TWO-CHAMBER BURNER AND PROCESS

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6 Claims. (Cl. 431—10)

This invention relates to a burner and to a process for burning liquid fuel which requires lower air pressure and is more efficient and more versatile than conventional burners.

Burners utilizing liquid hydrocarbons, such as LPG, liquid propane, fuel oil, etc., are in use in a number of applications, such as in the heating of rock aggregates for making asphalt or bituminous paving. One application of the burner is disclosed in my pending application S.N. 456,371, filed May 17, 1965, now Patent No. 3,336,019.

One problem in burners of the character described is that of efficientlycombusting all of the fuel supplied to the burner. A disadvantage of conventional burners lies in the relatively high air pressure required to operate the burner at reasonable efficiency. Also, conventional burners are less efficient than is desirable.

This invention is concerned with a burner structure and process for high efficiency in burning various liquid hydrocarbon fuels up to and including asphalt, which operates on substantially lower air pressure than is required in conventional burners.

Accordingly, it is an object of the invention to provide a burner of improved construction. Another object is to provide a two-chamber burner which burns liquid fuels more efficiently than conventional burners and with lower air pressure in the air supply to the burner. A further object is to provide a burner and burner process which is adaptable to a wide range of uses. Another object is to provide a process for burning liquid fuels of a wide range of gravity and viscosity at high efficiency and with low air pressure. Other objects of the invention will become apparent to one skilled in the art upon consideration of the accompanying disclosure.

The invention is best understood by reference to the accompanying schematic drawing of which FIGURE 1 is an elevation in partial section of a preferred embodiment of the burner of the invention and FIGURE 2 is a plan view of the burner ring of FIGURE 1.

Referring to the drawing, burner 10 comprises a preheating or booster section 12, a primary combustion section 14, and a fuel injection section 16. Each section is enclosed within a metal shell 18 and a header 20 closes the upstream end of section 12. Section 16 is coupled to section 12 by means of flanges 22 and bolts not shown. Section 14 is coupled to section 16 by similar flanges 24.

The precombustion or booster section 12 comprises a generally cylindrical, hollow, refractory burner body 26 enclosing a main combustion section 28 which terpers at the upstream end to a burner compartment 30 containing a burner 32. The outlet end or downstream end of the booster combustion section 28 converges to a throat 34 leading into an open gas space 36 extending from the downstream end of refractory burner body 26 thru section 16 into section 14. Refractory burner body 26 is supported at the downstream end by a spider arrangement one leg of which is designated 38. The upstream end of this burner body is supported directly from header 20. The structure shown provides a sizeable annulus 40 surrounding burner body 26 which serves as a preheating zone or compartment for introducing the fuel into the chamber 18 via conduit 42 under control of damper 44, air being supplied to this conduit by blower 46 in line 48. Throat 34 of restricted cross section is essential to efficient operation of the burner in that it has an eduction effect on air in annulus 40 and jets the hot gases into section 14.

Burner 32 is supplied air from conduit 50 which connects with conduit 42, the flow being controlled by damper 52. A suitable fuel gas, such as natural gas or propane, from line 54 is passed thru line 56 into burner 32 for admixture with air from conduit 50. Ignition of burner 32 is effected by an ignition means 58 supplying a small burner 60 which receives fuel gas from line 62 and air from line 64 to form a combustible mixture which is ignited by igniter 66 which may be a conventional spark plug or similar device.

Fuel injection section 16 comprises a portion of the free gas space 36 extending into the downstream burner described hereinafter and is provided with a fuel injection tubular ring 70 supported by spider arrangement 72 and connected with a fuel conduit 74 which is fed from a suitable fuel source via line 76. Fuel injection orifices or nozzles 78 are spaced uniformly around the tubular ring 70 so as to spray the liquid fuel in a generally central pattern indicated by dotted lines 80. Primary burner section 14 comprises a refractory burner body 82 which may be cylindrical or flared downstream in the form of a frusto conical member. A long, cylindrical burner body 82 produces a long, narrow flame, whereas a flared burner body produces a shorter, bushier flame.

Referring to FIGURE 2, which is a plan view of the burner ring 70 looking upstream, nozzles or orifices 78 are directed to a common center 81 downstream of the burner ring as shown in FIGURE 1 by zone 80.

The internal diameter of refractory section 28 (combustion section 28) should be approximately 1/4 times the diameter of throat 34. Refractory 26 should be about 1/6" in thickness and about 4 times the throat diameter and cylindrical chamber 28 should be about 4 times the throat diameter. The overall length of refractory 26 is about 5 times the throat diameter and the taps are about 45° with the axis of the burner. In a burner constructed and tested, throat 34 had a diameter of 4/" and a length of 3/".

The annulus 40 was about 2/" on the radius of the preheating or refractory section to give about 8,000 feet per minute air velocity thru the annulus and the fuel ring 70.

Fuel ring 70 is constructed of 1/4" O.D. stainless steel tubing with a diameter substantially the same as the internal diameter of burner body 82, or 9/". Ring 70 was constructed with 12 orifices sized to hold pressure on the fuel (LPG) of about 30 p.s.i. above its vapor pressure. Burner body 82 is 1/2" thick, 12" long, and 9 3/4" I.D.

In operation, burner 32 is ignited in obvious manner by means of device 58 and the injected fuel and air are burned in booster burner 26 to eject a flame and combustion gases thru throat 34 represented by line 84. The refractory burner body 26 becomes hot and the air fed into annulus 40 from conduit 42 by blower 46 becomes heated to an elevated temperature in the range of about 1200 to 1500° F. as it passes thru ring 70 into burner 82.

When the air reaches the desired operating temperature, liquid fuel injection thru ring 70 is initiated and the injected liquid fuel mixes with the hot air and is burned in the primary burner enclosed within burner body 82 to form a flame 86 projecting from the mouth of the burner. The air pressure in annular zone 40 is maintained in the range of about 7 to 10 oz. for efficient operation. The weight ratio of fuel burned in the upstream combustion zone to that burned in the primary combustion zone is in the range of 1:8 to 1:10.

The burner of the invention has numerous advantages over prior art burners. This burner burns only about 70 percent of the amount of fuel burned in conventional burners for the same heating area or volume and with the same liquid fuel and air supply. This burner is more efficient than the preheating and the manner of using this preheated air. The burner...
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3. A burner comprising in combination:
(a) a burner housing of generally cylindrical, elongated configuration;
(b) a hollow, elongated refractory booster burner body fixed in the upstream end of said housing coaxial therewith and forming an axial booster burner combustion chamber and a surrounding air heating annulus with said housing, said chamber having a restricted outlet on its downstream end and a burner in the upstream end thereof;
(c) means for feeding a combustible mixture of fuel gas and air to the burner of (b) and means for igniting same;
(d) means for feeding primary air to said heating annulus;
(e) an elongated hollow refractory primary burner body coaxial with said housing in the downstream end thereof spaced from the burner body of (b) to provide a substantial free gas space therebetween and forming an axial primary combustion chamber;
(f) a hollow fuel ring in the gas space of (e) coaxial with said housing having orifices therein directed in a conical pattern downstream into the primary combustion chamber of (e), said free gas space communicating between the annulus of (b) and said primary combustion chamber to provide for flow of heated combustion air from said annulus to said primary combustion chamber; and

4. (g) means for feeding fluid fuel to the fuel ring of (f).
2. The burner of claim 1 wherein the burner body of (e) is cylindrical.
3. The burner of claim 1 wherein the burner body of (e) is flared outwardly downstream.
4. The burner of claim 1 wherein the booster burner body of (b) comprises a main cylindrical central section converging at the upstream end into a housing for the burner of (b) extending outside of said housing and at the downstream end into a cylindrical throat section for directing flame and combustion gases thru the fuel ring of (f) as an eductor for primary air from the annulus of (b).
5. A process for burning a liquid fuel which comprises the steps of:
(a) burning a mixture of fuel gas and air in an upstream combustion zone to form flame and combustion gases;
(b) directing the flame and combustion gases from step (a) thru a restricted throat in the downstream section of said combustion zone and axially thru a fuel ring into a primary combustion zone in alignment with the combustion zone of (a);
(c) feeding primary combustion air into an enclosed annular heating zone open on the downstream end to the primary combustion zone of (b) immediately surrounding the upstream combustion zone of (a) so as to substantially heat said primary air, the passage of said flame and hot combustion gases thru said throat and ring educting primary air from said annulus into said primary combustion zone around and thru said ring;
(d) injecting liquid fuel from said fuel ring thru nozzles therein in a generally conical spray directed downstream so that said liquid fuel is heated, vaporized, and mixed with heated air and said combustion gases and burned in said primary combustion zone; and
(e) maintaining air pressure in said annular heating zone in the range of about 7 to 10 oz.
6. The process of claim 5 wherein the weight ratio of fuel burned in said upstream combustion zone to that burned in said primary combustion zone is in the range of about 1:8 to 1:10.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,376,098

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

Column 4, line 46, "10:10" should read -- 1:10 --.
Signed and sealed this 14th day of October 1969.

(SEAL)
Attest:
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