

Jan. 2, 1968

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LIQUID FUEL BURNER

3,361,183

Filed July 28, 1965

2 Sheets-Sheet 2

Fig. 3

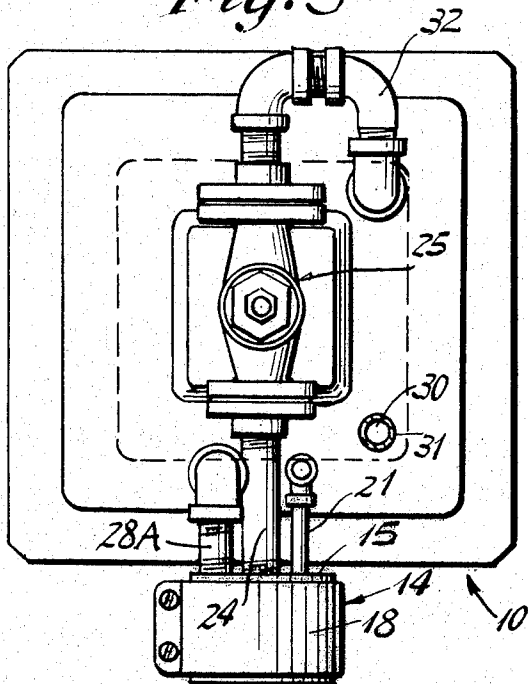
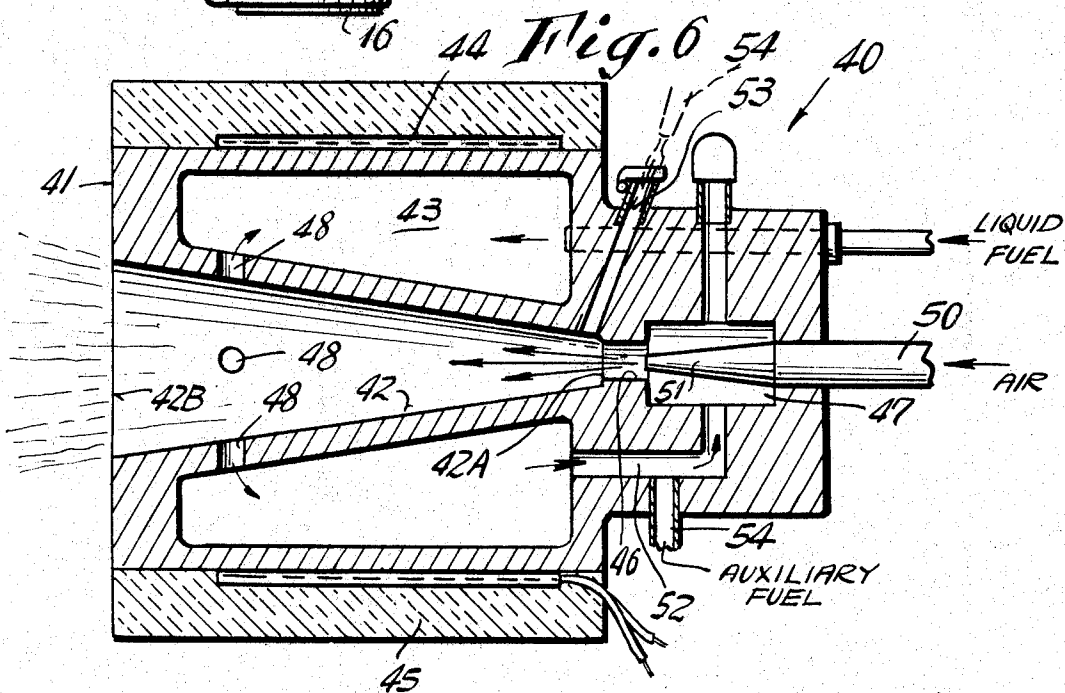
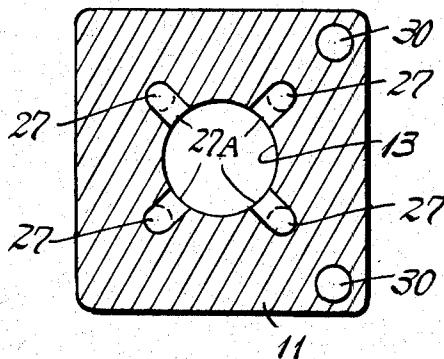


Fig. 5



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3,361,183

LIQUID FUEL BURNER

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Filed July 28, 1965, Ser. No. 475,377

9 Claims. (Cl. 158—5)

ABSTRACT OF THE DISCLOSURE

This invention is directed to a liquid fuel burner comprising a burner nozzle having an inlet end and a discharge end portion for providing an unimpeded flow path therethrough for the fuel mixture. A means defining a gasifying chamber is operatively connected to the burner nozzle for effecting gasification of the liquid fuel introduced therinto. The heat for effecting gasification of the liquid fuel in the gasification chamber is effected by providing a plurality of port openings spaced inwardly and adjacent the discharge end portion of the burner nozzle so as to effect recirculation of a portion of the products of combustion generated in or at the burner nozzle to the gasification chamber. Disposed in communication between the gasifying chamber and the inlet to the burner nozzle is a mixing chamber having a restrictor formed therein. Accordingly, combustion air is introduced into the mixing chamber whereby the flow of air through the restrictor induces a natural circulation to enhance the mixture of the combustion air with the gasified fuel and which creates a zone of reduced pressure adjacent the circulating ports thereby permitting the same to function as a means for retaining the flame adjacent the discharge end of the burner nozzle.

This invention relates in general to a burner construction, and more specifically to a burner construction arranged to gasify a liquid fuel prior to burning to provide for a more intimate and homogeneous mixture of fuel and combustion air; and thereby achieve a more complete and efficient combustion of the fuel.

Many efforts have been made to develop a highly efficient liquid fuel burner. Various means have been employed in the past to effect an optimum mixture of liquid fuel with the necessary combustion air to attain a good combustible mixture. Heretofore, either mechanical and/or physical means have been utilized for atomizing the liquid fuel into a liquid fuel spray or mist to render the same more readily mixed or combined with necessary air to create the optimum combustible mixture. However, even with the best known atomizing means, the desired homogeneous fuel mixture for optimum combustion efficiency was not readily attainable. This was because the finely divided atomized particles of fuel was still confined to their liquid state and consequently the air could only combine with surface portions of liquid fuel particles or droplets. Consequently, only the smaller of the atomized fuel particles could be totally consumed if enveloped in sufficient combustion air. The relatively larger particles of atomized fuel could only be partially consumed, since the surrounding air would be insufficient to support the complete combustion thereof.

To further enhance the intimate mixing of the atomized fuel particles with combustion air, means in the form of impellers have also been utilized in conjunction with the atomizing means to impart a whirling or swirling action to the atomized fuel and air. However, while such impellers have been somewhat successful in effecting a more thorough mixing of the atomized fuel with the combustion air, they introduced into the art of combustion additional problems, such as noise and flame

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instability. Consequently, unless the velocities, which the impellers imparted to the swirling fuel and air, were carefully regulated or controlled, the flame would tend to be blown away from the tip of the burner and thus result in a burner flame-out, which unless quickly detected could and did create serious hazardous conditions in the system in which such burner was used.

The incomplete combustion of liquid fuel also created a maintenance problem in that the formation and accumulation of residue resulting therefrom required frequent cleaning of the burner parts to maintain the burner at optimum operating efficiency. Consequently, the known oil burner constructions have never achieved the cleanliness or efficiency of operation comparable to that of gas burners.

Efficient combustion and maintenance of liquid fuel burners become even more aggravated when such burners are supplied with a relatively low-grade of fuel oil. Also, the structure of the prior known liquid fuel burners have not been readily adapted for burning a gaseous fuel as the structure of the known burners for liquid fuel has not been compatible for the burning of a gaseous fuel. Consequently, in installations requiring the use of gas as an alternate fuel, separate and distinct gas burner construction was required to accommodate the burning of gas when used as an alternate fuel.

It is therefore an object of this invention to provide a liquid fuel burner constructed and arranged so as to affect complete gasification of the liquid fuel supplied so that it can be more intimately mixed with the necessary combustion air prior to the burning of the same so that the efficiency and completeness of combustion of the liquid fuel is greatly enhanced.

Another object of this invention is to provide a burner construction in which a portion of the products of combustion generated by the burner are recirculated so that the heat of the combustion gases is utilized to effect gasification of the liquid fuel supplied to the burner.

Another object of this invention is to provide a liquid fuel burner constructed and arranged in a manner in which flame stability is greatly enhanced and in which noise is substantially minimized.

Another object of this invention is to provide a burner construction in which the liquid fuel supplied thereto is gasified and intimately mixed with combustion air to form a homogeneous fuel mixture in a manner in which prohibits the condensation of the gasified fuel.

Another object of this invention is to provide a burner construction in which preheated combustion air is intimately mixed with the gasified fuel to form an optimum combustible fuel mixture that is totally consumed to effect a complete and efficient combustion of the liquid fuel.

Another feature of this invention resides in the provision of a liquid fuel burner in which the liquid fuel is gasified prior to burning and which is relatively simple in structure, that can be inexpensively fabricated, and which is positive in operation.

Another object of this invention is to provide a liquid fuel burner in which the liquid fuel supplied thereto is quickly gasified prior to the combustion thereof.

Another object of this invention is to provide in a liquid fuel burner means for retaining and stabilizing the flame adjacent the discharge end of the burner nozzle.

Another object of this invention is to provide in a liquid fuel burner an arrangement which creates a natural recirculation of a portion of combustion gases through the burner to create adjacent the tip end of the burner an area of reduced pressure that functions to retain the flame thereat.

The foregoing objects, and other features and advantages are attained in a burner construction comprising a means defining a burner nozzle operatively associated

with a gasifying chamber. Liquid fuel is supplied to the gasifying chamber. By subjecting the liquid fuel in the gasifying chamber to heat, the liquid fuel therein is transformed into its gaseous state.

In accordance with this invention, the liquid fuel during burner operation is gasified by recirculating a portion of the combustion gases generated by the burner through the gasifying chamber. Thus, the heat of the combustion gases is utilized to transform the liquid fuel into its substantially gaseous state within the gasifying chamber.

In one form of the invention, the gasifying chamber is remotely disposed with respect to the burner nozzle and is connected to the nozzle by suitable conduit means, through which a portion of the combustion gases is drawn off and circulated therebetween.

In another form of the invention the gasifying chamber is disposed in heat transfer relationship with the burner nozzle with suitable port openings interconnecting the burner nozzle into direct communication with the gasifying chamber to provide for the circulation of combustion gases therebetween.

In either form of the invention a means is provided for mixing combustion air with the gasified fuel and recirculated combustion gases mixed therewith to form a homogeneous combustible fuel mixture. The mixing of the combustion air with the gasified fuel mixture is attained in a mixing chamber adjacent the inlet to the burner nozzle by passing the air through a Venturi-like restrictor which is open in communication with the gasifying chamber. Thus, a negative or reduced pressure zone created thereat causes the gasified fuel to flow from the gasification chamber to the burner nozzle and to mix with the air flowing thereto to define the combustible mixture which is delivered to the burner nozzle. If desired, the combustion air may be preheated by first passing the combustion air through an air heater, e.g. an air heater means disposed in a heat exchange relationship to the burner nozzle. Because the recirculating means of the combustion gases are connected into direct communication with the gasifying chamber, the differential in pressure resulting from the flow of air through the restrictor induces a natural recirculation of a portion of the combustion gases from the burner nozzle to the gasifying chamber associated therewith. Accordingly, a low pressure area is created adjacent ports through which the combustion gases are drawn from the burner nozzle and recirculated to the gasification chamber. Preferably, these ports are disposed adjacent the discharge end of the burner so that the area of reduced pressure created thereat functions to retain and/or stabilize the flame at the burner tip during burner operation. Accordingly, as the load of the burner is increased, the greater becomes holding characteristics of the flame adjacent the discharge end of the burner nozzle.

If desired, a means may also be provided for supplying an auxiliary fuel, as for example a gaseous fuel to the burner nozzle to render the burner readily compatible for burning either liquid fuel and/or gaseous fuel.

A feature of this invention resides in a burner construction having in combination, a burner nozzle and cooperatively associated gasifying chamber with means for recirculating a portion of the combustion gases generated in the burner nozzle to the gasifying chamber so that the heat of the combustion gases is utilized to gasify or transform the liquid fuel into a state to form with the combustion air a substantial homogeneous fuel mixture.

Another feature of this invention resides in a burner having a construction in which the mixing of combustion air with gasified liquid fuel creates a low pressure area or zone adjacent the tip end of the burner to function as a means for retaining a stable flaming condition adjacent the discharge end of the burner nozzle.

Another feature of this invention resides in a burner construction which is rendered compatible for the burning either liquid and/or gaseous fuels.

Another feature of this invention resides in the provision of a liquid burner in which liquid fuel is gasified and then is intimately mixed with combustion air to form a homogeneous combustible fuel mixture by passing the same through a Venturi-like restrictor.

Another feature of this invention resides in the provision of a liquid fuel burner in which the liquid fuel is transformed into its substantial gaseous state prior to the combustion by the direct heat transfer between products of combustion generated by the burner and the liquid fuel.

Another feature of this invention resides in the provision of a burner having means in which the liquid fuel supplied thereto is gasified in an atmosphere containing insufficient air to support combustion and thereby minimizes any danger of any flashback.

Other features and advantages will become more readily apparent when considered in view of the specifications and drawings in which:

FIGURE 1 is a perspective view of a liquid fuel burner constructed in accordance with the instant invention.

FIGURE 2 is a side elevation view of the burner construction of FIG. 1 having portions thereof shown in section.

FIGURE 3 is a front end view of the burner construction of FIG. 1.

FIGURE 4 is a detailed plan view taken along line 4—4 on FIG. 2.

FIGURE 5 is a detailed sectional view taken on line 5—5 on FIG. 2.

FIGURE 6 is a side sectional view taken through a burner block of a modified form of the invention.

Referring to the drawings, there is shown in FIGS. 1 through 5 an embodiment of a liquid fuel burner 10 constructed in accordance with the instant invention. The liquid burner 10 of FIGS. 1 to 5 comprises a burner block 11 having connected thereto a burner front plate 12 by which the burner 10 can be readily installed in a burner opening of a furnace wall or burner box (not shown). The burner block 11 may be formed of any suitable high temperature, heat resistant, material, e.g. a ceramic or other suitable fire resistant refractory material, and the like. Integrally formed within the block 11 is a bore which defines a burner nozzle 13. In the illustrated form of the invention, the bore defining burner nozzle 13 is shown as being substantially conical in shape and diverges from the inlet 13A to the outlet end 13B thereof.

Operatively connected with the burner nozzle 13 is a gasifying chamber 14. In the illustrated embodiment of FIGS. 1 through 3, the gasifying chamber 14 is defined by a housing which is remotely connected to the burner block 11. Essentially, the gasifying chamber 14 comprises a housing having top and bottom walls 15, 16 interconnected by a circumscribing side wall 17. An electric band heater 18 circumscribes the side wall 17 of the housing 14 for reasons as will hereinafter appear with suitable conductors 19, 20 connecting the heater into a suitable electric circuit or source of electrical energy. A conduit 21 is connected into communication with the interior of the gasifying chamber to supply liquid fuel thereto. To control the flow of liquid fuel thereto, a valve or control 22 is interposed into the liquid supply conduit 21. The gasifying chamber 14 in turn is provided with an outlet 23, connected by a suitable conduit 24 to a fixture 25 which defines a chamber in which the gasified liquid fuel is mixed with combustion air supplied to the mixing chamber 25 through a Venturi-like orifice or restrictor 26 whereby the air and gasified fuel are intimately mixed to define a homogeneous combustion mixture.

In accordance with this invention, the liquid fuel supplied to the gasifying chamber 14 is gasified by imparting heat thereto. This is attained by circulation in direct heat transfer with the liquid fuel of the heated product of combustion generated by the burner 10. In the form of the invention of FIGS. 1 to 5, the means for recirculation

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of a portion of the products of combustion to the gasifying chamber 14 comprises one or more passageways or conduits 27 connecting the discharge end 13B of the burner nozzle 13 in communication with the gasifying chamber 14. In the arrangement of FIGS. 1 to 5, four such passageways 27 are circumferentially spaced about the nozzle 13, each having an opening 27A adjacent the discharge end 13B of the burner nozzle. Preferably, the ports 27A are circumferentially spaced about the tip end of the nozzle. The outlet ends of the respective passages or conduits connect into a manifold 28 formed in the burner block. The manifold 28 in turn connects into communication with the interior of the gasifying chamber 14 by means of a connecting conduit 28A. Accordingly, the arrangement is such that a portion of the products of combustion generated by the ignition of the combustible fuel mixture within the burner nozzle 13 is recirculated to the gasifying chamber through passageways 27 as will be hereinafter more fully set forth.

If desired, the combustion air to be mixed with the gasified fuel may be preheated to avoid condensing of the gasified fuel during mixing. As shown, means for heating the combustion air comprises an air preheater disposed into heat transfer relationship with respect to the burner nozzle. In the illustrated form of the invention of FIGS. 1 to 5, the air preheater comprises a passageway 30 which is integrally formed in the burner block in heat transfer relationship to the burner nozzle 13 therein. Air is supplied to the air heating passageway 30 of the burner block by a supply pipe 31 that connects with a source of force air, e.g. a fan or blower. The outlet of the air heater 30 is connected by a suitable fixture or conduit 32 to the inlet of the mixing chamber 25. As best seen in FIG. 2, the discharge end of the air fixture 32 which discharges the preheated air into the mixing chamber is defined as a Venturi-like restrictor or nozzle 36 which is disposed in alignment with an opening 33 to the burner nozzle inlet. Accordingly, the air supplied through the air heater 30 by a suitable fan or blower is ejected in a heated state through the Venturi-like restrictor 26. The orifice 26 is such that the velocity of the air increases as it flows through the Venturi restrictor, thus creating the pressure differential in the mixing chamber 25 which influences the flow of gasified fuel from the chamber 14 to the burner imparting a considerable velocity to the combustion air-fuel mixture extending past the ports 27a, and also inducing the recirculation of the products of combustion through the recirculating passageways 27 of the burner block to the gasifying chamber 14. If desired, a suitable valve 34 is disposed into the air supply line 31 controlling the flow of air through the preheater means 30. As shown in FIG. 2, the valve 34 for controlling the flow of air through the preheater 30 is illustrated in the outlet end of the preheater 30. Accordingly, by appropriate proportioning of the liquid fuel valve 22, and combustion air valve 34, the desired characteristics of burner performance can be achieved. It will be understood that a suitable valve may be also interposed into the gas recirculating line 27 to proportion or control the amount of combustion gases recirculated to the gasifying chamber.

In accordance with this invention, the amount of combustion gas that is circulated is the amount sufficient to maintain the temperature within the gasifying chamber in a range which is greater than the gasifying temperature of the liquid fuel, but less than the cracking temperature thereof. Accordingly, a temperature range of 600° F. to 900° F. is considered to be the optimum temperature range to be maintained in the gasifying chamber 14 to effect the desired gasification of the liquid fuel. The temperature of the preheated air is such as to prohibit condensation of the gasified fuel when the air is mixed therein in the mixing chamber 25.

The operation of the burner construction described is as follows:

On start-up, the valve 22, controlling the flow of liquid fuel to the gasifying chamber, and valve 34 controlling the air flow through the air preheater 30 are proportioned in accordance to a desired flame setting. To provide the heat necessary for initial gasification of the liquid fuel on start-up, the band heater 18 surrounding the gasifying chamber 14 is energized. Accordingly, the band heater 18 is maintained energized for a time sufficient to effect the initial gasification of the liquid fuel within the gasifying chamber 14. If desired, there may be operatively connected in the heater circuit a thermostatic switch (not shown) to insure maintenance of the proper temperature within the gasifying chamber at all times during burner operation by automatically effecting intermittent energization of the band heater whenever the temperature within the gasifying chamber falls below the optimum temperature range hereinbefore set forth.

After the initial gasification of the fuel oil has been completed, the gasified fuel is directed to the mixing chamber 25 by the flow of air passing through the Venturi or orifice 26. Accordingly, the air and gasified fuel are intimately mixed into a homogenous fuel mixture which is then supplied to the inlet of the burner nozzle. A suitable igniter means (not shown) effect ignition of the fuel within the burner nozzle.

Once the operation of the burner has thus been commenced and the fuel ignited, the operation of the band heater 18 is discontinued except for possible automatic intermittent operation thereof as may be required by operation of the thermostatic switch to maintain the optimum temperature range as hereinbefore described. With the burner in operation, a portion of the products of combustion generated in the burner nozzle 13 are recirculated through the port openings 27A adjacent the discharge end of the burner nozzle and the connected passageways 27 to the gasifying chamber 14 so that the heat of the recirculated gases is now utilized to effect the necessary gasification of the liquid fuel within the gasifying chamber. Accordingly, it has been noted that the recirculating combustion gases effects gasification of the liquid fuels in an atmosphere containing insufficient air to support combustion. Consequently, because of the insufficiency of air within the gasifying chamber 14, the danger of flashback is all but eliminated.

Because of the pressure differential created by the discharge of the air through the Venturi-like orifice 26, an area of reduced pressure is created adjacent the port openings 27A of the gas recirculation ducts 27 at the discharge end of the burner nozzle. Accordingly, the reduced pressure areas defined at the port openings 27a in coaction with the combustion air-fuel mixture flowing at considerable velocity past said ports function as means to retain the flame adjacent the tip end of the burner, and thereby greatly stabilizes the flame conditions of the instant burner.

With the burner construction described, the arrangement is such that it is rendered readily compatible for operation with a gaseous fuel. Accordingly, whenever a natural or artificial gas fuel is desired to be utilized in the burner as an alternate fuel, an auxiliary fuel inlet may be provided for introducing the gaseous fuel into the gasifying chamber or directly into the mixing chamber wherein it is then subsequently mixed with the air introduced into the mixing chamber. By proper controls, the burner construction described can thus be made readily compatible for burning either a liquid or gaseous fuel separately and/or in combination. Consequently, separate and distinct burner spuds or nozzles for respective gas or oil fuels are not necessary as heretofore required. Thus, either a gas or liquid fuel may be burned in the same burner nozzle with substantially equal efficiency.

It will be noted that with the instant construction, the recirculated products of combustion have a catalytic like effect on the combustion of the liquid fuel. This is attributed to the fact that condensation of the gasified fuel

is minimized during operation. Also, by utilizing the recirculated products of combustion, the response to the gasification of the fuel in the gasifying chamber is rendered more immediate since the time interval necessary to bring the heating medium up to the temperature necessary to effect gasification of the liquid fuel is reduced to a minimum. Also, the recirculation products of combustion, as the heating medium for effecting the gasification of the liquid fuel in the gasifying chamber minimizes the danger of flashback because of the low oxygen contents in the chamber. Accordingly, the burner described is relatively simple in structure, positive in operation. Further the maintenance problems of the burner are reduced to a minimum as a minimum of heat exchange surfaces are required. By using the products of combustion as the heating medium, the volume of gaseous medium required to be circulated through the gasifying chamber to effect the desired gasification of the liquid fuel can be substantially minimized.

FIGURE 6 illustrates a modified form of the invention. In this form of the invention, the burner construction 40 comprises a burner block 41 which has integrally formed therein a burner nozzle or bore 42 and a circumscribing gasifying chamber 43. As shown, the burner nozzle 42 is defined as a conically shaped bore which diverges from the inlet 42A to outlet 42B end thereof. The gasifying chamber 43 is defined by an annular chamber formed integral in the burner block and circumscribing the nozzle defined therein. A band heater 44 circumscribes the outer wall of the gasifying chamber 43. Circumscribing the burner block 41 and band heater is a layer of suitable insulating material 45. In this embodiment, the burner nozzle 42 is disposed in heat transfer relationship with respect to the vaporizing chamber 43 formed integral therewith. The inlet 42A to the burner nozzle 42 is connected by a restricted opening 46 to a mixing chamber 47, integrally formed adjacent the front end of the burner block 41. Means in the form of a plurality of circumferentially port openings 48 connect the discharge end portion 42B of the burner nozzle 42 into direct communication with the gasifying chamber 43.

In accordance with this invention, liquid fuel is supplied to the gasifying chamber 43 through a liquid fuel conduit 49. Accordingly, the liquid fuel introduced into the gasifying chamber 43 is gasified indirectly by the transfer of the heat generated by the combustion of the fuel gases within the burner nozzle through the walls of the chamber, and directly by the recirculation of a portion of the products of combustion through ports 48 and into the gasifying chamber.

In this form of the invention, pressurized air which may be at ambient air temperature, is introduced into the mixing chamber 47 through an air supply conduit 50 discharging thereinto. Accordingly, the discharge end of the conduit defines a Venturi-like orifice 51 to create a pressure differential to induce both the recirculation of the products of combustion through the gasifying chamber 43 and the flow of gasified fuel to the mixing chamber. Accordingly, the gasified liquid, mixed with the products of combustion, is circulated from the gasifying chamber 43 to the mixing chamber 47 through a connecting passageway 52. Accordingly, the mixture of gasified fuel and the heating products of combustion are intimately mixed with the combustion air flowing to the burner nozzle 42.

As shown in FIG. 6, an igniter opening 53 is provided in the burner block through which a suitable igniter or torch 54 may be inserted to effect the ignition of the combustible mixture delivered to the nozzle. Also, auxiliary fuel inlet 54 may be connected into communication with the mixing chamber 47 so as to render the burner construction 40 readily compatible for burning an auxiliary fuel, as for example a gaseous fuel. Due to the differential pressure created within the mixing chamber 47 and the gasifying chamber 43 connected in communication therewith, the port openings 48 connecting the

gasifying chamber into communication with the burner nozzle defines a low pressure area about the discharge end 42B of the burner nozzle, and in coaction with the combustion air-fuel mixture or flame flowing at considerable velocity past the openings 48 will thus function to stabilize and retain the flame adjacent the discharge end of the burner. Accordingly, the operation of the burner construction of FIG. 6 is substantially similar to that hereinbefore described.

While the instant invention has been described with reference to several embodiments thereof, it will be readily understood and appreciated that variations and modifications of the invention may be had without departing from the spirit or scope thereof.

What is claimed is:

1. A burner comprising:

- (a) a burner nozzle having a bore extending therethrough, said bore having an inlet end and an unimpeded discharge end portion spaced from said inlet end,
- (b) means defining a gasifying chamber into which a liquid fuel is introduced and gasified by heating the same to a temperature ranging between 600° F. and 900° F.,
- (c) means connecting said gasifying chamber into communication with the inlet end of said nozzle through which the fuel gasified in said chamber is directed to said nozzle,
- (d) means for introducing and mixing pressurized combustion air with said gasified fuel in said connecting means to form combustible fuel mixture,
- (e) and, means including a plurality of ports spaced inwardly of said unimpeded discharge end portion, and connected passageways for recirculating a portion of the products of combustion generated by the burning of said fuel mixture to said gasifying chamber whereby the heat of said recirculated combustion gases is utilized to effect the gasification of said liquid fuel in said gasifying chamber, and said mixing means including a restrictor disposed adjacent the inlet end of said burner nozzle for imparting a considerable velocity to said combustion air-fuel mixture extending past said ports and which induces a natural circulation of said products of combustion through said ports and connected passageways, thereby creating a zone of reduced pressure at said ports to function for retaining the flame adjacent the discharge end of said nozzle.

2. The invention as defined in claim 1 wherein said gasifying chamber is remotely connected to said mixing chamber.

3. The invention as defined in claim 1 wherein said gasifying chamber circumscribes said burner nozzle in heat transfer relationship thereto.

4. The invention as defined in claim 3 and including an auxiliary heater means disposed about said gasifying chamber to impart initial heat to said liquid fuel to effect gasification of said liquid fuel upon start-up.

5. The invention as defined in claim 1 and including means defining an auxiliary inlet to said mixing chamber for introducing thereto an auxiliary fuel.

6. A burner construction comprising:

- (a) a burner block having a conical bore formed therein to define a burner nozzle, the larger end of said bore defining the discharge end of said nozzle,
- (b) means defining a gasification chamber remotely connected to said burner block,
- (c) means for introducing a liquid fuel into said gasifying chamber,
- (d) means defining a mixing chamber, said mixing chamber having an inlet and outlet,
- (e) means defining a gasification restriction interconnecting the outlet of said mixing chamber to the inlet of said nozzle,

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- (f) means connecting said gasifying chamber to said mixing chamber for directing the gasified fuel generated in said gasifying chamber to said mixing chamber,
- (g) means for recirculating a portion of the products of combustion generated in said nozzle to said gasifying chamber wherein the heat of said recirculated gases is utilized to gasify said liquid fuel,
- (h) and, means for introducing preheated air into said mixing chamber to form a combustible mixture with said gasified fuel.
7. A burner construction comprising:
- (a) a burner block having integrally formed therein a burner nozzle that diverges from its inlet to its outlet,
- (b) a mixing chamber,
- (c) a Venturi-like restrictor connecting said mixing chamber in communication with the inlet of said nozzle,
- (d) a gasifying chamber remotely connected from said burner block and nozzle therein,
- (e) a supply pipe feeding liquid fuel into said gasifying chamber,
- (f) an auxiliary heater means operatively connected to said gasifying chamber for heating the liquid fuel in said gasifying chamber on start-up to gasify said liquid fuel,
- (g) means for recirculating a portion of the combustion gases generated by said burner nozzle to said gasifying chamber to sustain the gasification of said liquid fuel during burner operation,
- (h) said latter means including a plurality of ports circumferentially spaced about the discharge end of said nozzle,

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- (i) conduit means connecting said ports into communication with said gasifying chamber for directing the recirculated gases thereto,
- (j) means connecting said gasifying chamber to said mixing chamber for delivering thereto a mixture of said gasified liquid fuel and recirculated combustion gases,
- (k) means for introducing preheated air into said mixing chamber to form a combustible mixture with said gases from said gasifying chamber,
- (l) said latter means including an air preheater formed integral in said burner block in heat transfer relationship to said burner nozzle formed therein,
- (m) and conduit means connecting the outlet of said air preheater to said mixing chamber,
- (n) means to control the amount of air flowing through said preheater,
8. The invention as defined in claim 1 and including means for igniting the combustible fuel-air mixture within said nozzle.
9. The invention as defined in claim 1 wherein the bore of said nozzle diverges from said inlet end thereof to said discharge end thereof.

References Cited

UNITED STATES PATENTS

687,535	11/1901	Machlet	158—1
1,092,212	4/1914	Hauck	158—36
1,386,091	8/1921	Chapman	158—5
1,946,817	2/1934	Stenfors	158—53
2,735,481	2/1956	Reichhelm	158—5

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