

[54] **AUTOMATIC FLAME ADJUSTING MEANS IN A LIGHTER**
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[57] **ABSTRACT**
In a lighter of the gas fuel type, a resilient porous filter means provided in a fluid passageway connecting a reservoir with a burner nozzle is contracted or expanded by a member automatically actuated towards or against said filter means in response to changes of pressure inside said reservoir, thereby flow of fluid vaporized by the filter means and ejected into the burner nozzle is controlled constant independently of changes of pressure in the reservoir. The density of porosity of said filter means is not only adjustable by said automatically actuated member but also adjustable by a manual operation, if desired.

5 Claims, 2 Drawing Figures

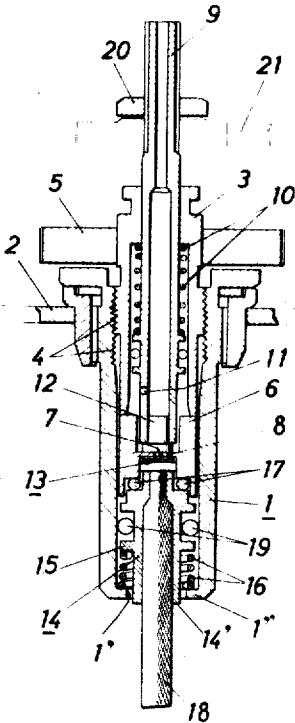
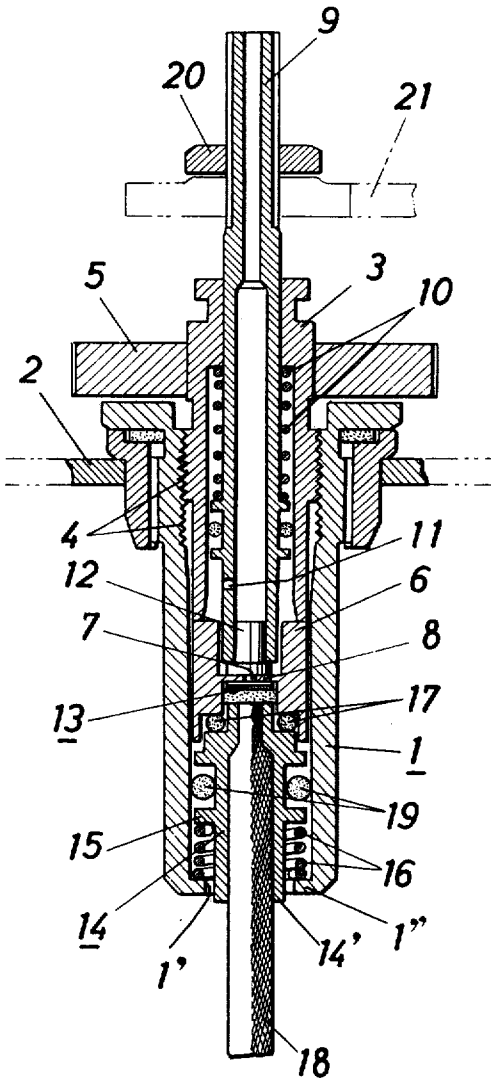


FIG. 1



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AUTOMATIC FLAME ADJUSTING MEANS IN A LIGHTER

This invention relates to an automatic flame adjusting means in a lighter. More particularly, it relates to an automatic flame adjustment means in a hand held pyrophoric device of the gas fuel type.

The principal object of the present invention is to provide in a lighter of the gas fuel type an adjustment means which can control the rate of jet of highly volatile fuel maintained within a walled reservoir under pressure in its liquified state, whereby the height of flames is kept constant independently of pressure within the walled reservoir.

In gas lighters, generally, pressure acting on fuel within a walled reservoir is subject to, in addition to the amount of fuel kept in the reservoir, changes in atmospheric temperature and pressure, and the rate of flow of gas from the reservoir through a burner nozzle varies in accordance with such difference of pressure, resulting in making the height of flames at the burner nozzle instable.

Obviously, this is undesirable by reason of the fact that the rate of gas flow from the burner nozzle has to be controlled on all such occasions by manually operating an adjusting device provided to a regulating valve, and such operation is time-consuming and to a certain extent annoying.

An object of the present invention, in view of the above, is to provide in a gas lighter an automatic flame adjustment means, which comprises a resilient filter means provided in a fluid passageway connecting a walled reservoir for maintaining highly volatile fuel under pressure in its liquified state and having a reservoir outlet with a burner nozzle mounted externally of the reservoir and an adjustment member having a free end in abutment with the internal bottom of said filter means, said adjustment member being movable in the direction in parallel with the fluid passageway either to compress the filter means to restrict fluid flow through said filter means in proportion to the increase of the velocity of fluid flow when pressure inside the reservoir rises or to release the filter means from compression and cause it to expand by its own resiliency in the direction parallel to the fluid passageway to increase fluid flow through said filter means in proportion to the decrease of the velocity of fluid flow when pressure inside the reservoir becomes comparatively low, whereby the rate of flow of gas jetting out from the burner nozzle is kept constant independently of changes of pressure inside the reservoir and the height of a flame at the nozzle is consequently maintained at a predetermined level.

A further object of the present invention is to provide in a gas lighter an automatic flame adjustment means as stated, in which the adjustment member is kept in abutment with the internal bottom of the filter means by sets of resilient means such as spiral springs and the like which respectively gives a repulsive force working along or against the direction of fluid flow and the amount of the repulsive force exerted on the adjustment member by the resilient means is readily adjustable so as to make the adjustment member highly responsive to changes of pressure inside the reservoir even when the changes are minor.

A further object of the present invention is to provide in a gas lighter an automatic flame adjustment means as stated, in which there is provided an auxiliary adjustment member having a flange in abutment with the external surface of the filter means, which is manually operable to move vertically along or against the direction of fluid flow to control fluid flow either by compressing the filter means or releasing it from compression, whereby auxiliary to the automatic control of flames by means of the main adjustment member, the height of flames is adjustable also by manually operating the auxiliary adjustment member.

For further comprehension of the invention, and of the objects and advantages thereof, reference will be had to the following description and accompanying drawing, and to the appended claims in which the various novel features of the invention are more particularly set forth.

In the accompanying drawing:

FIG. 1 is a vertical section view of an automatic flame adjustment means for a gas lighter in accordance with the present invention, and

FIG. 2 is an enlarged vertical section view of the principal parts of the automatic flame adjustment means illustrated in FIG. 1.

In FIGS. 1 and 2, to an upper wall of a walled reservoir 2 there is fitted a tubular supporting member 1, within which a driving means 3 for an auxiliary adjustment member 6 is movably supported by a thread 4 which is provided to an upper inner circumferential wall of the supporting member 1. Said driving means 3 is moved vertically, viz., in the direction of flow of gas from the reservoir or against said direction, by manually rotating a rotary knob 5 fitted to the driving means near at its top end. The auxiliary adjustment member which is in abutment with the lower circumferential edge of the driving means 3 at its upper circumferential edge, is driven by said driving means in a vertical direction in parallel with flow of gas. Gas flows from the reservoir through an outlet 7 provided centrally to a partition 8 of the auxiliary adjustment member 6 into a burner nozzle 9. The burner nozzle is accommodated inside the tubular driving means 3 and coaxially therewith is arranged a spiral spring 10 which normally pushes the nozzle inwardly of the reservoir. A valve 12 fitting to a bottom opening of the nozzle 9 normally closes the outlet 7 of the auxiliary adjustment member 6 and when the valve opens the outlet 7, gas flows into the burner nozzle through an inlet opening 11 provided in the nozzle adjacent to its bottom opening where the valve is insertedly fitted.

A filter means 13, which is in abutment with the inner surface of the partition 8 and closes the outlet 7 provided in said partition, can vaporize highly volatile fuel maintained within the reservoir under pressure in its liquid state and absorbed thereonto by a wick 18, and also can control the rate of flow of fuel. Said filter means consists of a resilient filter 13a made of a material having continuous pores such as urethane sponge, a metallic plate 13b having a diameter smaller than that of the filter 13a and a rectifying plate made of a metallic screen. They are mounted each other in layers to form an integral unit. A principal or automatic adjustment member 14 supported inside the tubular supporting member 1 coaxially therewith is movable vertically towards or against the direction of flow of fuel fluid. The lower circumferential edge 14' of the principal adjustment member 14 faces a lower opening 1' of the tubular supporting member 1 and receives pressure acting inside the walled reservoir. A spiral spring 16 mounted between a flange 15 laterally outwardly extending from a circumferential outer wall of the adjustment member 14 and a flange 1' laterally inwardly extending from the lower opening 1' of the tubular supporting member 1 normally urges the adjustment member 14 in upward direction as seen in the drawing, viz., outwardly of the reservoir and keeps a resilient annular body 17 which is mounted inside the bottom flange of the auxiliary adjustment member 6, in contact with a flange 14'' laterally outwardly extending from the outer wall of the principal adjustment member 14 near at its top end 14'''. The top end 14''' of the member 14 comes, at the same time, into abutment with the bottom surface of the resilient filter 13a. The vertical movement of the adjustment member 14 causes the compression or enlargement of the filter 13a, thereby the density of pores in the filter is adjusted to restrict flow of gas passing therethrough. It shall be noted that any other suitable resilient means can be used in place of the spiral spring 16. The aforementioned wick 18 is mounted in a central bore of the principal adjustment member 14. Numeral 19 indicates an O-ring and numeral 20 a nut fitted to the burner nozzle 9 and engaging a lever 21 of a ignition mechanism to raise the nozzle upwardly.

In use of the lighter, and assuming that atmospheric temperature and pressure are normal and pressure within the walled reservoir is P , the force F exerted onto the principal adjustment member 14 upwardly, viz., in the direction of flow of gas and the force f acting on the said member 14 downwardly, viz., against the direction of flow of gas are represented by the following equations.

$$F = P + \alpha \quad (I)$$

in which α represents the resiliency of the spring 16.

$$f = W_1 + W_2 \quad (II)$$

in which W_1 represents the resiliency of the resilient body 17 and W_2 that of the filter means 13, especially of the filter 13a.

Since the adjustment member 14 always keeps resiliency its balance, the force F is equal to the force f . Hence, the following equation is obtainable.

$$P + \alpha = W_1 + W_2 \quad (III)$$

When pressure inside the reservoir rises as much as ΔP in accordance with the rise of atmospheric temperature and pressure, the force acting on the pressure adjustment member 14 in the direction of flow of fluid becomes $P + \Delta P + \Delta$, in view of the above equation (I). Since only the force F has increased as much as ΔP while the force f remains at it was, the adjustment member 14 moves upwardly from the position where it was at a rate corresponding to said ΔP , compressing the filter means 13a. In consequence of this, the increase of flow of fluid into the burner nozzle 9 is prevented and the height of flames from the nozzle is also kept constant.

When pressure inside the reservoir decreases as much as ΔP , the force F acting on the principal adjustment member upwardly, viz., in the direction of flow of gas becomes $P - \Delta P + \Delta$ and descends to the distance corresponding to said ΔP . The filter 13a elongates thereby, resulting in keeping the rate of flow of gas ejected into the burner nozzle constant and maintaining flames from the nozzle at a desired level. Though the value of resiliency α afforded to the spring 16 is theoretically not constant but varies in accordance with the degree of its compression it could be considered as constant because the spring expands or contracts practically only, by 3 to 5 percent of its whole length. In case where the resiliency of the filter means 13 is large enough, the resilient annular body 17 might be eliminated.

In the present invention automatic flame adjustment means having the constructions as above-stated, the adjustment member which automatically moves towards or against the filter means in response to changes of pressure inside the reservoir can expand or contract said filter means in order to control the flow of fluid ejected into the nozzle through the filter means and to keep thereby the height of flames from the nozzle at a desired level independently of changes of pressure inside the reservoir.

In addition to above advantages, the density of porous structures of the filter means is adjustable not only automatically by the adjustment member 14 but also manually adjustable by means of the auxiliary adjustment member 6. It shall be noted also that said member 14 can easily be incorporated into a conventional lighter by slightly changing a manual flame adjustment mechanism provided thereto.

While a preferred embodiment of the invention has been illustrated and described, it is to be understood that the invention shall not be limited to the precise construction herein disclosed and the right is reserved to all changes and modifications coming within the scope of the invention as defined in the appended claims.

I claim:

1. In a lighter using liquid gas as a fuel, a combination comprising a reservoir adapted to contain a liquefied gas; a burner nozzle mounted externally of said reservoir; fluid passage means connecting said burner nozzle with said reservoir; resiliently compressible and expandable porous filter means in said fluid passage means and having continuous pores extending through said filter means and forming fluid passages therethrough; a first adjustment member axially movable in said fluid passage means and having one end engaging said

resiliently compressible and expandable porous filter means on one side thereof and opposite end subjected to the gas pressure in the reservoir so that the gas pressure acts in opposition to the resilient expansion force of said filter means, said first adjustment member having spaced from said one end a first shoulder; an axially adjustable auxiliary adjustment member coaxially arranged with said first adjustment member and engaging said filter means on the other side thereof and having a second shoulder spaced from and facing said first shoulder; resilient means sandwiched between said shoulders and radially spaced from the remainder of said adjustment members so as to be freely radially expandable during axial compression thereof, said resilient means exerting a force on said first adjustment member in opposition to the gas pressure depending on the axial adjustment of said auxiliary adjustment member; and additional resilient means acting on said first adjustment member for pressing said one end thereof against said resilient filter means so that the compression of the latter will depend, on the one hand, on the axial adjustment of said auxiliary adjustment member, and, on the other hand, on the gas pressure in the reservoir whereby as the gas pressure decreases, the filter means and therewith the pores therein will expand to thereby keep the flow of gas through the pores and said passage means substantially constant during decrease of pressure in said reservoir.

2. A combination as defined in claim 1, wherein said reservoir is formed in a wall thereof with an opening and wherein said fluid passage means comprise tubular support means tightly fitted in said opening, said adjustment member being slidably guided in said tubular support means, said auxiliary adjustment member being arranged axially movable in said tubular support means, said auxiliary adjustment member having a transverse wall formed with an opening therethrough, said filter means being engaged at one face thereof by said transverse wall and at the opposite face by said one end of said adjustment member, the driver means extending from the exterior of said reservoir into said tubular support means axially adjustable relative to the latter and having a lower end engaging said auxiliary adjustment member for adjusting the axial position of the latter so that said filter means may also be compressed to a variable degree by adjusting the axial position of said auxiliary adjustment member relative to said tubular support means.

3. A combination as defined in claim 2, wherein said driver means is threadingly connected to said tubular support means and including manually operable means fixed to a portion of said driver means outside said reservoir for turning said driver means about its axis to thereby adjust its axial position relative to said tubular support means.

4. A combination as defined in claim 2, wherein said driver means is tubular and wherein said burner nozzle means is axially slidably arranged in said tubular driver means and being formed in the wall thereof with an opening communicating with the interior of said tubular driver means, said burner nozzle having a lower end facing said transverse wall, and including a valve member in said lower end of said burner nozzle, biasing means for biasing said burner nozzle toward said transverse wall so that said valve member engages said transverse wall and closes the opening therethrough, and operating means connected to said burner nozzle for moving the latter and said valve member against the force of said biasing means away from said transverse wall.

5. A combination as defined in claim 1, wherein said adjustment member is formed and an axial bore therethrough and including a wick extending through said bore and having an upper end engaging said filter means.

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