March 29, 1949. A. CLARKSON 2,465,711

HIGH VELOCITY GASEOUS FUEL BURNER FOR AIR HEATERS

Filed April 3, 1944 3 Sheets-Sheet 1

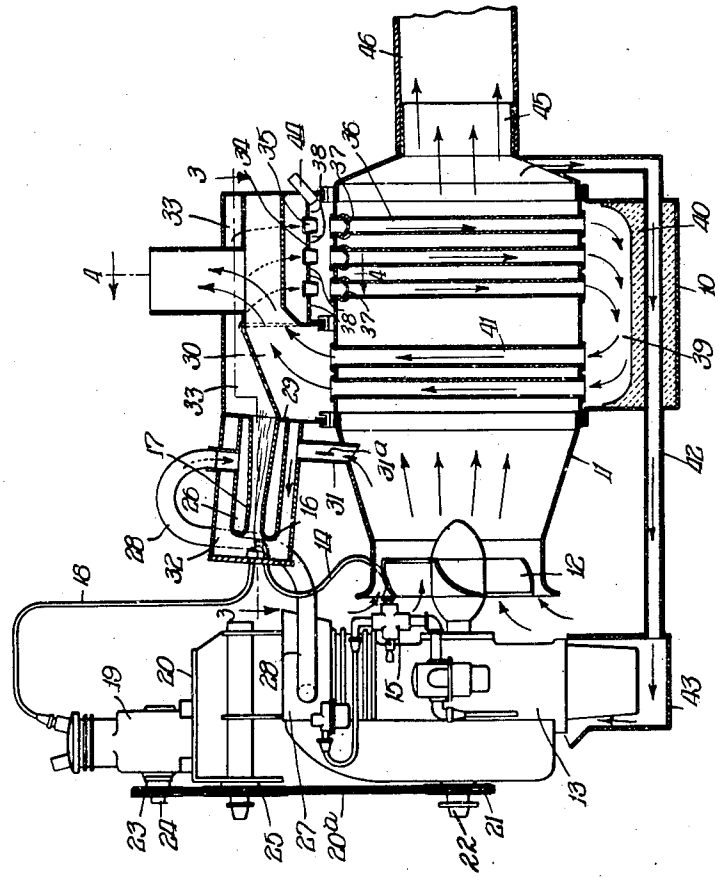


Fig. 1

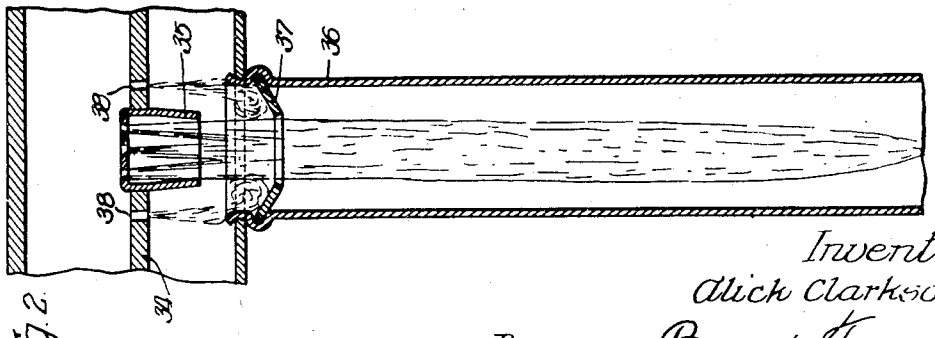


Fig. 2

Inventor:
Alick Clarkson,
By Barnett & Truman
Attys

March 29, 1949. A. CLARKSON 2,465,711

HIGH VELOCITY GASEOUS FUEL BURNER FOR AIR HEATERS

Filed April 3, 1944 3 Sheets-Sheet 2

Fig. 3

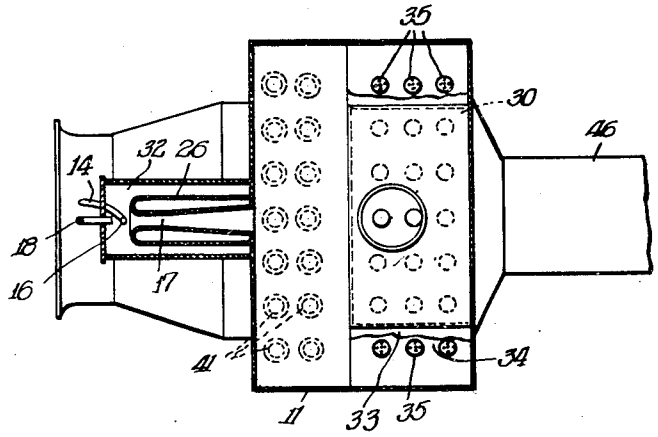
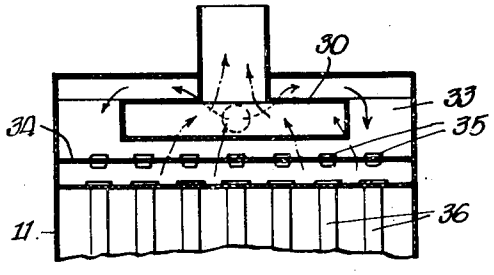


Fig. 4



INVENTOR.
Alick Clarkson,
BY
Barnett & Truman
Attys.

March 29, 1949. A. CLARKSON 2,465,711

HIGH VELOCITY GASEOUS FUEL BURNER FOR AIR HEATERS

Filed April 3, 1944 3 Sheets-Sheet 3

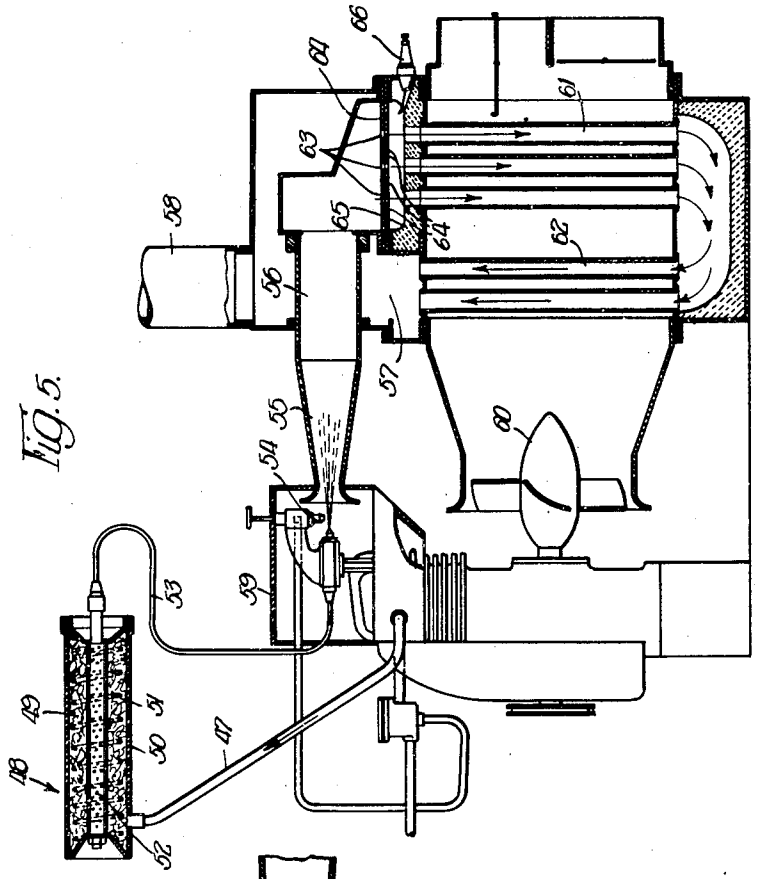


Fig. 5.

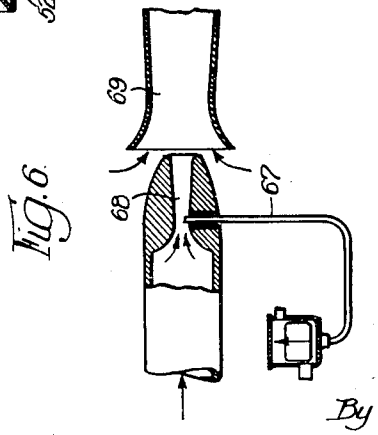


Fig. 6.

Inventor:
Alick Clarkson,
By Barnett & Truman
Attys

Patented Mar. 29, 1949

2,465,711

UNITED STATES PATENT OFFICE

2,465,711

HIGH VELOCITY GASEOUS FUEL BURNER FOR AIR HEATERS

Alick Clarkson, Bloomingdale Township, Du Page County, Ill.

Application April 3, 1944, Serial No. 529,297

11 Claims. (Cl. 126—110)

1

This invention relates to improvements in apparatus for heating and more particularly to air heaters adapted to use liquid or gaseous fuels.

The principal object of the invention is to provide improved arrangements and constructions for heating apparatus of the above character which so increase their efficiency and capacity that a large volume of air can be quickly and economically heated in a relatively small heater.

The invention includes, as one of its specific objects, the provision of a liquid fuel burner constructed to provide a plurality of relatively long pencil-like flames each of which passes through a long and relatively narrow passage, for example, a metal tube which constitutes a combustion chamber. The said tubes which constitute combustion chambers are spaced apart to provide air passages between them and communicate with similarly spaced return tubes for conducting the hot products of combustion to the smoke stack. The object of this construction is to provide a long path for the flame and for the hot products of combustion so as to insure complete transfer of the heat to the air passing through the heater chamber.

A further object of the invention is to obtain maximum efficiency in heaters of the above character by insuring complete evaporation of the fuel and by preventing condensation thereof. In this connection, the invention contemplates a high pressure aspirating device for atomizing the liquid fuel in connection with means for conducting heat to the atomizing and mixing chambers whereby the heat is utilized to expedite complete evaporation of the liquid fuel and to prevent subsequent condensation thereof when the heater is used in sub-zero temperatures.

Another object is to provide a long flame heater of the above character in which air sufficient to support combustion may be preheated and safely mixed with the vaporized liquid fuel at the point of vaporization and thereafter passed through a Venturi passage into a distributing chamber. The distributing chamber communicates with the several combustion chambers through nozzle members adapted to deliver the vaporized fuel and air into the combustion chambers at high velocity. The velocity of the fuel introduced is somewhat greater than the speed of propagation of the flame. Consequently there is little or no tendency for the flame to back-fire and burn at the atomizer or within the distributing chamber.

Another object of the invention is to provide means for producing a suitable pilot flame for maintaining a high velocity main flame thoroughly ignited. The invention is illustrated in certain preferred embodiments in the accompanying drawings wherein:

2

Fig. 1 is a vertical sectional view through an air heater constructed in accordance with this invention.

Fig. 2 is a fragmentary sectional view showing one of the tubular combustion chambers and illustrating the manner in which the pilot flames are directed against a fire ring inserted in the tube.

Fig. 3 is a fragmentary sectional view taken on line 3—3 of Fig. 1.

Fig. 4 is a fragmentary sectional view taken on line 4—4 of Fig. 1.

Fig. 5 is a view similar to Fig. 1 but illustrating a modified construction; and

Fig. 6 is a fragmentary view illustrating a further modified form of aspirator whereby the products of combustion from an internal combustion engine or other fluid under pressure may be directed through a restricted passage adjacent the discharge end of an aspirator tube.

Referring first to Figs. 1 to 4; 10 designates a base portion of an air heater, and 11 the heating chamber through which the air may be forced or induced in any suitable manner. In the present embodiment, the air is forced through the heating chamber 11 by means of a fan 12. Inasmuch as the heater is designed to be portable and adapted for use in situations where other motive power may not be readily available, for example, in rural locations, the fan 12 is operated by an internal combustion engine 13. In addition to providing a suitable source of portable power, the engine 13 also provides a suitable source of heat which is used in the present combination to expedite the vaporization of liquid fuel. The liquid fuel, used in the present instance, is high octane gasoline. However, other liquid fuels may be used if desired.

The fuel pipe 14 leads from a manifold valve 15 to an aspirator 16 located adjacent the entrance opening of a Venturi passage 17. Compressed air from pipe 18 is directed across the open upper end of the aspirator pipe 16 to atomize the liquid fuel and carry it into the heater. The compressed air is preferably furnished by a compressor 19 mounted on a support 20 above the engine. The air compressor is operated by a link belt 20a meshing with a sprocket 21 on the drive shaft 22 of the engine and a sprocket 23 on the power shaft 24 of the compressor 19. An idler sprocket 25 which is preferably larger than the sprockets 21 and 23 is posi-

tioned intermediate the smaller sprockets so as to support the link belt in a desirable position relative to the sprockets.

The Venturi passage 17 is surrounded by a heating jacket 26, the heat for which is supplied by the hot exhaust gases from the engine which enter a hood 27 surrounding the upper portion of the engine. A pipe 28 leads from said hood to the heater jacket. The hot gases are exhausted from the heater jacket through port 29 into a passage 30 leading to the smoke stack of the heater. The heat from the internal combustion engine in addition to heating the atomized fuel also preheats a quantity of combustion air. This combustion air is directed through pipe 31 into the air chamber 32 surrounding the heater jacket 26 and is mixed with the vaporized fuel as it passes through the venturi 17. In this way the heated air assists in further vaporizing the small particles of gasoline or other liquid fuel as it is forced into a distributing chamber 33. The volume of air supplied through pipe 31 may be controlled by means of a valve 31a. The distributing chamber 33 surrounds the stack passage 30 so that the combustion mixture is maintained relatively hot even in sub-zero weather. A bottom plate 34 of the distributing chamber 33 is provided with a plurality of nozzle members 35 which align with the longitudinal axis of combustion chamber tubes 36. These nozzles, however, are spaced from the upper ends of the tubes so that the fuel burns a substantial distance away from the nozzles for the purpose hereinafter explained. The said tubes 36 extend across the air chamber 11 but are spaced apart so that the air from fan 12 will pass between them. They are provided at their upper ends with dished fire rings 37. The gas jets discharged from the several nozzles 35 into their associated combustion tubes pass through the center openings of the fire rings. Normally the velocity of the gas from the nozzles is greater than the rate of propagation of the flames. In order to provide a satisfactory pilot flame to ignite the high velocity main flames, the bottom plate 34 of the chamber 33 is provided adjacent each of the said nozzles 35 with a series of small openings 38 (see Fig. 2). The openings 38 are so arranged that the jets of gaseous mixture discharged therefrom are projected against the fire rings 37 positioned in the tubes 36. When the jets of combustible mixture from the pilot jet openings 38, associated with a particular combustion tube, strike the fire ring 37 positioned in such tube, the jets burn in a turbulent flame along the upper surface of the ring, for example as indicated in Fig. 2. In other words, the flames resulting from the ignited gas jets discharged from openings 38, form a whirling ring of fire along the upper surface of said fire ring. The high velocity jets of combustible gas discharged from the nozzles 35 are ignited by the turbulent pilot flame. The velocity of the main gas stream is such that the pilot flame is entrained and drawn downwardly into the combustion tube 36 so as to keep the long high velocity flame ignited throughout its full length. By reason of the high velocity discharge of the gas jets for the main and pilot flames, these flames burn away from the nozzle openings. This makes it practicable to use liquid fuels containing lead in the solution. Otherwise, it would be impractical to use leaded gasolines or other leaded fuels since the lead of such fuel has a tendency to adhere to the nozzle or other discharge orifice at the point of ignition of the gas. Apparently the lead content of the fuel is burned in suspension and that portion which strikes the baffle ring 37 is vaporized by the high temperature at that point so that there is no lead deposit built up on any member of the burner. The long pencil-like flames pass downwardly through the conduits 36 into a lower receiving chamber 39. This chamber is preferably provided with a lining 40 of refractory material. The flame and/or hot combustion gases are deflected upwardly by the refractory material into tubes 41 leading to the flue discharge passage 30. By providing the two groups of heating tubes 36 and 41 over which the air is forced by fan 12, most of the heat is absorbed by the air stream. The heat discharged from tubes 41 into passage 30 serves, as previously described, to preheat the combustion mixture in the distributing chamber 33. In order to improve the efficiency of the internal combustion engine, a conduit 42 leading from the forward end of the heater casing 11 directs a stream of heated air into a hood 43 surrounding the crank case of the engine so as to heat the lubricating oil in the crank case during cold weather.

The initial lighting of the pilot flames may be accomplished by inserting a lighted torch through a tube 44. The heated air discharged from the outlet 45 may be conducted to any remote location by means of rigid or flexible conduits 46 as may be desired.

In the modification shown in Fig. 5, the products of combustion from the internal combustion engine are passed from the exhaust pipe 47 through a filter 48. The filter is composed of filter material 49 held in a drum 50 by means of a spiral spring 51 so that the products of combustion will pass through the filter material into an inner perforated conduit 52, leading to a pressure pipe 53. The pressure pipe 53 directs the hot products of combustion across the discharge opening of an aspirator 54 so as to atomize the liquid fuel and direct it through a Venturi passage 55 into a preheating chamber 56. The preheating chamber in this case is heated by the discharge products of combustion from the main air heater which pass through passage 57 to the smoke stack 58. Air in quantities sufficient to support combustion is mixed with the vaporized fuel as it is forced into the venturi 55. This air is preheated by means of a hood 59 surrounding the upper end of the internal combustion engine. The engine of this modified embodiment is used to operate a fan 60 for directing forced drafts of air across the relatively long narrow combustion tubes 61 and 62 which correspond to the tubes 36 and 41 of the previous embodiment. The combustible gas mixture is forced from the preheating and distributing chamber 56 through discharge openings 63 and into the heater pipes 61 so as to form relatively long pencil-like flames. The gas for the pilot flame is discharged from openings 64 which are arranged to direct small jets of gas against a refractory baffle 65 to form turbulent flames 38 similar to the pilot flames described in the previous embodiment. The pilot flames are entrained with the main gas jets so as to keep them ignited for their full length.

In order to initially light the pilot flames, an electric spark plug 66 may be positioned to ignite one of the pilot flames. The other pilot flames are ignited because of their close relation to the initially lighted pilot flame.

In Fig. 6 another modification is illustrated

in which the discharge end of a fuel aspirating tube 67 is positioned at the throat of a venturi 68, through which the products of combustion from an internal combustion engine or other hot gases are discharged so as to vaporize the aspirating fuel and carry it into a mixing passage 69 leading to a preheating chamber, for example, chamber 33 of Fig. 1 of the drawings.

While the invention is illustrated herein in connection with certain specific embodiments, it will be obvious to persons familiar with the art that further changes in structure may be made without departing from the spirit of the invention. It will be understood, therefore, that the present invention contemplates all such changes in structure as come within the scope of the appended claims.

I claim:

1. In a heater for burning gaseous fuel having means defining a main combustion chamber; means for delivering a main jet of gaseous fuel into said combustion chamber at relatively high velocity so as to form a long pencil-like flame, means providing a baffle within the main chamber and formed with a central orifice for the said jet of gaseous fuel, means for delivering a small high velocity jet of gaseous fuel into impinging contact with said baffle where it is burned to provide constant ignition for the main flame.

2. In a heater for burning gaseous fuel having means defining a main combustion chamber; means for delivering a main jet of gaseous fuel into said combustion chamber at relatively high velocity so as to form a long pencil-like flame, means spaced inwardly from the main jet delivery means for providing a baffle having an opening therein through which the main jet is adapted to pass, means for delivering a small high velocity jet of gaseous fuel into impinging contact with said baffle where it is burned in a turbulent flame and incandescent particles thereof are entrained with the main jet and carried into the combustion chamber to provide constant ignition for the main flame.

3. In a heater for burning gaseous fuel having a main combustion chamber; comprising a tube of small diameter defining said main combustion chamber, means for delivering a main jet of gaseous fuel into said combustion chamber at relatively high velocity so as to form a long pencil-like flame, means spaced rearwardly from the main jet delivery means for providing a baffle having an opening therein through which the main jet is adapted to pass, means for delivering a small high velocity jet of gaseous fuel into impinging contact with said baffle where it is burned in a turbulent flame and incandescent particles thereof are entrained with the main jet and carried into the combustion chamber to provide constant ignition for the main flame.

4. In a heater for burning gaseous fuel having a plurality of combustion chambers comprising in each case a tube of small diameter; means spaced outwardly from the entrance ends of said tubes for delivering a main jet of gaseous fuel into each of said tubes at relatively high velocity so as to form a long pencil-like flame, means providing a baffle located inwardly from the entrance of each tube and having an opening therein to permit the main jet to pass therethrough, means for delivering a small high velocity jet of gaseous fuel into impinging contact with each said baffle where it is burned in a turbulent flame and incandescent particles thereof are entrained with the main jet and carried into the combustion chamber to provide constant ignition for the main flame.

5. A heater for burning gaseous fuel composed of vaporized liquid fuel and air, comprising in combination, means for delivering a mixture of atomized liquid fuel and air into the heater at relatively high velocity including an atomizer, means defining a mixing and distributing chamber in which the atomized fuel is mixed with combustion air, means for applying heat to said mixture delivering means to vaporize particles of the liquid fuel in suspension, a plurality of tubes providing separate combustion chambers, means communicating with said mixing chamber for delivering separate jets of the gaseous mixture therefrom into each of the several combustion chambers at relatively high velocity, means providing a baffle located in each combustion chamber and formed with an open passage for its associated jet of gaseous mixture, and means defining discharge ports communicating with said mixing and distributing chamber, each port directing a high velocity pilot jet of gaseous mixture from said mixing chamber against one of said baffles which when ignited provides constant pilot ignition at the inlet end of its associated combustion chamber.

6. A heater for burning gaseous fuel composed of vaporized liquid fuel and air, comprising in combination, means for delivering a mixture of atomized liquid fuel and air into the heater at relatively high velocity, including an aspirator including a fuel discharge member and means for producing and delivering a high velocity gaseous stream across said fuel discharge member, means defining a mixing and distributing chamber in which the atomized fuel is mixed with combustion air, means for applying heat to said mixture delivering means to vaporize particles of the liquid fuel in suspension and to prevent subsequent condensation thereof, a plurality of tubes providing separate combustion chambers, means communicating with said mixing chamber for delivering separate jets of the gaseous mixture therefrom into each of the several combustion chambers at relatively high velocity, means providing baffle surfaces adjacent the inlet ends of the several combustion chambers, and means defining discharge ports communicating with said mixing and distributing chamber, each port directing a high velocity jet of gaseous mixture from said mixing chamber against one of said baffle surfaces which when ignited provides constant pilot ignition at an inlet end of one of said tubular combustion chambers.

7. A heater for burning gaseous fuel composed of vaporized liquid fuel and air, comprising in combination, means for delivering a mixture of atomized liquid fuel and air into the heater at relatively high velocity, including an aspirator including a fuel discharge member and means for delivering a high velocity gaseous stream across said fuel discharge member, means defining a mixing and distributing chamber in which the atomized fuel is mixed with combustion air, means for applying heat to said mixture delivering means to vaporize particles of the liquid fuel in suspension and to prevent subsequent condensation thereof, a plurality of tubes defining combustion chambers, means communicating with said mixing chamber for delivering separate jets of the gaseous mixture therefrom into the several combustion chambers at relatively high velocity, means providing a baffle adjacent each said jet of gaseous mixture, means

defining discharge ports communicating with said mixing and distributing chamber for directing high velocity jets of gaseous mixture against said baffles which when ignited provides constant pilot ignition at the inlet ends of the tubular combustion chambers, means defining an exhaust heat chamber for supplying additional heat to the gaseous mixture within said distributing chamber, and tubes communicating with the tubular combustion chambers for directing hot gases of combustion into said exhaust chamber.

8. A heater for burning gaseous fuel composed of vaporized liquid fuel and air, comprising in combination, means for delivering a mixture of atomized liquid fuel and air into the heater at relatively high velocity, including an aspirator including a fuel discharge member and means for delivering a high velocity gaseous stream across said fuel discharge member, means defining a mixing and distributing chamber in which the atomized fuel is mixed with combustion air, means for applying heat to said mixture delivering means to vaporize particles of the liquid fuel in suspension and to prevent subsequent condensation thereof, a plurality of tubular combustion chambers, means communicating with said mixing chamber for delivering separate jets of the gaseous mixture therefrom into each of the several combustion chambers at relatively high velocity, means providing a baffle adjacent each said jet of gaseous mixture, means defining discharge ports communicating with said mixing and distributing chamber for directing high velocity jets of gaseous mixture against said baffles which when ignited provides constant pilot ignition at the inlet ends of the tubular combustion chambers, means defining an exhaust heat chamber for supplying additional heat to the gaseous mixture within said distributing chamber, tubes communicating with the tubular combustion chambers for directing hot gases of combustion into said exhaust chamber, means for passing air to be heated into contact with the outer surfaces of said tubes, and a conduit for directing a portion of said air to the inlet end of said mixing chamber.

9. In a heater for burning gaseous fuel composed of vaporized liquid fuel and air comprising in combination, means defining a combustion chamber, means defining a mixing chamber, an aspirator nozzle for delivering atomized liquid fuel into said mixing chamber, an internal combustion engine and means connected therewith for supplying combustion air to said mixing chamber, and means for directing hot products of combustion from the engine to said aspirator nozzle, whereby said hot exhaust gas is utilized to atomize the liquid fuel and to preheat the same.

10. In a heater for burning gaseous fuel composed of vaporized liquid fuel and air comprising in combination, means defining a combustion chamber, means defining a mixing chamber, an aspirator nozzle for delivering atomized liquid fuel into said mixing chamber, an internal combustion engine and means connected therewith for supplying combustion air to said mixing chamber, and means for directing hot products of combustion from the engine to said aspirator nozzle, including a conduit leading from the engine exhaust port to said nozzle and a gas strainer interposed in said conduit, whereby said hot exhaust gas is utilized to atomize the liquid fuel and to preheat the same.

11. In a heater adapted to burn gaseous fuel and having relatively long tubes defining separate combustion chambers of small diameter, means spaced outwardly from the inlet ends of the tubular combustion chambers for directing jets of gas into said chambers at a velocity greater than the rate of propagation of the flame, a fire ring positioned inwardly from the entrance end within each tubular combustion chamber, means for directing small jets of the gas into impinging contact with each fire ring to provide a turbulent pilot flame along said fire ring so as to maintain separate pilot flames for the first mentioned jets.

ALICK CLARKSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,658,198	Hosch	Feb. 7, 1928
1,687,983	Klees et al.	Oct. 16, 1928
1,769,821	Barber	July 1, 1930
1,788,716	Hepburn	Jan. 13, 1931
1,922,144	Snyder	Aug. 15, 1933
1,972,549	Cameron	Sept. 4, 1934
1,989,421	Kerrick	Jan. 29, 1935
2,031,335	Sloyan	Feb. 18, 1936
2,047,471	Hepburn et al.	July 14, 1936
2,162,394	Whiteley	June 13, 1939
2,188,133	Hepburn	Jan. 23, 1940
2,191,173	McCollum	Feb. 20, 1940
2,219,522	Hinsch	Oct. 29, 1940
2,374,203	Holthouse	Apr. 24, 1945
2,390,380	McCollum	Dec. 4, 1945

Certificate of Correction

March 29, 1949.

Patent No. 2,465,711.

ALICK CLARKSON

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 51, claim 3, for the word "rearwardly" read *inwardly*;

and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 30th day of August, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.