United States Patent [19]

Thomson et al.

[11] **3,726,634**

[45] **Apr. 10, 1973**

[54] **BURNER**

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[73] Assignee: **Dimiter S. Zagoroff,** Marblehead, Mass.

[22] Filed: **Sept. 30, 1970**

[21] Appl. No.: **76,762**

[52] **U.S. Cl.** **431/353,** 239/403, 239/424.5, 239/474, 239/488

[51] **Int. Cl.**.....**F23d 15/02**

[58] **Field of Search**.....431/158, 185, 353, 431/334, 352; 239/399, 424.5, 403, 474, 475, 487, 488

[56] **References Cited**

UNITED STATES PATENTS

551,875	12/1895	Schutte	239/488
1,096,585	5/1914	Yost et al.	239/487 X
1,079,327	11/1913	Chadborn	431/353
1,435,778	11/1922	Williams	239/399 X
3,070,317	12/1962	Hunter et al.	431/353 X
2,027,159	1/1936	Fulton	431/353 X

OTHER PUBLICATIONS

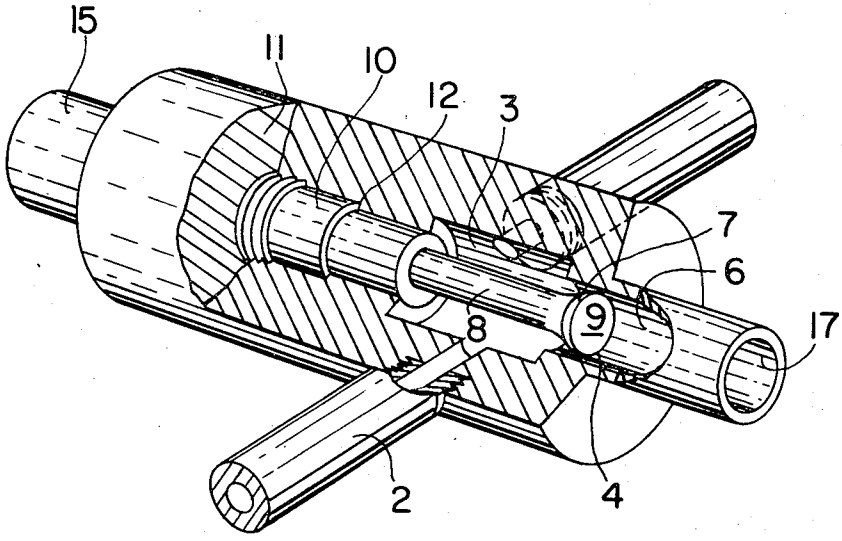
Applications of the Wingaer Sheek Burner–Presented at the 1967 Technical Meeting of the Central States Section of the Combustion Institute March 28, 1967 by Alex F. Wormset, The Wingaersheer Turbine Co., Lynn, Mass.

Primary Examiner—Carroll B. Dority, Jr.
Attorney—Kenway, Jenney and Hildreth

[57] **ABSTRACT**

A burner construction for burning gaseous fuel with a gaseous oxidizer. The fuel and oxidizer are mixed and directed so as to impart a swirling motion to the resultant mixture. The swirling mixture is passed through an annulus formed by a flame holder and the inside surface of a flame tube and ignited in a combustion chamber. The construction provides improved combustion intensity and permits the use of pure oxygen as the oxidizer without overheating or melting the combustion chamber walls.

11 Claims, 7 Drawing Figures



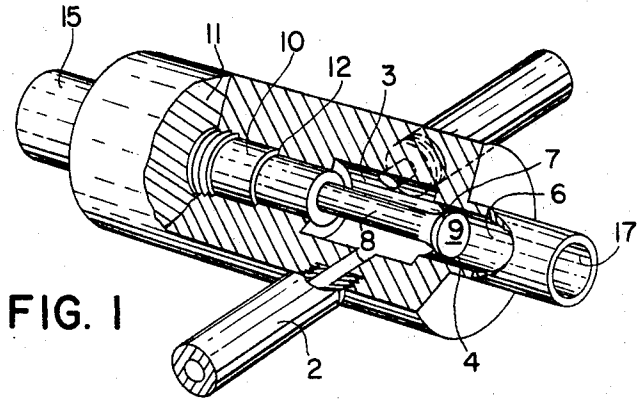


FIG. 1

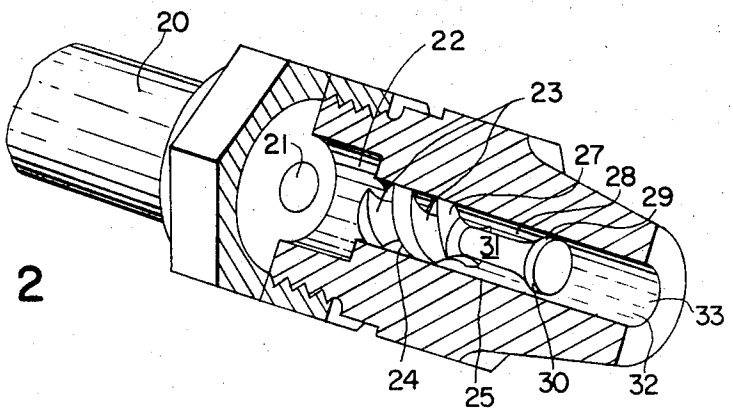


FIG. 2

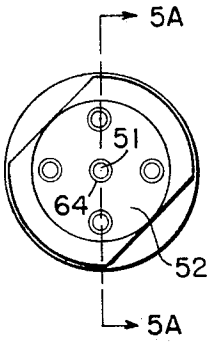


FIG. 5B

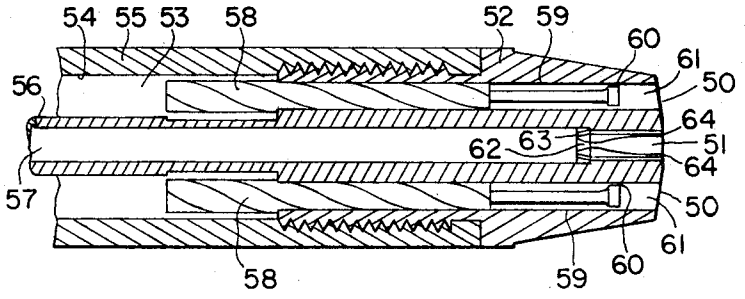


FIG. 5A

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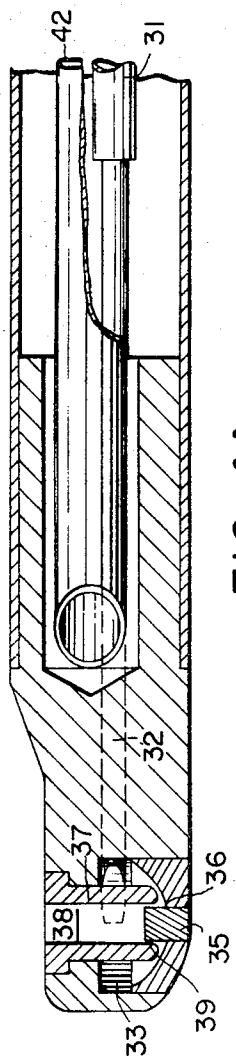


FIG. 4A

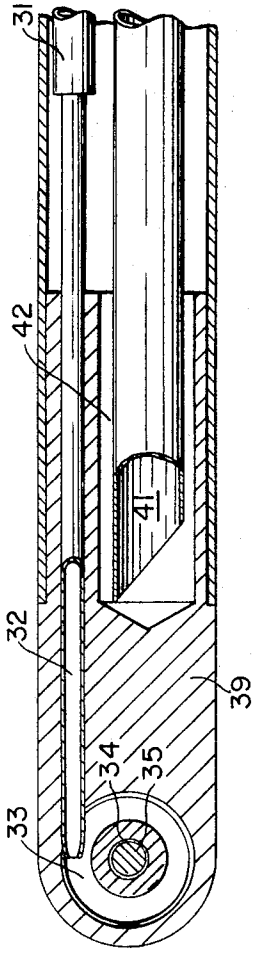


FIG. 4B

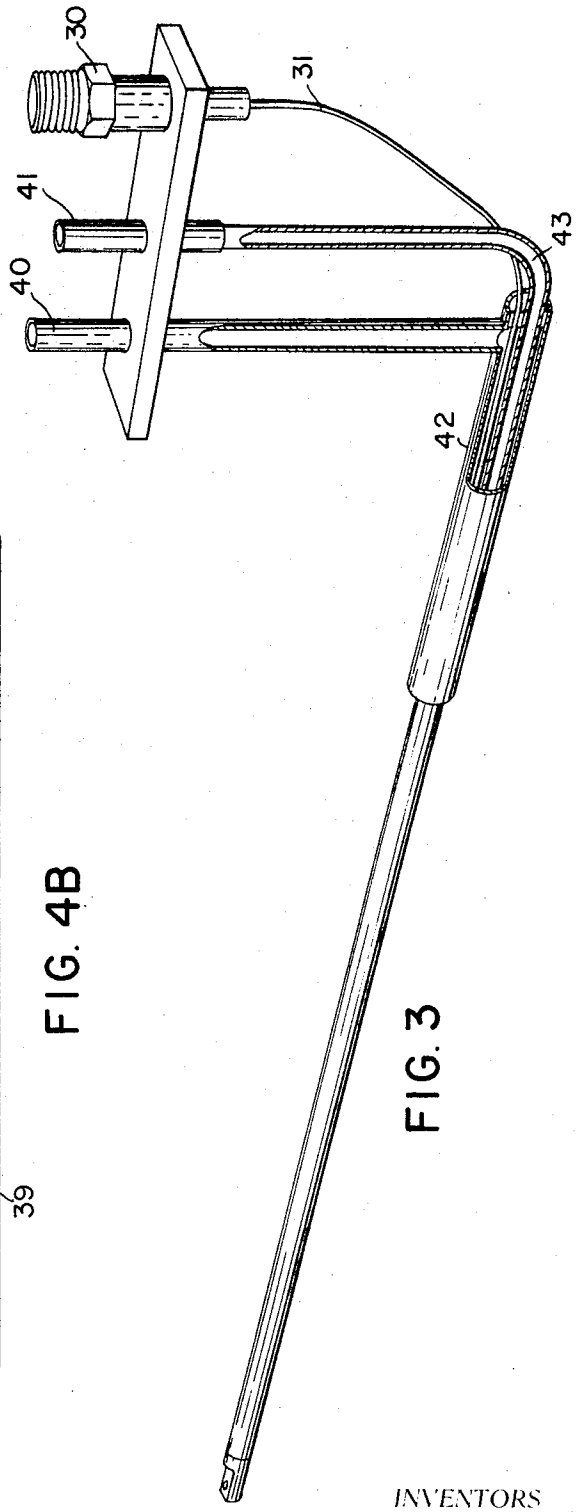


FIG. 3

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BURNER

It has been proposed to employ in a burner, a flame holder (between) a combustion chamber and a fuel-oxygen mixing chamber that effects a swirling motion to the gases in the mixing chamber to provide a stable flame of high combustion intensity. The flame holder includes a hub and a plurality of air foils mounted on the hub to form a set of passages with the inside surface of the flame tube to impart a swirling motion to the fuel-air mixture. The air foils have bluff trailing edges of substantial area projected normal to the direction of net gas flow. This flame holder effects greatly increased combustion intensities by imparting the swirling and eddying effects to the fuel-air mixture. Unfortunately, the gas flow imparted by this flame holder is undesirable when pure oxygen is used as the oxidizing gas. It has been found when pure oxygen is used in a burner employing the above-described flame holder, luminescent streaks which form helices downstream from the flame holder become extremely hot and cause burning or melting of the flame tube walls. The luminescent helices eliminate the self cooling effect normally attained when the gases are swirled in the combustion zone.

It would be highly desirable to provide a means for imparting the swirling motion to the fuel-oxygen mixture and desired flame stability while eliminating the hot luminescent streaks. In this manner, most of the increased combustion intensity associated with the swirling motion of the gases and self cooling effects of the walls could be obtained when employing pure oxygen.

In accordance with the present invention, there is provided a burner that includes a gas combustion zone, a gas swirl zone wherein swirling motion is imparted to the fuel-oxidizing gas mixture and a flame holder between the swirl zone and the combustion zone. The flame holder is positioned so that it forms a narrow annulus with the inside surface of the flame-tube wall. The annulus should be sufficiently large to maintain the swirling motion of the gas downstream of the flame holder but not so large as to cause the flame to become unstable and has a radial width between 0.002 and 0.012 inch, preferably between 0.003 and 0.005 inch. The apparatus of this invention provides high combustion intensities by causing the swirling gas to issue into the combustion chamber as an annular ring. In this manner hot spots are eliminated while high combustion intensity is retained, thus permitting the use of pure oxygen as the oxidizer.

The present invention is more fully described with reference to the drawings.

FIG. 1 is a cross sectional isometric view of the mixing chamber wherein fuel and oxygen are introduced separately, the flame holder and a portion of the combustion chamber.

FIG. 2 is a cross sectional isometric view of a swirl chamber wherein fuel and oxygen are introduced as a mixture, flame holder and combustion chamber.

FIG. 3 is an isometric view, in partial cross section, of one burner of this invention.

FIG. 4A is a vertical cross sectional view of the end of the burner of FIG. 3 showing the swirl chamber, flame holder and combustion chamber.

FIG. 4B is a horizontal cross sectional view of the burner of FIG. 3.

FIG. 5A is a horizontal cross sectional view along 5A—5A of FIG. 5B showing an oxygen cutting torch employing this invention.

FIG. 5B is a view of the end of the cutting torch of FIG. 5A.

Referring to FIG. 1, fuel and oxygen are introduced separately and tangentially through feed tubes 1 and 2 into mixing and swirl chamber 3. The fuel and oxygen are swirled in chamber 3 and exit therefrom through an annulus 4 defined by the inner surface of combustion chamber 6 and the peripheral surface 7 of the outer end of flame holder 8. The forward surface 9 of flame holder 8 functions to maintain the burner flame stable in combustion chamber 6. The flame holder 8 is inserted through mixing chamber 3 along the central axis thereof by screwing the flame holder shaft 10 into sleeve 11. Shaft 10 is provided with shoulder 12 which limits the extent to which the surface 9 is extended into chamber 6. The outer end 15 of the flame holder shaft 10 is provided with means for attaching the assembly to a handle or any other apparatus as desired. The swirling gas passes from mixing chamber 3 through annulus 4 as an annular ring into combustion chamber 6 wherein the fuel is ignited. The flame passes through chamber 6 and out through opening 17.

Referring to FIG. 2, gas is introduced through tube 20 and opening 21 into chamber 22. The gas comprises a mixture of fuel and oxygen. The gas mixture passes into spiral swirl chamber 23 which is formed by the inside surface 24 of chamber 25 and by spiral grooves 26 in shaft 27. The gas mixture passing through chamber 23 has a swirling motion imparted thereto and from the mixing chamber 23 passes into chamber 28 and through annulus 29 formed by the inside surface of chamber 25 and by the peripheral surface 30 of flame holder 31. The swirling gas mixture is ignited in combustion chamber 32 and passes out through hole 33. The angle formed by the grooves 26 and the central axis of shaft 27 should be between 40° and 50°, preferably about 45° to effect gas swirling without excessive gas turbulence and pressure drop.

Referring to FIG. 3, a water-cooled burner employing this invention is shown. A mixture of fuel and oxidizing gas is introduced from a source not shown, and attached to connector 30 and passed through tube 31 and tube 32, tangentially into swirl zone 33. The gas mixture passes downwardly in swirl zone 33 and then up through annulus 34 formed by the outside surface 36 of flame holder 35 and the inside surface 37 of combustion zone 38. The gas mixture passes through annulus 34 as a swirling gas stream. In combustion zone 38, the fuel mixture is ignited and a stable flame is retained by flame holder 35. When this burner is used in a very restricted space, and the burner exhaust gases tend to overheat the burner assembly, cooling water is used. However, when used in an open space the burner is self-cooling. Cooling water is circulated through the burner by means of tubes 40 and 41. Water is introduced through tube 40 connected to tube 42 that surrounds outlet tube 41. The water passes down the length of tube 42, reverses direction at the end of passageway 42 and is returned through outlet tube 41.

Referring to FIGS. 5A and 5B, a cutting torch is shown employing this invention. Peripheral burner holes 50 surround a central hole 51 for pure oxygen in

burner head 52. A mixture of fuel and oxygen is introduced into annular chamber 53 formed by the inner surface 54 of tube 55 and the outer surface 56 of oxygen supply tube 57. The mixture of fuel gas and oxidizing gas is introduced into helically shaped swirl chamber 58 wherein a swirling motion is imparted to the gas mixture and then into each of the chambers 59. The swirling gas mixtures pass from chamber 59 through annulus 60 into combustion chamber 61 and out through openings 50. The fuel-oxygen mixture is ignited to form a stable flame in combustion chambers 61. As shown in FIG. 5A, the end of the burner 52 can be screwed into the tube 55. The flames issuing from holes 50 serve to preheat the piece being cut so that the pure oxygen introduced through tube 57 can cut the metal piece. Pure oxygen introduced through tube 57 passes through venturi 62 and out through opening 51. Optionally, an oxygen shroud as shown in FIG. 5A can be formed by providing an annular hole 63 surrounding venturi 62 so that oxygen can pass out of annular hole 64. The shroud passing out of annular opening 64 serves to prevent or minimize premixing of oxygen issuing from hole 51 with the outside atmosphere prior to cutting the piece being worked.

The burner of this invention is particularly useful with propane or acetylene gaseous fuel. However, it is to be understood that any gaseous fuel can be employed. Furthermore, any oxidizing gas such as air can be employed with pure oxygen from a source under pressure being preferred.

While the invention has been described with reference to introducing the gases tangentially into the mixing and swirl chamber or the employment of spiral passages as the swirl chamber, it is to be understood that other means are suitable for imparting a swirling motion to the fuel and oxidizing gas prior to being passed through the annulus formed by the flame holder and flame tube.

We claim:

1. In a burner for gaseous fuel comprising a combustion chamber defined by a flame holder and a hollow tube surrounding and extending downstream of said flame holder, and means for delivering a mixture of gaseous fuel and oxidizer to an entry to said chamber, said entry being formed by an annulus between said tube and said flame holder, the improvement enabling burning of gaseous fuel mixed with oxygen while the gas in the combustion chamber keeps the wall of the chamber cool relative to the high intensity combustion occurring therein, said improvement comprising swirling means spaced upstream of said entry and capable of imparting a general swirl to gaseous fuel and oxygen in the direction about the axis of flow, an exit passage extending from said swirling means to said entry, said flame holder at said entry being supported at the end of a support member comprising a shaft reduced in cross sectional area from said flame holder and which extends upstream from said flame holder along said passage, said support member having a peripheral surface constructed to permit undisturbed flow of said swirling gas to said entry, and said exit passage being otherwise circumferentially unobstructed whereby an uninterrupted ring of swirling gas can uniformly reach said entry, and said entry being of unobstructed, form, constructed to admit said ring and maintain its uninterrupted, swirling and uniform character downstream thereof adjacent the wall of the tube.

2. The burner of claim 1 wherein said swirling means comprises means defining a helical gas path coaxial with and discharging toward said passage and entry.

3. In a burner for gaseous fuel comprising a combustion chamber defined by a flame holder and a hollow tube surrounding and extending downstream of said flame holder, and means for delivering a mixture of gaseous fuel and oxidizer to an entry to said chamber, said entry being formed by an annulus between said tube and said flame holder, the improvement enabling burning of gaseous fuel mixed with oxygen while the gas in the combustion chamber keeps the wall of the chamber cool relative to the high intensity combustion occurring therein, said improvement comprising swirling means spaced upstream of said entry and capable of imparting a general swirl to gaseous fuel and oxygen in the direction about the axis of flow, said swirling means comprising a circular chamber concentric with said entry and at least one tangential inlet to said circular chamber admitting gas in a swirling flow about the axis of said chamber, a circumferentially unobstructed exit passage extending from said swirling means to said entry for causing an uninterrupted ring of swirling gas to uniformly reach said entry, and said entry being of unobstructed form, constructed to admit said ring and maintain its uninterrupted, swirling and uniform character downstream thereof adjacent the wall of the tube.

4. The burner construction of claim 2 wherein said swirling means to impart swirling motion to the gases comprises passages formed by grooves on a shaft and a tubular member surrounding said shaft.

5. The burner construction of claim 3 wherein said swirling means to impart swirling motion to the gases comprises a cylindrical mixing and swirl chamber and means for separately introducing the gases tangentially into said mixing and swirl chamber.

6. The burner construction of claim 3 wherein the gases are passed downwardly from said inlet through said swirl chamber and then upwardly through the annular entry and combustion chamber.

7. Burner for gaseous fuel, the burner capable of use with oxygen to produce high intensity heat comprising the combination in a burner head of a plurality of combustion chambers each having an annular entry for mixture of gaseous fuel and oxidizer and an exit for hot gases, said annular entry defined by a central flame holder member and a surrounding wall defining a passage, said passage communicating with a swirl chamber spaced apart upstream of said flame holder, means associated with said swirl chamber to effectively impart swirling motion to a gaseous mixture of fuel and oxidizer, with said swirl substantially coaxial with said annulus, said passage shaped to conduct said swirling mixture to said annular entry and said annular entry shaped to introduce a swirling annular ring of said gaseous mixture into said combustion chamber where it is ignited, said means for producing said swirl, said passage and said annular entry constructed and arranged to cause said swirling motion to be maintained downstream of the flame holder in the combustion chamber, cooperating to produce a stable flame in the

combustion chamber without substantial heating of the wall defining said passage, the exits for hot gases of said burner head being in a common plane.

8. The burner of claim 7 wherein the burner chambers surround a passage for oxygen extending through said burner head, said passage having an exit centrally located within said exits for hot gas on said plane.

9. The burner of claim 1 wherein said swirling means is constructed and arranged to enable advance of said whirling mixture in a helical flow with a helix angle between about 40° and 50°.

10. The burner of claim 9 wherein said annular entry has a radial width between 0.002 inch and 0.012 inches.

11. The burner of claim 3 wherein said flame holder is supported upon a support member which extends through said swirl chamber, the swirl pattern of said mixture circulating about said support member, and proceeding therealong to said entry to said combustion chamber.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,726,634 Dated April 10, 1973

Inventor(s) John H. Thomson and Dimiter S. Zagoroff

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

Col. 1, under Title "BURNER" insert the following two paragraphs:

This invention relates to a burner construction.

Generally, aerodynamic burners of either the toroidal or the cyclone type are employed in applications where higher combustion intensity is desired. Of these, the toroidal burner produces the higher flame intensity, but with a larger pressure drop. In the toroidal burner, a bluff body is introduced into the path of flow of fuel and air to produce a wake. The wake acts to stabilize the flame even at relatively high flow rates by increasing the average residence time of the combustible mixture in the region of the flame. However, with toroidal burners combustion intensity is undesirably limited.

Col. 1, line 4 omit the parenthesis around the word "between";

Col. 1, lines 21 and 22 insert parenthesis around "or melting";

Col. 3, line 67, claim 1, delete the comma after "unobstructed".

Page 1 - References cited - Under "Other Publications"
line 1, "Wingaer Sheek" should be --Wingaersheek--;
line 4, "Wormset" should be --Wormser;
line 4, "Wingaersheer" should be --Wingaersheek--.

Signed and sealed this 1st day of January 1974.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents

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