June 23, 1970 R. B. ROSENBERG ET AL 3,516,773

BURNER

Original Filed Jan. 17, 1968

Fig 1

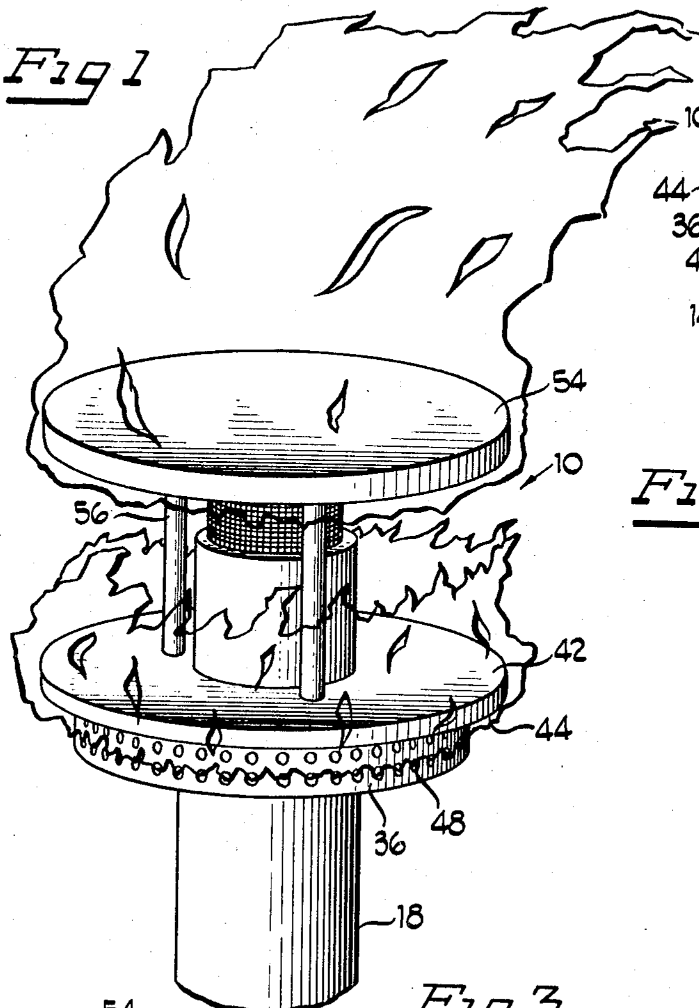


Fig 2

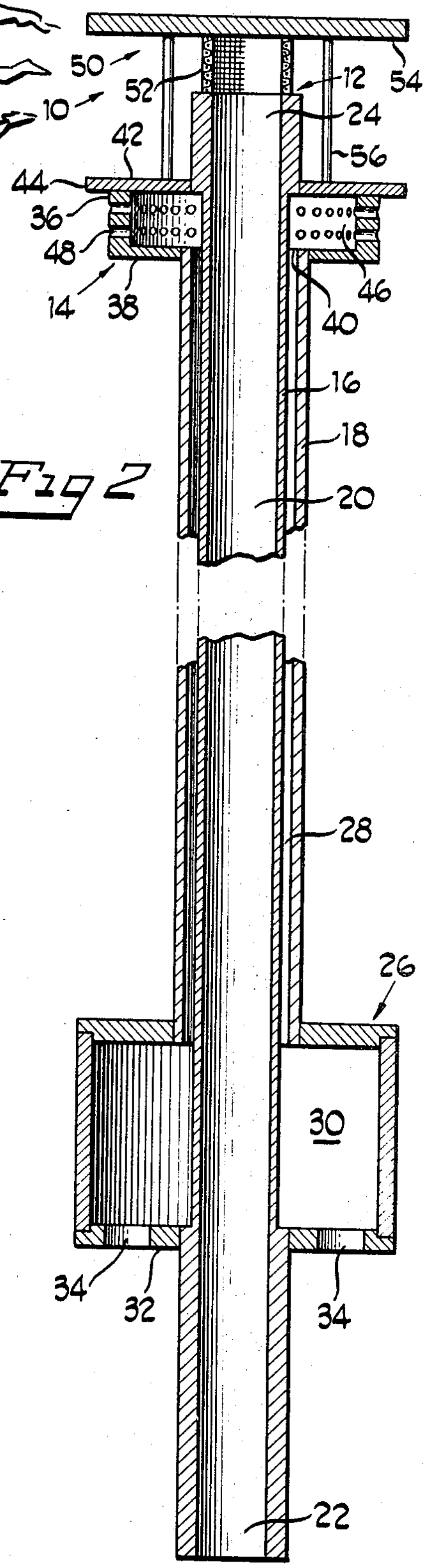
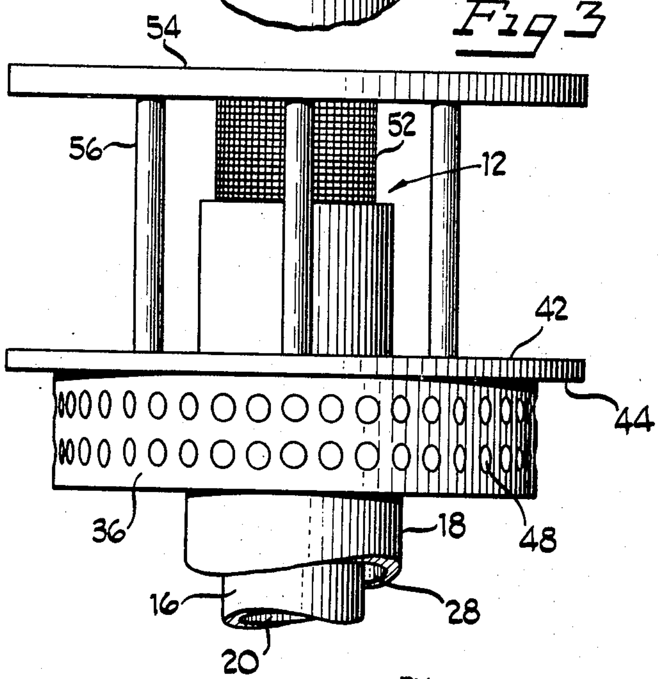


Fig 3



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BURNER

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Int. Cl. F23q *9/00*
U.S. Cl. 431—284 **4 Claims**

ABSTRACT OF THE DISCLOSURE

A gaeous fuel burner including a pilot burner section providing an inherently stable pilot flame unaffected by severe weather conditions or adverse operating conditions associated with applications involving high turndown ratios. The pilot burner includes a distribution chamber defined by means including a generally cylindrical distribution ring provided with a plurality of discharge orifices. The fuel-air mixture emitted from the discharge orifices provides a stable pilot flame for ignition of the main burner fuel.

This application is a continuation of application Ser. No. 698,529 filed by applicant, on Jan. 17, 1968, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a burner for gaseous fuels. More particularly, it relates to a gaseous fuel burner including a pilot burner arrangement for ignition of the main burner flame.

As is well known, exposure of gaseous fuel burners to adverse environmental conditions, such as high winds, wind gusts, rain, and the like, significantly increases the possibility of flame loss. Also, in applications where a relatively high turndown ratio is desirable, the possibility of loss of combustion is greatly increased.

In both of these applications, the possibility of flame loss dictates that measures to be taken to insure continuous burner operation. This is true not only to insure continuous operation but also because of the inherent danger associated with escaping gaseous fuel in the event that the flame is extinguished.

Attempts have been made to develop a burner which can maintain continuous operation even under the extreme conditions described. Typically burners exposed to the elements are provided with pilot arrangements which require complex shielding to protect against loss of the pilot flame. These shielded pilots however have not proven to be successful in severe weather conditions.

Another solution has been to provide an electrical reignition system which would re-ignite the burner flame in the event it were extinguished. These systems are extremely complex and expensive, and have not proven to be the ultimate solution because of the relatively slow response to a flame outage.

Accordingly, it is the principal object of the present invention to provide an improved form of gaseous fuel burner which includes a pilot arrangement which is inherently stable and unaffected by adverse environmental or operating conditions.

SUMMARY OF THE INVENTION

Very generally, this invention relates to an improved gaseous fuel burner including a pilot burner which produces an inherently stable flame even under severe environmental conditions. The pilot burner includes a generally cylindrical discharge ring including a plurality of discharge orifices positioned to provide a circular pilot

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flame which is unaffected by high velocity air streams passing about the burner. The pilot burner is disposed in operative association with the main burner discharge to insure ignition of the main burner fuel. A protective lip is provided in overlying relation to the cylindrical discharge ring intermediate the ring and the main burner discharge to prevent flame extinction by exposure to heavy rainfall.

Particular objectives and advantages of the present invention will become apparent with reference to the following detailed description and accompanying drawing.

DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view of a gaseous fuel burner illustrating various features of the invention.

FIG. 2 is a sectional elevational view of the gaseous fuel burner of FIG. 1, and

FIG. 3 is an elevational view, on an enlarged scale, of a portion of the apparatus of FIG. 1.

DETAILED DESCRIPTION

Referring now to the drawings, there is shown a gaseous fuel burner, generally designated **10**, which incorporates the principles of the present invention.

Accordingly, the burner includes a main burner section **12** and a pilot burner section **14**. The pilot burner is designed to provide an inherently stable pilot flame which is unaffected by severe environmental conditions or operating conditions associated with applications requiring a high turndown ratio.

The burner of the present invention therefore is particularly suitable for applications where exposure to the elements is a critical factor or where operation with a high turndown ratio is deemed desirable.

The term "turndown ratio" as utilized herein is the ratio of the maximum achieveable heat input to a gaseous fuel burner without loss of combustion divided by the minimum heat input thereto; both values being expressed in B.t.u.'s per hour (B.t.u.'s/hr.). That is to say, the turndown ratio is equal to:

$$H_1/H_2$$

wherein:

H_1=maximum obtainable heat input in B.t.u.'s/hr.
H_2=minimum heat input in B.t.u.'s/hr.

As best seen in FIG. 2, the burner **10** includes an inner tubular member **16** and a concentrically disposed outer tubular member **18**. The inner tubular member defines a flow path **20** for the main burner gaseous fuel. It includes an inlet **22** adapted to be placed in communication with the source of gaseous fuel (not shown). This tubular member includes an opposite end defining a main burner discharge **24**.

The outer tubular member **18** extends between the pilot burner section **14** and a generally annular mixing cylinder **26**. This tubular member defines an annular conduit **28** extending between the mixing cylinder **26** and the pilot burner section **14** which provides communication of a mixture to the pilot burner section.

The generally annular mixing cylinder **26** is disposed in concentric relation with the inner tubular member **16** and defines an annular mixing chamber **30** surrounding the inner tubular member. The mixing cylinder includes an annular wall **32** extending radially of the tubular member **18** which includes inlet openings **34** adapted to be connected to a source of gaseous fuel and air (not shown). The annular mixing chamber **30** insures proper mixing of the gaseous fuel and air supplied to the chamber. In this manner, a fuel-air mixture suitable for efficient combustion is provided. This mixture is communicated through the annular conduit **28** to the pilot burner section.

In accordance with the present invention, and as best seen in FIGS. 2 and 3, the pilot burner section **14** is disposed adjacent the main burner discharge **24**. It includes an annular distribution ring **36**, disposed in concentric spaced relation to the inner tubular member **16** and connected to the outer tubular member **18** by a radially directed annular wall **38**. This wall terminates at the connection with the tubular member **18** and defines an inlet aperture **40** communicating with the annular conduit **28**.

A protection plate **42** is disposed in spaced relation to the annular wall **38** and extends radially between the distribution ring **36** and the inner tubular member **16** intermediate the ring **36** and the main burner discharge **24**. The protection plate includes a radially extending lip portion **44** extending radially outwardly of the distribution ring **36** for reasons as will become apparent shortly. The annular distribution ring **36**, wall **38** and protection plate **42**, define a generally annular pilot distribution chamber **46**. The combustible fuel-air mixture for pilot flame combustion is delivered to the distribution chamber **46** from the mixing chamber **30** through the annular conduit **28** and inlet **40**.

The distribution ring **36** includes a plurality of discharge orifices **48** which communicate between the distribution chamber **46** and the exterior of the burner **10**. These orifices may be best seen in the FIGS. 2 and 3. Two rows of orifices are provided, and they are formed in a generally equally spaced pattern upon radially directed center lines. This arrangement provides a circular distribution pattern for the pilot mixture to produce a pilot flame surrounding the main burner discharge **24**. The relative location of the pilot section **14** and the main burner discharge **24** must be such that the pilot flame can reach the gaseous fuel emitted from the main burner for ignition of the main burner.

In operation, a pilot mixture comprising gaseous fuel and air in a mixture of about 3 to 1 is delivered to the annular pilot distribution chamber **46** from the annular mixing chamber **30** through the annular conduit **28**. The mixture is discharged through the orifices **48** generally transversely to the burner centerlines.

When ignited, a pilot flame is provided which extends from the distribution ring orifices upwardly past the radial lip **44** of the protection plate **42** in a direction toward the main burner discharge **24**. Main burner gaseous fuel is then supplied through the inner tubular member **16** to the main burner discharge **24** whereupon ignition of the main burner fuel is accomplished by the pilot flame. If desired, air can also be mixed with the main fuel supply to produce desired flame characteristics.

The cylindrical pattern of the pilot flame produced by the pilot burner section **14** creates a pilot flame which is inherently stable even in the presence of high velocity air streams. This insures the availability of an ignition source for the main burner section even under the most extreme operating conditions.

For example, if the burner **10** were utilized in an application utilizing a high turndown ratio, say 100 to 1, the circular pilot flame produced by the pilot section **14** would continue to provide an ignition source throughout the entire range of main burner gas flow rate. Also, if the burner were subjected to high velocity air streams such as produced by high winds or wind gusts, at least a portion of the pilot flame would remain effective. This is true because the shape of the pilot distribution ring **36** produces a quiescent vortex opposite the source of air flow. The pilot flame will continue to burn in that quiescent zone, even though the remainer of the pilot discharge will be so diluted that it will cease to support combustion. When the air velocity returns to normal, port-to-port ignition of the pilot fuel-air discharge will effect reinstatement of the entire circular flame pattern.

Further, the pilot flame remains effective even when exposed to conditions of wind gusting or directional change. The quiescent vortex will merely travel about the circular exterior surface of the annular distribution ring **36** and combustion will continue in the quiescent zone. As the wind direction changes, the area of combustion will travel about the ring by virtue of port-to-port ignition.

The pilot section **14** is also protected from heavy rain fall by virtue of the presence of the radially extending lip portion **44** of the protection plate **42**. Rain impinging upon the protection plate will be caused to run off of the lip portion **44** at a location spaced radially outwardly from the distribution ring **36**. Thus, flowing water cannot block the discharge orifices **48**, and the fuel mixture will continue to flow from the distribution ring. Also, the lip portion **44** prevents accumulated water from contacting the surface of the distribution ring **36**. Thus water accumulation on the lip portion **44** will not extinguish the pilot flame either by forming excessive amounts of steam or clogging the pilot holes.

The inherent stability of the pilot flame produced by the pilot section makes the burner **10** suitable for applications other than those requiring immunity to environmental conditions. In industrial applications where high turndown ratios are deemed desirable, the continuous presence of a re-ignition source is essential to safe operation of the system. This is true because of the great possibility of main burner flame loss when operating between a relatively low and relatively high range of fuel flow rates. It is contemplated that turndown ratios of 100 to 1 may be obtainable utilizing the principles of the present invention.

In applications wherein distribution or dispersement of the main burner flame is desirable, a flame diffuser arrangement such as arrangement **50** shown in the illustrated embodiment of the invention is utilized.

This arrangement includes a discharge screen **52** in the form of an axially extending porous cylinder positioned in surrounding relation to the main burner discharge **24**. A cover plate **54** supported upon a plurality of pins **56** is disposed in overlying relation to the screen **52**. The main burner discharge is therefore caused to disperse generally radially with respect to the centerline of the burner **10** producing a varied flame configuration. Such an arrangement is suitable for decorative displays or the like, wherein the aesthetic quality of the main flame is of significant importance. Since the pilot flame is always available for ignition of the main fuel supply, such a decorative burner may be used in applications exposed to even the most severe environmental conditions.

An example of a gaseous fuel burner has been constructed incorporating the principles of the present invention. This burner was designed to operate at a main fuel delivery rate of 2 million B.t.u.'s/hr. at an inlet pressure of 0.33 p.s.i. (gauge). The orifice ring **36** was 2.5 inches in diameter and the orifices were 0.082 inch in diameter. This same burner configuration has also been run at as low as 30,000 B.t.u.'s/hr.

Two rows of discharge orifices **48** were provided, spaced apart an axial distance of 0.244 inch. The circumferential port spacing was 0.196 inch between centers. Emperically, it was determined that the following relationship between circumferential port spacing to port diameter was particularly effective.

$$A-D=0.11$$

wherein:

A=Circumferential port spacing in inches
D=Port diameter in inches

The distance between the upper radial surface of the protection plate **42** and the main burner discharge **24** was 0.75 inch. The protection lip **44** had a radial width of 0.25 inch. A burner arrangement so constructed was unaffected by winds of up to 100 miles per hour as well as conditions of heavy rain.

The design diameter of the orifice ring can be varied depending upon the wind conditions anticipated. For example, it has been found that a 2 inch diameter ring will provide a stable pilot with winds of 40–50 miles per hour. A ring diameter greater than 2½ inches would be required in winds over 100 miles per hour. In all cases the relationship $A-D=0.11$ must be maintained.

As can be seen, the gaseous fuel burner has been provided which includes a pilot burner having an inherently stable pilot flame which provides a dependable ignition source making the burner suitable for application in conditions of adverse environment.

Various features of the invention have been particularly shown and described in connection with the illustrated embodiments of the invention. However, it must be understood that these particular arrangements are only for purposes of illustration and that the invention is to be given its fullest interpretation within the terms of the appended claims.

We claim:

1. A gaseous fuel burner suitable for operation while exposed to high velocity air streams, comprising a main burner section for providing a main burner flame and a pilot burner section for providing a stable pilot flame which extends about and below said main burner flame in close proximity thereto so as to ignite and to maintain said main burner flame, said main burner section comprising a generally cylindrically-shaped tubular member having an open upper end which forms a main burner discharge, said main burner section being coupled to a source of gaseous fuel and providing said main burner flame at said main burner discharge, said pilot flame burner section being coupled to a source of gaseous fuel which is independently controllable to provide gaseous fuel to said pilot burner section, said pilot flame burner section comprising a pilot flame discharge chamber, the peripheral side wall of which has a plurality of radially disposed pilot flame discharge orifices therein forming a pilot flame distribution about and below said main burner flame, at least a portion of said pilot flame distribution remaining effective in presence of high velocity air streams by providing a quiescent zone opposite the source of said air stream whereby said main burner flame is protected against extinguishment, and the top wall of said pilot flame discharge chamber forming a circular-shaped protection plate which is below said main burner, said protection plate having a diameter larger than said pilot flame discharge chamber so as to provide an outwardly extending lip portion for shielding the pilot flame distribution ring from rain and the like.

2. The gaseous fuel burner of claim **1** wherein said pilot flame burner section comprises a generally cylindrical-shaped pilot flame discharge chamber, the peripheral side wall thereof having a plurality of radially disposed pilot flame discharge orifices therein and forming a pilot flame of circular distribution.

3. The gaseous fuel burner of claim **2**, wherein said pilot flame discharge orifices are generally circumferentially equally spaced, the difference between the distance between adjacent centers of said pilot flame discharge orifices and the diameter thereof being equal to 0.11 inch.

4. The gaseous fuel burner of claim **2** further including a mixing chamber coupled between said pilot flame distribution chamber of said pilot flame burner section and said source of gaseous fuel therefor for providing a gaseous and air mixture of an established value to said pilot flame burner section, said mixing chamber being generally cylindrical-shaped and circumferentially disposed about said tubular member of said main burner section, said pilot flame burner section further including a generally tubular member disposed concentrically of said tubular member of said main burner section and defining therewith a conduit communicating between said pilot flame discharge chamber and said mixing chamber for conveying gaseous fuel to said pilot flame discharge chamber.

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