April 10, 1956 S. L. KILE 2,741,302

PILOT BURNER AFFORDING A STABLE FLAME

Original Filed Aug. 30, 1946

Fig. 1

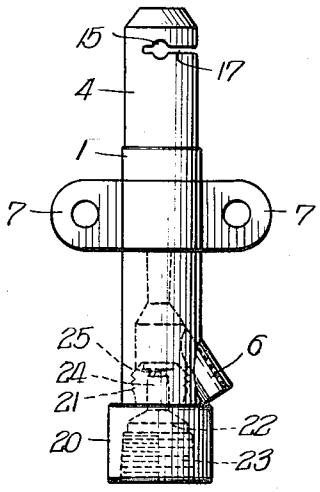


Fig. 2

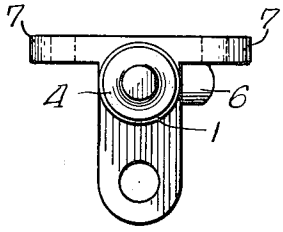


Fig. 3

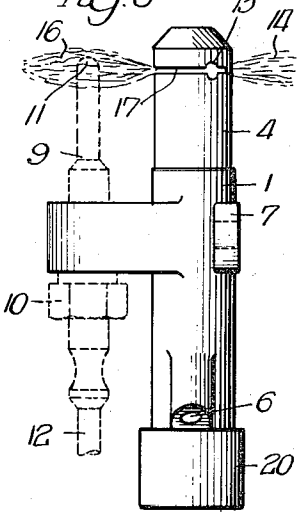


Fig. 4

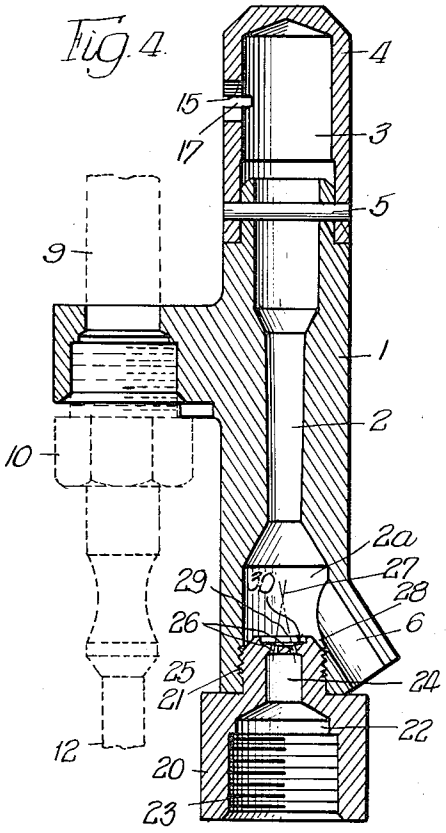


Fig. 5

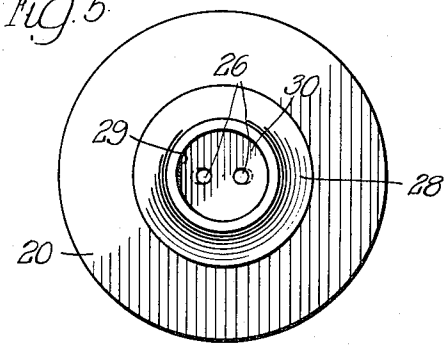
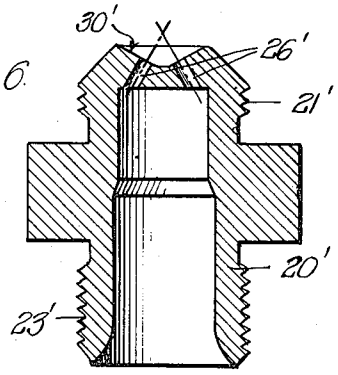


Fig. 6



INVENTOR.
Stephen L. Kile,
BY
Brown, Jackson, Boettcher & Dienner
attys.

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PILOT BURNER AFFORDING A STABLE FLAME

Stephen L. Kile, Whitefish Bay, Wis., assignor to Milwaukee Gas Specialty Company, Milwaukee, Wis., a corporation of Wisconsin

Continuation of abandoned application Serial No. 693,927, August 30, 1946. This application April 18, 1952, Serial No. 282,985

2 Claims. (Cl. 158—115)

This invention relates, in general, to a burner and fuel supply means, and has particular relation to an improved orifice arrangement for the supply of fuel for maintaining the desired flame.

The present application is a continuation of my copending application Serial No. 693,927, filed August 30, 1946, and now abandoned.

The particular burner which I shall describe hereinafter in connection with the drawing is a pilot burner for maintaining an ignition flame for a main burner and a flame for heating the "hot" junction of the thermocouple of a thermocouple safety control device.

The flame characteristics of a standard Bunsen burner are not stable at all operating temperatures because the flame characteristics are dependent upon the mixture of the fluid fuel and air. With a turbulent flow, the fluid fuel and air will mix, but with a streamline flow the desired mixture of the fluid fuel and air is not obtained.

Moreover, the flame characteristics of a standard Bunsen burner are variable with variations in pressure—assuming that the temperature remains constant. As a result, different flame characteristics have been obtained, namely:

(*a*) With manufactured gas at pressures within the ordinary operating range the flame is hard and objectionably noisy.

(In this discussion I mean by "flame hardness" a very sharp, short, blue inner cone with the other parts of the flame, except the inner cone, practically invisible.)

(*b*) With natural gas and L. P. G. (liquefied petroleum gas) too much air is entrained and the flame blows out at the upper half of the range of operating pressures.

(*c*) With manufactured gas at extremely low pressures there is a tendency in the standard Bunsen burner for the flame to flash back and burn at the fluid fuel orifice.

The foregoing are the reasons a standard Bunsen type burner is usually provided with air shutters. In some cases these shutters are not desired, and even with such air shutters the flame characteristics at different operating temperatures cannot be controlled.

One of the main objects of the present invention is to provide an improved burner and fuel supply method by means of which constant flame characteristics of predetermined character may be maintained over the complete range of operating pressures and any operating temperature.

Another object of the invention is to accomplish the new and advantageous results set forth by delivering a plurality (two or more) fluid fuel streams at an angle so that they will intersect each other, entraining air in proximity to the intersection of the fluid fuel streams, and passing the resulting fuel mixture to flame position remote from the intersection of the fuel streams.

Another object of the invention is to provide an improved burner and fuel supply means with which the only change necessary for different fluid fuels is in the angularity of the orifices, or the angularity of the plurality of fluid fuel streams, and the size of the orifices

which is determined by the B. t. u. content of the fluid fuel.

Another object of the invention is to provide an improved burner and fuel supply means with which air shutters and other adjustments for the air and fuel may be omitted.

Another object of the invention is to provide an improved burner and fuel supply means which will operate with manufactured gas at pressures within the ordinary operating range without producing a flame which is hard or objectionably noisy.

Another object of the invention is to provide an improved burner and fuel supply means which will operate with natural gas and L. P. G. without entraining too much air or blowing out of the flame at the upper half or any other part of the range of operating pressures.

Another object of the invention is to provide an improved burner and fuel supply means which will operate with manufactured gas at extremely low pressures without any tendency for the flame to flash back and burn at the fluid fuel orifices.

Another object of the invention is to provide a burner of the character described having the novelty and advantages set forth and characterized by its simplicity in construction, its economy in manufacture, and its effectiveness in use for accomplishing the desired results.

Further objects and advantages of the invention will appear from the following detailed description, taken in connection with the accompanying drawing in which:

Figure 1 is a front elevational view of one form of burner embodying the present invention;

Figure 2 is a top plan view of the burner shown in Figure 1;

Figure 3 is a side elevational view showing in dotted lines a thermocouple applied to the burner;

Figure 4 is an enlarged axial sectional view of the burner body and gas or fluid fuel inlet fitting in place therein;

Figure 5 is an end view of the inner end of the fitting or spud shown in Figure 4; and

Figure 6 is a fragmentary axial sectional view of the inner end of a gaseous fluid fuel inlet fitting showing the fuel orifices at the inner end of the fitting at different angles within the scope of the present invention.

Referring now to the drawing, I have shown the invention, for purposes of illustration in Figures 1, 2, 3, and 4, embodied in a pilot burner which, except as will hereinafter appear, is one of the types now commonly in use.

The pilot burner comprises a pilot burner body or body casting 1 shown in Figure 4 as having a passage 2 communicating with the internal passage 3 within the interior of the pilot burner tip 4. The tip 4 is shown fitting telescopically on the adjacent end of the body 1 and secured in place, for example, by a diametrical pin 5.

The pilot burner body 1 has a primary air inlet 6, shown angularly disposed and opening angularly into the side of the adjacent enlarged diameter passage 2*a*, which passage 2*a* opens into the passage 2. The body 1 is shown as having integral lugs 7 for mounting the pilot burner in appropriate position, for example, in the burner box. These features may vary within the scope of the present invention.

The body 1 further has a lug provided with an opening in which a thermocouple shown in dotted lines at 9 is secured, for example, by a bushing 10. The thermocouple 9, which may be of the type disclosed and claimed in Oscar J. Leins Patent No. 2,126,564, August 9, 1938, or any other suitable or preferred type, has a "hot" thermojunction at 11, and thermocouple lead means 12 for connecting the thermocouple in circuit with the coil of an electromagnet for a thermocouple safety control device.

The particular tip 4 has a port at 13 for maintaining the ignition flame 14 for a main burner, and a port at 15 for maintaining a pilot flame 16 for heating the hot junction 11 of the thermocouple 9. The ports 13 and 15 are connected by a circumferentially extending slit 17, whereby the ignition and thermocouple heating flames 14 and 16 are joined together, making it impossible for either flame to burn without the other.

Fluid fuel, such for example as manufactured gas, for the pilot burner is supplied through a tube or pipe joined by a suitable coupling to the burner inlet fitting 20. The fitting 20 is threaded externally at 21 to be screwed into the body 1. The fitting 20 has an internal passage of enlarged diameter 22, which passage 22 is threaded internally at 23 to permit a suitable coupling or union member (not shown) to be screwed therein. The fitting 20 may have an hexagonal or other portion adapted for application of a tool thereto to screw the inlet fitting 20 into and from the burner body 1.

The passage 22 communicates with the passage 24 of reduced diameter at the jet end of the fitting. The jet end of the fitting 20 has a transverse wall 25, and the means constituting the present invention and by which the improved results are obtained comprises a plurality (two being shown) of orifices 26, which are drilled at angles to the axis of the fitting 20 so that the two gas streams will intersect each other. In this way, a turbulent flow is maintained at all times, although each individual gas stream might be in a streamline flow condition.

In the illustrated embodiment of the invention, the outer periphery of the jet end of the gas inlet fitting 20 is tapered at 28 to avoid undue impingement thereon of the air drawn through the air inlet 6 when the fitting 20 is functioning in the pilot burner body. The ends of the orifices 26 are shown countersunk at 29 into the end of the fitting 20, with the countersunk portion having surfaces 30 substantially normal to the adjacent ends of the orifices 26.

In operation, the intersection of the two or more streams of fluid fuel appears to cause the fluid fuel to fan out to provide a large, turbulent mass with which the air is intimately intermixed. A turbulent condition is established in proximity to the position where the air is entrained, and the resulting fuel mixture then passes to flame position remote from the intersection of the fuel streams.

As a result, constant flame characteristics of predetermined character are maintained over the complete range of operating pressures and any operating temperature. This assures lighting of the main burner and proper heating of the hot junction of the thermocouple under all operating conditions and against false or erroneous shut off of the fuel by the thermocouple safety control means, such as occurred heretofore in the art where proper heating of the thermocouple is not maintained, notwithstanding the fact that the system is not in a condition requiring shut off of the fuel supply by the thermocouple safety control means.

It is also believed that the angular streams of fuel striking together, where they intersect at 27, removes energy and eliminates or reduces variations in pressure in the fuel mixture passing to flame position.

With the features shown and described, air shutters and other adjustments for the air and fuel may be omitted. This, and the ability to omit a venturi in the burner throat, makes it possible to eliimnate restrictions and thereby dust collection, which is objectionable. Moreover, the air may come in slower so that not only is there little, if any, impingement on parts which knock out dust, but if there is some impingement the speed of the same is less, and thereby less dust is knocked out to collect at the burner. Gum collection is also reduced. Where the air inlet is larger, the angle of the plurality of fuel

streams is preferably greater—assuming that everything else remains the same.

According to the present invention, the angularity of the streams of fuel delivered from the angular orifices 26 is preferably correlated with respect to the type of fluid fuel employed and with respect to the design of the burner. The size of the orifices 26 is determined by the B. t. u. content of the fluid fuel.

While the angularity and size of the orifices 26 may vary widely within the scope of the present invention, I find that, according to one illustrative embodiment of the invention for natural gas, the orifices 26, when drilled at angles of about 9° to the axis of the fitting and approximately .018" in diameter will give the desired results.

As measured from the jet end of the spud 20, the intersection point of the two streams of gas indicated at 27 in Figure 4 may vary widely within the scope of the present invention. With the intersection point 27 from about 3/32" to 1/4" from the end of the spud, the desired results are obtained with the particular burner design shown and described, but this may, of course, vary according to the use of the invention.

With the orifices 26' drilled at angles from about 22½° to 30° to the axis of the fitting as shown in Figure 6, I find that the desired results are obtained with manufactured gas.

The proper orifice angle to use is thus correlated with respect to the type of fluid fuel employed and with respect to the design of the burner.

There are, in general, two types of butane and propane air gases which are identified by their B. t. u. content per cubic foot, namely 530 B. t. u. per cubic foot and 1,000 B. t. u. per cubic foot. A dual orifice spud, according to the present invention, can be designed for use with either of these gases, and on pilot burner specifications would be the same as those used with natural and manufactured gas. For the 530 B. t. u. gas the orifices may be drilled, for example, on angles to the axis of the spud from about 28° to about 35°, depending upon the size of primary air openings and the design of the burner. The orifices would be sized according to the B. t. u. content of the gas. For the 1,000 B. t. u. gas the orifice may be drilled, for example, on an angle to the axis of the spud of about 20° to 25°, depending upon the size of primary air opening and the design of the burner.

While I have shown two angular fluid fuel orifices in each of the embodiments of the invention shown in the drawing, it is to be understood that two or more of such angular fluid fuel orifices are contemplated within the scope of the present invention, and that the appended claims are to be construed accordingly.

The embodiments of the invention shown in the drawing are for illustrative purposes only, and it is to be expressly understood that such drawing and the accompanying specification are not to be construed as a definition of the limits or scope of the invention, reference being had to the appended claims for that purpose.

I claim:

1. A pilot burner for use in proximity to a thermoelectric generator of an automatic shut-off device and a main burner, said pilot burner affording a stable flame for heating said thermoelectric generator under all operating conditions of fuel pressure and ambient temperature and comprising, a hollow body having a tubular fuel inlet end, a tubular outlet end and a connecting chamber between said inlet and outlet ends, said tubular outlet end having a generally transversely extending imperforate wall closing the outer end thereof and at least one flame port spaced inwardly from said generally transversely extending wall and opening radially through said tubular outlet end for direction toward said thermoelectric generator, said connecting chamber having a constricted mid-portion and having an internally enlarged end portion in proximity to said flame port, a primary air inlet opening into said connecting chamber downstream of

said fuel inlet for admittance of air to said chamber, and fuel inlet injection means having at least two fuel inlet orifices angularly disposed with respect to each other and to the axis of said chamber to cause the streams of injected fuel to converge at a focal point in coacting proximity to said air inlet, said air inlet having a size sufficient to permit inflow therethrough of the maximum amount of air required for flame stability under all operating conditions of fuel pressure and ambient temperature, injection of fuel into said hollow body through said fuel injection means affording air entrainment in amount dependent upon the velocity of the fuel flow up to a maximum amount, said connecting chamber being sufficiently constricted to introduce resistance to flow and friction losses into the flow of the air-fuel mixture therethrough, and the end portion of said chamber being internally enlarged sufficiently to permit expansion of the air-fuel mixture therein and discharge of the air-fuel mixture therefrom through the flame port under the pressure maintained therein, said fuel injection orifices being sized relative to the B. t. u. content of the fuel and of such angularity as to provide with said air inlet a fuel-air mixture affording a stable thermoelectric generator heating flame at said flame port over the range of normal pressure variations of the fuel and over the range of normal ambient temperature variations to which said burner is subjected.

2. A pilot burner for use in proximity to a thermoelectric generator of an automatic shut-off device and a main burner, said pilot burner affording a stable flame for heating said thermoelectric generator under all operating conditions of fuel pressure and ambient temperature and comprising, a hollow body having a tubular fuel inlet end, a tubular outlet end and a connecting chamber between said inlet and outlet ends, said tubular outlet end having a generally transversely extending imperforate wall closing the outer end thereof and a pair of flame ports at least one of which is spaced inwardly from said generally transversely extending wall and opening radially through said tubular outlet end, one for direction toward said thermoelectric generator and the other for direction toward position in lighting proximity to said main burner, with a slit opening through a side

wall portion of said tubular outlet end and connecting said flame ports, said connecting chamber having a constricted midportion and having an internally enlarged end portion in proximity to said flame port, a primary air inlet opening into said connecting chamber downstream of said fuel inlet for admittance of air to said chamber, and fuel inlet injection means having at least two fuel inlet orifices angularly disposed with respect to each other and to the axis of said chamber to cause the streams of injected fuel to converge at a focal point in coacting proximity to said air inlet, said air inlet having a size sufficient to permit inflow therethrough of the maximum amount of air required for flame stability under all operating conditions of fuel pressure and ambient temperature, injection of fuel into said hollow body through said fuel injection means affording air entrainment in amount dependent upon the velocity of the fuel flow up to a maximum amount, said connecting chamber being sufficiently constricted to introduce resistance to flow and friction losses into the flow of the air-fuel mixture therethrough, and the end portion of said chamber being internally enlarged sufficiently to permit expansion of the air-fuel mixture therein and discharge of the air-fuel mixture therefrom through the flame ports under the pressure maintained therein, said fuel injection orifices being sized relative to the B. t. u. content of the fuel and of such angularity as to provide with said air inlet a fuel-air mixture affording a stable thermoelectric generator heating flame at said flame port over the range of normal pressure variations of the fuel and over the range of normal ambient temperature variations to which said burner is subjected.

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