LIQUID FUEL BURNER AND IGNITION MEANS THEREFOR

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This application is a continuation in part of our application Serial No. 89,874 filed April 27, 1949 (same title as given above), which application is now abandoned in favor of the present application.

The invention relates to an improved heating apparatus of the spark-ignited, liquid hydrocarbon burner class, thereby indicating the general object.

The apparatus, in the form shown, was designed primarily for use in truck cabs, buses, auto-trailers, motor boat and other cabins, airplane cockpits and the like; but is applicable to various other uses, for example water heating and steam generation particularly in connection with relatively small capacity installations, indicating further objects.

A specific object is to provide a hydrocarbon burner heater adapted for electrical spark ignition of atomized fuel and with effective provision for producing localized vaporization of sufficient quantities of atomized or comminuted fuel in the vicinity of the spark gap to insure ignition of the fuel at extremely low temperatures.

In the drawing, Fig. 1 is a fragmentary central longitudinal sectional view of one form of burner head and ignition apparatus. Fig. 2 is a transverse sectional view thereof taken on a plane such as indicated at 2—2 on Fig. 1. Fig. 3 is a fragmentary view similar to Fig. 1 showing a modified construction.

The drawing shows a portion of the heat exchange apparatus in typical form, comprising a flame tube 1 (combustion chamber) having radiating fins 2 within an air-chamber-forming casing 3. Said casing has an air inlet duct portion 4 and hot air outlet or discharge duct 4a communicating in suitable fashion (not shown) with the space to be heated (or aerated and heated). Power blower apparatus (not shown) is suitably arranged to propel the air to and through the casing 3. The same or a separate source of air supplies a tube 6 (part of an air and fuel mixer block assembly 7) for atomizing fuel and for supporting combustion in the flame tube 1. The arrangement and controls may be of the type shown and described in our U. S. Patent 2,544,299 issued March 6, 1951.

The mixer block or injector assembly 7 includes a fuel pickup venturi tube 8 and fuel jet 9 mounted on the tube 6 and discharging within the tube 8. The burner head includes a conical metal member 10 in sealed connection with the mixer block assembly and with the inlet end of the flame tube 1.

Air from the tube 6 is blown through the venturi 8 with sufficient force to atomize fuel at the tip 9. Fuel is supplied from a duct 20 through an adjustable needle valve assembly 21 (same as in said patent, hence not described in detail here). The atomized fuel and air flows through the metal burner head member 10, the larger (outer) end of which is screened or baffled by a perforate, atomized-fuel-distributing wall or screen member 11 of high-heat-resistant metal. The screen 11, as shown, is of shallow dome shape and is intimately connected at its peripheral margins or edges (as by welding) with the end wall of the flame tube 1. Said end wall of the flame tube, in the illustrated construction, is provided by an integral flange portion of the burner head member 10. It is impracticable to electrically insulate the screen 11 from the metal of the support because, during operation of the burner, sufficient carbon would accumulate on the screen to establish an electrical connection between the screen 11 and the support. Combustion takes place inside the flame tube 1 rightwardly beyond the wall 11, Fig. 1.

To retard or control the rate of flame velocity or propagation and to secure an efficient progressive heat exchange to the air chamber a plurality of flame baffles 12 (only one shown) are arranged in series inside the tube 1 and thermo-conductively connected to its wall. The baffles comprise, for example, cup-shaped high-heat-resistant sheet metal elements in stacked self-spacing arrangement and with maze-effecting fingers 13 in circumferentially staggered or zig-zag arrangement at the central part of the flame tube (not fully illustrated).

The inlet or smaller threaded end 22 of the burner head member 10 is removably attached to the atomizer or mixer block assembly 7. The venturi tube 8 is preferably removable from the assembly 7 so as to enable selection of different sizes and/or shapes of mixer throats for optimum mixing with different capacity installations. The tube 8 is removably locked in the block (tube 6) in any suitable way, for example by a set screw, not shown. The discharge end of the tube 8 is flanged at 23 and the flange is clamped between heat barrier (low-heat-conductive) gaskets or washers 24 and 25 inside the threaded attachment sleeve nut 26 and the support end contact therewith. The nut 26 is screwed tightly onto the threads 22 of the burner cone. The heat barrier connection, in addition to its main purpose viz., prevention of vapor-lock or explosions in the mixer throat due to overheating by conduction, enables the mixer block assembly to be secured in any desired relatively turned position on the burner head (e. g. member 10), thereby facilitating connection of fuel and air supply conduits thereto in various angular relationships as may be required in different installations.

The spark ignition means, as shown, includes a terminal-supporting and insulating plug 14, essentially of conventional form and purpose, but especially designed so as to have its spark terminal positioned to assure igniting contact of the spark with fuel at a point such as will normally provide adequate protection against premature ignition and blow-back of flame into the burner cone.

The spark plug 14, for partial protection from the heat within the combustion chamber is mounted on and extends through a wall of the burner head member 10, being removably secured to said wall by conventional means. The terminal conductor 16 of the plug extends through an elongated, e. g. elliptical, opening 17 in the apertured screen wall 11 out of contact therewith and spaced therefrom sufficiently on all sides to prevent occurrence of spark against the apertured wall 11. The spark gap is at the end of the terminal 16 which, in the form shown in Fig. 1, extends close enough to the tubular metal shell or wall 31 of a glow plug 30 to determine the position of the spark.

A glow plug alone (without spark ignition) is not satisfactory for igniting combustion at low temperatures, principally because it is so highly sensitive to voltage variations. Battery output becomes sharply reduced with temperature drop and the glow plug designed to effect ignition with battery current at (e. g.) —70° F. would burn out at normal temperature battery output capacity and/or the necessarily higher generator output voltage.

Only a little fuel has to be vaporized at or near the spark gap to insure commencement and continuance of
combustion within the flame tube. An extremely hot spark, operating unassisted, at temperatures in the magnitude of $-50^\circ$ F. to $-70^\circ$ F., is insufficient. The spark is unable to vaporize enough fuel to start or at least maintain continuous combustion at such low temperatures. Unless combustion is started by the introduction of atomized fuel into the flame tube the region of the spark gap becomes wet or flooded with condensed or re-liquified fuel and ignition then becomes increasingly difficult of attainment.

The present solution to the problem indicated above comprises placement of a glow plug such as shown at 30 in the vicinity of the spark gap and the glow plug is operable to convert atomized fuel into vaporized or readily ignitable atomized fuel at the spark gap.

The electrical "ground" afforded by the shell 31 of the glow plug 30 is, as shown in Fig. 1, supported by a tubular fitting 32 rigidly secured to the burner head assembly (e.g., member 10 or associated parts) in position to serve as a collector trough for fuel. The top side of the tubular fitting 32 is shown as cut away at 33 so that the collector trough is formed around, under and close to the glow plug. Thereby fuel can be collected in intimate association with the glow plug for vaporization by its heat and, in turn, ignition by the spark at the terminal or inner end of the electrode 16. The filament of the glow plug is indicated at 35. The glow plug can be energized by connection of a suitable conductor (not shown) to the stem 34, and readily upon the introduction simultaneously with atomization and sparking by well known electric circuit and fuel control means which preferably is automatically arranged to deenergize the glow plug as soon as combustion starts. In less elaborate or costly installations the glow plug is push-button controlled so as to insure deenergization after commencement of steady heater operation. The glow plug cannot be designed to insure sufficient localized heating for vaporization of fuel at the spark gap, as on battery current and, while energized, to withstand the necessary exposure to heat of the flame in the combustion chamber. The separate fitting 32 is dispensed with and the collector trough provided thereby is replaced by an integral portion 132 of the burner head member 110. A cavity 113 in said head member behind the screen 111 is open as at 113' around the glow plug 31 for conduction of fuel to the trough from said cavity.

We claim:

1. In a burner apparatus, means forming a combustion chamber, a metal member forming a burner head adjacent said means and rigid therewith, said member having a passage serving to conduct atomized fuel and air to the chamber, a perforate screen of electrically conductive material interposed between the passage and combustion chamber and in electrically conductive contact with said metal member, a spark plug having a body mounted on said metal member and having a spark terminal extending through the screen into the combustion chamber, an electric glow plug mounted on the metal member and extending into the combustion chamber for the glow plug having a metal jacket in spark-gap-forming association with the spark terminal within the combustion chamber, and means on said metal member forming a collector trough for fuel in underlying, partially encasing relationship to the glow plug jacket, the trough extending on both sides of the principal plane of the perforate screen, one of the perforations of the screen, through which the spark terminal of the plug extends, having its defining wall surfaces spaced farther from the terminal all around it than the effective length of the spark gap.

2. In a burner apparatus, wall means forming a combustion chamber, wall means forming a duct to convey atomized fuel and air to the chamber, a perforate screen of electrically conductive material interposed between the duct and chamber and supported in contact with one of said wall means, an electric spark device having a spark terminal extending from the duct through the screen into the chamber, electrically conductive tubular means extending into the chamber and having a wall portion within the chamber adjacent to the terminal but spaced therefrom to establish a spark-gap, an electric heat-producing filament within the tubular means for heating said wall portion and vaporizing atomized fuel in the vicinity of the spark gap, said wall portion being interposed between the terminal and filament, the screen having an opening receiving the spark terminal and the defining wall surfaces of the opening being spaced from the terminal farther than the length of the spark gap, and a trough-shaped wall element partially encasing the tubular means, said wall element being supported by one of said wall means and extending part way around and in spaced relation to said tubular means on the side thereof opposite the spark gap, the trough-defining or inner surface of said trough-shaped wall element extending from within the atomized fuel and air duct means past the screen and into the combustion chamber to form a collector for fuel condensate, whereby such condensate will be retained and exposed to heat radiated from the tubular means.

References Cited in the file of this patent

UNITED STATES PATENTS