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THERMOSTATIC CONTROLS FOR LIQUID FUEL BURNERS

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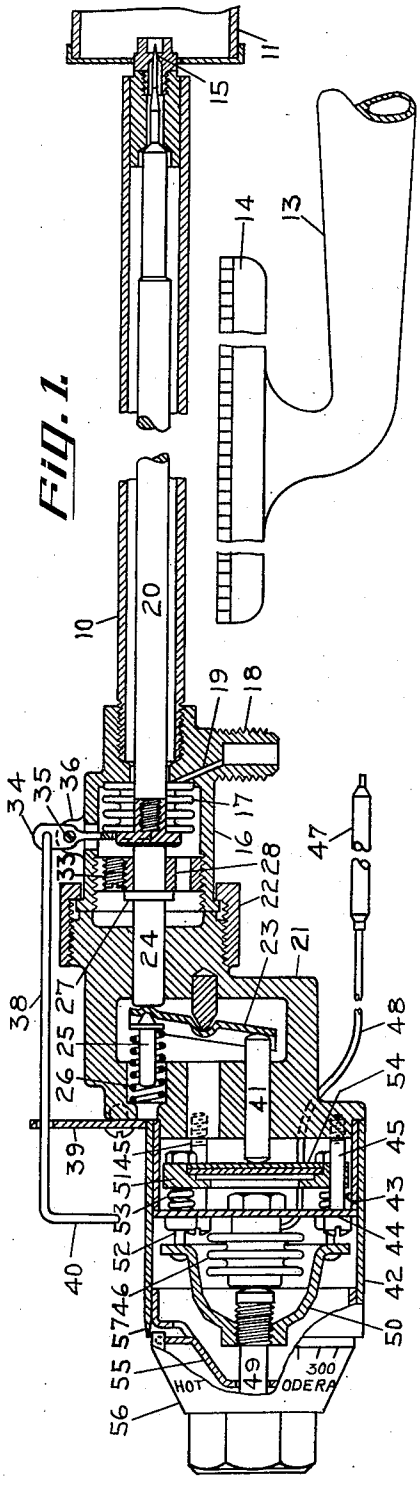


Fig. 1.

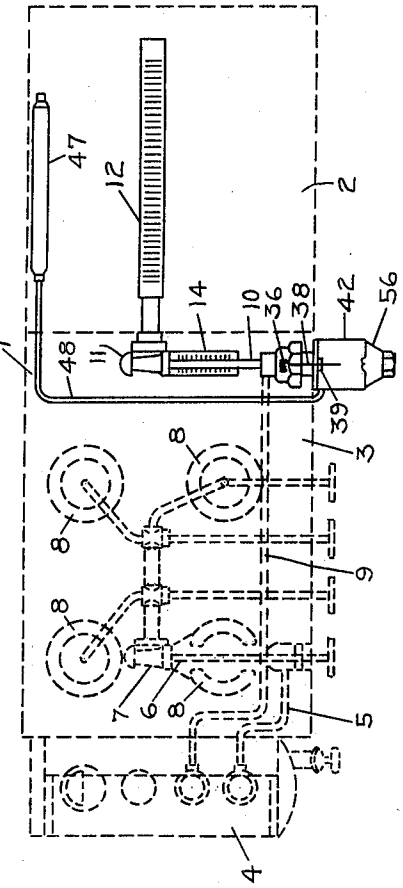


Fig. 4.

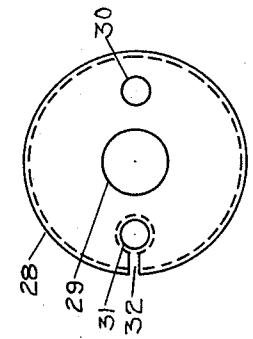


Fig. 3.

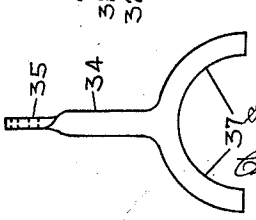


Fig. 2.

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THERMOSTATIC CONTROLS FOR LIQUID FUEL BURNERS

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18 Claims. (Cl. 236—15)

This invention relates to temperature control as exercised in connection with liquid fuel heaters wherein the liquid fuel is delivered under pressure to a chamber from which it is discharged through an orifice to a burner and while the invention may be successfully embodied and adapted in other ways, it is particularly valuable when used to control the temperature within the oven of a domestic range using liquid fuels such as gasoline, butane, and propane.

It is the usual practice to keep the liquid fuel under pressure in a supply tank to be fed to a generator tube wherein it is vaporized by external heat applied thereto. From the generator tube the vapor goes to a manifold to be mixed with air before passing to the burner. Only a very small orifice is necessary to pass a sufficient quantity of the fuel vapor from the generator tube to the manifold and a needle valve operated by hand is commonly used to control the flow through the orifice.

The necessity for vaporizing the liquid fuel before mixing it with air to form a combustible mixture to be passed to the burner, was the underlying cause of most of the difficulties encountered in providing a suitable thermostatic control. Several controls have been developed heretofore in which the valve regulates the supply of liquid fuel to the generator. Under these conditions the fuel pressure at the generator undergoes such variations as to require a fan or pump to force air into the mixer and carry the vapor to the burner. This system has been employed rather extensively in connection with oil furnaces but the fan and cooperating parts were too bulky and expensive to be used on a domestic range. Also liquid fuel ranges are often installed in places where a convenient source of power for the fan is not available. There was also the objection that the temperature of a small compartment like an oven could not be accurately regulated by controlling the supply of liquid fuel for it was the vapor that was burned and a slight variation in the amount of liquid fuel supplied would make a tremendous difference in the amount of vapor to be burned. Attempts have been made to control the flow of vapor between the mixer and the burner but the vapor tends to condense when its flow is restricted.

We propose to control the flow of vapor from the generator itself and avoid these difficulties. However, in such an arrangement only a small outlet orifice and a slight opening of the valve is necessary to supply an abundance of fuel vapor for the burner, which makes the connection of a thermostat therewith extremely difficult, particularly so because jamming of the thermostat has to be avoided. This difficulty is also increased because of the seal that must be provided and because means for closing the valve manually to clean the orifice is desirable. Another problem arises in the provision of means for constantly passing sufficient fuel vapor to the burner to prevent it from being completely extinguished when the desired temperature was reached or the thermostat was re-set to a lower temperature after the oven was heated. A constant bypass opening would not be suitable because it would have to be so small that it would be quickly stopped up with dirt and carbon.

By our invention we overcome the aforementioned and other obstacles and provide novel means for connecting a thermostat to the needle valve within the generator tube to automatically control the flow of fuel vapor to the burner to maintain various desired uniform temperatures within the oven. The structural details, operation and advantages of our device will be hereinafter described with reference to the accompanying drawing wherein;

Figure 1 is an elevation view of our novel structure which embodies a generator tube and means for automatically controlling the flow of fuel vapor therefrom in response to the temperature of the oven;

Figure 2 is an enlarged view showing the details of the manually-operated, valve closing lever of Figure 1;

Figure 3 is an enlarged view showing the details of the adjustable stop used in our structure shown in Figure 1; and

Figure 4 is a plan view in outline of a liquid fuel domestic range with our thermostatic control mounted thereon.

As shown in this drawing, the number 1 indicates generally a domestic range having an oven 2 and a cooking top 3. A fuel supply tank 4 in which the liquid fuel is kept under pressure, has a fuel line 5 through which fuel passes to a generator 6 and thence to a manifold 7 and the top burners 8. A second fuel line 9 leads from the tank 4 to the generator tube 10 of our new structure. The fuel vapor flows therefrom into manifold 11 to the oven burner 12 within the oven 2, a portion of the vapor being diverted from the manifold through pipe 13 to burner 14 for heating the generator tube to vaporize the liquid fuel therein.

The generator tube 10 has a small orifice 15

in one end and the other end of the tube is attached to a bellows housing 16. A flexible bellows 17 is located within said housing 16 and seals the end of the generator tube 10. The fuel line 9 is connected to a boss 18 on said housing and the fuel is arranged to flow from line 9 through passage 19 into the bellows and generator tube. A valve rod 20, located concentrically within the tube 10, has a needle point on one end arranged to cooperate with the orifice 15 to control the flow of fuel vapor therethrough. The other end of the valve rod 20 is secured to and carried by the movable head of the bellows 17. Thus the fuel pressure acting on the bellows will constantly tend to move the valve toward an open position.

The bellows housing 16 is connected to a casting 21 by a union nut 22. The left end of the housing 16 is made first of a uniform size, then upset to form the shoulder after the union nut 22 has been slipped on, and finally machined and connected to the casting 21. Mounted within this casting at substantially right angles to the axis of the valve rod, is a lever 23 which is pivoted at its center. A rod 24 engages the upper end of lever 23 and extends therefrom through the wall of the casting to bear against the movable head of the bellows 17 which carries the end of the valve rod 20. On the opposite side of the lever 23 and in line with the rod 24, is an actuating pin 25. Situated between a shoulder on pin 25 and the wall of the casting is a spring 26 serving to constantly urge the upper end of the lever 23 and rod 24 to be moved to the right to move the valve towards a closed position. Such movement of rod 24 to the right is limited by a shoulder 27 thereon striking an adjustable stop 28.

The stop 28 consists of a threaded plug having an opening 29 through its center for passage therethrough of the end of rod 24, and having two smaller holes 30 and 31 adapted to be engaged by a spanner wrench or similar tool in screwing the plug into the bellows housing. One of these holes, 31, is threaded on a taper, and a slot 32 extends from the hole to the outer edge of the plug. Thus a screw 33 when screwed into the tapered hole will cause the slot to spread and result in tightening the threads which hold the plug in place within the bellows housing. This is, of course, only done after the proper adjustment of the plug or stop has been made.

As will be explained hereinafter, a thermostat responsive to the oven temperature is arranged to regulate the effect of the spring 26 on the valve so that as the desired temperature is reached, the spring is allowed to move the valve toward closing, lowering the flame on the oven burner. It is necessary that the complete closure of the valve by the spring be prevented to eliminate the necessity of re-igniting the burner upon the re-opening of the valve in response to a call for more heat to maintain the desired oven temperature. The purpose of the stop 28 is to limit the valve closing movement of rod 24 to prevent the complete closure of the valve thereby. Proper adjustment of the stop is exceedingly important and should be such that the minimum valve opening during the operation of the device will pass only sufficient fuel vapor to the oven burner to just maintain a flame thereon. Such a flame is not large enough to overheat the oven above any of the various temperatures normally desired. In setting the stop, account must be taken of the fact that though the generator tube may be made of a metal having a coefficient of expansion substantially equal to or only slightly greater than that of the valve rod, the tube, being exposed to the direct flame of the heater 14, will get hotter and expand more than the valve rod within the tube. Of course, suitable metals having various coefficients of expansion may be used in the manufacture of the tube and valve rod, such being entirely a matter of design. However, in all cases the stop should be set to insure the proper minimum valve opening as long as the generator heating burner is functioning. In addition to the difference in expansion of the tube and valve rod, the amount of orifice opening required to maintain a minimum flame on the particular size of oven burner to be used, must be considered in setting the stop.

It is, of course, desirable to provide some convenient means to at least momentarily close the valve in order to clean the orifice of any dirt or carbon which would hinder the passage of fuel vapor to the burner. A second lever 34 is pivoted about a small pin 35 resting in bosses 36 on the exterior of the bellows housing 17. The lever 34 extends downward through an opening into the interior of housing 17, the lower end of the lever being composed of two arms 37 shaped to fit about the head of the bellows. A stiff wire 38 is attached to the extreme upper end of lever 34 and extends therefrom through a guide 39, supported by casting 21, to a handle 40. Pulling on the handle will cause the pivoted lever to press against and compress the bellows to cause the valve to be closed. Manually operated means for closing the valve independently of the thermostat is particularly useful in case dirt from the fuel begins to clog up the orifice during operation of the burner. The handle can be pulled to force the needle through the orifice to clean it and then quickly released. Upon release of the handle, the fuel pressure will immediately reopen the valve and the entire cleaning process may be accomplished so quickly as to enable the burner to remain in operation. Each time before starting the oven burner, the operator should pull the handle to remove any carbon that may have been deposited during the previous operation of the oven. Such preliminary cleaning is desirable to insure proper working of the valve.

At the opposite end of the first lever 23 from rod 24 and pin 25, is another pin 41, which is on the same side of the lever as pin 25 and extends from the lever and parallel to the axis of rod 24 through the wall of the casting 21 into the interior of a tubular casing 42 which is secured to the casting 21 and which encases a thermostatic assembly similar to that described in Patent No. 1,998,818 issued to Robert E. Newell, Clarence W. Robertshaw and William B. Mackintosh on April 23, 1935.

Within the casing 42 is a second shorter tube 43 which abuts against the casting 21. A baseplate 44 is held stationary against the ends of this shorter tube 43 by screws 45 which extend into casting 21. A second bellows 46 has one end secured to this stationary baseplate while the other end remains free to move. The bellows 46 is connected to a bulb 47 located within the oven, by a capillary tube 48, the bellows, bulb and capillary tube being filled with a suitable thermally responsive fluid so that an increase in the oven temperature will expand the fluid, which in turn will move the free end of the bellows. Similarly a decrease in oven temperature will result in a contraction of the bellows.

The movable end of bellows 46 acts against

the end of an adjusting shaft 49 which has a threaded portion engaging the head of a yoke 50. The yoke extends around the bellows and is connected to a movable plate 51 on the opposite side of the baseplate by bolts 52. Load springs 53 surrounding the bolts between the plate 51 and the baseplate 44, serve to keep the end of the adjusting shaft 49 in constant engagement with the bellows 46. A bimetal disc 54 is carried by plate 51 and is arranged to expand in the opposite direction from the bellows expansion to compensate for the effect of local, extraneous heat which may be applied to the assembly, so that temperatures other than the oven temperatures will have no effect on the operation of the device. This is particularly advantageous in this installation because of the proximity of the burner 14.

The end of the actuating pin 41 rests against the bimetal disc 54 and is movable therewith. Thus a decrease in oven temperature will contract bellows 46 and allow load springs 53 to move the yoke and the pin 41 to the right and an increase will cause the bellows to expand and move the yoke and pin to the left.

The adjusting shaft 49 extends from bellows 46 and yoke 50 through a center guide 55 to the end of the tubular casing 42, at which point a dial 56 is secured to said shaft, said dial carrying appropriate indicia arranged to cooperate with a pointer 57 located on the casing, to enable the operator to set the temperature at which the oven is to be maintained. Thus, because of the bearing of the end of the adjusting shaft on the bellows and the threaded engagement of said shaft with the yoke, rotation of the dial changes the position of the yoke relative to the bellows. The indicia on the dial is so arranged that changing the setting from low to high moves the yoke and pin 41 to the right and changing from high to low moves the yoke to the left removing the force of the pin from the lever 23.

The operation of our device is as follows:—The dial is set to the temperature at which it is desired to maintain the oven. This moves the pin 41 to the right which acts through the lever 23 to move pin 25 to the left against spring 26 to remove the pressure thereof from the end of rod 24. The liquid fuel is then allowed to flow through line 9 to enter the bellows 17 and generator tube 10 under pressure. This fuel pressure acts on the bellows 17 to move the head thereof to the left until rod 24 engages the end of the lever 23, the spring 26 having a greater force than the fuel pressure. As the head of the bellows 17 moves to the left, the needle valve 20 is carried in the same direction, opening the valve and allowing fuel to flow to both the oven burner and the burner for heating the generator tube. As the temperature of the oven increases, the thermostatic bellows 46 gradually moves the yoke 50 to the left removing the force of the pin 41 from the lever and allowing spring 26 to move the rod 24 to the right to gradually reduce the flow of fuel to the burner. By the time the oven reaches the desired temperature, the shoulder 27 of rod 24 will strike the stop 28 and, as previously explained, prevent the oven burner from being completely extinguished. The minimum flame on the oven burner thus insured, is not large enough to raise the oven temperature above that which may be desired in the ordinary oven and if the temperature begins to drop lower than that desired, the thermostatic bellows will be contracted and the pin 41 moved to the right to compress spring 26 and allow the fuel pressure to open the valve to allow passage of more fuel vapor to the burner.

Thus we provide a structure for automatically controlling the temperature of a chamber heated by a liquid fuel burner by having a needle valve which has opposing forces constantly acting thereon tending to both open and close the valve, and a thermostat arranged to regulate the movement of the valve by these forces in accordance with the temperature of the chamber. In addition we provide means for preventing the complete closure of the valve by the actuating means to keep the burner from being extinguished when the chamber reaches the desired temperature and manually operated means for closing the valve independently of the thermostat for cleaning purposes. The particular method which has been hereinbefore described for preserving at least a minimum flame on the oven burner is advantageous in that it works equally well whether the valve is automatically moved towards closing or the dial is turned by hand from a high to a low temperature setting which, if the oven temperature is high, would tend to shut the valve completely.

Although we have shown and described a preferred embodiment of our invention, it is to be understood that we do not intend to be limited thereby as the invention may be otherwise embodied within the scope of the appended claims.

We claim:

1. The combination with a burner for burning gasified liquid fuel, of a generating chamber wherein the fuel is gasified, said chamber having an outlet orifice, a valve cooperating with said orifice to control the flow of gasified fuel therethrough, means for actuating said valve, and a thermostat for regulating the movement of said valve by said actuating means.

2. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an orifice at one end thereof, a needle valve arranged to cooperate with said orifice to control the flow of fuel vapor therethrough to said burner, means for actuating said valve, and a thermostat for regulating the operation of said valve by said actuating means.

3. The combination with a liquid fuel range having an oven and a heating burner therefor, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a valve arranged to control the flow of fuel vapor therethrough to said burner, of means for actuating said valve, a thermostat responsive to the temperature of said oven for regulating the movement of said valve by said actuating means, and means including a dial which may be set to various temperatures for adjusting the thermostat relative to said actuating means.

4. A thermostatic control for a liquid fuel burner comprising a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a valve arranged to cooperate with said orifice to control the flow of fuel vapor therethrough to said burner, means for constantly urging said valve toward an open position, means for constantly urging said valve toward a closed position, and a thermostat for regulating the movement of said valve by said first and second mentioned means.

5. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a needle valve cooperating with said orifice to control the

flow of fuel vapor therethrough to said burner, means for actuating said valve, a thermostat connected with said actuating means for regulating the movement of said valve thereby, and means for preventing the complete closure of said valve by said actuating means to assure a continuous flow of sufficient fuel vapor to maintain a flame at said burner.

6. The combination with a liquid fuel range having an oven and a heating burner therefor, a generator tube wherein the liquid fuel is vaporibed, said tube having an outlet orifice, a needle valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, of means for actuating said valve, a thermostat responsive to the temperature of said oven for regulating the movement of said valve by said actuating means, and means including an adjustable stop associated with said actuating means for limiting the valve closing movement, whereby the minimum supply of fuel to said burner is fixed.

7. The combination of a burner for burning vaporized liquid fuel, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a needle valve arranged to control the flow of fuel vapor through said orifice to said burner, means for constantly urging said valve toward an open position, means for constantly urging said valve toward a closed position, a thermostat between said first and second mentioned means for regulating the movement of said valve, and means associated with said valve closing means for preventing the complete closure of said valve thereby to assure a continuous supply of fuel vapor to said burner.

8. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, means for actuating said valve, a thermostat for regulating the movement of said valve thereby, and manually operated means for closing said valve independently of said thermostat and actuating means.

9. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a needle valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, means for constantly urging said valve toward a closed position, a second means for constantly urging said valve toward an open position, a thermostat arranged to regulate the movement of said valve by said first and second mentioned means, and manually operated means connected with said valve for closing same independently of said thermostat and said first mentioned valve closing means.

10. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a needle valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, means for actuating said valve, a thermostat associated with said actuating means for regulating the movement of said valve thereby, means for preventing the complete closure of said valve by said actuating means, and manually operated means for closing said valve independently of said thermostat and actuating means.

11. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, a valve cooperating with said orifice for controlling the flow of fuel vapor therethrough to said burner, means for constantly urging said valve toward an open position, a second means for constantly opposing said valve opening means, and a thermostat connected between said first and second means and arranged to oppose one of said means with a varying force to regulate the movement of said valve.

12. In combination with a burner for burning vaporized liquid fuel, a generator tube wherein the liquid fuel is vaporized, said tube having an outlet orifice, flexible means for sealing one end of said tube, a needle valve attached to and movable with said flexible seal and arranged to cooperate with said orifice to control the flow of fuel vapor therethrough to said burner, a supply passage through which liquid fuel is fed under pressure to said generator tube, said flexible seal being responsive to said fuel pressure to constantly urge said valve toward an open position, resilient means connected with said flexible seal in opposition to said fuel pressure to constantly urge said valve toward a closed position, and a thermostat connected with said resilient means for regulating the effect thereof on the movement of said valve.

13. In combination with a burner for burning liquid fuel, of a generator tube wherein the liquid fuel is vaporized, said tube having an orifice at one end thereof and a flexible seal at the other end, a needle valve attached to and movable with said flexible seal and arranged to cooperate with said orifice to control the flow of fuel vapor therethrough to said burner, a supply passage through which liquid fuel is fed under pressure to said tube, said flexible seal being responsive to said fuel pressure to constantly tend to move said valve toward an open position, means including a spring connected with said flexible seal in opposition to said fuel pressure for constantly urging said valve toward a closed position, a thermostat for regulating the movement of said valve, and means including a stop arranged to engage said valve closing means for preventing the complete closure of the valve thereby, whereby the continuous operation of said burner is assured.

14. In a liquid fuel burning apparatus, a burner, a generator tube wherein the liquid fuel is vaporized, said tube having an orifice at one end thereof and a flexible seal at the other end, a needle valve attached to and movable with said flexible seal and arranged to cooperate with said orifice to control the flow of fuel vapor therethrough to said burner, a supply passage through which liquid fuel is fed under pressure to said tube, said flexible seal being responsive to said fuel pressure to constantly tend to move said valve toward an open position, means including a spring connected with said flexible seal in opposition to said fuel pressure for constantly urging said valve toward a closed position, a thermostat connected with said valve closing means for regulating the effect thereof on the movement of said valve, and manually operated means for closing said valve independently of said thermostat.

15. The combination with a liquid fuel range having an oven and a heating burner therefor, a generator tube wherein the liquid fuel is vaporized, said tube having an orifice at one end thereof, a flexible bellows for sealing the other end of the tube, a needle valve attached to and movable with said bellows and arranged to co-

operate with said orifice to control the flow of fuel vapor therethrough to said burner, a supply passage through which liquid fuel is fed under pressure to said tube, said flexible bellows being responsive to said fuel pressure to constantly tend to move said valve to an open position, means including a spring connected with said flexible bellows in opposition to said fuel pressure for constantly urging said valve toward a closed position, a thermostat responsive to the temperature of said oven and connected with said valve closing means for regulating the effect thereof on the movement of said valve, means including a stop arranged to engage said valve closing means for preventing the complete closure of said valve thereby to assure a continuous flow of sufficient fuel vapor to maintain a flame on said burner, and manually operated means for closing said valve independently of said thermostat and valve closing means.

16. In a liquid fuel burning apparatus, a burner, a generating chamber wherein the liquid fuel is vaporized, said chamber having a discharge orifice, a supply passage through which liquid fuel is fed to said chamber under pressure, a valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, means responsive to said fuel pressure tending to move said valve toward an open position, spring means for closing said valve, and a thermostat connected between said first and second means for regulating the movement of said valve.

17. In a liquid fuel burning apparatus, a burner, a generator wherein the liquid fuel is vaporized, said generator having an outlet orifice, a valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, means for constantly urging said valve toward a closed position, a second means for constantly urging said valve toward an open position, a thermostat arranged to regulate the movement of said valve by said first and second means, a stop associated with said first means for preventing the complete closure of the valve thereby, and manual means connected with said second means for closing said valve independently of said thermostat and said stop.

18. In a liquid fuel burning apparatus, a burner, a chamber wherein the liquid fuel is vaporized, said chamber having a discharge orifice, a supply passage through which liquid fuel is fed to said chamber under pressure, a valve cooperating with said orifice to control the flow of fuel vapor therethrough to said burner, means responsive to said fuel pressure tending to open said valve, spring means for closing said valve, a thermostat connected between said pressure responsive and spring means for regulating the movement of said valve, means associated with said spring for preventing the complete closure of said valve thereby, and manually operable means connected with said pressure responsive means to close said valve independently of said thermostat and spring.

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