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LIQUID FUEL BURNER

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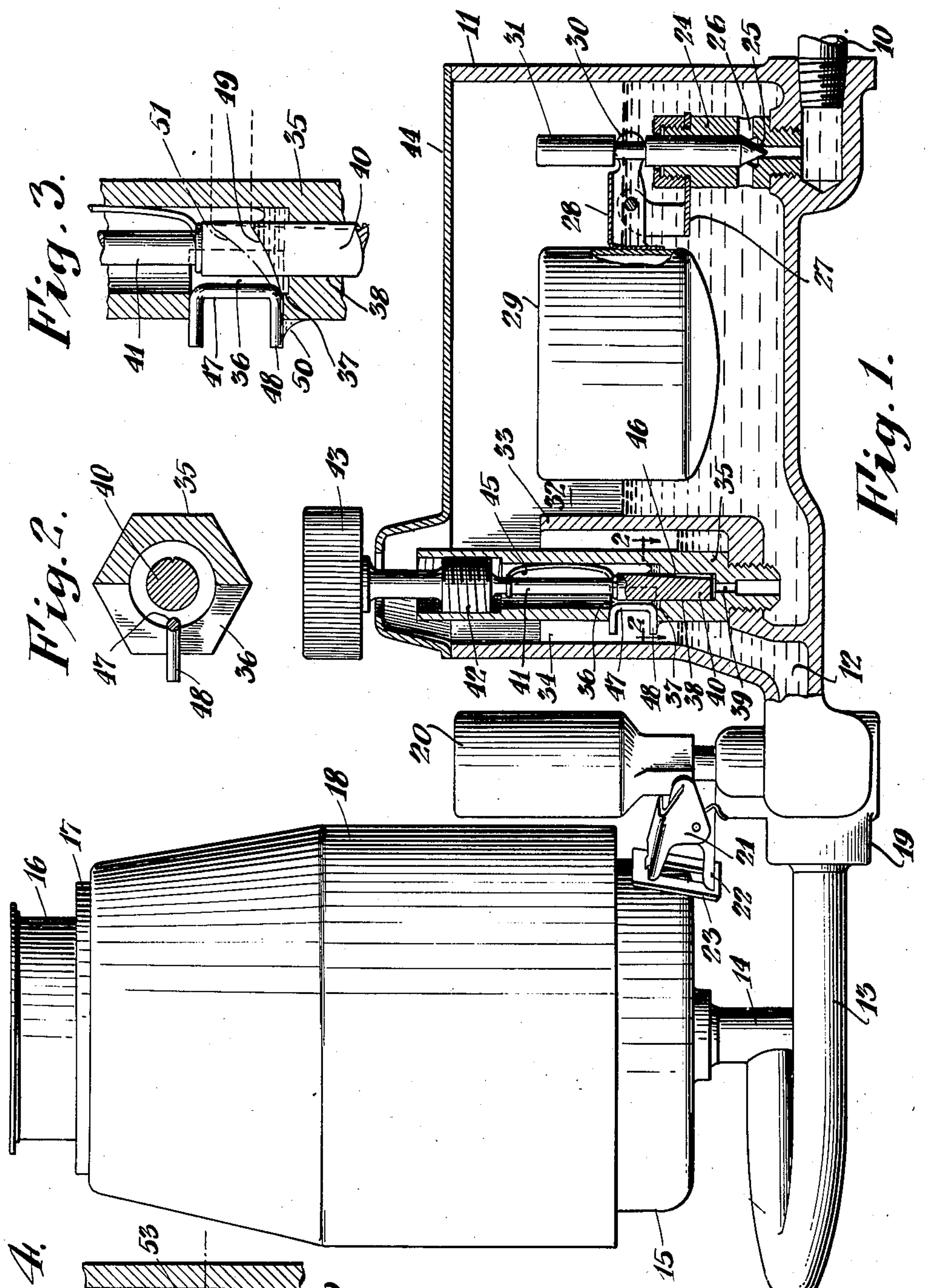

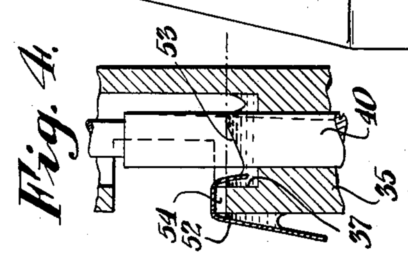

INVENTOR.

Ralph M. Buffington

BY

E. A. Fenander his ATTORNEY.

UNITED STATES PATENT OFFICE

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LIQUID FUEL BURNER

Ralph M. Buffington, Evansville, Ind., assignor to Servel, Inc., New York, N. Y., a corporation of Delaware

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10 Claims. (Cl. 137—21)

My invention relates to liquid fuel burners, and it is an object of the invention to provide an improvement to obtain a substantially constant rate of flow of liquid fuel to a burner.

The objects and advantages of my invention will be better understood from the following description taken in conjunction with the accompanying drawing forming a part of this specification, and of which Fig. 1 illustrates a liquid fuel burner embodying the invention, the burner being shown partly in elevation and partly in section; Fig. 2 is an enlarged fragmentary sectional view taken on line 2—2 of Fig. 1; Fig. 3 is an enlarged fragmentary sectional view of parts of the burner shown in Fig. 1; and Fig. 4 is a fragmentary sectional view similar to Fig. 3 illustrating a modification of the invention.

Referring to Fig. 1, a liquid fuel, such as kerosene, is delivered from a source of supply to an inlet 10 of a casing 11. The liquid is conducted from an outlet 12 of the casing through a conduit 13 and vertically extending tube 14 to a burner well 15 in which the fuel is vaporized. Above the burner well 15 are disposed spaced perforated chimneys 16 and 17, only the upper parts of which are shown, and about the chimneys is provided an enclosing shell 18.

A valve 19 is interposed between the outlet 12 and conduit 13 for shutting off the flow of liquid in the event of faulty operation of the burner. The valve 19 is provided with a weighted valve member 20 to which is attached a lever 21. The lever 21 is pivoted on a bracket 22 which is secured to the casing of valve 19. A link 23 of fusible metal is fitted over the outer ends of lever 21 and bracket 22 to keep the weighted valve member 20 in its upper position and permit flow of liquid to the burner. When the link 23 melts due to an excessive rise in temperature of the burner, the weighted valve member 20 moves downward to its closed position and shuts off the flow of liquid to the burner.

A vertical sleeve 24 located in casing 11 is threadedly secured at its lower end in an opening which communicates with the inlet 10. A valve seat 25 is formed at the lower end of sleeve 24, and above the valve seat are located openings 26 in the wall of the sleeve. To the upper end of sleeve 24 is secured a bracket 27 having pivotally mounted thereon an arm 28 of a float 29. The arm 28 is provided with rounded bifurcated ends 30 which fit into a reduced portion of a needle valve 31 which is vertically movable in sleeve 24. The float 29 and needle valve 31 control the flow of fuel through inlet 10 into casing 11 in a well-known manner to maintain the liquid level in a float chamber 32 substantially constant.

A partition 33 is provided in casing 11 to form the float chamber 32 and an overflow chamber 34 which communicates with the outlet 12. The lower horizontal part of partition 33 is provided with an opening to receive the lower threaded end of a hollow sleeve 35 which extends upward in chamber 34. Intermediate the ends of sleeve 35 is provided an opening or cut-out portion 36 which extends about 180° about the sleeve, as shown most clearly in Fig. 2. A slight distance below the lower edge of opening 36 the bore of sleeve 35 is reduced to form a lip 37 at the lower edge of the opening. The reduced portion of the bore forms a passage 38 into the lower end of which liquid flows from chamber 32 through a restriction 39 in the lower end of sleeve 35.

The passage 38 is adapted to receive a valve 40 having a stem 41 extending upward therefrom. The stem 41 is provided with an enlarged portion 42 which is in threaded engagement with the upper part of sleeve 35. A control knob 43 is fixed to the upper end of stem 41 which extends through an opening in a cover plate 44 removably secured in any suitable manner to the casing 11. To prevent accidental movement of valve 40 after it is adjusted to a desired position, a bowed spring 45 is secured to valve stem 41. The spring 45 frictionally engages the inner wall of sleeve 35 to prevent undesired turning movement of stem 41, and at the same time permits axial movement of valve 40 when control knob 43 is rotated.

The valve 40 is in the form of a plug which is more or less cylindrical in shape and is tapered about a portion of the periphery thereof, as shown most clearly in Fig. 1. When the lower end of valve 40 is seated on the shoulder formed at the restriction 39, the flow of liquid from chamber 32 into chamber 34 is shut off. By raising valve 40 a slight distance from the lower end of passage 38, a restricted passage 46 for flow of liquid is provided about the tapered portion of the valve.

Assuming that valve 40 is in its closed position and chamber 32 is filled with liquid, the operation of the burner is started by adjusting valve 40 for a predetermined rate of flow of liquid from chamber 32 through the restricted valve passage 46. The liquid flows over the lower edge of opening 36 into chamber 34, and thence through conduit 13 into burner tube 14. With flow of liquid out of chamber 32 the lowering of float 29 opens needle valve 31, and liquid flows into chamber 32 from inlet 10 until the liquid is again at such a level that float 29 closes needle valve 31. When this occurs the liquid in burner tube 14, chamber 34 and chamber 32 are at the same level. Upon igniting the liquid fuel in the burner the fuel is consumed from the upper end of burner tube 14, and the liquid level falls in tube 14 and chamber 34.

The liquid in chamber 34 may fall to the level indicated in Fig. 1, and, due to the pressure head resulting from the difference in liquid level in chamber 32 and in sleeve 35, flow of liquid continues from chamber 32 into chamber 34. This flow of liquid is dependent upon the extent that valve 40 is opened in sleeve 35.

When accurate control of the burner flame is desired, it is of considerable importance to obtain a substantially constant rate of flow of liquid to the burner. When the burner is operating and the flow of liquid increases, the size of the burner flame increases and a greater amount of heating is effected than is desired. Conversely, when the flow of liquid to the burner decreases and less liquid is supplied to the burner, the size of the burner flame decreases and less heating is effected than is desired.

The flow of liquid through capillary passage 46 in valve member 40 in sleeve 35 is governed by the laws of viscous or capillary flow. The chief factors influencing the rate of flow, considering constant liquid levels or pressure head, are the viscosity and surface tension of the liquid. The rate of flow of liquid varies directly with the pressure head and inversely as the viscosity of the liquid. When the viscosity of the liquid increases, due to a decrease in temperature, for example, the rate of flow of liquid decreases if the pressure head remains constant; and, when the viscosity of the liquid decreases, the rate of flow of liquid increases if the pressure head remains constant.

In accordance with my invention, in order to obtain a substantially constant rate of flow of liquid to the burner, I vary the pressure head to compensate for variations in viscosity of the liquid. I accomplish this by fixing a clip 47 at the opening 36 of sleeve 35 to provide a capillary syphon drain. The clip 47 is C-shaped and secured to sleeve 35, as by soldering, for example, with the lower side 48 bearing against the lower edge of the opening 36. The lower side 48 of the clip extends radially outward from a point inside sleeve 35 and projects beyond the outer wall of the sleeve.

With the clip 47 at the overflow point of liquid in sleeve 35, a meniscus of the character indicated by the solid line 49 is formed within the sleeve, as shown in Fig. 3. In addition to the meniscus 49 formed within the sleeve, an inverted meniscus 50 is formed outside the sleeve below the lower side 48 of the clip 47.

When no clip is employed, a meniscus of the character indicated by dotted line 51 is formed at the overflow point in sleeve 35. In such case the pressure head remains constant when the viscosity of the liquid increases, and the flow of liquid is reduced. By using the clip 47 so that the inverted meniscus 50 is formed outside sleeve 35, an increase in viscosity of the liquid is compensated for by an increase in pressure head. This increase in pressure head is effected by a lowering of the liquid level in sleeve 35, and results from outward movement of meniscus 49 toward the space occupied by the portion 50 of the meniscus. This outward movement of the meniscus is effected by the increased surface tension of the liquid.

By forming an inverted meniscus at the outside of sleeve 35 which acts on the principle of a syphon, therefore, the liquid level in sleeve 35 may be lowered with an increase in viscosity of the liquid. With such lowering of the liquid level in sleeve 35, the pressure head is increased and compensates for the increased viscosity of the liquid.

When the viscosity of the liquid decreases, the inverted portion 50 of the meniscus becomes smaller and the meniscus 49 within the sleeve becomes higher due to the lower surface tension of the liquid. This decreases the pressure head and compensates for the increase in flow of liquid which tends to take place when the liquid becomes less viscous.

The angle that the lower side 48 of the clip 47 forms with the side wall of sleeve 35 determines the effect that surface tension plays in compensating for variations in viscosity of the liquid. In the embodiment just described the lower side of the clip or capillary drain forms a 90° angle with the sleeve to form the space for the inverted meniscus 50.

By making the angle of the capillary drain smaller, the inverted meniscus outside the sleeve may be made to extend downward a greater distance to compensate for variations in viscosity of the liquid. Such a modification is shown in Fig. 4 in which a flat strip 52 forms a relatively sharp acute angle with the sleeve 35. The flat strip 51 is fixed at the lower edge of opening 36 in any suitable manner, and, in addition, has a portion extending downward within the sleeve to form a meniscus of the character indicated by the solid line 53. It will be seen that this meniscus is reversed from the meniscus 49 shown in Fig. 3, whereby the liquid in sleeve 35 falls to a lower level. A wide groove 54 is formed below the strip 52 at the overflow point to provide a channel through which liquid may readily flow. The inner depending portion of strip 52 preferably extends downward a sufficient distance to provide a capillary syphon from a liquid level in sleeve 35 that is below the overflow point. The modification shown in Fig. 4 compensates for changes in viscosity of the liquid by varying the pressure head in a manner similar to that described above in connection with the embodiment shown in Fig. 1.

It will now be understood that by providing a capillary drain any changes in viscosity of liquid fuel are compensated by varying the pressure head, so that the flow of liquid to the burner is substantially constant. Not only may the capillary drain be employed to effect a substantially constant rate of flow of liquid to the burner, but it may also be used to vary the pressure head in any other desired manner with changes in viscosity of the liquid.

Although I have shown and described particular embodiments of my invention, it will be apparent to those skilled in the art that modifications and changes may be made without departing from the spirit and scope of the invention, as pointed out in the following claims.

What is claimed is:

1. In a liquid fuel burner having a constant level chamber, a passage communicating with said chamber, a valve for controlling flow of liquid in said passage, said passage having a discharge opening below the liquid level in said

chamber whereby a pressure head is provided during operation of the burner to cause flow of liquid at said discharge opening, and means at said opening to vary said pressure head with changes in viscosity of the liquid.

2. In a liquid fuel burner having a constant level chamber, a passage communicating with the lower part of said chamber and extending vertically upward, said passage having an overflow point below the liquid level in said chamber whereby a pressure head is provided during operation of the burner to cause flow of liquid at said overflow point, and means at said overflow point to vary said pressure head with changes in viscosity of the liquid.

3. In a liquid fuel burner having a constant level chamber, a passage communicating with the lower part of said chamber and extending vertically upward, a valve for controlling the flow of liquid in said passage, said passage having an overflow point below the liquid level in said chamber, and a member at said overflow point and extending outside said passage and constructed and arranged to form a downward divergent capillary passage from said overflow point.

4. In a liquid fuel burner having a constant level chamber, a passage communicating with said chamber, a valve for controlling flow of liquid in said passage, said passage having an overflow point below the liquid level in said chamber whereby a pressure head is provided to cause flow of liquid at said overflow point, and means including a capillary drain member at said overflow point to vary said pressure head with changes in viscosity of the liquid.

5. In a liquid fuel burner having a burner well and a constant level chamber, a conduit for conducting liquid fuel from said chamber to said burner well and including a vertically extending member, said member having a discharge opening below the liquid level in said chamber, and a member at said opening so constructed and arranged that the meniscus formed at said opening by the liquid in said member includes an inverted portion outside said member.

6. In a liquid fuel burner having a burner well and a constant level chamber, a conduit for conducting liquid fuel from said chamber to said burner and including a vertically extending member, said member having a discharge opening below the liquid level in said chamber, a V-shaped member at the lower edge of said opening and having a portion extending downward in said member and another portion extending downward outside of said member, and a channel formed below said V-shaped member at the lower edge of said opening.

7. In a liquid fuel burner having a burner well and a constant level chamber, a conduit for conducting liquid fuel from said chamber to said burner and including a vertically extending member, said member having an opening in a side wall thereof with the lower edge of the opening below the liquid level in said chamber, and a member at the lower edge of the opening and extending from a point inside said member and projecting beyond the outer wall of said member to form a capillary passage over said edge.

8. A liquid fuel burner including a burner well, a constant level fuel chamber, a capillary overflow conduit from said chamber to said burner well, and means to vary the effective head causing liquid flow through said capillary responsive to change in viscosity of the liquid fuel to maintain a substantially constant rate of overflow.

9. A liquid fuel burner as set forth in claim 8 in which said means is a capillary syphon with downward divergent walls on the down leg and arranged in series with the said capillary overflow conduit.

10. A method of flowing liquid fuel to a burner which includes maintaining a body of liquid fuel at a certain surface level, conducting liquid from said body by overflow at a point below said surface level, and keeping the liquid flow constant without changing said overflow point by compensating for variations in viscosity of the liquid by varying the mean surface level of liquid at said overflow point relative to the surface level of said body of liquid responsive to change in viscosity of the liquid.

RALPH M. BUFFINGTON.