May 26, 1970 D. R. ADCOCK 3,514,245

BURNER ASSEMBLY FOR FLUID FUELS

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FIG. 1.

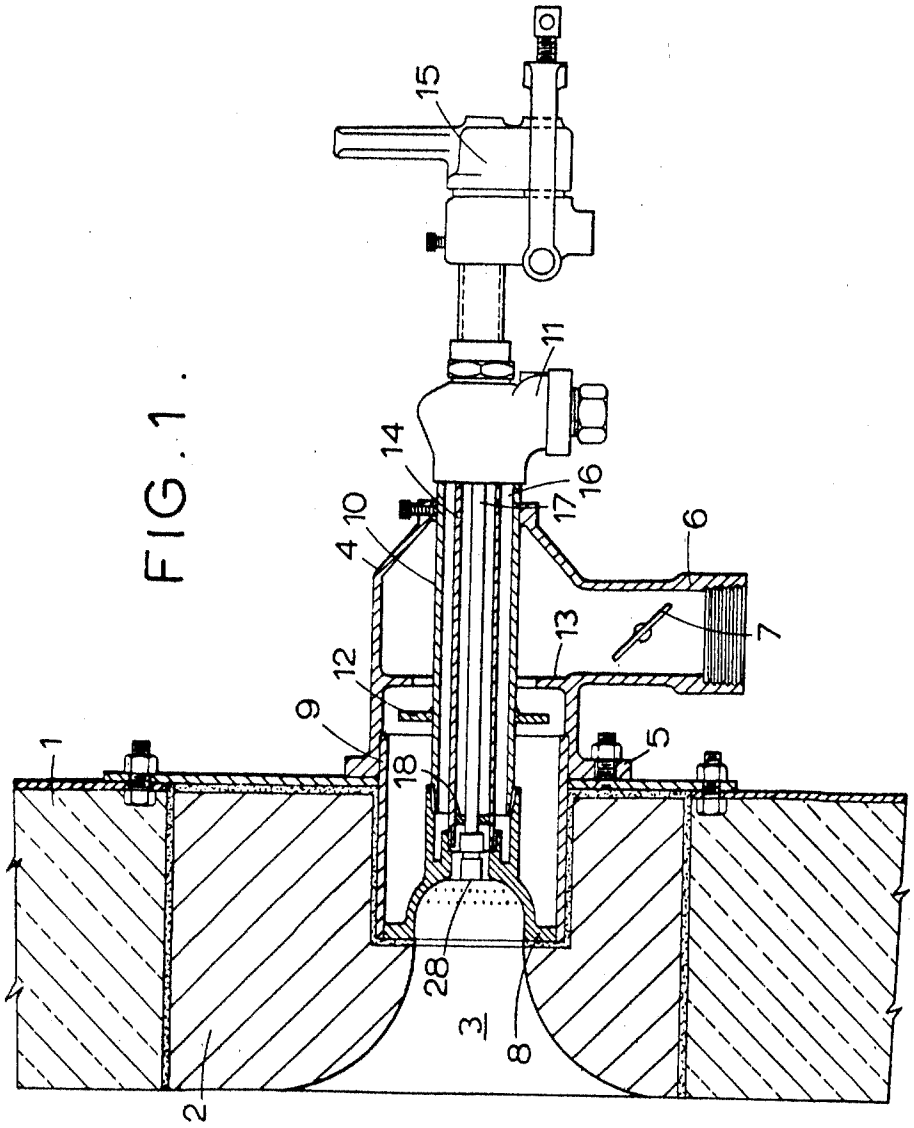

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FIG. 2.

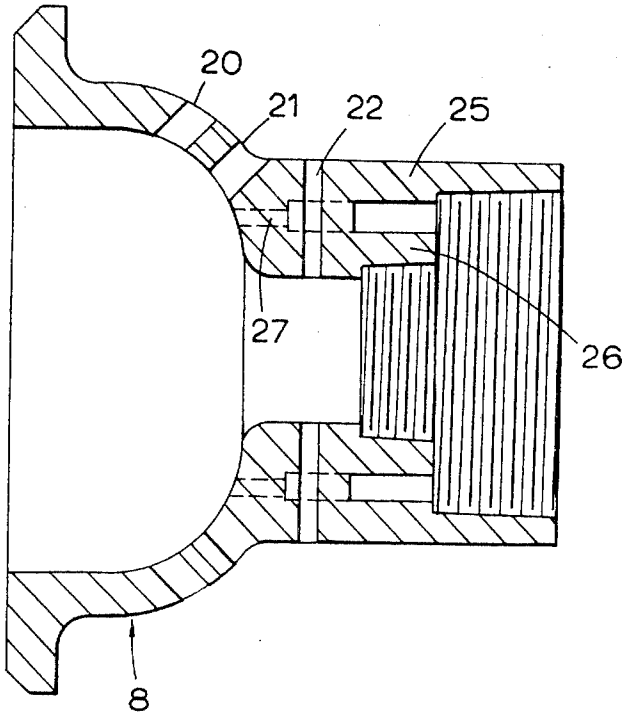

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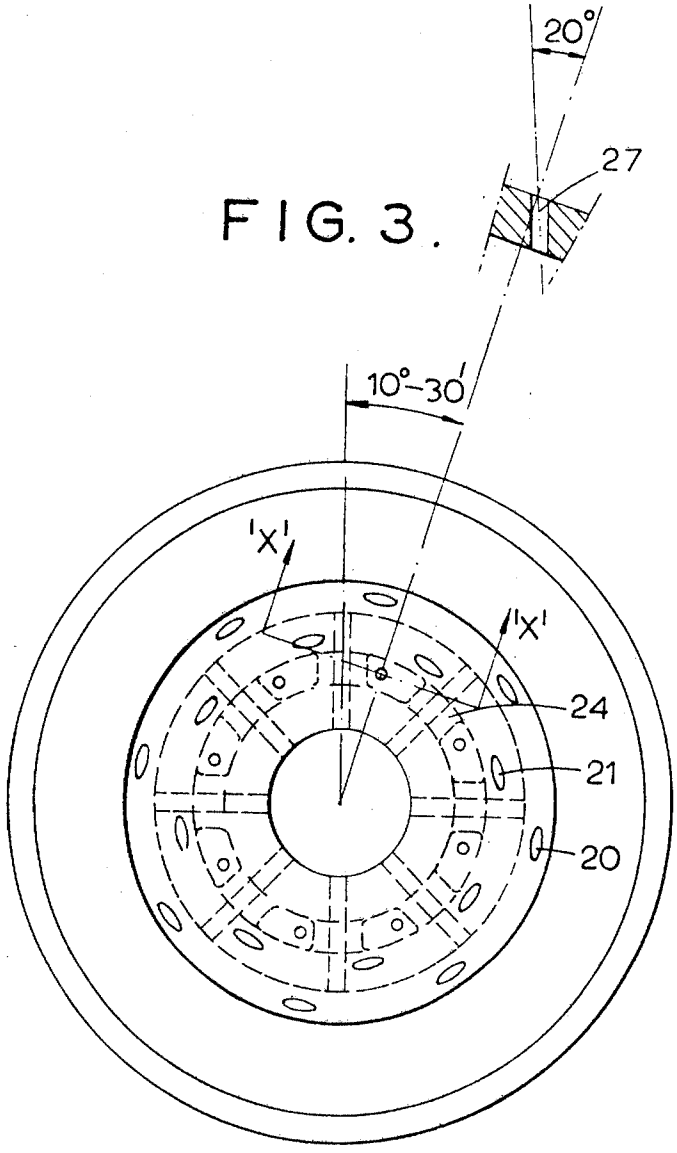
FIG. 3.



United States Patent Office 3,514,245 Patented May 26, 1970

3,514,245

BURNER ASSEMBLY FOR FLUID FUELS

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Filed Apr. 10, 1968, Ser. No. 720,205
Claims priority, application Great Britain, Apr. 11, 1967, 16,645/67
Int. Cl. F23d 17/00
U.S. Cl. 431—348 7 Claims

ABSTRACT OF THE DISCLOSURE

A burner assembly for the combustion of liquid fuel, or gaseous fuel or a combination of liquid and gaseous fuel, adapted to be fitted to the wall of a furnace. The burner assembly has a curved funnel-shaped shroud into which fuel and air is emitted for combustion. The shroud has circumferential air passages in its enlarged portion disposed so that the air passed into the shroud is mixed with the fuel and swirled and further air passages in its narrowest portion which emit an air stream which flows over a fuel emitting nozzle so as to clean this part and prevent the formation of carbon deposits. Where the assembly burns both liquid and gaseous fuel gas supply passages extend through the narrowest portion of the shroud and also disposed so that when fuel gas is emitted it also swirls and mixes with the liquid fuel/air mixture.

BACKGROUND TO THE INVENTION

Burner assemblies have been known which are adapted to be fitted into the wall of a furnace so as to heat the surface of the wall portion around the burner assembly and thus produce a heated surface which radiates heat to the interior of the furnace. Such assemblies usually burn liquid fuel. With these assemblies it is desirable to produce agitation or whirling movement of the air injected into the combustion chamber in order that the liquid fuel and air should become more thoroughly mixed. It has been found that the construction of such assemblies is generally complicated and very often the assembly does not work at maximum efficiency.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a burner assembly which is adapted to burn liquid fuel, or gaseous fuel or a combination of liquid fuel and gaseous fuel.

A further object of the invention is to provide a burner assembly which is simple to construct and will operate with maximum efficiency and is designed to facilitate easy location in the wall of a furnace.

According to the present invention there is provided a burner assembly comprising:

(a) A housing,

(b) A generally funnel-shaped shroud with a smoothly curved enlarged outlet portion which shroud is attached to the housing,

(c) A burner nozzle for supplying fuel into the space defined by the enlarged outlet portion of the shroud,

(d) Means for supporting said nozzle at the narrowest portion of the shroud,

(e) Fuel injecting means connected to said nozzle,

(f) Air supply means communicating with the shroud through the housing,

(g) Circumferential air passages provided in the enlarged portion of the shroud with axes extending obliquely forwardly relative to the axis of the shroud so as to emit jets of air which produce a swirling mass of fuel/air mixture in the space defined by the enlarged outlet portion of the shroud, and

(h) Circumferential air passages provided in the narrowest portion of the shroud and disposed to provide a stream of air which flows over said nozzle.

Further according to the invention there is provided a combination of a burner assembly comprising:

(a) A housing,

(b) A generally funnel-shaped shroud with a smoothly curved enlarged outlet portion which shroud is attached to the housing,

(c) A burner nozzle for supplying fuel into the space defined by the enlarged outlet portion of the shroud,

(d) Means for supporting said nozzle at the narrowest portion of the shroud,

(e) Fuel injecting means connected to said nozzle,

(f) Air supply means communicating with the shroud through the housing,

(g) Circumferential air passages provided in the enlarged portion of the shroud with axes extending obliquely forwardly relative to the axis of the shroud so as to emit jets of air which produce a swirling mass of fuel/air mixture in the space defined by the enlarged outlet portion of the shroud,

(h) Circumferential air passages provided in the narrowest portion of the shroud and disposed to provide a stream of air which flows over said nozzle,

(i) A refractory block having an outwardly flared aperture disposed co-axially with the shroud, whereby the surface of the aperture extends from the enlarged portion of the shroud so as to act as a radiant heat source, and

(j) Means for attaching the assembly to said refractory block.

The fuel supply means can be a liquid fuel injector connected to the burner nozzle by means of a liquid fuel supply tube.

Alternatively, the fuel supply means can be a gaseous fuel injector connected to the burner nozzle by means of a gaseous fuel supply tube.

Where it is desired to employ the burner assembly for combustion of both gaseous and liquid fuel simultaneously both liquid fuel supply means and gaseous fuel supply means are provided. The liquid fuel is ejected by the burner nozzle and gaseous fuel is conveyed to supply passages provided in the shroud. These gas supply passages are directed forwardly and obliquely to the axis of the shroud so that the gas is also swirled and mixed with the liquid fuel/air in the space defined by the enlarged portion of the shroud.

Further various other aspects of the burner assembly made in accordance with the invention will become more apparent from the consideration of the following description of a preferred embodiment thereof.

BRIEF DESCRIPTION OF DRAWINGS

In the accompanying drawings,

FIG. 1 is a section through a burner assembly made in accordance with the invention for the combustion of both liquid and gaseous fuel,

FIG. 2 is an enlarged section through the funnel-shaped shroud, and

FIG. 3 is an end view of the shroud together with a partial view of a section through one of the fuel gas passages.

DESCRIPTION OF PREFERRED EMBODIMENT

As shown in the drawings, the burner assembly is fitted to the wall 1 of a furnace by removing a section of the wall and replacing it with a refractory block 2 having an aperture 3. Although the particular construction depicted is for the combustion of both liquid and gaseous

fuel it is to be understood that the construction can be easily modified to serve for the combustion of liquid fuel solely or gaseous fuel solely as will be described hereinafter. The aperture **3** is flared outwardly towards the interior of the furnace and the narrow outer end of the aperture **3** is shaped to receive the burner assembly. The burner assembly comprises a main housing **4** having a flange portion **5** which is bolted to the wall **1**. The housing **4** includes an air inlet conduit **6** which is provided with an adjustable damper **7** to control the flow of air into the assembly.

The burner head itself comprises a shroud **8** which is smoothly curved and generally funnel-shaped. The shroud **8** is fixed to the end of a support tube **9**, e.g. by welding, extending into the housing **4**. The support tube **9** projects inwardly into the housing **4** and the location of the shroud **8** within the aperture **3** can be adjusted, preferably during installation, by varying the amount by which the support tube **9** projects into the housing **4**. The shroud **8** has its narrowest end, remote from the inside of the furnace, attached to a tube **10** which is connected at its other end to a gas inlet manifold **11**. The tube **10** is provided with an external baffle **12** which operates in conjunction with a baffle **13** provided on the inner surface of the housing **4** so that air fed into the assembly is reduced in velocity and any air pressure differences are equilised.

A further tube **14** is mounted concentrically within the tube **10** and extends between the shroud **8** and a liquid fuel injector or gun **15** to form an annular passage **16** for the flow of fuel gas to the shroud **8**. The liquid fuel supply tube **17** extends between the liquid fuel injector **15** and the shroud **8** and is mounted within the tube **14** and supported therein by means of spacers **18**. A burner nozzle **28** is fitted to the end of the tube **17** and is disposed within the narrowest portion of the shroud **8**.

Referring more particularly to FIGS. 2 and 3 the shroud **8** is provided with two series of circumferential air passages **20** and **21** located in the wall of its enlarged widest portion. These passages **20, 21** are directed forwardly and obliquely to the axis of the shroud **8**. In the arrangement illustrated the axes of the holes **20, 21** are inclined at an angle of 45° to the axis of the shroud in one plane and at 50° to the axis of the shroud in the plane at right angles to said one plane. However, these angles are not unduly critical and can be altered to suit a particular combustion parameter. The wall of the narrowest portion of the shroud **8** is also formed with a series of air passages **22** and these are simply disposed radially towards the axis of the shroud **8**. If desired these passages **22** can be inclined forwardly and obliquely to the axis of the shroud but there appears no great advantage in this construction. The passages **22** pass through webs **24** (FIG. 3) which extend between an outer wall **25** and an inner wall **26** in the narrowest portion of the shroud **8**. Further passages **27** are provided between these webs **24** for the supply of fuel gas into the space defined by the enlarged portion of the shroud **8**. These passages **27** extend parallel to the axis of the shroud **8** in one plane and obliquely to the axis of the shroud in the plane at right angles to said one plane. In the arrangement illustrated they are inclined at an angle of 20° to the axis in one of the planes.

Referring once more to FIG. 1 of the drawings the operation of the burner assembly is as follows. Liquid fuel is fed to the injector **15** and passes along the tube **17** to the burner nozzle **28** where it is injected into the space defined by the enlarged portion of the shroud **8** in a flared atomized spray. Fuel gas is fed from the manifold **11** along the annular passage **16** to the shroud **8** were it passes into the space defined by the enlarged portion of the shroud through the passages **27** which are arranged to swirl the fuel gas and mix it with the liquid fuel delivered by the nozzle **28**. Air is fed into the housing **4** from the conduit **6** from whence it passes around the

baffles **12** and **13** and into the space between the tube **9** and the outer surface of the shroud **8**. A small portion of the air (thought to be about 10%) passes into the narrowest portion of the shroud **8** via the passages **22** and this serves to keep the burner nozzle free from liquid fuel and prevents the formation of deposits of carbon. The majority of air passes through the passages **20** and **21** in the enlarged portion of the shroud and because of the angle at which the passages **20** and **21** face the space defined by the enlarged portion of the shroud **8** air passing through these passages is swirled to efficiently mix with the liquid and gaseous fuel. On igniting the mixture of air and fuel by, for example, a gas pilot extending through the block **2** the fuel/air mixture burns in a cone extending from the nozzle **28** in the direction of the widest flared portion of the aperture **3**. As a result, the outwardly flared surfaces of the block **2** are heated and consequently act as a radiator which radiates heat to the furnace. It will be appreciated that the embodiment described can be modified for use solely in burning liquid fuel or gaseous fuel.

In the case where the assembly is to consume liquid fuel only the tube **14** and gas inlet manifold **11** can be dispensed with. The liquid fuel supply tube **17** can then be located within the tube **10** and if desired the gas supply passages **27** in the shroud **8** can be omitted. In the case where the assembly is to consume gaseous fuel only the liquid fuel injector **15** is replaced with a gaseous fuel injector so that the supply tube **17** becomes a gaseous fuel supply tube and the burner nozzle **28** emits gaseous fuel. As before the tube **14** and gas inlet manifold **11** can be dispensed with and the gas supply passages **27** in the shroud **8** omitted.

If it is desired to have an assembly capable of burning gaseous fuel, liquid fuel, or a combination of fuels, then the basic construction shown in the drawings could be used and the only modification required would be in the case of burning gaseous fuel only when the liquid fuel injector **15** would be replaced with a gaseous fuel injector.

I claim:

1. A burner assembly comprising:

(a) a housing;

(b) a support tube extending partially within one end of said housing;

(c) a shroud carried by and extending within the support tube, the shroud having a cup-shaped outlet portion adjoining an inlet portion, the outlet portion being disposed outwardly relative to said housing and being smoothly curved and enlarged relative to said inlet portion;

(d) a burner nozzle disposed within said inlet portion of the shroud and arranged at the axis thereof, said nozzle being adapted to emit combustion fuel in a divergent pattern emanating from the axis of the shroud at said inlet portion and into the space defined by the outlet portion of the shroud for combustion therein;

(e) means for supporting said nozzle at the inlet portion of the shroud;

(f) fuel injecting means connected to said nozzle via the housing;

(g) gas supply passages extending generally longitudinally through the wall of the inlet portion of the shroud, the gas supply passages having axes extending parallel to the longitudinal axis of the shroud in one plane and obliquely relative to the axis of the shroud in a plane perpendicularly to said one plane so as to emit fuel gas supplied thereto into the space defined by the outlet portion of the shroud in a swirling pattern;

(h) a series of air supply passages extending through the wall of the outlet portion of the shroud, said air passages being disposed downstream relative to said nozzle and having axes extending generally obliquely

forwardly relative to the longitudinal axis of the shroud and inclined at different angles relative to each of two mutually perpendicular planes so as to swirl combustion air emitted into the space defined by the outlet portion of the shroud and produce a swirling mass of fuel/air mixture therein;

(i) further air passages extending generally radially through the wall of the inlet portion of the shroud, said further passages having axes which intersect the longitudinal axis of the shroud within said inlet portion so as to emit cleaning air directly onto said nozzle, which air only supports combustion indirectly, and

(j) adjustable air supply means communicating via the housing with said air passages in the inlet and outlet portions of the shroud.

2. A burner assembly according to claim 1, wherein the fuel supply means is a liquid fuel injector connected to the burner nozzle by means of a liquid fuel supply tube.

3. An assembly according to claim 1, wherein the fuel supply means is a liquid fuel injector and there is provided gaseous fuel supply means connected to said gas supply passages via a chamber formed in the housing.

4. An assembly according to claim 1, wherein the air supply means is composed of an air inlet conduit which has a damper to control the flow of air into the assembly and wherein baffles are provided in the housing for reducing the velocity of air fed to said air passage.

5. An assembly according to claim 1, wherein each passage of said series of air passages located in the outlet portion of the shroud has an axis extending at an angle of 45° to the axis of the shroud in one plane and at an angle of 50° to the axis of the shroud in the plane at right angles to said one plane and each passage of said further air passages located in the inlet portion of the shroud extends radially of the axis of the shroud.

6. An assembly according to claim 1, wherein each of the gas supply passages has an axis which extends parallel to the axis of the shroud in one plane and at an angle of 20° to the axis of the shroud in the plane at right angles to said one plane.

7. The combination of a burner assembly comprising:

(a) a housing;

(a) a support tube extending partially within one end of said housing;

(c) a shroud carried by and extending within the support tube, the shroud having a cup-shaped outlet portion adjoining an inlet portion, the outlet portion being disposed outwardly relative to said housing and being smoothly curved and enlarged relative to said inlet portion;

(d) a burner nozzle disposed within said inlet portion of the shroud and arranged at the axis thereof, said nozzle being adapted to emit combustion fuel in a divergent pattern emanating from the axis of the shroud at said inlet portion and into the space defined by the outlet portion of the shroud for combustion therein;

(e) means for supporting said nozzle at the inlet portion of the shroud;

(f) fuel injecting means connected to said nozzle via the housing;

(g) gas supply passages extending generally longitudinally through the wall of the inlet portion of the shroud, the gas supply passages having axes extending parallel to the longitudinal axis of the shroud in one plane and obliquely relative to the axis of the shroud in a plane perpendicularly to said one plane so as to emit fuel gas supplied thereto into the space defined by the outlet portion of the shroud in a swirling pattern;

(h) a series of air supply passages extending through the wall of the outlet portion of the shroud, said air passages being disposed downstream relative to said nozzle and having axes extending generally obliquely forwardly relative to the longitudinal axis of the shroud and inclined at different angles relative to each of two mutually perpendicular planes so as to swirl combustion air emitted into the space defined by the outlet portion of the shroud and produce a swirling mass of fuel/air mixture therein;

(i) further air passages extending generally radially through the wall of the inlet portion of the shroud, said further passages having axes which intersect the longitudinal axis of the shroud within said inlet portion so as to emit cleaning air directly onto said nozzle, which air only supports combustion indirectly;

(j) adjustable air supply means communicating via the housing with said air passages in the inlet and outlet portions of the shroud;

(k) a refractory block having an outwardly flared aperture disposed co-axially with the shroud, the surface of the aperture extending from the inner wall of the outlet portion of the shroud and being smoothly merged therewith to form a continuation thereof; and

(l) means for attaching the assembly to said refractory block.

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