ATOMIZER FOR LIQUID FUEL

Robert D. Reed, Tulsa, Okla., assignor to John Zink Company, Tulsa, Okla., a corporation of Delaware
Filed Apr. 19, 1961, Ser. No. 104,050

2 Claims. (CI. 239—404)

The present invention relates to a device for breaking liquid fuel into micron-size particles of substantially uniform size to facilitate mixture of the small size fuel droplets with air prior to delivery of such a fuel mixture to a zone of combustion. The invention more specifically pertains to structural characteristics which cooperate to produce a spattering of the liquid fuel without mechanically moving parts and the spinning liquid is released as a generally conical shaped spray providing a preliminary atomization prior to the action of steam or compressed air. Each of the prior devices the liquid fuel is delivered to the presence of steam or compressed air as an unbroken liquid. The steam or air serves the function of breaking the liquid into drops but such devices do not produce small droplets of uniform size by the time the fuel mixture is delivered into the zone of combustion. Variations in the size of the drops produces incomplete combustion and smoke. The drops of liquid fuel which are too large to be vaporized escape from the body of the flame and appear as sparks of still burning liquid fuel. When these unburned globules of fuel engage a heat transfer surface or a wall of the furnace deposits are formed.

It is accordingly an object of the invention to provide an atomizer wherein the liquid fuel is broken into small droplets before the liquid fuel is subjected to the action of steam or compressed air whereby substantially micron-size particles are produced of substantially uniform size which are capable of virtually complete fuel vaporization with-in the time interval prior to delivery into the zone of combustion.

The prior devices function reasonably well in association with a fuel burner when it is operated throughout a limited range of firing but such an assembly is not satisfactory when the turn down ratio exceeds ten to one. In other words when a burner equipped with a conventional atomizer is fired to release ten million British thermal units per hour and is turned down to release but one million British thermal units per hour the operation is not satisfactory.

It is another object of the present invention to provide a device for breaking the oil into small droplets so as to reduce the time interval required for conversion of the liquid fuel into a gas by vaporization so that the gaseous mixture delivered into the zone of combustion provide a fuel which makes it possible to adjust the range of firing of the burner from one hundred percent to about six percent of its rating to thereby provide a turn down ratio for the assembly of approximately sixteen to one.

A more specific object of the invention, is to provide a chamber having at least one port disposed in tangential or chord position with respect to the axis of the chamber through which the liquid fuel is delivered at a velocity to set up centrifugal force acting on the liquid within the chamber whereby it whirs in a generally helical path in proceeding downstream on the wall of the chamber and escapes at the downstream end thereof as a substantially conical spray of small droplets before being subjected to the action of a gaseous medium which converts the already small droplets, into particles of micron-size and of substantially uniform size to facilitate and accelerate the conversion of the liquid fuel into a gaseous fuel mixture.

Other objects and features of the invention will be appreciated and become apparent to those skilled in the art to which the invention pertains as the present disclosure proceeds and upon consideration of the annexed drawing and the following detailed description wherein an embodiment of the invention is disclosed.

In the drawing:
FIG. 1 is a side elevational view of an atomizing device exhibiting the invention.
FIG. 2 is an axial sectional view of the device on a larger scale.
FIG. 3 is a transverse sectional view taken on the line 3—3 of FIG. 2.
FIG. 4 is a transverse sectional view taken on the line 4—4 of FIG. 2.
FIG. 5 is a section taken on the line 5—5 of FIG. 2.
FIG. 6 is a view similar to FIG. 4 showing a modified disposition of the holes for the steam or air.
FIG. 7 is a fragmentary sectional view diagrammatically illustrating the manner in which the liquid is split from the annular chamber.

A feature of the invention as will be apparent as the detailed description of the structure proceeds is that it provides for the disintegration of the liquid fuel into a multitude of small droplets prior to being subjected to the action of steam or compressed air without action of mechanically moving parts. The liquid fuel after being broken into small particles is subjected to the action of steam or air to develop droplets of uniformly small size which readily vaporize to provide a fuel mixture which serves to provide stable combustion.

A structural assembly exhibiting the invention is shown in the drawing and it includes a discharge nozzle or tip. The nozzle portion may be formed of bar stock having a generally cylindrical interior 11. The forward portion of the nozzle 10 is conically shaped and provided with a plurality of discharge ports 12. The exterior of the tip 10 has flat sides to facilitate the threading into a sleeve 14 which may have flat exterior surfaces. The sleeve 14 carries interior threads 16 for engaging threads on the exterior of a reduced diameter portion of the tip 10. A suitable seal 17 may be provided between the sleeve 14 and the nozzle 10.

A tubular member 18 is arranged within the assembly. It is provided with an exterior annular surface 19 which fits snugly within the interior of the nozzle member 10. The juncture of the tubular member 18 with the nozzle is a slip fit which avoids leakage from the assembly but permits expansion or contraction between the associated parts of the assembly.

The invention includes means for closing the tubular member 18 and such means may take the form of a body member or plug element 21. The body member 21 has an annular exterior surface at the forward end carrying threads which engage threads on the interior of the tubular member 18. The rear portion 22 of the plug element 21 is of smaller cross section than the forward portion and may be rectangular in shape as shown in FIG. 3. The flat faces on the rear portion 23 of the body member facilitates the threading thereof into the tubular member 18.

A feature of the invention pertains to the characteristics of a cavity 23 within the body member 21. The cavity 23 is cylindrical shaped and its axis coincides with that of the tubular member 18. The downstream end of the cavity 23 terminates in an annular sharp corner 24 at the forward face 26 of the plug element.

The rear portion 22 of the plug element 21 is provided with at least one inlet opening 27. The axis of the opening 27 is disposed in a chord or tangential position with respect to the cylindrical wall of the cavity 23 as best shown in FIG. 3. Another inlet opening 27 may be provided in the rear portion of the body member 21 and its axis is in the same transverse plane as the first inlet.
opening and also disposed in a chordal or tangential position with respect to the cylindrical wall of the cavity 23. A generally annular space 28 is provided between the inner surface of the tubular member 18 and the exterior surfaces of the rear portion 32 of the body member 21.

A source of liquid fuel under pressure is supplied into a pipe 31 which is connected to the rear portion of the tubular member 18. This connection may be made by means of threads having larger diameter than the threaded connection between the body member 21 and the tubular member 18. The liquid fuel is supplied into the pipe 31 at pressures above atmospheric. A larger pipe 32 is threaded into the rear end portion of the sleeve 14 and an annular space 33 is provided between the exterior of the tubular member 18 and the interior of the pipe 32. This space is supplied with steam or compressed air at pressures equal to or greater than the pressure applied to the liquid fuel in the pipe 31.

One or more inlet holes for the steam or compressed air are provided through the tubular element 18. These holes 36 are disposed in a common transverse plane which are located downstream in the face 26 of the body member 21. In the embodiment shown in FIG. 4, three inlet holes 36 are provided through the tubular element 18 which are equally spaced circumferentially around the assembly. Each of the inlet holes 36 is disposed with its axis in a chordal or tangential position with respect to the inner circumference of the tubular element 18.

The liquid fuel supplied under pressure into the pipe 31 enters the annular space 28 and passes inwardly through an opening 27. The liquid fuel is supplied under pressure and there is a drop in pressure across the opening 27 and the flow of the liquid is accelerated. The rapidly flowing liquid enters the cavity 23 and a tangential component is imparted to the liquid. The liquid fuel stream engages the cylindrical wall forming a major portion of said cavity, a surface on said body member forming an annular corner with said cylindrical wall at the downstream end thereof, said body member having an opening therethrough adjacent the upstream end thereof with its axis disposed substantially tangentially to said cylindrical wall, means guiding liquid fuel under pressure greater than atmospheric through said opening whereby the liquid moves circumferentially and substantially helically as a film on said cylindrical wall over said corner and spills particles of liquid in a substantially frustoconical pattern, said tubular member having holes therethrough spaced downstream from said surface, means for supplying a gaseous medium under pressure equal to or greater than the pressure applied to the liquid fuel whereby the gaseous medium engages the fuel particles after they have been released from said cavity to promote further atomization of the fuel while confined within the tubular member and within said chamber, and said discharge ports being disposed to release the vaporized fuel as a fixed pattern through said discharge ports.

References Cited in the file of this patent

UNITED STATES PATENTS

982,655 Albee .......... Dec. 19, 1911
1,474,603 Morse .......... Nov. 20, 1923
1,567,582 Anthony .......... Dec. 29, 1925
1,594,591 Starr .......... Aug. 3, 1926
2,325,495 Ferguson .......... July 27, 1943
2,379,161 Kraps .......... June 26, 1945
2,566,788 Berggren et al. .......... Sept. 4, 1951
2,656,778 Michelsen .......... Apr. 28, 1953

FOREIGN PATENTS

662,651 Germany .......... July 18, 1938