

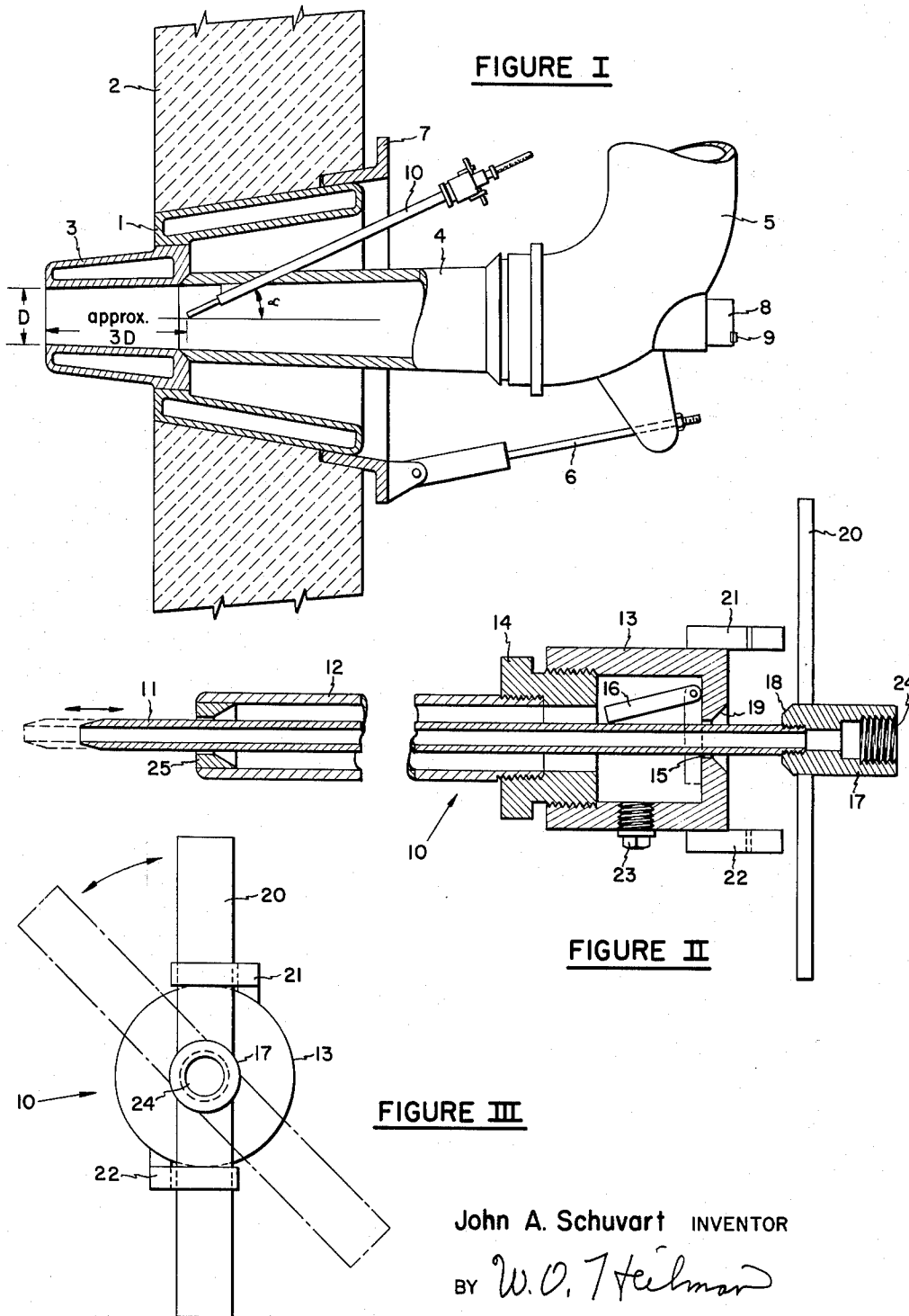
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SIDE-ENTRY FLUID FUEL INJECTION SYSTEM FOR FURNACES

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3,209,810 SIDE-ENTRY FLUID FUEL INJECTION SYSTEM FOR FURNACES

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This invention relates in general to a method of injecting fluid fuel into furnaces and more particularly with the injection of fluid fuel such as hydrocarbon oil and the like in admixture with hot blast air into a blast furnace, cupola, Bessemer converter and the like.

The use of fluid hydrocarbon fuels as a partial replacement of coke in blast furnaces and the like has been receiving increased attention. The injection system of this invention provides an excellent means of injecting gaseous fuels into furnaces but is best suited for injecting liquid hydrocarbon fuels such as petroleum-type residual fuels, distillate fuel oils and the like into blast furnaces.

Liquid hydrocarbon fuels are best utilized by admixing them with hot blast air prior to their entering the combustion area of the furnace. In the past, this admixing has commonly been accomplished by employing a centerline injection nozzle, i.e., a fuel injection nozzle, which entered the furnace through the tuyere faceplate adjacent to the tuyere peepsight and extended along the centerline of the blowpipe. This type of injection system has the disadvantage of having a very long section of the fuel injection nozzle located in the hot blowpipe. The high blast air temperatures, up to 2000° F. and even higher, tend rapidly to subject the liquid fuel to sludging, carbonization and coking. This, of course, can result in partial or complete clogging of the injection system. Moreover, the centerline injection system because of its length requires a nozzle-support hook in the blowpipe. This support hook complicates the insertion of the nozzle. In addition, it has been found that the support hook inside the blowpipe does not long withstand adverse furnace conditions such as backdrafting and rodding.

Thus, an object of this invention is to provide a side-entry fuel injection system for furnaces which greatly reduces and, in many instances, virtually eliminates the problems encountered in using a centerline injection system.

Another object of this invention is to provide an improved fuel injection nozzle having embodiments which protect the operator from hot blast air leakage.

Still another object of this invention is to provide a fuel injection nozzle having a quick locking mechanism for simple and safe nozzle changes.

Other objects and a fuller understanding of the invention may be had by referring to the accompanying drawings.

FIGURE I depicts a sectional plan of the side-entry injection system.

FIGURE II portrays the improved fuel injection nozzle in cross section.

FIGURE III demonstrates the quick locking mechanism of this invention.

As is illustrated in FIGURE I, a more or less conventional blast air conduit is fitted through the wall of a furnace. Fluid fuel is injected through a lateral wall of the conduit at an acute angle to the centerline of said conduit. A complete understanding of the invention is best obtained by referring to the detailed structure depicted in the drawings. In FIGURE I, a tuyere cooler casting 1 is mounted through the blast furnace wall 2. A water cooled tuyere 3 supported by the tuyere cooler casting

fits closely against the blowpipe 4. Each end of the blowpipe is turned to fit into a slight socket, one in the tuyere and the other in the tuyere stock 5. The blowpipe is generally held in place by pressure from the tuyere stock which in turn is held tightly against the blowpipe by a heavy spring and rod called the bridle 6, which is attached to the jacket plate 7.

In the prior art devices, the fuel injection nozzle commonly entered through the faceplate 8 adjacent to the peepsight 9 and extended more or less along the centerline of the blowpipe. However, in this invention the fuel injection nozzle 10 enters through the side wall of the blowpipe making an acute angle α with the centerline of the blowpipe. It is preferred that the acute angle be in the range of from about 15° to 60°.

This side-entry fuel injection has many advantages over the prior art systems. The nozzle is much shorter in total length. More importantly, there is such a short length in the blowpipe, only about 6 inches, that no supports are necessary. Since such a short section of the nozzle is in the hot blowpipe, the oil passing through the nozzle is heated for a shorter time and hence is subjected to lower maximum temperatures, thus reducing sludging, carbonization, and coking. In addition, the side-entry nozzle eliminates extra fittings and hardware from the tuyere faceplate area.

The fuel injection nozzle 10 is fitted through the lateral wall of the blowpipe and has an outlet substantially at the centerline of said blowpipe. This ensures adequate mixing of the fuel and the hot blast air. It has been found that if the outlet of the fuel injection nozzle is placed near the side wall of the blowpipe, the liquid fuel impinges on the side of the blowpipe and thus is not properly admixed with the blast air. It is desirable to position the nozzle outlet so that the distance from the nozzle outlet to the tuyere exit is or is slightly greater than about 3 times the conduit exit diameter designated as D in FIGURE I. Positioning in this manner minimizes the amount of fuel-hot blast air admixture which strikes the inner walls of the tuyere, thus minimizing smoke formation and tuyere plugging.

As shown in FIGURE I, the fuel injection nozzle is mounted through the top of the blowpipe. This is done in order to avoid possible damage to, or plugging of the nozzle by slag. Occasionally, molten slag runs back into the blowpipes during periods of erratic furnace operation. It is not necessary for the nozzle entry point to be exactly at the top of the blowpipe; but, it should be located in the top half of the blowpipe.

A preferred fuel injection device is the fuel injection nozzle shown in FIGURE II. The device shown has two members, a withdrawable fuel injection nozzle 11 and a nozzle outer shroud 12. The nozzle outer shroud is attached to the flapper valve chamber 13 by means of a bushing 14.

Two glands are employed to minimize serious accidents due to hot blast air leakage. The inner gland is the flapper valve chamber 13. Surface 15 of this gland forms a restriction orifice around the withdrawable fuel injection nozzle to minimize leakage while installing or removing the nozzle. This gland also has a hinged flapper valve 16 which forms a seal after the withdrawable nozzle is removed. The outer gland 17 forms a line contact seal with the inner gland for maximum tightness and prevents leakage when the nozzle is operatively positioned. The line contact seal is formed by surface 18 of the outer gland and surface 19 of the inner gland.

As an added safety feature, the nozzle is equipped with a quick locking mechanism for fast, simple, and safe nozzle changes. A nozzle handle 20 is attached to the outer gland 17. This handle fits into bayonet type lugs

21 and 22, which are attached to the inner gland 13, thus locking the nozzle tightly in place. The nozzle is quickly and easily disconnected by rotating the nozzle handle a quarter turn, as shown in FIGURE III.

The nozzle outer shroud 12 has an air connection 23. At blast air temperatures above 1800° F. air or other suitable fluid, e.g., carbon monoxide, nitrogen, gaseous hydrocarbon, or the like, is pumped into the nozzle shroud at a rate of approximately 5 c.f.m. The air or other gas acts as insulation between the nozzle and nozzle shroud. The air or other gas passes out of the nozzle shroud into the blowpipe. In cases where cooling gas is not needed, the connection 23 may be plugged, as shown in FIGURE II.

The withdrawable nozzle equipped with an oil connection 24 is preferably disposed substantially concentrically within the nozzle shroud. A tapered centering ring 25 at the tip of the nozzle shroud substantially centers the nozzle within the nozzle shroud. The centering ring also minimizes air convection and heat transfer into the nozzle shroud. The ring fits the tube 11 loosely so as to permit air or cooling gas to flow around tube 11. This is especially useful to minimize backflow of hot furnace gas when air is not being pumped into the shroud through the air connection 23.

As shown in FIGURE I, the nozzle shroud enters through an opening in the jacket plate 7 and at an acute angle through the side wall of the blowpipe. This nozzle shroud is attached, e.g., welded, in place. The withdrawable nozzle is removably disposed in the nozzle shroud as described hereinbefore.

Hot blast air is transferred from a conventional bustle pipe, not shown, through the tuyere stock 5 into the blowpipe. Suitable blast air pressure and flow rates for purposes of the present invention are those normally utilized in the operation of blast furnaces, for example, a pressure of from 5 to 40 p.s.i.g. and a flow rate of 1000 to 8000 c.f.m. per tuyere.

A fuel line is attached to the nozzle by means of the fuel connection 24. Fluid hydrocarbon fuel is pumped through the nozzle and is brought into admixture with the hot blast air substantially at the centerline of the blowpipe and preferably at a distance slightly greater than 3 times the tuyere exit diameter D from the tuyere exit. The admixture of hot blast air and fuel passes through the tuyere and into the combustion area of the furnace.

The side-entry injection system of this invention operates efficiently with blast air temperatures up to 2300° F. This is true even at low fuel flow rates.

Fuel injection flow rates vary according to furnace conditions, the fuel employed, size of nozzle and other factors known to the art but may range from 1 U.S. gal./hr. to 250 U.S. gal./hr. The following flow rates are effectively employed using the nozzle sizes shown:

Nozzle:	Flow rates, U.S. gal./hr.
1/8" schedule 80 pipe	10-60
1/8" schedule 40 pipe	20-110
1/2" O.D. tubing, 0.334 I.D.	20-200

Although the invention has been described in its preferred form with a certain degree of particularity, it is to be understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An apparatus for injecting fluid fuel in admixture with hot blast air into a furnace which comprises a fuel injection nozzle and a blast air conduit, said nozzle passing through the side wall of said conduit making an acute angle with an axial center line of said conduit and extending to a point substantially at the center line of said conduit, said fuel injection nozzle being characterized by

having in combination a nozzle outer shroud and a withdrawable fuel injection nozzle, said nozzle outer shroud being fitted through the side wall of said conduit, said withdrawable fuel injection nozzle being substantially concentrically and longitudinally disposed within and withdrawable from said outer shroud member.

2. An apparatus according to claim 1, comprising an inner gland means forming a restriction orifice around the withdrawable fuel injection nozzle to minimize blast air leakage while installing or removing said nozzle, a valve means to prevent substantial blast air leakage when the fuel injection nozzle is removed and an outer gland means forming a line contact seal with the inner gland means in order to prevent blast air leakage when the nozzle is operatively positioned.

3. An apparatus for injecting a fluid fuel such as hydrocarbon oil and the like into a furnace in admixture with blast air comprising in combination a blast air conduit having lateral walls, a nozzle outer shroud fitted through said conduit wall at an acute angle to the axial centerline of said conduit, a withdrawable fuel injection nozzle insertable into and through said nozzle outer shroud, means limiting said insertion so as to operatively position the outlet end of said fuel injection nozzle substantially at the axial centerline of said blast air conduit, means for maintaining substantially concentric spacing between said nozzle and said shroud, an inner gland means for supporting the outer portion of the nozzle, said gland means also forming a restriction orifice around said fuel injection nozzle to minimize blast air leakage while installing or removing said nozzle, a valve means for preventing blast air leakage when the fuel injection nozzle is removed, an outer gland means forming a line contact seal with the inner gland means and adapted to prevent blast air leakage when the nozzle is in said operative position, and quick locking means to facilitate nozzle changes.

4. An apparatus according to claim 3, wherein said acute angle is in the range of from 15° to 60° and said nozzle outer shroud is fitted through the top half of said conduit.

5. An apparatus for injecting a fluid fuel such as hydrocarbon oil and the like in admixture with blast air into a furnace, said blast air being directed by a blast air conduit having lateral walls; said apparatus comprising a nozzle outer shroud having an outlet within the blast air conduit, a withdrawable fuel injection nozzle insertable into and extending through said shroud member, outer support means for positioning the outlet of said nozzle in said blast air conduit so as to obtain proper admixing of the fuel and said blast air; said support means including an inner gland means forming a restriction orifice around said nozzle member to minimize blast air leakage while withdrawing or inserting said nozzle, a valve means forming a seal when said nozzle member is removed, and an outer gland means preventing blast air leakage when the nozzle is operatively positioned.

6. An apparatus according to claim 5, wherein said valve means is a flapper valve and said apparatus also includes a quick locking means permitting safe, fast, and simple nozzle changes.

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