United States Patent [19]

Wormser

[11] **3,844,707**

[45] **Oct. 29, 1974**

[54] **LOW COST, WIND PROOF CIGARETTE LIGHTER BURNER**

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[73] Assignee: **Wingaersheek Turbine Company, Inc.,** Peabody, Mass.

[22] Filed: **Aug. 20, 1973**

[21] Appl. No.: **389,534**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 142,402, May 11, 1971, abandoned.

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

[51] **Int. Cl.**..... **F23d 13/12**

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

[56] **References Cited**

UNITED STATES PATENTS

1,079,327	11/1913	Chadborn	239/399
1,404,610	1/1922	Higgins	239/399
1,817,066	8/1931	Crow	239/403
3,510,238	5/1970	Biber	431/350

FOREIGN PATENTS OR APPLICATIONS

804,375	8/1936	France	239/399

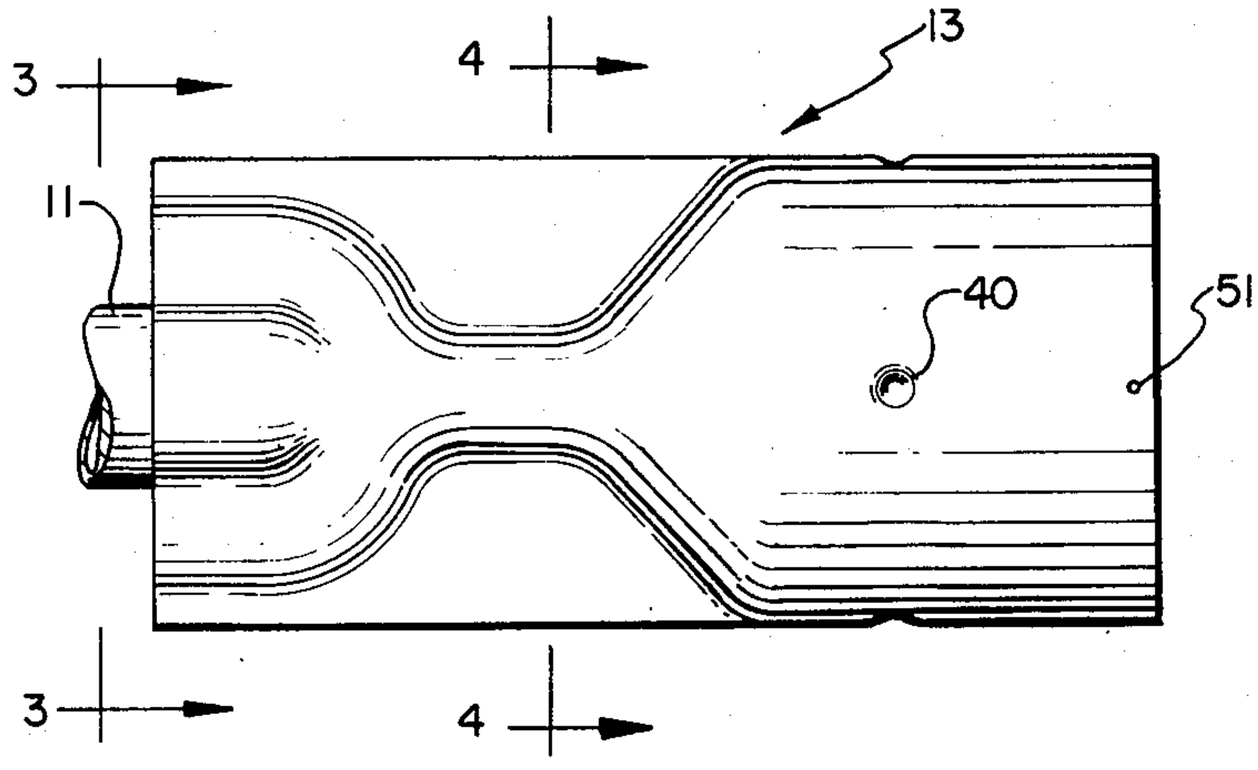
Primary Examiner—Carroll B. Dority, Jr.

Attorney, Agent, or Firm—Kenway & Jenney

[57] **ABSTRACT**

In the construction disclosed herein, a tubular burner member is crimped adjacent one end and in an intermediate portion to form air inlets and a jet pump, respectively. Inserted into the other, open end of the tubular member is a disk-like flame-holder having inwardly extending vanes struck from the sheet metal material of the flameholder, which vanes cooperate with a central hub in the flameholder to provide reliable recirculation and ignition of the incoming air-fuel mixture.

7 Claims, 7 Drawing Figures



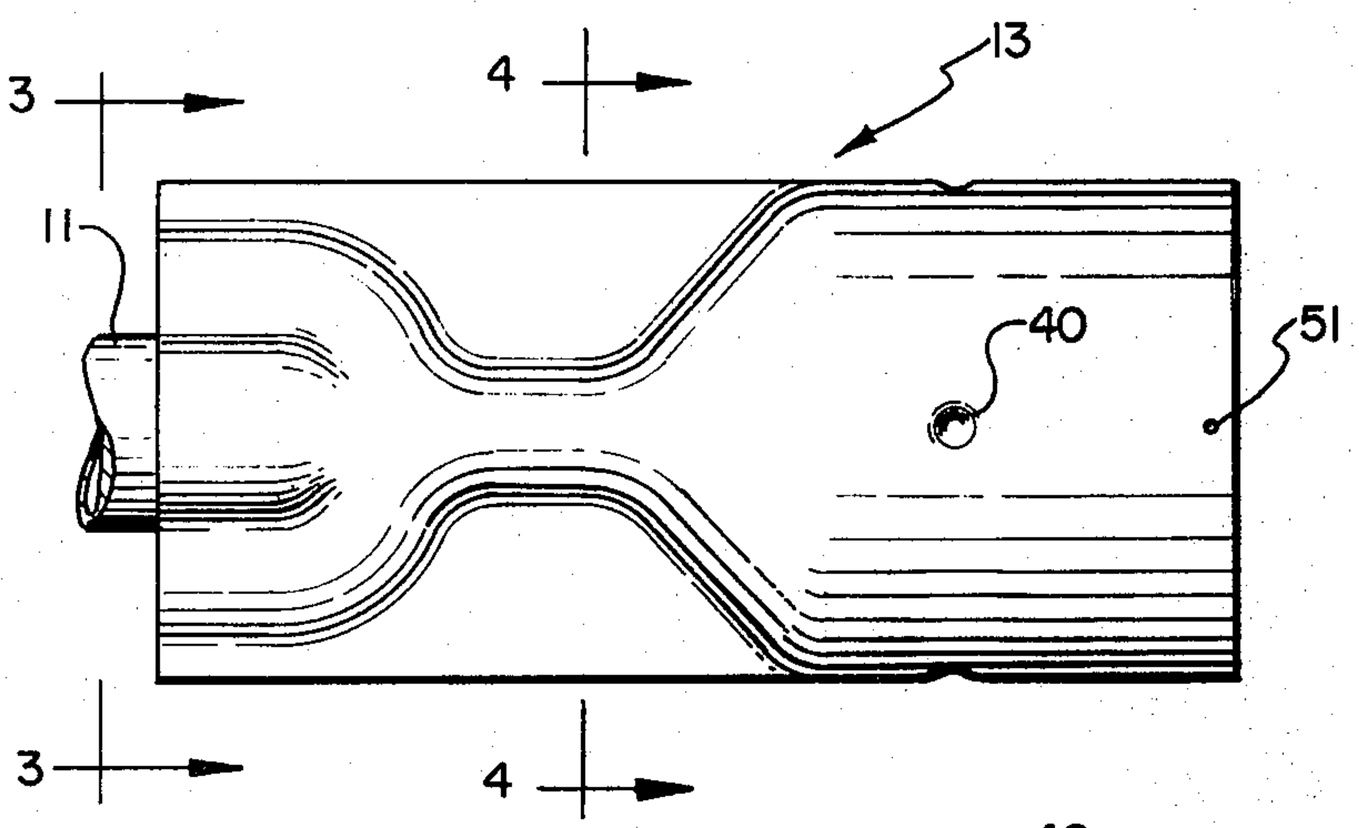


FIG. 1

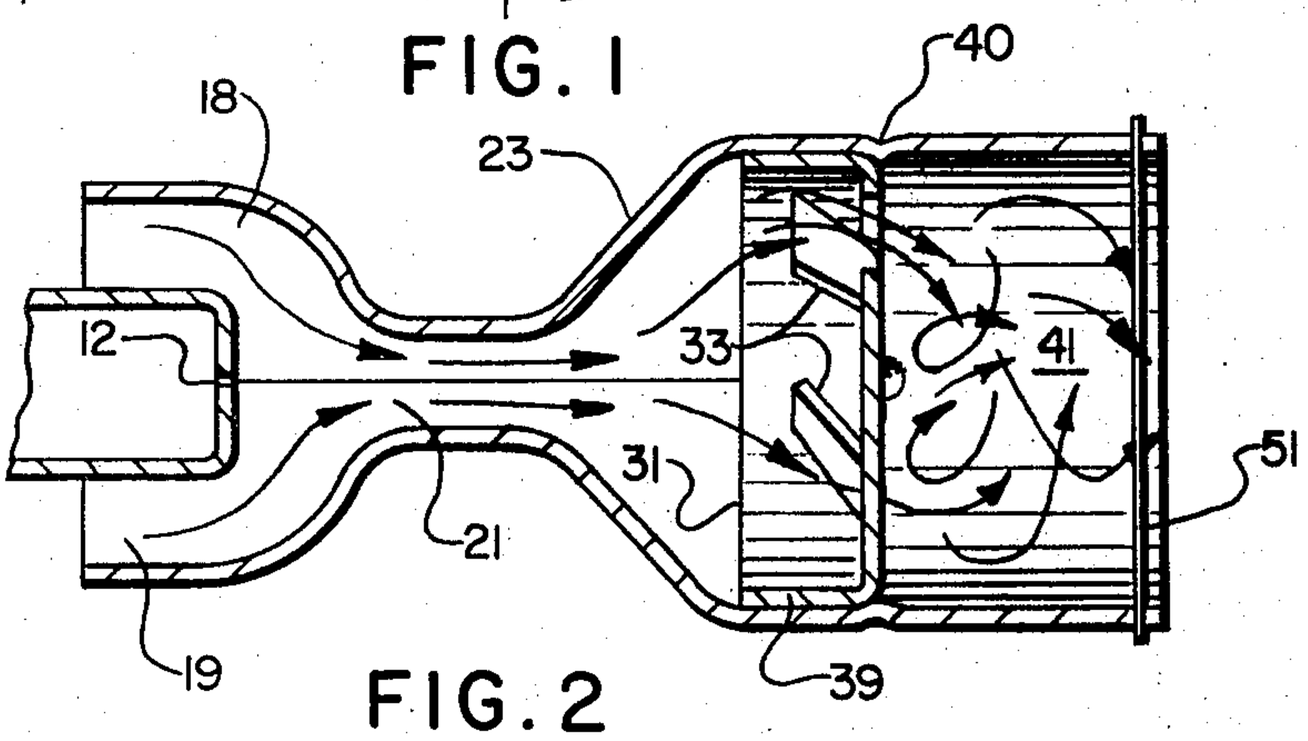


FIG. 2

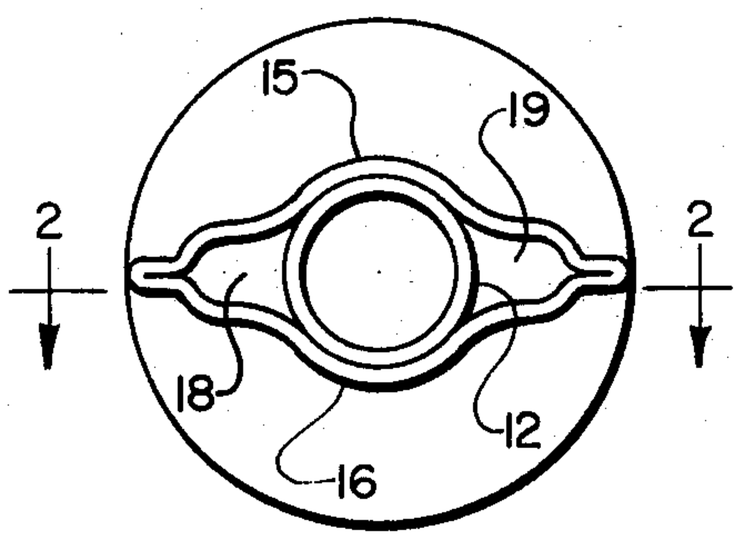


FIG. 3

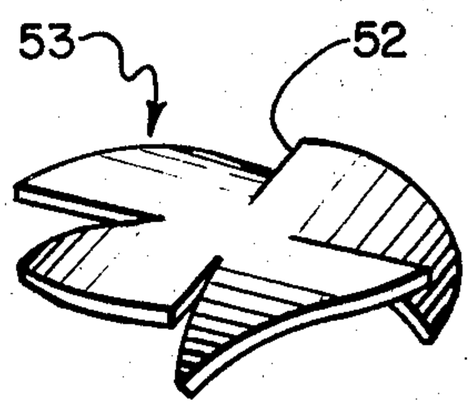


FIG. 7

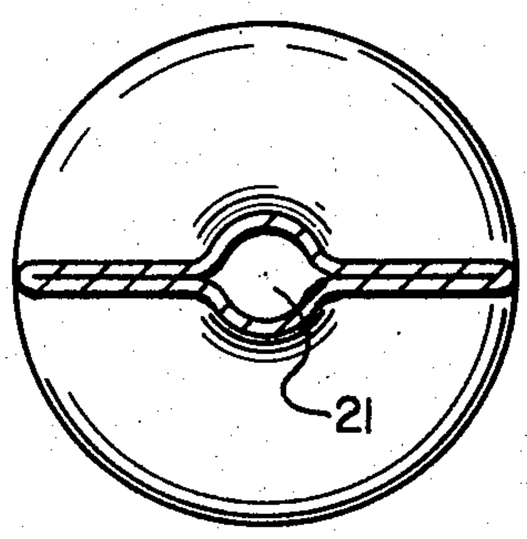


FIG. 4

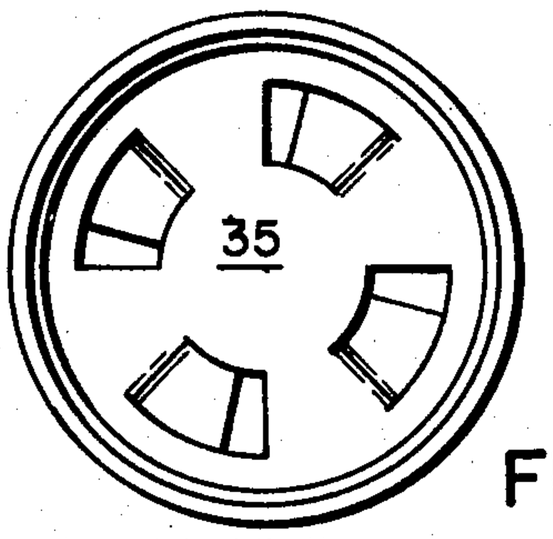


FIG. 5

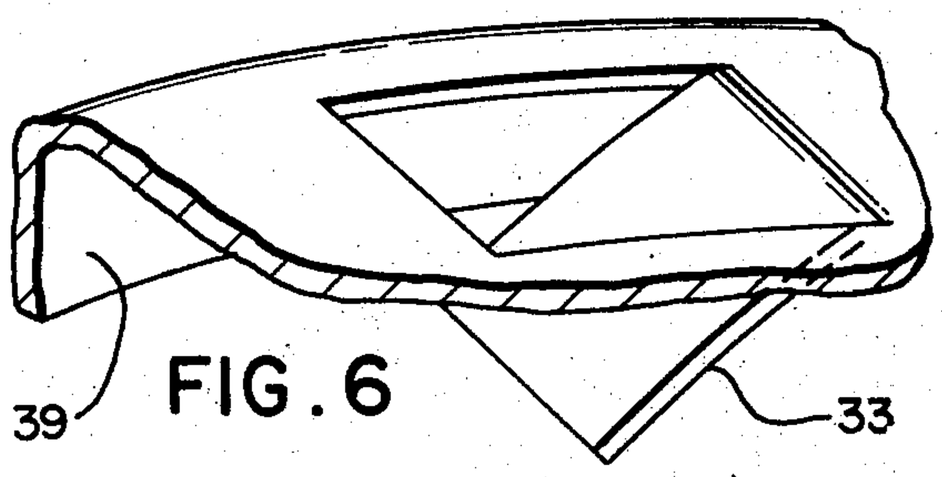


FIG. 6

LOW COST, WIND PROOF CIGARETTE LIGHTER BURNER

RELATIONSHIP TO EARLIER CASES

This application is a continuation-in-part of my co-pending application Ser. No. 142,402 filed May 11, 1971, now abandoned, for Aerodynamic Fuel Combustor which is itself a continuation, a continuation-in-part or otherwise related to applications Ser. Nos. 535,215, now abandoned; 728,933, now abandoned; 761,372, now abandoned, and 134,093, now abandoned.

BACKGROUND OF THE INVENTION

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

While cigarette lighters operating on compressed gases 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 compressed gas fuel, which is relatively blowout-proof. Other objects and features will be in part apparent and in part pointed out hereinafter.

In general, the desired objects are achieved by applying the principles disclosed in my earlier applications to a construction adapted to miniature burners such as cigarette lighters, having in mind the necessity of relatively low-cost construction. The unexpected result has been discovered that the introduction of a substantial swirl in the incoming fuel-air mixture permits sustained combustion in very small combustion chambers, i.e. smaller than ¼ inch, in spite of the chilling effect of closely adjacent walls.

SUMMARY OF THE INVENTION

Briefly, the present invention concerns a burner for a cigarette lighter fueled on compressed gas such as butane, the fuel being admitted to the burner through a generally tubular stem. The burner involves a sheet metal tubular member crimped so as to engage and clamp the fuel feed, while providing air entrance channels on either sie thereof. The tubular member is further shaped intermediate its ends to provide a jet-pump tube coaxial with the fuel jet for entraining air. Inserted into the other end of the tubular member, which acts as a combustion chamber, is a disk-like sheet metal flameholder engaging the tubular member. The flameholder also has a plurality of circumferentially disposed vanes formed from the material of the flame-holder, leaving a substantial central hub. The vanes project toward the jet pump tube and are inclined with respect to the plane of the disk-like member, thereby to produce a helical spin of gases passing through the flameholder. Accordingly, a recirculation zone is formed downstream of the hub, allowing hot, burning gases to recirculate and ignite incoming air-fuel mixture. The spin of the gases causes cooler, unburned gases to tend to the periphery of the burner with hotter gases tending to the axis of the burner facilitating this continuous ignition by recirculation. The recirculation and reliable ignition of the incoming fuel-air mixture inhibits blowouts in accordance with the principles of the invention

and permit continuous combustion in extremely small cylindrical chambers, i.e. smaller than ¼ inch.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a plan view of a burner construction in accordance with the present invention;

FIG. **2** is a sectional view taken on the line **2—2** of FIG. **3**;

FIG. **3** is a view, partially in section, taken substantially on the line **3—3** of FIG. **1**;

FIG. **4** is a view, partially in section, taken substantially on the line **4—4** of FIG. **1**;

FIG. **5** is an end view looking into the combustion chamber of the burner, taken substantially on the line **5—5** of FIG. **1**;

FIG. **6** is an isometric view of one of the vanes of a flame-holder employed in the burner of FIG. **1**; and

FIG.**7** is an isometric view of another embodiment of the flameholder.

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

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. **1**, there is indicated at **11** a generally tubular fuel feed stem of the type conventionally employed in compressed gas fueled cigarette lighters. The stem terminates in a jet **12.** Fitting on the end of the fuel feed stem **11** is a sheet metal burner member, designated generally by reference character **13.** As will be understood, the entire burner assembly can fit within the cowl conventionally extending from the tubular body and tank construction of conventional compressed gas lighter constructions. As described in greater detail hereinafter, member **13** is formed from a single section of sheet metal tubing, the diameter of the tubing being initially in the order of **0.2** inches. At one end, the tubular member **13** is crimped as illustrated in FIG. **3** so as to clamp onto the fuel feed **11,** engaging as indicated at **15** and **16,** while providing air inlet channels **18** and **19** on either side of the fuel feed, as shown in FIGS. **2** and **3.**

Intermediate its ends, the tubular member **13** is crimped as indicated in FIG. **4** so as to provide a jet pump tube, designated **21,** in alignment with the fuel feed jet **12.** If desired, a small separate tube can be inserted within the constricted portion of the member **13** to provide a more sharply defined venturi area. As understood by those skilled in the art, pressurized fuel exiting from the jet **12** will entrain air drawn in through the inlets **18** and **19,** providing a substantially mixed air-fuel mixture emerging from the jet pump tube **21.** The jet pump tube **21** flares, as indicated at **23,** to meet the full diameter portion of the member **13,** the flaring portion **23** providing a diffuser action as understood in the art.

Inserted into the full diameter portion of the tubular member **13** is a sheet metal disk-like member **31** which, as described hereinafter, functions as a flameholder. Struck from the material of the disk-like member **31** are a plurality of circumferentially disposed vanes **33,** these vanes being disposed at an angle shallower than 45° with respect to the plane of the disk-like member **31.** In this embodiment, the struckout areas forming the vanes **33** comprise about one-third of the cross-sectional area of the full diameter of the tube and are

disposed so as to leave a central hub **35** of diameter about half that of the tube. If desired, the vanes **33** may be formed with the material to the side of each vane being drawn rather than being cut through so as to impart maximum swirl by preventing leakage around the edges of the vane.

The member **31** also comprises an integral rim **39** which is also formed from the sheet metal of the disk member **31** itself. This rim forcibly engages the tubular member **13** so as to retain the disk-like flameholder **31** in place within the tube. If desired, dimpling may be provided to secure the engagement as indicated at **40.** The member **31** is inserted far enough within the tubular members so as to leave a relatively unobstructed open area **41** which comprises the combustion chamber of the burner.

Consistent with the teachings in my prior applications, the vanes **33** operate to produce a helical flow of the gases passing through the flameholder while the substantial central hub provides a bluff body permitting recirculation of burning gases. The helical spin of the moving gases tends to drive cooler, unburned gases to the periphery of the combustion chamber **41** while the hotter, burned gases tend toward the axis of the combustion chamber, facilitating recirculation back toward the hub of hot gases so that the entering fuel-air mixture is continuously re-ignited by the recirculation of the hot gases. This recirculation pattern permits combustion in small combustion chambers than otherwise possible. In typical burner constructions, the metal wall of the combustion chamber abstracts heat from the flame itself creating a layer of cooler gases. In large burners or ordinary construction, the thickness of this layer does not particularly affect operation. However, in smaller burners, the formation of this layer effectively prevents the construction of conventional burners in sizes smaller than ¼ inch. In accordance with the present invention, however, it has been discovered that the introduction of a substantially helical swirl permits sufficient heat to be retained in the core of the combustion zone so as to permit continuous combustion, even in very small flame tubes. The portions of the flameholder member between the vanes facilitate an interleaved re-ignition, penetrating up into the swirling mass of entering fuel-air mixture. Since continuous re-ignition of the incoming fuel-air mixture is accomplished efficiently and reliably, this burner is relatively insensitive to ambient air movement. Further, since the burner disclosed provides good mixing and intense combustion, nearly stoichiometric mixtures may be used so that the rate of flame front propagation is also relatively high, again adding to the wind resistance. While combustion normally takes place largely within the combustion chamber **41,** initial ignition may be applied at the mouth of the burner, e.g. by the usual flint striker employed in cigarette lighters. In order to make the presence of combustion more apparent, a wire of a material such as stainless steel may be positioned across the mouth of the burner as indicated at **51.** Combustion within the burner will heat the wire to a readily perceivable incandescence, even though the flame may be blue and itself difficult to see.

The construction disclosed is particularly adapted to miniature burners, i.e. burners in which the diameter of the combustion chamber is in the order of ¼ inches or less. In one embodiment of the invention, the combustion chamber was about 0.20 inches in diameter and 0.20 inches long while the jet-pump tube had an inner diameter of about 0.025 inches and a length of about 0.075 inches. Butane fuel was provided through a jet aperture of about 0.0015 inches under a pressure of about 30 psi. Each of the air inlets was of about 0.002 square inches in cross-section. Further, since the construction is amenable to fabrication by stamping of sheet metal elements, the cost of construction is relatively low.

An alternative disk-like flameholder construction is illustrated in FIG. **7.** In this embodiment, a series of radial cuts **52** are made in a sheet metal disk **53** and the metal on one side of each cut is bent up to form a shallow vane functioning as in the previous embodiment. If desired, the periphery of the disk **53** can also be bent over to form a rim which, though discontinous, facilitates the support of the flameholder in the burner.

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 compressed gas fuel provided through a fuel stem, a burner comprising:

a sheet metal tubular member, having a nominal diameter of ¼ inch or less, shaped adjacent one end to provide air entrance channels on either side of said fuel feed stem, said tubular member being shaped intermediate its ends providing a jet pump tube coaxial with said fuel jet, the fuel jet thereby operating to entrain air drawn through said entrance channels; and

inserted into the other end of said tubular member, a disk-like sheet metal flameholder having a plurality of circumferentially disposed vanes struck from the material of said flameholder, leaving a substantial central hub, said vanes being inclined with respect to the plane of the disk-like flameholder thereby to produce a helical spin of gases passing through said flameholder, whereby a recirculation zone is formed downstream of said hub allowing hot, burned gases to be recirculated and ignite incoming air-fuel mixture, the spin of gases causing cooler, unburned gases to tend to the periphery of the burner with the hotter gases tending toward the axis of the burner facilitating recirculation and preventing extinguishment due to cold wall effects.

2. A burner as set forth in claim **1** including a wire extending across the open end of said burner, which wire is heated to incandescence by combustion within said tubular member.

3. In a cigarette lighter operating on compressed gas fuel provided through a fuel stem terminating in a gas jet, a burner comprising:

a tubular member constricted adjacent one end to engage and clamp on said fuel feed stem and to provide air entrance channels adjacent thereto, said tubular member being constricted intermediate its ends providing a jet pump tube coaxial with said fuel jet, the fuel jet thereby operating to en-

train air drawn through said entrance channels; and

inserted into the other end of said tubular member, a disk-like flameholder having a plurality of circumferentially disposed vanes leaving a substantial central hub about half the diameter of the tubular member, said vanes projecting toward the jet pump tube and being inclined with respect to the plane of the disk-like flameholder at an angle of less than 45° thereby to produce a helical spin of gases passing through said flameholder, whereby a recirculation zone is formed downstream of said hub allowing hot, burned gases to be recirculated and ignite incoming air-fuel mixture, the spin of gases causing cooler, unburned gases to tend to the periphery of the burner with the hotter gases tending toward the axis of the burner facilitating recirculation and preventing extinguishment due to cold wall effects.

4. In a cirgarette lighter operating on compressed gas fuel provided through a fuel stem terminating in a gas jet, a burner comprising:

a sheet metal tubular member, having a nominal diameter of ¼ inch or less, crimped adjacent one end to engage and clamp on said fuel feed stem and to provide air entrance channels on either side of said fuel feed stem, said tubular member being crimped intermediate its ends to provide a jet pump tube coaxial with said gas jet, the gas jet thereby operating to entrain air drawn through said entrance channels; and

inserted into the other end of said tubular member, a disk-like sheet metal flameholder having an annular rim engaging said tubular member to support the flameholder therein, said flameholder having a plurality of circumferentially disposed vanes struck from the material of said flameholder leaving a substantial central hub of about half the diameter of the tubular member, said vanes projecting toward the jet pump tube and being inclined with respect to the plane of the disk-like flameholder at an angle of less than 45° thereby to produce a helical spin of gases passing through said flameholder, the struck-out area of the vanes comprising about one-third of the cross-sectional area of the tubular member, whereby a recirculation zone is formed downstream of said hub allowing hot, burning gases to be recirculated and ignite incoming air-fuel mixture, the spin of gases causing cooler, unburned gases to tend to the periphery of the burner with the hotter gases tending toward the axis of the burner facilitating recirculation.

5. A burner as set forth in claim **4** including a wire extending across to the open end of said burner, which wire is heated to incandescence by combustion within said tubular member.

6. In a cigarette lighter operating on compressed gas fuel provided through a fuel stem terminating in a gas jet, a burner comprising:

a sheet metal tubular member crimped adjacent one end to engage and clamp on said fuel feed stem and to provide air entrance channels on either side of said fuel feed stem, said tubular member being crimped intermediate its ends to provide a jet pump tube coaxial with said gas jet, the gas jet thereby operating to entrain air drawn through said entrance channels; and

inserted into the other end of said tubular member, a disk-like sheet metal flameholder having an annular rim engaging said tubular member to support the flameholder therein, the unconstricted portion of said tubular member extending beyond said flameholder forming a combustion chamber, the diameter of said unconstricted portion being in the order of 0.20 inches, said flameholder having a plurality of circumferentially disposed vanes struck from the material of said flameholder leaving a substantial central hub of about half the diameter of the tubular member, said vanes projecting toward the jet pump tube and being inclined with respect to the plane of the disk-like flameholder at an angle of less than 45° thereby to produce a helical spin of gases passing through said flameholder, the struck-out area of the vanes comprising about one-third of the cross-sectional area of the tubular member, whereby a recirculation zone is formed downstream of said hub allowing hot, burning gases to be recirculated and ignite incoming air-fuel mixture, the spin of gases causing cooler, unburned gases to tend to the periphery of the burner with the hotter gases tending toward the axis of the burner facilitating recirculation.

7. In a cigarette lighter operating on compressed gas fuel provided through a fuel stem terminating in a gas jet, a burner comprising:

a sheet metal tubular member, having a nominal diameter of ¼ inch or less, shaped adjacent one end to provide air entrance channels adjacent said fuel feed stem, said tubular member being formed intermediate its ends providing a jet pump tube of diameter about 0.025 inches coaxial with said gas jet, the gas jet thereby operating to entrain air drawn through said entrance channels; and

inserted into the other end of said tubular member, a disk-like sheet metal flameholder engaging said tubular member to support the flameholder therein, the unconstricted portion of said tubular member extending beyond said flameholder forming a combustion chamber, the diameter of said unconstricted portion being in the order of 0.20 inches and length in the order of 0.20 inches, said flameholder having a plurality of circumferentially disposed vanes struck from the material of said flameholder leaving a substantial central hub of about half the diameter of the tubular member, said vanes projecting toward the jet pump tube and being inclined with respect to the plane of the disk-like flameholder at an angle of less than 45° thereby to produce a helical spin of gases passing through said flameholder, whereby a recirculation zone is formed downstream of said hub allowing hot, burning gases to be recirculated and ignite incoming air-fuel mixture, the spin of gases causing cooler, unburned gases to tend to the periphery of the burner with the hotter gases tending toward the axis of the burner facilitating recirculation and preventing extinguishment due to cold wall effects.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,844,707 Dated October 29, 1974

Inventor(s) Alex F. Wormser

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 47, "sie" should be --side--.
Col. 4, line 3, after "0.075 inches.", insert --The overall length of the burner member 13 was about 0.50 inches.--.

Signed and sealed this 1st day of April 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.