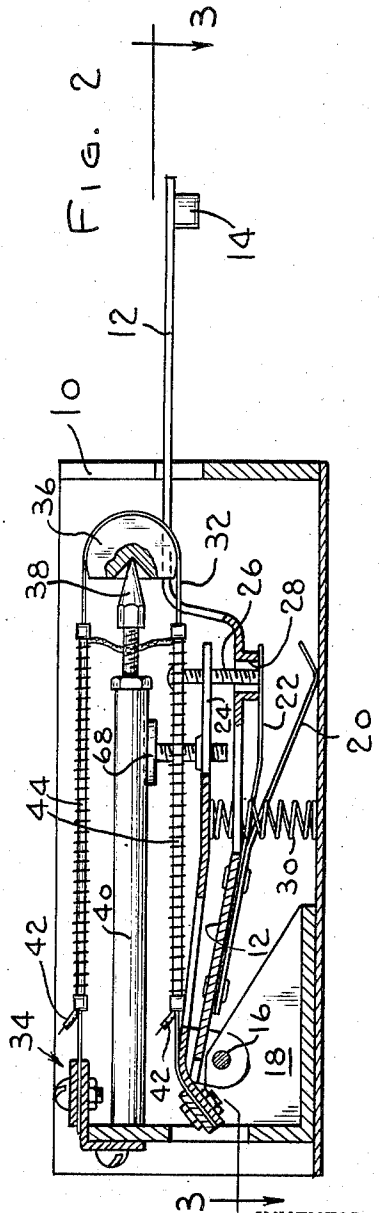


Fig. 2



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Filed Oct. 15, 1954 4 Sheets-Sheet 2

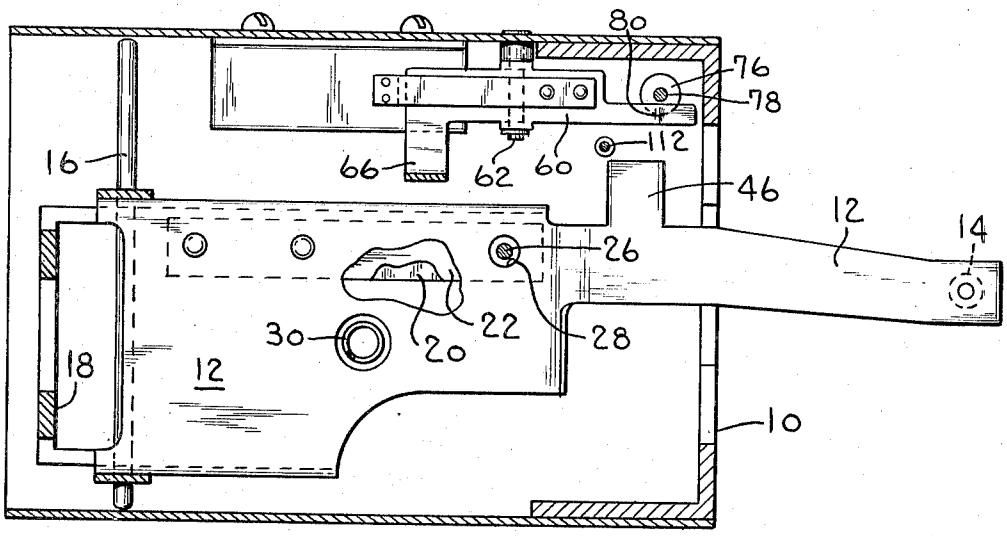


FIG. 3

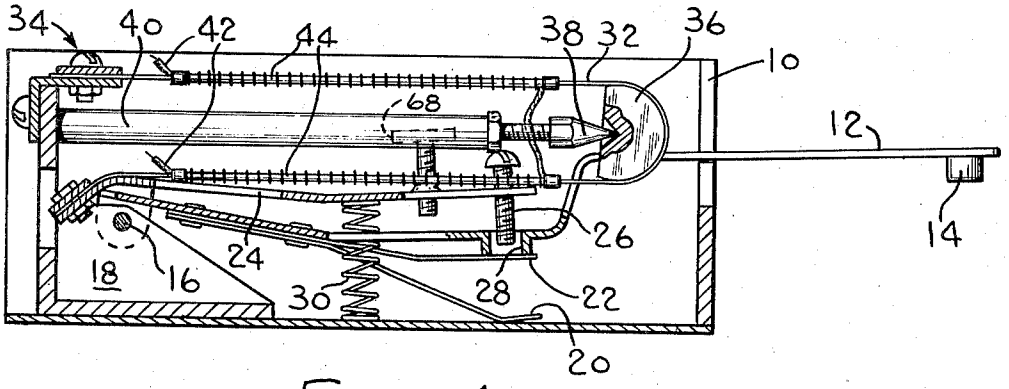


FIG. 4

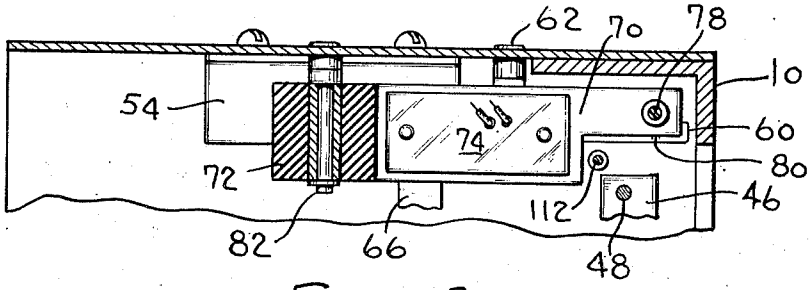


FIG. 5

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IGNITION AND FUEL FLOW CONTROL

Filed Oct. 15, 1954 4 Sheets-Sheet 3

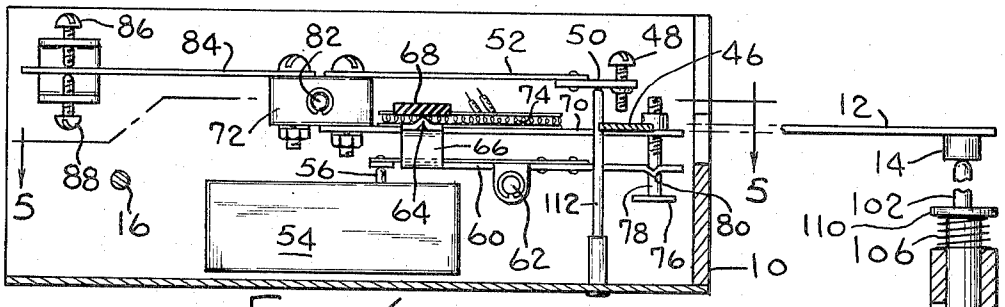


FIG. 6

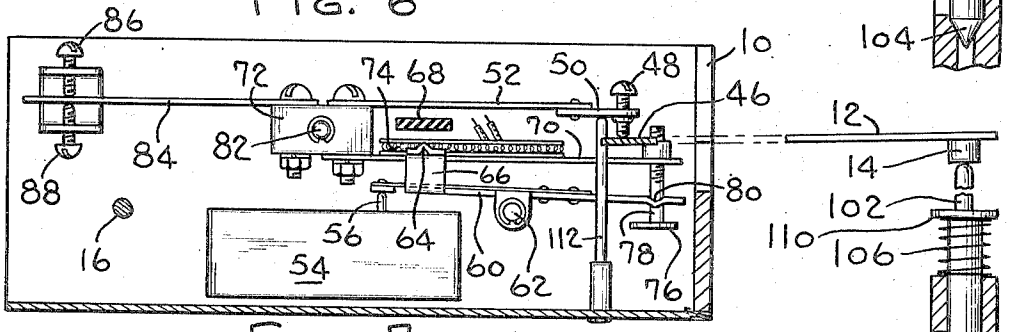


FIG. 7

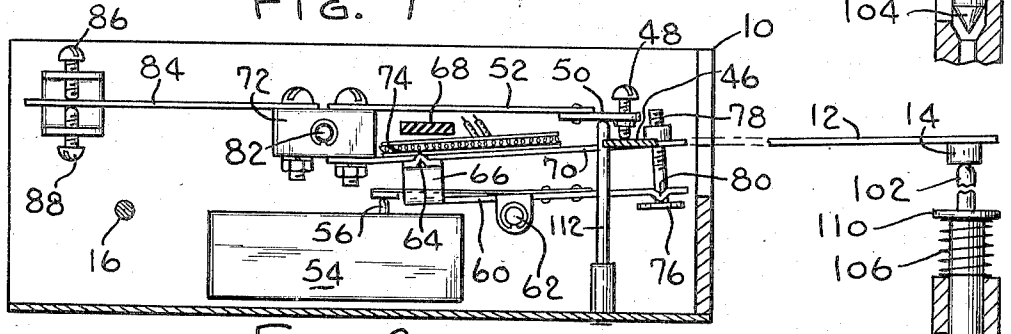


FIG. 8

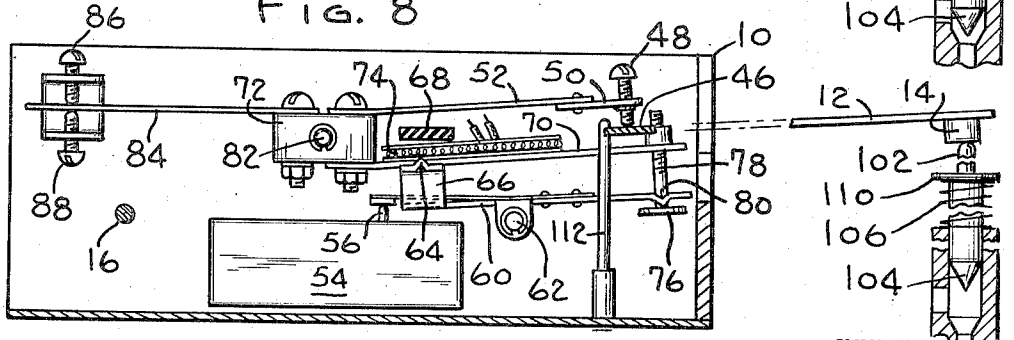


FIG. 9

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Nov. 19, 1957 W. A. BIERMANN ET AL 2,813,579

IGNITION AND FUEL FLOW CONTROL

Filed Oct. 15, 1954 4 Sheets-Sheet 4

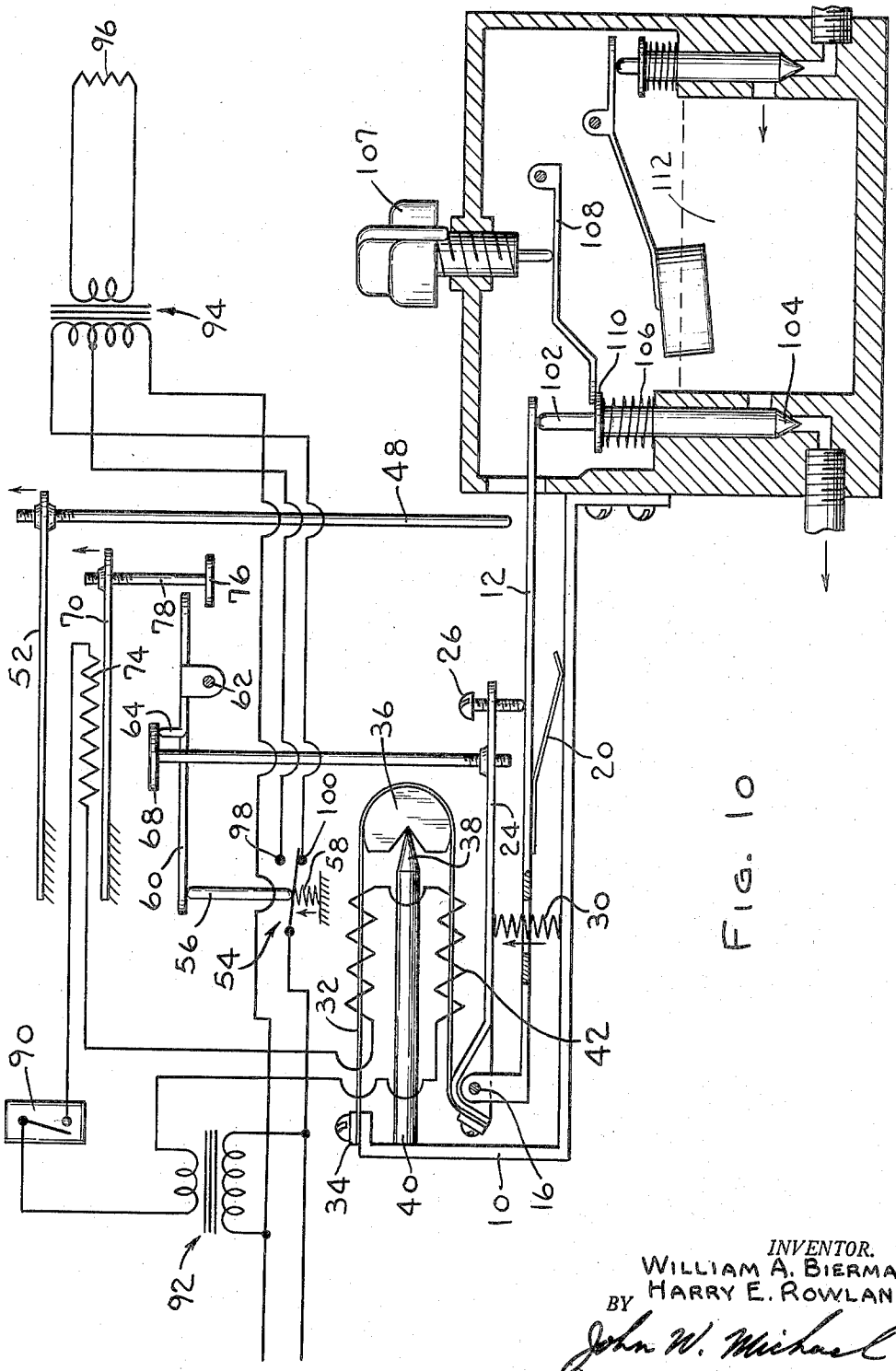


Fig. 10

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2,813,579

IGNITION AND FUEL FLOW CONTROL

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Application October 15, 1954, Serial No. 462,418

11 Claims. (Cl. 158—28)

This invention relates to a fuel flow and ignition control particularly suited for operation in connection with pot type burners.

The need in the past for a pilot flame in a pot type burner has hindered wide adoption of this type heating unit since the pilot flame gave rise to various difficulties centered about the deposition of soot in the burner by the pilot flame. It is generally agreed that a pot type burner not requiring a pilot flame would prove to be a highly desirable heating unit due to its quiet operation and the lower heat outputs obtainable which better match the heat requirements of smaller homes and result in less overshooting of temperature. In order to operate without a pilot fire it is, of course, necessary to provide some form of igniter and igniters have not been very successful in this field. An igniter which showed promise was a resistance igniter of the armored element type, but in use the life of the igniter proved poor where the igniter was continuously energized. If the igniter was operated in an on-off manner, the time to reach incandescence was prohibitively long.

In order to overcome the objections to the armored resistance element igniter the present igniter is normally operated at low voltage and is operated at a higher voltage only when the igniter is to be used. This type of operation results in greatly increased igniter life and the response of the igniter to increased voltage is a very rapid rise to ignition temperature. In so operating an igniter the temperature of the igniter doesn't reach the critical temperature of the element which would destroy the element.

In connection with this operation of the igniter, flow of fuel to the burner is so regulated as to insure proper ignition and pot warm-up prior to full flow to the burner. The combined fuel and ignition control is excellent and permits very clean operation of the pot burner.

The principal object of this invention is to provide a novel operation of an igniter for pot type burners.

Another object is to provide a fuel and ignition control for pot burners which properly cycles the igniter and the fuel flow to obtain clean operation of the pot.

Other objects and advantages will be pointed out in, or be apparent from, the specification and claims, as will obvious modifications of the single embodiment shown in the drawings in which:

Fig. 1 is a top plan view of the control unit which is adapted to be mounted on a constant level valve of the type shown in Pawelsky et al., U. S. Patent No. 2,506,937;

Fig. 2 is a section taken on line 2—2 in Fig. 1;

Fig. 3 is a horizontal section of the control taken on broken line 3—3 in Fig. 2;

Fig. 4 is a view similar to Fig. 2 but shows the parts in the position occupied when the steel strip is heated while Fig. 2 shows the strip cold;

Fig. 5 is a partial section taken on line 5—5 in Fig. 6 to show the bimetallic switch operator and its mounting;

Fig. 6 is a partly schematic section on line 6—6 in Fig. 1 showing the parts in the "off" position of the cycle;

Fig. 7 is similar to Fig. 6 but shows the switch in position to put a high voltage across the igniter and the valve partly opened to provide ignition flow;

Fig. 8 is similar to Fig. 7 but the switch is back to the low igniter voltage position by reason of the switch bimetal warping;

Fig. 9 is similar to Fig. 8, but here the valve is fully open, being permitted to open by the warpage of the time delay bimetal; and

Fig. 10 is a schematic showing of the present control in its circuit and operating a valve.

As noted above, the present control is adapted to be used particularly in connection with the type of constant level float valve shown in Pawelsky et al., U. S. Patent No. 2,506,937. In this float valve, shown somewhat schematically in Fig. 10, the upper corner at one end of the control valve body is cut out to receive an accessory control unit. The present control unit is housed in a casing 10 which is adapted to be mounted on the constant level valve at the cut-out portion. The casing 10 is cut out so that the valve operating lever 12 can project into the constant level valve housing and act on leverage connected with the outlet valve of the constant level valve. The pad 14 on the end of the valve lever 12 would thus act on the leverage, but for the purposes of illustration in Figs. 6 through 10, the lever is shown acting directly on the valve since the principle is the same. As the description progresses it will be clear that with various changes the present control can be adapted to many valves. For this reason the present disclosure is not to be limited to the type of constant level valve shown.

The valve operating lever 12 is pivotally mounted on pin 16 in frame 18 and is urged upwardly by leaf spring 20 riveted to its underside and acting against the floor of casing 10. Also riveted to the lever 12 is another leaf spring 22 which comprises a yielding interconnection between lever 12 and control lever 24. Thus, control lever 24, which is also pivotally mounted on pin 16, is provided with an adjustable screw 26 which acts on leaf spring 22 through aperture 28 in valve lever 12. This type of interconnection permits overtravel of the control lever 24 towards the valve lever 12 without damage to or straining any of the parts. A compressed coil spring 30 acts between the bottom of casing 10 and control lever 24 to urge the lever 24 upwardly. Upward movement of the control lever under influence of coil spring 30 is limited by the strainless steel strip 32 one end of which is securely fixed to the left-hand end of control lever 24 on the opposite side of fulcrum pin 16 from the coil spring 30. The other end of the steel strip is securely anchored at 34 and the strip extends around the partial cylindrical member 36 which is rockable on point 38 adjustably mounted in shaft 40. The point 38 is turned out until the steel strip is well tensioned as shown in Fig. 2.

A heating wire is wrapped about the horizontal reaches of the steel strip so that the strip may be heated and expanded when desired. In order to wrap the wire 42 about the steel strip, insulating sleeving 44 is first slit and mounted on each edge of the strip so as to support the wire 42 out of contact with the steel strip. When current is impressed across the heating wire 42, the steel strip will be heated and expand and permit cylinder 36 to rock about point 38 in a clockwise direction as viewed in Figs. 2, 4 and 10. When the strip thus expands, the end anchored to control lever 24 can move downwardly as the coil spring 30 pushed the control lever upwardly. When this happens the valve lever 12 will follow the action of the control lever. This arrangement gives a very powerful and fast acting power element in which considerable movement is available. When the movement is multi-

plied through a leverage such as herein shown a very satisfactory action can be obtained.

When the heater wire 42 is energized, as it is adapted to be when the room thermostat calls for heat, the steel strip will expand rapidly and the control lever 24 will rapidly rise. As the control lever rises the valve operating lever 12 attempts to follow the control lever, but is able to do so only until the arm 46 projecting laterally from the valve lever 12 comes up against the depending screw 48 mounted in the small plate 50 carried on the free end of the flow limiting bimetal 52. The screw 48 is adjusted so as to limit the upward movement of the valve lever 12 to the desired flow rate for ignition. This flow rate is selected as being above the so-called sooty flow rate for the particular burner. Thus, it will be apparent that when the heater 42 is energized to expand steel strip 32, the control lever 24 rises rapidly and the valve operating lever 12 can follow the action of the control lever only until it is prevented from further upward movement by contact of the laterally projecting arm 46 with the screw 48.

The control lever also regulates action of the snap switch 54 mounted to one side of the lever assembly. The snap switch is provided with a projecting pin 56 which is biased upwardly by an internal spring shown diagrammatically in Fig. 10 and designated as 58. The action of the spring 58 tends to rock lever 60 mounted on pin 62 in a clockwise direction as viewed in Figs. 6 through 9. Movement of the lever 60 under influence of the switch spring 58 is normally prevented by contact of boss 64 on arm 66, projecting upwardly and laterally from the lever 60, with the underside of the large headed screw 68 threadably mounted in a control lever 24. It will be appreciated that as the control lever 24 moves upwardly when the steel strip expands, the screw 68 will rise and boss 64 will follow as the switch spring 58 urges the lever 60 upwardly. The screw 68 is adjusted so that very shortly after the steel strip starts expanding, the snap switch will operate to close a high voltage circuit across the igniter.

From the above it will be clear that the movement of control lever 24 upon energization of heater 42 when the thermostat calls for heat is utilized to allow valve operating lever 12 to rise to the ignition flow position as determined by the setting of stop 48 carried by the limiting bimetal 52. This upward movement of the control lever is also employed to actuate switch 54 to change the voltage across the igniter from a low voltage to a high voltage. This igniter may be of the sheathed or armored resistance type igniters. The low voltage may be, for example, 90 volts while the high voltage would be line voltage of 115 volts. On the other hand, the low voltage may be 12 volts and the high voltage around 15 volts. In the latter case, of course, the current is greater than would be true in the former case. In either event, however, the low voltage operation tends to saturate the igniter to a point where the voltage increase to high voltage will raise the igniter to ignition temperature within a matter of but a few seconds.

The voltage is not changed between high and low with the idea of saving current, but is done with the idea of greatly increasing the life of the ignition element. In order to increase the igniter life, however, it is necessary to reduce the voltage after ignition has taken place in order that the combined heating of the resistor within the igniter and the full flow oil flame will not act to raise the temperature of the igniter above its critical temperature. With this in mind, a switch operating bimetal 70 is provided to actuate snap switch 54 back to low voltage after a predetermined period of time from the start of the cycle. Thus, the bimetal is mounted on insulating block 72 and carries the heater 74 which is connected in series with the heater 42 on the steel strip 32. Thus, the switch bimetal heater 74 is energized simultaneously with the heater on strip 32. However, strip 32 is fast acting while

bimetal 70 is selected for slow operation in order that the strip will act to move switch 54 to the high voltage position prior to bimetal 70 warping upwardly to lift the head 76 of screw 78 to the point where it engages boss 80 on the right-hand end of the lever 60 to rock lever 60 in a counter-clockwise direction and push the switch plunger 56 down to return the snap switch to the low voltage contact.

The heater 74 and the bimetal 70 are selected to act on the switch plunger 56 to reduce the voltage impressed across the igniter two and one-half or three minutes after the thermostat calls for heat. Therefore, the igniter has two and one-half to three minutes to ignite the oil flowing from the constant level valve. Of course, the oil flow starts shortly after energization of heater 42 on strip 32 since valve lever 12 rises to the ignition flow position as fast as permitted by control lever 24 following the expansion movement of strip 32. It will be appreciated that screw 78 may be turned to adjust the position of screw head 76 with respect to boss 80 in order to adjust the timing.

About the same time that the switch bimetal returns the snap switch to the low voltage position, or possibly shortly thereafter, the heat from heater 74 starts to affect the flow limiting bimetal 52 which then starts to warp upwardly. As the limiting bimetal 52 rises slowly, the screw 48 carried thereby also rises and allows the valve lever 12 to rise up to permit the outlet valve in the constant level valve to open to the full flow position. The heat flow from heater 74 to limiting bimetal 52 is rather slow and it takes about six minutes from the time the thermostat calls for heat for the limiting bimetal to warp to full flow position.

It will be noted that limiting bimetal 52 and the switch bimetal 70 are both mounted on an insulating block 72 which is pivotally mounted on pin 82. The other side of insulating block 72 supports an ambient temperature compensating bimetal 84 the free end of which is held between set screws 86, 88 at an adjusted position. The compensating bimetal 84 will cause the insulating block 72 supporting the limiting bimetal 52 and switch bimetal 70 to rock about pin 82 to adjust the position of the switch and limiting bimetals to offset changes in ambient temperature. In other words, the compensating bimetal prevents ambient temperature from affecting the timing relationship set at the factory.

It will be appreciated that when the thermostat is satisfied, both heater 74 and heater 42 are de-energized and the various parts returned to their original positions in which the igniter is operating at low voltage and there is no flow to the burner.

Fig. 10 is a schematic showing of the manner in which the present control operates. It will be noted that room thermostat 90 is on the secondary of step-down transformer 92 and when the room thermostat closes to call for heat, the secondary circuit is completed through the thermostat and heaters 42 and 74 which are connected in series so that if either heater should burn out, the system will fail safe and go to the "off" position. This figure also shows the manner in which snap switch 54 normally connects the primary coil of the transformer 94 in the high voltage or line circuit so the secondary voltage across the igniter 96 is a low voltage. When the control lever 24 moves upwardly, however, screw 68 moves up and allows lever 60 to rock in a clockwise direction under the influence of switch spring 58 acting through the switch pin 56. This will allow the switch 54 to snap to the high voltage contact 98 which puts line voltage across only part of the primary winding of transformer 94 so the secondary voltage is increased. When the heater 74 on switch bimetal 70 warps the bimetal, head 76 on pin 78 will engage the right end of lever 60 and push switch plunger 56 down again to remake the circuit at contact 100, and thus return the igniter to low voltage operation.

Reference to Fig. 10 will also show the manner in which upward movement of the control lever **24** allows the valve lever **12** to follow until the lever **12** is prevented from further upward movement by depending pin **48**. The drawing also shows the manner in which the lever can be considered as acting on stem **102** of valve **104**. This valve is biased upwardly by spring **106** to allow flow to the burner from fuel supply **112** and tends to follow the valve operating lever **12** unless prevented from doing so by the setting of manual knob **107** which acts on leverage **108** engaging or limiting the upward movement of shoulder **110** on the valve stem.

In order to insure complete understanding of the present operation and the various control functions, a complete cycle will now be described with reference to Figs. 6 through 9 in particular. Fig. 6 shows the position of the various parts when the thermostat is satisfied, that is, there is no call for heat. In order to readily understand these figures, it is well to remember that screw head **68**, shown in section above lever boss **64**, is carried by the control lever and its position, therefore, is indicative of the position of the control lever which does not appear in these figures. Similarly, ear **46** projecting laterally from lever **12** is indicative of the position of lever **12**. The right end of lever **12** is also shown in full lines in connection with the schematic showing of valve **104**.

In Fig. 6 screw head **68** acts on boss **64** to hold lever **60** down on switch plunger **56** and hold the switch **54** in position to impress a low voltage on igniter **96**. At the same time, the control lever acts through screw **26** onto lever **12** to hold valve **104** closed.

When the thermostat calls for heat, the circuit through the secondary of transformer **92** is completed through bimetal heater **74** and strip heater **42**. The steel strip expands more rapidly than the bimetal warps and, therefore, the parts rapidly move to the position shown in Fig. 7. In this figure, the screw **68** carried by the control lever has risen to such an extent that it has entirely cleared boss **64**. This allows switch spring **58** to move switch **54** to contact **98** which occasions a high voltage across the igniter **96**. At the same time, the valve lever **12** has risen to strike pin **48** carried by the limiting bimetal **52**. At this point the switch bimetal has not warped, or if it has warped, it has warped to such an extent as to be negligible. Also at this point, the control lever **24** has travelled upwardly to a point where set screw **26** no longer contacts the valve lever **12** through the medium of leaf spring **22**. The position of the control lever and the valve lever just described is illustrated in Fig. 4. Fig. 4 does not, however, show the various bimetals which would normally be in the background of the figure. By viewing Figs. 4 and 7 together, the position of the levers and bimetals can readily be visualized. To summarize Figs. 7 and 9, very shortly after a call for heat a high voltage is impressed on the igniter and valve **104** rises to the position allowing a rate of flow suitable for ignition, but not a full flow rate. The rate should preferably be above the "sooty" flow since the slow upward movement of the limiting bimetal at a later time would otherwise result in the control slowly going through the sooty stage.

About two and one-half minutes after the thermostat calls for heat, the switch operating bimetal **70** warps sufficiently to lift head **76** of depending screw **78** against boss **80** on the right-hand end of lever **60** to rock the lever down against switch plunger **56** to return the switch to the low igniter voltage contact **100**. This is shown in Fig. 8 wherein it will be noted that the valve **104** is still held in the ignition flow condition since the heat from heater **74** has not yet affected the flow limiting bimetal **52** which continues to rest against post **112**. This post prevents adjusting screws **86**, **88** acting on the compensating bimetal **84** to a position where the flow limiting bimetal **52** and the switch bimetal **70** would be so far from the normal position that sufficient control or adjustment would not be available in screws **48** and **78** to properly time the operation.

About the same time the switch bimetal **70** acts to return the switch **54** to the low voltage position, the flow limiting bimetal starts to warp under influence of the heat from heater **74**. About three minutes after the flow limiting bimetal starts to warp, it is fully warped to the position shown in Fig. 9. Thus, the flow limiting bimetal rises to the position shown in Fig. 9 approximately five and one-half or six minutes after the thermostat calls for heat. When the flow limiting bimetal reaches the illustrated position, valve **104** is fully open so that oil flows to the burner at full flow. It will be noted that the valve lever **12** still follows the flow limiting bimetal. This need not necessarily be true under normal control since it is only necessary that the valve lever **12** be permitted to go to the full flow position, and beyond that point if the limiting bimetal continues to travel upwardly, it is not necessary for the valve lever to also travel.

In the above description, switch **54** was described as being placed in the primary of transformer **94**. It will be readily appreciated that the switch could be placed in the secondary of a transformer having suitable taps. The objection to operating in the low voltage or secondary of the transformer **94** is that the current is greater which results in more arcing at the contacts. Also, since the secondary voltage is so much smaller, any foreign matter on the contacts could result in failure to make the circuit. For this reason, it is preferred to use the high voltage side of the transformer for the switching operation.

Other safety controls could be used in conjunction with the present apparatus. Thus, suitable controls could be provided to prevent more than a minimum amount of oil to flow into the burner until ignition actually takes place. Without such a control, however, the only reason for failure of ignition would be failure of igniter **96** or of the switch **54**. In either case, however, a dangerous condition would not arise since it would result only in a flooded pot. Furthermore, by the present operation, the life of the igniter is so long as to make such an occurrence extremely rare and, therefore, of not much concern. Similarly, a modern, well-designed switch has such a long life expectancy as to pretty well preclude difficulties in that end of the operation.

The present control can be modified to be mounted on many constant level controls by altering the shape of the valve lever. Indeed, since the valve lever acts only on the outlet valve it is not necessary to provide more than such a valve for the lever to operate and the other units for controlling the incoming flow etc. are not required.

Although but one embodiment of the present invention has been illustrated and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. A fuel and ignition control comprising, an igniter adapted to be placed in a burner, an electric circuit for the igniter for constantly energizing the igniter at a low voltage to heat the igniter to a preheating temperature below fuel igniting temperature, a room thermostat, means controlled by the thermostat to increase the voltage across the igniter to increase the temperature thereof to fuel igniting temperature when the thermostat calls for heat, means for reducing the voltage across the igniter to said low voltage a predetermined period of time after the thermostat calls for heat, said period of time being normally sufficient for the igniter to reach ignition temperature and ignite fuel in said burner, a fuel supply, valve means for regulating fuel flow to the burner from the supply, valve operating means for normally holding the valve means closed and controlled by the thermostat to open the valve when the thermostat calls for heat,

means for temporarily limiting the opening movement of the valve means for a predetermined period of time greater than said first named period of time after the valve operating means moves to open the valve when the thermostat calls for heat, said limiting means being rendered ineffective a period of time after the thermostat calls for heat, thus allowing the valve means to open fully.

2. A control according to claim 1 including manually operable means for acting on the valve means to determine the maximum open position thereof.

3. A fuel and ignition control comprising, an igniter adapted to be placed in the burner, an electric circuit for the igniter for constantly energizing the igniter at a low voltage to heat the igniter to a preheating temperature below fuel igniting temperature, a room thermostat, means controlled by the thermostat to increase the voltage across the igniter to increase the temperature thereof to fuel igniting temperature when the thermostat calls for heat, said means including an electrically energized operator means connected in a circuit including the thermostat, fuel valve operating means normally in a valve closing position and controlled by the thermostat to move in the valve opening direction when the thermostat calls for heat, second electrically energized operator means in said thermostat circuit, a switch in the igniter circuit for altering the voltage across the igniter and normally in position to connect the igniter for low voltage operation, said first operator means being connected to said switch to actuate the switch to connect the igniter for high voltage operation when the first operator means is energized, the second operator means being connected to the switch to restore the switch to its normal position and to override the action of the first operator means, said first operator means being fast acting and the second operator means being slow acting whereby the voltage across the igniter is not reduced until the igniter has had sufficient time to reach ignition temperature and ignite the fuel in the normal course of operation of the control.

4. A control according to claim 3 including a fuel supply, valve means adapted to regulate flow from the supply to a burner, said valve operating means including said first operator means and being connected to the valve means to hold the valve means closed when de-energized and to open the valve means when energized so fuel flowing to the burner will be ignited by the igniter.

5. A control according to claim 4 including a third electrically energized operator means regulated by the thermostat and being the slowest acting of the three operator means, said third operator means acting when de-energized to limit the opening movement of the valve means and when energized and fully actuated to allow full opening movement of the valve means, the third operator means being the slowest acting serving to restrict the opening movement of the valve means during ignition of the fuel and serving thereafter to gradually increase the fuel flow rate.

6. A control according to claim 5 in which the second and third operator means include bimetals and are heated by a heater in circuit with the thermostat, said heater being positioned to heat the second operator means faster than the third operator means.

7. An ignition control comprising, an igniter, a switch, and electric circuit means including the igniter and the switch and operable to impose a low voltage on the igniter when the switch is in the first position and to impose a high voltage on the igniter when the switch is in the second position, the temperature of the igniter at low voltage being a preheating temperature below fuel igniting temperature and the temperature at high voltage being a fuel igniting temperature, said switch normally being in said first position, a room thermostat, an electric circuit including and controlled by said thermostat, an electrically energized operator means in the thermostat circuit and connected to the switch to move the switch to said second position when energized, a second electrically energized operator means, the second operator means being connected in the thermostat circuit and being slower acting than the first operator means, the second operator means being connected to the switch to move the switch to said first position when the second operator means is energized, the operation of the second operator means following the operation of the first operator means by a predetermined time lag normally sufficient for the igniter to reach ignition temperature and ignite the fuel in said burner.

8. A control according to claim 7 including a fuel supply, valve means regulating flow of fuel from the supply, means biasing the valve means open, means operatively connecting the first operator means to the valve means to hold the valve means closed when the first operator means is de-energized and to allow the valve means to open under influence of the biasing means when the first operator means is energized whereby fuel flow is initiated with raising the voltage across the igniter to raise the temperature thereof to ignition temperature.

9. A control according to claim 8 including a third operator means controlled by the thermostat, the third operator means being movable between a first position preventing opening of the valve means beyond a low flow position and a second position in which it does not restrict valve movement, said third operator means normally being in its first position and being movable to its second position only when the thermostat closes the thermostat circuit, said third operator means being the slowest acting of the three operator means so the valve means cannot open to full flow until the second operator means has actuated said switch to its first position.

10. A control according to claim 9 in which the second and third operator means include bimetals and the thermostat controls the action of the bimetals through the medium of a heater in circuit with the thermostat, said heater being mounted to heat the second operator means more rapidly than the third operator means.

11. A fuel and ignition control comprising, an igniter adapted to be placed in a burner, an electric circuit for the igniter for constantly energizing the igniter at a low voltage to heat the igniter to a preheating temperature below fuel igniting temperature, a room thermostat, means controlled by the thermostat to increase the voltage across the igniter to increase the temperature thereof to fuel igniting temperature when the thermostat calls for heat, a fuel supply, valve means for regulating fuel flow to the burner from the supply, valve operating means for normally holding the valve means closed and controlled by the thermostat to open the valve when the thermostat calls for heat, and means for temporarily limiting the opening movement of the valve means for a predetermined period of time after the valve operating means moves to open the valve when the thermostat calls for heat, said period of time being normally sufficient for the igniter to reach ignition temperature and ignite fuel in said burner, said limiting means being rendered ineffective a predetermined period of time after the thermostat calls for heat thus allowing the valve means to open fully.

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