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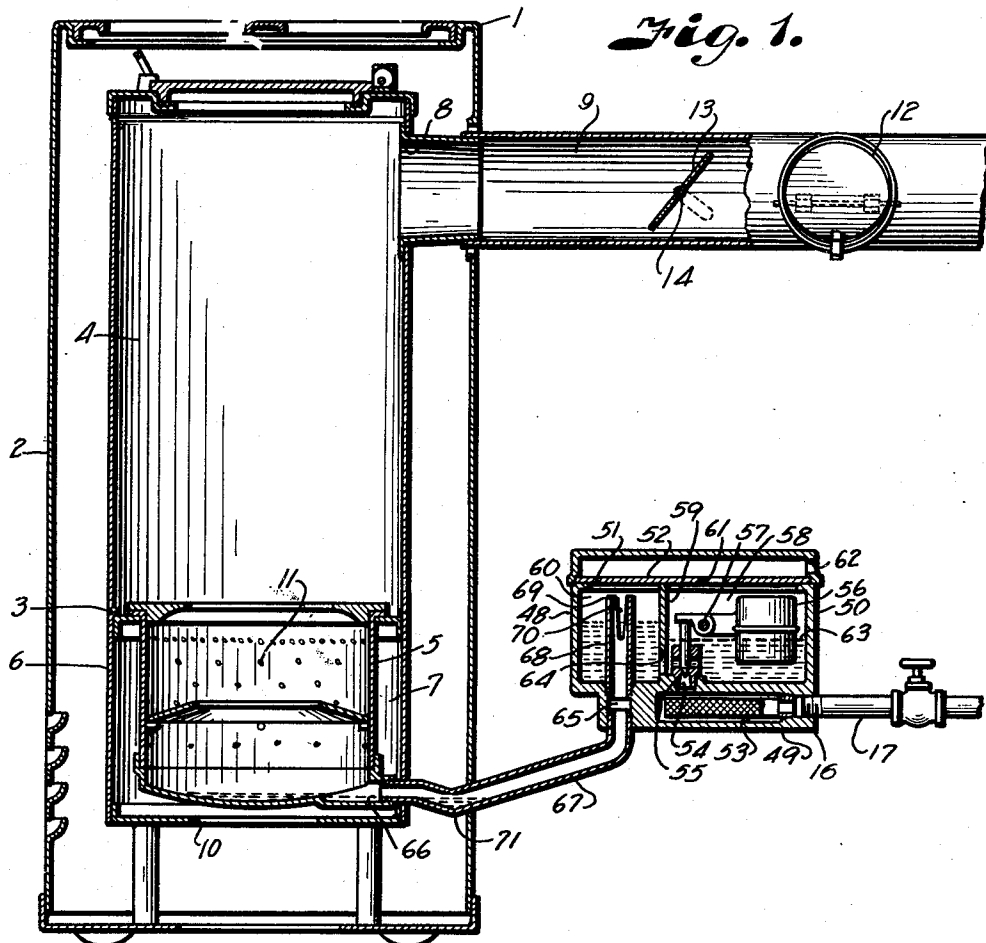
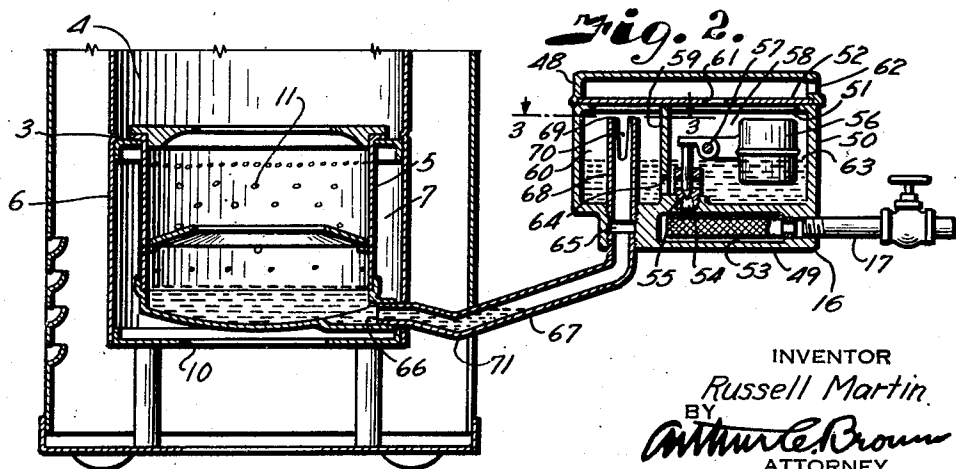
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CONTROL APPARATUS FOR FUEL BURNING APPLIANCES

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CONTROL APPARATUS FOR FUEL BURNING APPLIANCES

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9 Claims. (Cl. 158—91)

This invention relates to fuel burning appliances, for example heaters wherein a fluid fuel is delivered to the burner or fire-pot thereof.

Since draft as applied to the burner of a heater is the pressure differential between the incoming and outgoing sides of the burner or fire-pot, the rate of air intake is determined by the amount of the draft, and any change in the draft therefore affects the air and fuel ratio. It is well known that if a heating appliance of this character is to operate more efficiently, the air supply must be maintained in proper ratio to the fuel supply. Therefore, with a given setting of the fuel control valve, the draft or pressure differential must remain uniformly constant, but in actual operation the pressure differential, and consequently the amount of air, varies with fluctuation of the chimney draft.

This variation in pressure differential or draft has been corrected in part through use of draft regulators. However, when the rate of fuel flow is changed to maintain a predetermined room temperature, the fuel and air ratio is then out of balance and inefficient operation results.

It is, therefore, an object of the present invention to maintain proper air and fuel ratio throughout the heating rate range so as to accomplish more efficient operation of fluid fuel burning appliances.

It is also an object of the invention to control the rate of fuel supply to the burner and, therefore, the heating rate of the heater through adjustment of the draft control means.

It is also an object of the invention to provide a structural means whereby the draft operates to control the input of both fuel and air to the fuel burning appliance.

It is also an object of this invention to provide a structure which will maintain, with great accuracy, the proper ratio between fuel and air flowing to the burner when a portion or all of the draft is provided by mechanical means, such as a blower. When a blower is used the air rate of flow is caused by the summation of two pressure differentials, namely, chimney draft and blower draft, so that this invention makes possible the coordination of the rate of fuel flow to burner with the resultant of either or both factors effecting the flow of air to the burner. This maintains an accuracy in the proper ratio between fuel and air at variable heating rates, which has not been attained heretofore.

In accomplishing these and other objects of the invention, as hereinafter described, I have

provided suitable means as illustrated in the accompanying drawings, wherein:

Fig. 1 is a diagrammatic section through a heater equipped with a draft controlled fuel supply regulator embodying the features of the present invention.

Fig. 2 is a sectional view of the apparatus illustrated in Fig. 1, but showing automatic suspension of the fuel flow to the fire-pot.

Fig. 3 is a section through the fuel flow regulator on the line 3—3 of Fig. 2.

Fig. 4 is a detail perspective view of the fuel flow regulating device.

Fig. 5 is a section through a heater equipped with an embodiment of the present invention and provided with a blower for supplying a mechanically forced draft.

Referring more in detail to the drawings:

While it is to be understood my invention is adapted to various types of fluid fuel burning appliances, I have illustrated adaptation thereof to an air heater 1, such as used in heating rooms in residences and the like. A heater of this character may include an outer casing 2 through which air is circulated in contact with a heater unit 3. In the illustrated instance the heater unit includes a combustion chamber 4, in the bottom of which is supported a fire-pot 5 spaced from a depending wall 6 formed as a continuation of the combustion chamber wall to form an annular air passageway 7. The upper portion of the combustion chamber has an outlet connection 8 with a pipe 9 leading to a chimney (not shown), whereby draft is effected through the fire-pot responsive to pressure differential established between the air in the passageway 7 and the interior of the fire-pot 5 to effect intake of combustion supporting air through an opening 10, (Figs. 1 and 2) into the passageway 7, from the passageway into the fire-pot, and through a plurality of air distribution openings 11 formed in the side wall of the pot. The draft is regulated to a predetermined maximum by a draft regulator 12, and may be throttled down to control the amount of combustion supporting air by means of a damper 13, which, in the present instance, is located in the pipe 9 in spaced relation with the outlet 8. The damper illustrated is of the butterfly type and mounted on a shaft 14 extending transversely through the pipe 9. The shaft 14 is actuated to move the damper by a lever fixed to an outer projecting end of the shaft.

Connected with the fire-pot, near the bottom thereof, is a fuel supply pipe 67 connected with

a fuel control regulator 16 having connection with a pipe 17 leading from a source of fluid fuel supply (not shown).

The heating appliance thus far described may operate in conventional manner in that the regulator 16 may be adjusted to regulate the rate of fuel to the fire-pot and the damper 13 may be adjusted so that the combustion supporting air and fuel are delivered in proper proportions to effect the desired combustible mixture.

The heater will operate efficiently as long as the air and fuel supplied are in proper portion, but when the fuel valve is operated to vary the burning rate, the fuel and air ratio is thrown out of balance requiring readjustment of the draft regulating means for every change in fuel feed rate to the burner. It is also pointed out that automatic draft regulators are activated by the chimney draft and are subject to inaccurate regulation due to changing wind velocities over the chimney and for other reasons. Thus even though the heater is equipped with an automatic draft regulator 12, it rarely operates at greatest efficiency under any burning rate conditions because it often fails to maintain the proper air and fuel ratio.

Inasmuch as the air flow into the burner is always responsive to the draft, I have utilized the draft or pressure differential to control the flow of fuel to the burner, thereby maintaining the proper ratio of air and fuel, at all times, supplied to the burner. I also provide for manually varying this pressure differential to regulate the burning rate of the heater, instead of adjusting the fuel flow as is the present practice. Obviously this pressure differential may be controlled by automatic means if so desired.

In carrying out the invention the fuel flow is automatically controlled by pressure differential on the inner and outer sides of the fire-pot. The regulating means 16 includes a casing 48 having a bottom 49 and side walls 50 forming an open top 51 closed by a cover 52. Formed in the bottom 49 is a strainer chamber 53, to which the fuel supply pipe 17 is connected. The strainer chamber has an outlet port 54 controlled by a valve 55 responsive to a float 56, the float being supported on a transverse shaft 57 in a float chamber 58 similarly to the float chamber previously described. The float chamber 58 is separated by a partition 59 from a pressure chamber 60 sealed from external atmospheric pressures but which carries the fire-pot pressures as later described. The float chamber, however, is open to atmospheric pressure through ports 61 and 62 in the cover so that the fuel level maintained by the float and indicated at 63 is under atmospheric pressure. The partition 59 has an opening 64 located therein at a point below the fuel level 63 to admit fuel into the pressure chamber 60. The bottom of the pressure chamber has an outlet port 65 that is connected with the inlet opening 66 of the fire-pot by the pipe 67. Threaded into the port 65 and extending upwardly within the pressure chamber 60 is a tubular fuel control member 68, having its upper end 69 extending above the maximum fuel level in the pressure chamber. Formed in the sides of the tubular control member are downwardly extending slots 70 terminating slightly above the fuel level 63 maintained by the float chamber 58. Thus when the pressures in the chambers 60 and 58 are equal, flow will be cut off to the pipe 67. However, when a draft is established through the heater, as by

opening the damper 13, reduction in pressure on the interior of the fire-pot is transmitted through the pipe 67 to the pressure chamber 60, whereupon the fuel level rises in the pressure chamber above the lower ends of the slots, proportional to the pressure occurring within the fire-pot. Thus the greater the pressure in the fire-pot relatively to the external pressure, the lower the level of fuel in the pressure chamber, and the lesser the pressure the higher the fuel level. Therefore, the rate of flow of fuel through the slots is governed by the draft or pressure differential between the inner and outer sides of the path with the result that change in draft automatically increases or decreases the fuel flow to the heater. To increase the burning rate, it is only necessary to open the damper 13 to reduce pressure in the interior of the fire-pot, which reduction in pressure is also effected in the pressure chamber to cause a rise in the fuel level therein subjecting a greater portion of the slots to the fuel and thereby effecting a greater flow to the fire-pot. If, for any reason, the draft should diminish, a corresponding increase of pressure occurs in the fire-pot and pressure chamber to readjust the fuel level, so that a smaller portion of the slots is effective and a smaller stream of fuel is delivered to the fire-pot.

Attention is directed to the fact that the pipe 67 is of sufficient capacity relatively to the maximum effective area of the slots so that the pipe 67 is not completely filled with liquid, therefore, the pressure chamber is open to connect the pressure chamber of the regulating valve with the interior of the fire-pot.

To automatically suspend the fuel flow to the burner from the pressure chamber in case the fire should become extinguished, or for other reasons, the pipe 67 is provided with a trap or dip 71 so that when fuel collects in the fire-pot to a certain level a liquid seal is effected, shutting off air communication between the interior of the fire-pot and the pressure chamber 60, (see Fig. 2) so when the hydrostatic head of fuel in the fire-pot above the fuel line balances the existing pressure differential then the flow is automatically suspended, in which case the pressure in chamber 60 becomes the same as that outside the pot.

The form of the invention shown in Fig 5, is the same as that illustrated in Figs. 1 to 4, inclusive, however, the heater is provided with a "forced draft" whereby air is discharged through the air inlet opening 72 by a blower 73, connected thereto by a duct 74. The flow of air through the duct is controlled by a damper 75. In order that the float chamber may be subject to the pressure in the space 7 exteriorly of the fire-pot, the float chamber is connected therewith by a pipe 76. Thus the pressures acting on the fuel levels in the respective chambers of the fuel control device are the same as the pressures maintained on the interior and exterior sides of the fire-pot, and the proper ratio of fuel and air flowing to the burner is maintained when either a portion or all of the air is supplied by "forced draft."

From the foregoing it is obvious that I have provided means for maintaining the proper air and fuel ratio when there is change in draft and consequent burning rate so that a heating appliance equipped with my invention will operate at maximum efficiency at all burning rates. It is also obvious that the heater may be operated at any

selected burning rate upon adjusting the draft control damper and that this adjustment simultaneously increases or decreases the fuel supply with the increased or decreased air supply, thus maintaining the proper air and fuel ratio.

What I claim and desire to secure by Letters Patent is:

1. In combination with a heater having a burner pot, a blower for supplying air to the burner pot, means supplying a liquid fuel to the burner pot, means controlling the flow of liquid fuel thereto including a variable pressure chamber, means connecting the variable pressure chamber with the interior of said burner pot for maintaining pressure in said chamber corresponding to the pressure in the burner pot, a liquid fuel discharge member in said chamber having connection with the burner pot through said connection means and arranged to discharge liquid fuel at rates responsive to rise and fall of the liquid fuel level in said chamber under action of the variable pressures maintained in said burner pot, a constant level chamber having connection below the liquid level with the variable pressure chamber, means supplying liquid fuel to the constant level chamber, and a duct connecting the pressure chamber supplying air to the burner with the constant level liquid fuel chamber.

2. In a fuel burning appliance provided with a liquid fuel burner and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus for said appliance, including a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween, said fuel supply chamber having means for maintaining equalized pressures in said fuel supply and air supply chambers, and means connecting the fuel feed chamber and the burner for delivering liquid fuel to the burner and for introducing combustion chamber pressure into the feed chamber of the control apparatus whereby differential pressures in the fuel supply and feed chambers vary the liquid level in the feed chamber for co-ordinating the liquid fuel feeding rate with air flow to the combustion chamber.

3. In a fuel burning appliance provided with a liquid fuel burner and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus for said appliance, including a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween below the levels of liquid to be maintained in said chambers, a liquid fuel level control mechanism in said supply chamber for maintaining a constant liquid fuel level in said chamber, liquid fuel outlet mechanism in the feed chamber and having an inlet the capacity of which is dependent upon the liquid level in said feed chamber, and a duct connecting the outlet mechanism with the burner, said fuel supply chamber having means for maintaining equalized pressures in the liquid fuel and air supply chambers, and said duct being normally open above the fuel therein for admitting combustion chamber pressure to the fuel feed chamber whereby differential pressures in the fuel supply and feed chambers of the control apparatus vary the liquid level in the fuel feed chamber for co-ordinating the rate of liquid fuel feed with the air flow to the combustion chamber.

4. In a fuel burning appliance provided with a

liquid fuel burner and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus, including a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween, said fuel supply chamber having means for maintaining equalized pressure in said fuel and air supply chambers, a duct connecting the feed chamber with the burner for delivering liquid fuel to the burner and for introducing combustion chamber pressure into the fuel feed chamber of the control apparatus whereby differential pressures in the fuel supply and feed chambers vary the liquid level in the fuel feed chamber for co-ordinating the liquid fuel feeding rate with the air flow to the combustion chamber, and means in said duct for forming a liquid seal between the combustion and fuel feed chambers when liquid fuel accumulates in the burner.

5. In a fuel burning appliance, provided with a liquid fuel burner and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus, including a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween below the levels of liquid to be maintained in said chambers, a float controlled valve mechanism in said fuel supply chamber for maintaining a constant fuel level in said chamber, fuel outlet mechanism in the fuel feed chamber, a duct connecting the fuel feed chamber with the burner, said fuel supply chamber having means for maintaining equalized pressure in the fuel and air supply chambers, said duct being normally open above the fuel therein for admitting combustion chamber pressure to the fuel feed chamber whereby differential pressures in the fuel supply and feed chambers vary the liquid level in the fuel feed chamber for co-ordinating the liquid fuel feeding rate with the air flow to the combustion chamber, and means for effecting change in said differential of pressures to vary the burning rate.

6. In a fuel burning appliance provided with a liquid fuel burner and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus, including a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween, said fuel supply chamber having means for maintaining equalized pressure in the fuel and air supply chambers, a duct connecting the fuel feed chamber with the burner for delivering fuel to the burner and for introducing combustion chamber pressure into the fuel feed chamber of the control apparatus whereby differential pressures in the fuel supply and feed chambers vary the fuel level in the fuel feed chamber for co-ordinating feed of the liquid fuel with the combustion supporting air flow to the combustion chamber, and a trap in said duct to provide a liquid seal in said duct to exclude the combustion chamber pressure from the feed chamber for limiting flow of fuel to the burner.

7. In a fuel burning appliance, provided with a liquid fuel burner and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus, including

a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween below the levels of liquid to be maintained in said chambers, a liquid fuel control mechanism in said fuel supply chamber for maintaining a constant liquid level in said chamber, a liquid fuel outlet mechanism in the fuel feed chamber and having an inlet the capacity of which is dependent upon the liquid level in said fuel feed chamber, a duct connecting the outlet mechanism with the burner for delivering the liquid fuel to the burner and for admitting combustion chamber pressure to the fuel feed chamber, and a duct connecting the air supply chamber with the fuel supply chamber for equalizing pressures therein and to maintain the same pressure differential between the fuel feed and fuel supply chambers that occurs between the air supply and combustion chambers for co-ordinating the liquid fuel feed with the air flow to the combustion chamber.

8. In a fuel burning appliance, provided with a liquid fuel burner, and having air supply and combustion chambers in which differential pressures are normally maintained to supply combustion supporting air to the combustion chamber, a liquid fuel feeding apparatus, including a fuel supply chamber and a separate fuel feed chamber having a flow connection therebetween below the levels of liquid to be maintained in said chambers, a liquid fuel control mechanism in said fuel supply chamber for maintaining a constant liquid level in said chamber, a liquid fuel outlet mechanism in the fuel feed chamber and having an inlet the capacity of which is dependent upon the liquid level in said fuel feed chamber, a duct connecting the outlet mechanism with the burner for delivering the liquid

fuel to the burner and for admitting combustion chamber pressure to the fuel feed chamber, a duct connecting the air supply chamber with the fuel supply chamber for equalizing pressures therein and to maintain the same pressure differential between the fuel feed and fuel supply chambers that occurs between the air supply and combustion chambers for co-ordinating the liquid fuel feed with the air flow to the combustion chamber, and a blower connected with the air supply chamber for delivering combustion supporting air to said chamber.

9. A liquid fuel feeding apparatus including separate supply and feed chambers having a flow connection therebetween and located below liquid levels which are to be maintained in said chambers, a float controlled valve mechanism in said fuel supply chamber for maintaining a constant fuel level in said chamber, a liquid fuel outlet mechanism in the fuel feed chamber having an inlet the capacity of which is dependent upon the liquid level in said chamber, fuel delivery means connected with the outlet mechanism and adapted to be connected with a burner of a liquid fuel burning appliance, said chambers being completely closed from each other above said constant level in the supply chamber so that differential pressures may be maintained in said chambers to position the liquid level in the fuel feed chamber relatively to said inlet for varying feeding rate of the liquid fuel through the outlet mechanism, and at least one of said chambers having means for admitting a pressure different than the pressure prevailing in the other chamber when the apparatus is in operation to create said differential pressures.

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