United States Patent [19]

Wormser

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[54] **WIND-PROOF CIGARETTE LIGHTER BURNER**

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[*] Notice: The portion of the term of this patent subsequent to Oct. 29, 1991, has been disclaimed.

[22] Filed: **Sept. 6, 1974**

[21] Appl. No.: **503,611**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 389,534, Aug. 20, 1973, Pat. No. 3,844,707, which is a continuation-in-part of Ser. Nos. 142,402, May 11, 1971, abandoned, and Ser. No. 535,215, March 17, 1966, abandoned, and Ser. No. 728,933, May 14, 1968, abandoned, and Ser. No. 761,372, July 18, 1968, abandoned, and Ser. No. 134,093, April 14, 1971, abandoned.

[52] **U.S. Cl.** **431/347;** 431/353; 239/399

[51] **Int. Cl.²** **F23D 13/12**

[58] **Field of Search** 431/344, 347, 353, 354; 239/399, 403

[56] **References Cited**

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Primary Examiner—Carroll B. Dority, Jr.
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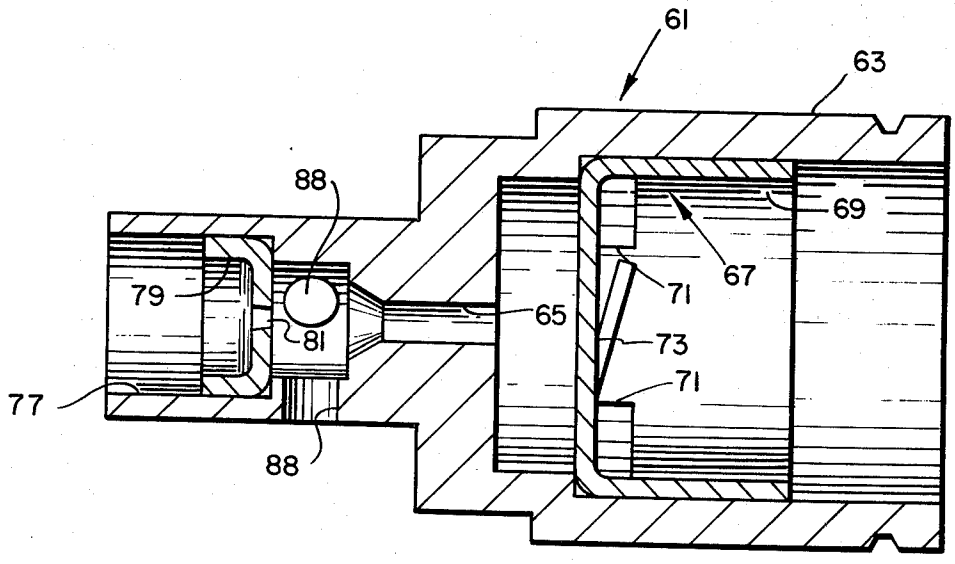
[57] **ABSTRACT**

A miniature burner construction disclosed herein employs a jet pump driven by a fuel jet so as to aspirate air for combustion of the fuel. The jet pump opens into a flame tube in which is positioned a disk-like flameholder having a series of peripheral notches around a central hub. The central hub provides reliable re-circulation and ignition of the incoming air-fuel mixture. Critical ratios relating the cooperating dimensions of the jet pump and burner are disclosed together with the ranges over which satisfactory operation is obtained.

6 Claims, 3 Drawing Figures



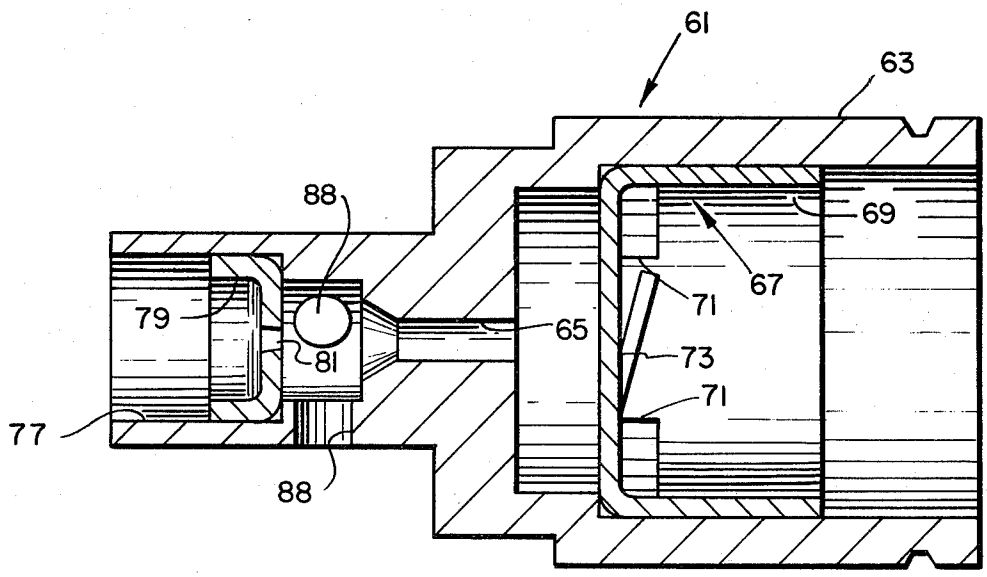


FIG. 1

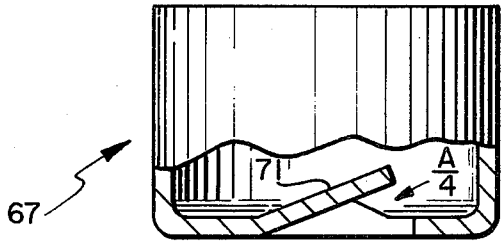


FIG. 2

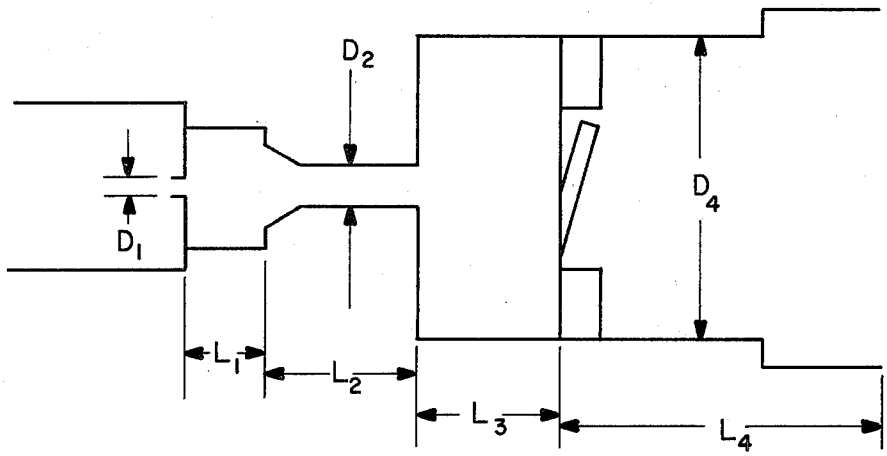


FIG. 3

WIND-PROOF CIGARETTE LIGHTER BURNER

RELATIONSHIP TO EARLIER CASES

This application is a continuation-in-part of application Ser. No. 389,534, filed Aug. 20, 1973, now patent No. 3,844,707, for a Low-Cost, Wind-Proof Cigarette Lighter Burner, which application is itself a continuation-in-part or otherwise related to applications Ser. Nos. 142,402 filed May 11, 1971; 535,215 filed Mar. 17, 1966; 728,933 filed May 14, 1968; 761,372 filed July 18, 1968; and 134,093 filed Apr. 14, 1971, which latter applications are all now abandoned. Applicant disclaims any part of the term of any patent which issues on the present application which extends beyond the term of any patent issuing from application Ser. No. 389,534, now patent No. 3,844,707.

BACKGROUND OF THE INVENTION

This invention relates to burners of exceptionally small size, i.e. ¼ inch diameter or less, and particularly to such burners adapted for use in a cigarette lighter operating on gaseous fuel.

While cigarette lighters operating on gaseous fuel have been available previously, lighters of this type have in the past been particularly susceptible to blowout problems in the presence of ambient winds or even relatively gentle air movement.

Among the several objects of the present invention may be noted the provision of a cigarette lighter operating on gaseous fuel which is relatively blowout-proof. Other objects and features will be in part apparent and in part pointed out hereinafter.

While burners in accordance with the present invention to some extent employ the principles disclosed in my earlier applications relating to larger burners, i.e. application Ser. No. 142,402, now abandoned, and its predecessors, it has been discovered that in the design of relatively small burners, i.e. those having flame tubes ¼ inch or smaller, the ratios of various dimensions become highly critical and that, in order to provide a satisfactory wind-proof burner for a cigarette lighter using gaseous fuel, these relationships must be rather closely adhered to. The disclosure in the present application which is additional to that of application Ser. No. 389,534, now U.S. Pat. No. 3,844,707, concerns itself largely with the critical relationships and the ranges over which these relationships may vary and yet obtain satisfactory results, the particular burner disclosed in application Ser. No. 389,534, now U.S. Pat. No. 3,844,707, being an example of one such burner within these teachings, another example being disclosed in the specification of the present application.

Briefly, in one aspect, the invention involves a burner for a cigarette lighter operating on a gaseous fuel, the burner having means defining a fuel jet orifice of diameter D1 and, aligned with said orifice, a jet pump venturi of effective diameter D2 and length L2, the separation between the orifice and the entrance of the venturi being designated L1. The burner further involves a flame tube fed by the venturi, the inside diameter of the flame tube being D4. Inside the flame tube, there is provided a disk-like flameholder providing a central hub and, around said hub, a plurality of peripheral openings, the combined area of the openings being A. The flameholder is spaced from the outlet of the venturi along the flow path by a distance L3. The burner is characterized by having a flame tube diameter D4 of

about ¼ inch or less and having proportions such that

L1/D2	is about	1.67
D2/D1	is about	17
L2/D2	is about	3.3
L3/D2	is about	1.5
D4/D1	is about	120 and
$A/(D4)^2$	is about	0.05.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view in section of a burner constructed in accordance with the present invention;

FIG. 2 is a side view of a flameholder, partially broken away, employed in the burner of FIG. 1; and

FIG. 3 is a diagrammatic view of the burner of FIG. 1 with various critical dimensions and relationships being designated for reference to various critical ratios discussed in the specification.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates a burner construction in which various of the parts are constructed of solid material, i.e. die cast or machined metal, rather than the stamped sheet metal construction disclosed in application Ser. No. 389,534, now U.S. Pat. No. 3,844,707. Referring now to FIG. 1, a die cast member 61 provides the flame tube 63 and a venturi 65 having a convergent inlet. A stamped sheet metal flameholder 67 is inserted into the flame tube, the flameholder being similar to that employed in the embodiment of application Ser. No. 389,534, now U.S. Pat. No. 3,844,707, i.e. having an annular rim 69 which facilitates its insertion within the flame tube and a series of vanes 71 which are struck up from the material of the flameholder so as to form peripheral openings around a central hub 73 (FIG. 2).

In the embodiment illustrated in FIG. 1, the burner is part of an overall lighter construction and is arranged so as to be urged, to the left as viewed in the drawing, by a spring (not shown) which constitutes part of the valving arrangement. A counter bore 77 at the end of member 61 opposite the flame tube receives an orifice member 79 having therein a fuel jet orifice 81. The orifice 81, being of small diameter, e.g. 0.0019 inch, is preferably cut with a laser drill. The counter bore 77 is of a depth such that the orifice is spaced from the entrance of the venturi 65 by a predetermined gap. Peripherally around this gap are a series of air inlet openings 88 arranged so that air is drawn in through these openings by jet pump action of the fuel jet in the venturi 65, the air being entrained with the fuel so as to provide an air-fuel mixture to the flame tube. The fuel flow entering the orifice is assumed to be gaseous although it may be derived from a liquified storage state.

As indicated previously, it has been found that, in order to obtain satisfactory wind-proof operation, the proportions of a small burner must conform to surprisingly critical dimensional ratios.

In FIG. 3 which is a diagrammatic representation of the burner shown in FIG. 1, the various critical dimensions have been designated by appropriate reference characters in accordance as follows: D1 is the jet orifice diameter; D2 is the effective venturi diameter; D4

is the nominal flame tube diameter; L1 is the gap between the jet orifice and the entrance to the venturi; L2 is the length of the venturi itself; L3 is the distance between the outlet of the venturi and the flameholder; L4 is the length of the flame tube downstream of the flameholder; and A is the combined area of the openings formed by striking up the vanes 71 (FIG. 2). The area A is being considered to be the maximum area of the opening, i.e. looking into the opening essentially at an angle along the inclined vane. The venturi diameter D2 is expressed as an effective diameter since, as is well understood in the art, the effective diameter of a venturi is increased if the inlet is smoothly rounded and is decreased if its inlet is square-shouldered.

A preferred construction of this burner employs dimensions as set forth in the following Table I.

Table I

D1	=	0.0019	inch
D2	=	0.033	"
D4	=	0.225	"
L1	=	0.055	"
L2	=	0.100	"
L3	=	0.050	"
A1	=	0.0025	square inches.

However, the critical range within which these dimensions are variable is most meaningfully expressed in terms of ratios of dimensions since the various quantities interact to a considerable degree in manners which are not apparent even to those quite skilled in the art. In the following Table II, the three lengths L1, L2 and L3 are defined relative to the venturi diameter D2 while the venturi diameter and flame tube diameters are defined in relation to the jet orifice diameter. Similarly, the combined area of the peripheral flameholder openings is defined in relation to the square of the flame tube diameter. The particular value given for each ratio is that calculated from the previously given preferred dimensions. However, following each ratio, there is given a plus and minus range over which the ratio may be varied and beyond which substantial degradation of performance occurs. Hereinafter and in the claims, the identification of one of these ratios as being about the specified value should be understood to encompass the range set forth in Table II.

Table II

L1/D2	=	1.67	±36%
L2/D2	=	3.33	+70% −45%
L3/D2	=	1.5	+600% −67%
D2/D1	=	17	±29%
D4/D1	=	118	±23%
A/(D4)²	=	0.05	+180% −55%

While the use of vanes to induce a helical flow of the gases is preferred as set forth in the parent application Ser. No. 389,534 in order to minimize cold wall effects as disclosed herein, it is also been found that the critical nature of the above-described dimensional ratio also obtains where the flameholder is the more conventional bluff body construction, i.e. a disk with peripheral slots which are not inclined and that by staying within the constraints described above, essentially satisfactory operation can be obtained even with a non-swirl flameholder.

In addition to the relatively critical relationships described above, at least one other ratio may be defined which is useful in describing preferred embodiments. In the embodiment of FIG. 1 the flame tube length, designated L4 is 0.260 inch. With reference to the overall design considerations, this length is appropriately related to the flame tube diameter D4 to give a ratio L4/D4 = 1.16. As suggested previously, this ratio is less critical and is reasonably variable over a range +600% −50% or more.

Likewise, in the preferred embodiment the diameter of the chamber providing the gap between the fuel jet and the venturi was 0.078 giving a ratio D3/D2 = 2.4 but this ratio can be varied considerably within the constraints of the overall mechanical construction.

In view of the foregoing, it may be seen that several objects of the present invention are achieved and other advantageous results have been attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it should be understood that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a cigarette lighter operating on a compressed gas fuel, a burner construction comprising:

means defining a fuel jet orifice of diameter D1;

means defining a jet pump venturi which is aligned with said fuel orifice, said venturi having an effective diameter D2 and a length L2, the separation between said orifice and the entrance of said venturi being L;;

a flame tube aligned with said venturi, the inside diameter of said flame tube being D4; and

inside said flame tube, a disk-like flameholder providing a central hub and, around said hub, a plurality of peripheral openings, the combined area of said openings being A, said flame-holder being spaced from the outlet of said venturi by a distance L3, said burner being characterized by having a flame tube diameter D4 of about ¼ inch or less and having proportions such that

L1/D2	is about	1.67
D2/D1	is about	17
L2/D2	is about	3.33
L3/D2	is about	1.5
D4/D1	is about	118 and
A/(D4)²	is about	0.05

2. A burner construction as set forth in claim 1 wherein the length of the flame tube downstream of the flameholder is L4 and

L4/D4 is about 1.16.

3. A burner construction as set forth in claim 2 wherein there is a cavity of diameter D3 separating said orifice and the entrance of said venturi and wherein D3/D2 is in the order of 2.4.

4. In a cigarette lighter operating on a compressed gas fuel, a burner construction comprising:

means defining a fuel jet orifice of about 0.0019 inch diameter;

means defining a jet pump venturi which is aligned with said fuel orifice, said venturi having an effective diameter of about 0.033 inch and a length of about 0.100 inch, the separation between said orifice and the entrance of said venturi being about 0.055 inch;

a flame tube aligned with said venturi, the inside diameter of said flame tube being about 0.225 inch; and

inside said flame tube a disk-like flameholder providing a central hub and, around said hub, a plurality of peripheral openings, the combined area of said openings being about 0.0025 square inches, said flameholder being spaced from the outlet of said venturi by a distance of about 0.050 inches.

5. A burner construction as set forth in claim **4** wherein the length of the flame tube downstream of the flameholder is about 0.260 inches.

6. A burner construction as set forth in claim **5** wherein there is a cavity of diameter in the order of 0.078 inches separating said orifice and the entrance of said venturi.

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