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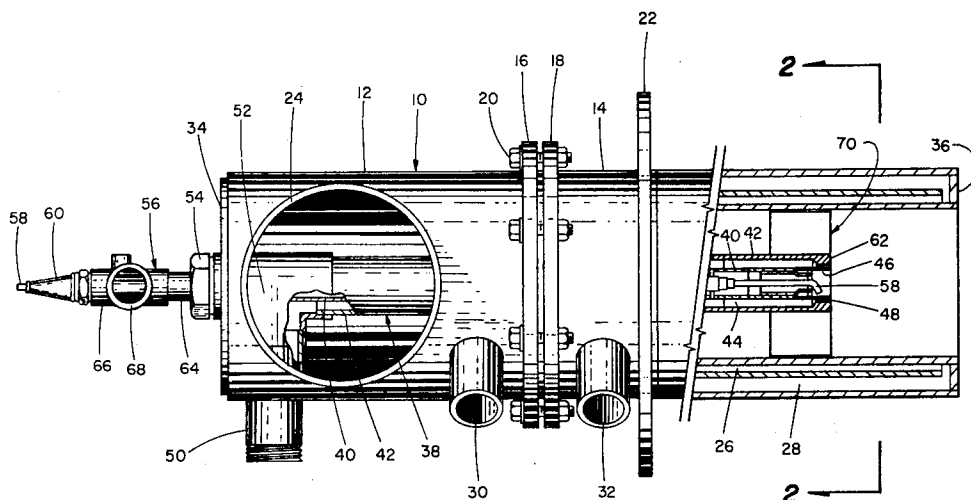
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[54] **METALLURGICAL BURNER**
8 Claims, 4 Drawing Figs.

[52] U.S. Cl..... **431/265,**
 239/406, 431/160, 431/183, 431/346, 431/353
 [51] Int. Cl..... **F23q 3/00**
 [50] Field of Search..... 431/160,
 182, 183, 265, 263, 266, 346, 353; 239/405, 406,
 132.3

ABSTRACT: An industrial burner of the post mix type capable of being operated using a natural gas-air mixture or a mixture of natural gas and air that has been enriched with industrial oxygen. The burner is characterized in that a stator is used to assure post mixing thereby preventing explosion from flashback. Water cooling, self-contained ignition and an integral pilot flame are further features of the burner.



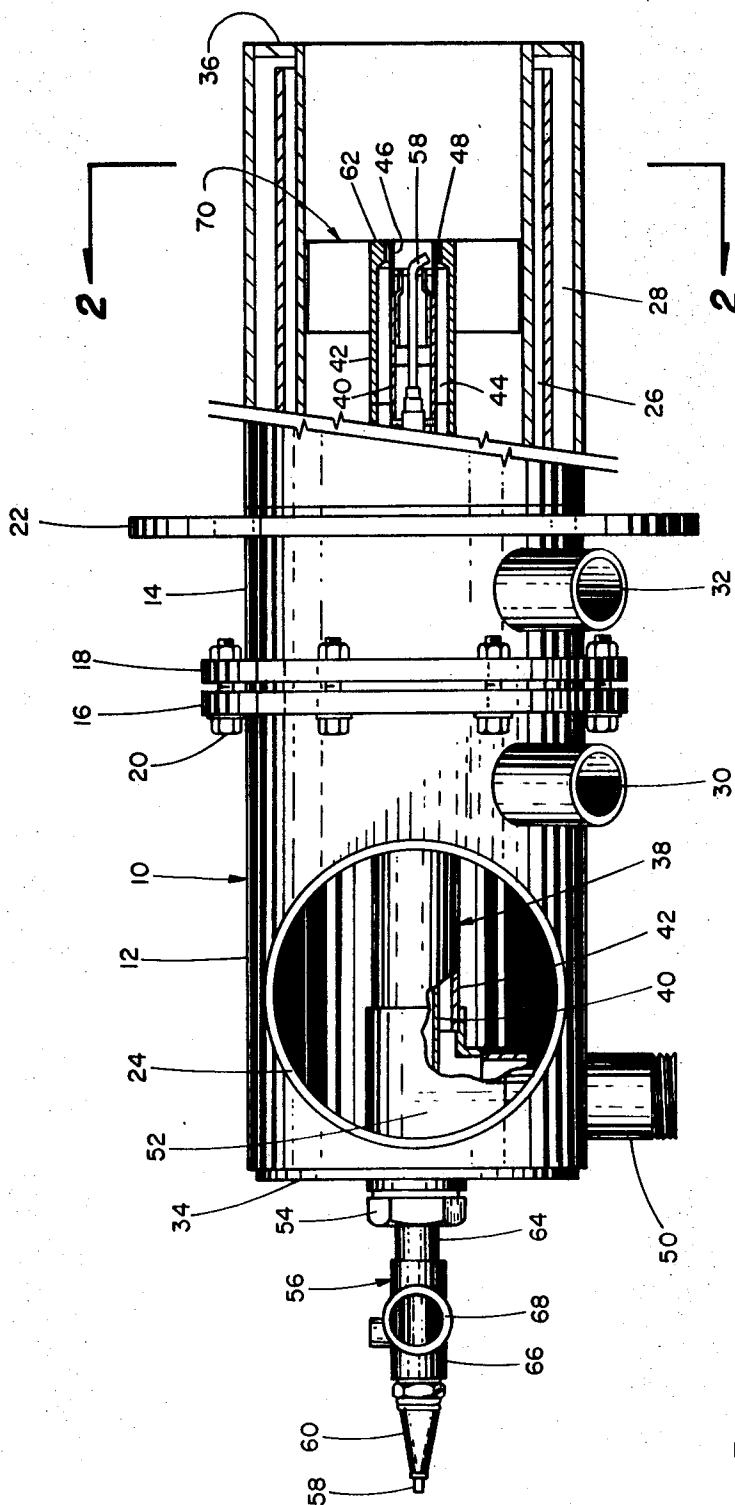


FIG. 1.

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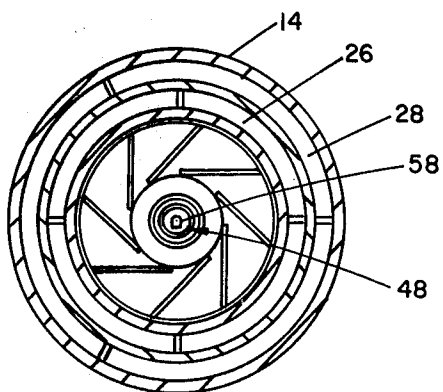


FIG. 2.

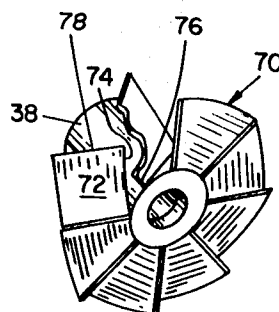


FIG. 3.

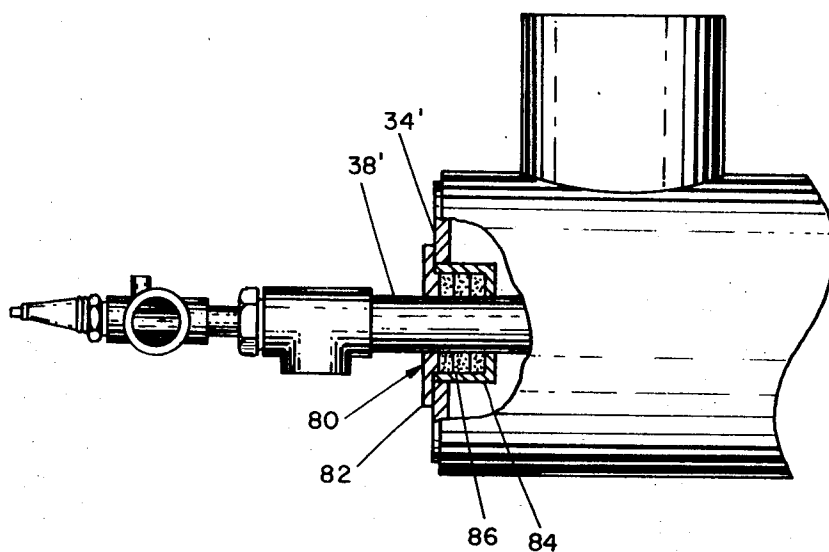


FIG. 4.

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METALLURGICAL BURNER

BACKGROUND OF THE INVENTION

This invention pertains to industrial burners of the type used in melting vessels, metal heating furnaces, metal preheating furnaces and the like for the metallurgical industry. Such burners have been used to preheat large vessels for vacuum degassing molten metal. Burners of this type are generally fired using air mixed with a fuel such as natural gas or a mixture of fuel and air that is enriched with gaseous oxygen.

Burners of the type herein disclosed are shown in U.S. Pat. Nos. 1,779,647 and 2,855,033. The first of the aforementioned patents relies on a burner block which is designated A to provide an ignition device. In other words, the burner is fired with a pilot flame until the burner block becomes hot enough to support combustion. Use of a burner block is not desirable since it adds to the weight and size of a burner that must be supported in a refractory lining of a furnace and limits the maximum operating temperature of the burner.

The second of the above-mentioned patents discloses an industrial burner wherein there is a swirling device used to assure postmixing of the air and fuel mixture. This type of burner relies on creation of eddy currents in the air-fuel mixture to sustain combustion and is not suitable for a fuel mixed with air enriched with oxygen.

Neither of the prior art burners are provided with water or fluid cooling means so that they can be operated at elevated temperatures.

SUMMARY OF THE INVENTION

The present invention relates to an industrial burner that is capable of producing 10,000,000 B.t.u./hr. using a natural gas and air mixture of the mixture of natural gas and air enriched with oxygen. The burner is cooled by a suitable fluid and is provided with an ignitor, a source of a pilot flame gas mixture, a stator to assure that the burner is a "post mix" type and will not flashback. A burner of this type is readily fabricated because the stator blades are straight and can be easily affixed to the burner fuel nozzle.

Therefore, it is the primary object of this invention to provide an improved industrial burner.

It is a further object of this invention to provide an industrial burner capable of operating at elevated temperature with an oxy-fuel mixture or an air-oxy-fuel mixture.

It is still another object of this invention to provide an industrial burner of the post mix type that substantially reduces the risk of the flashback when operating on oxygen-enriched mixtures.

It is still a further object of the invention to provide an industrial burner wherein the distance of the stator from the end of the burner projecting into the vessel to be heated can be adjusted in order to optimize burner performance.

It is yet another object of this invention to provide an industrial burner that can be made to project into the vessel being heated.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a front elevation partially in section showing a burner according to the present invention.

FIG. 2 is a cross section of the burner taken along line 2—2 of FIG. 1.

FIG. 3 is an isometric view of the stator of the burner with one blade partially broken away to illustrate the details thereof.

FIG. 4 is a partial front elevation of a burner according to the present invention with part of the figure in section illustrating a second embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 there is shown an industrial burner comprising a housing 10. The housing 10 is made in two sections,

12 and 14, secured together by flanges 16 and 18 and a plurality of circumferential bolts 20 as is well known in the art. The sealing of the sections 12 and 14 as accomplished with suitable O-rings or other devices as are well known in the art. Section 14 of the housing is fitted with a circumferential flange 22 for mounting the burner in a furnace or other vessel to be heated. Section 12 of housing 10 is fitted with a large conduit 24 for admitting air or enriched air to the burner to be mixed with the fuel. The housing 10 is further provided with a fluid cooling jacket comprising a cylindrical inlet passage 26 and a return passage 28 for cooling at least a substantial portion of the burner. Water or other cooling fluid is introduced to the burner via conduit 30 and discharged by conduit 32. Fluid cooling is necessary along the entire portion of the burner projecting into a vessel being heated to high temperature so that it can survive its environment.

Housing 10 is further fitted with a cover 34 opposite to the flame-producing end 36.

Disposed within the burner housing 10 is a fuel pipe 38. The fuel pipe 38 contains an inner wall 40 and an outer wall 42 thereby defining a fuel passage 44 and an internal bore 46. The fuel passage 44 terminates in a constricted annular orifice 48 in the end of the burner tube near the open end 36 of the housing 10 as is shown more clearly in FIG. 2. Fuel is introduced to passage 44 via pipe 50 fixed in section 12 of housing 10. For each of construction a tee-fitting 52 is used to join the fuel pipe 38 and the conduit 50.

Tee 52 projects through cover 34 and is fitted with a locking nut 54 for securing an ignition device 56 within the burner.

The ignition device 56 consists of a conductor wire 58 mounted on the end of the ignition device 56 projecting outwardly of the burner and secured thereto by insulator 60. The conductor 58 projects through the ignition device 56 to the nozzle end 62 of the fuel pipe and is disposed therein for striking an arc to ignite the pilot mixture. The ignition device 56 includes outer tube 64 which is an extension of inner wall 40 of the fuel tube. Outwardly of the housing 10 on tube 64 is a tee-fitting 66 with an entry conduit 68 for admitting a pilot mixture to the nozzle end 62 of the fuel pipe 38 for igniting the pilot burner. The pilot mixture is generally a fuel such as natural gas mixed with air. The wire 58 is connected to a source of electrical current (not shown) for causing a spark at the nozzle end of the fuel pipe and ignition of the pilot mixture.

Disposed around the nozzle end of the fuel pipe 38 is a stator shown generally as 70. The stator comprises a plurality of blades 72 shown more clearly in FIG. 3. The blades 72 are preferably made from a high-temperature ferrous alloy material and are flat pieces affixed to the nozzle end of the fuel pipe 38 by welding along joint 74. The blades 72 are positioned at an angle to the longitudinal axis of the fuel tube so that the leading edge 76 overlaps the trailing edge 78 of the adjacent blade. In this manner the air introduced to the burner through conduit 24 strikes the stator blades 72 and a spin flow pattern is imparted thereto. This in turn causes intimate mixing of the air with the fuel gas and insures that postmixing occurs. Postmixing is taken to mean firing of the air-fuel gas mixture beyond the nozzle face 62. The stator blades assure that there are no straight-through openings for the air by imposing a tangential component of velocity as well as a longitudinal component of velocity to each molecule of the air. The straight blades are easier to fabricate and can be made from available commercial materials. The stator assures safety in operation by preventing flashback when oxygen is used to enrich the air.

The operation of the burner is affected by the ratio of the distance of the nozzle face 62 from the open end 36 of the burner to the diameter of the stator 72. This (L/D) ratio should be in the range of 0.67 to 1.5. Below 0.67 the flame has a tendency to extinguish and for L/D ratios greater than 1.5 there is a significant increase in the water-cooling requirement of the burner without a significant improvement in burner performance.

Shown in FIG. 4 is an embodiment whereby the L/D ratio can be varied for a given diameter burner by making the fuel pipe 38' and hence the stator (not shown) fixed thereon, movable along the burner axis. In order to do this the fuel pipe 38' is slidably mounted in the cover 34' by using a stuffing box assembly shown generally as 80 comprising a flanged bushing 82 that is capable of sealing the fuel pipe 38 as well as allowing for movement thereof and a receiving member 84 with sealing material 86 therebetween. The adjustable stator will increase the maximum to minimum firing ratio of the burner and therefore the turndown capability.

A burner of the type described above except for the stator assembly and pilot assembly can be constructed of steel for ease in fabrication. The ignitor is fabricated as a separate unit and preferably has a stainless tip at the firing end. As described above the stator is fabricated from a high temperature alloy such as type 309 stainless steel.

Water cooling of the burner enables the burner to be operated with an air—natural gas mixture, natural gas and air enriched with oxygen. For an air—natural gas mixture the flame temperature is about 2,800° to 3,000° F. As oxygen is added to the air the flame velocity increases and the flame temperature increases until with a 30 percent oxygen in air and fuel mixture the flame temperature is about 4,000° F. Water cooling enables the burner to survive such an environment.

In operation the burner is connected to the sources of water, power, pilot fuel and fuel (natural gas). First, the pilot is ignited, then the air is introduced into the burner and finally fuel is introduced to the burner. If oxygen enrichment is needed the oxygen is introduced preferably after the main burner is ignited.

A burner of this type can also be provided with an ultraviolet flame sensor mounted in cover 34 and "looking" at the side of stator 70 opposite to where the flame is produced. A small hole drilled in one of the blades 72 will permit the ultraviolet sensor to detect the lighted pilot flame or main burner flame. This allows the operator to detect if the pilot is on and whether the main burner flame is on and also permits the utilization of an automatic flame safety system. Such flame sensors are known to the industry and can be readily fitted to the burner herein disclosed.

Having thus described our invention the appended claims define what is desired to be secured by Letters Patent of the United States.

We claim:

1. A metallurgical burner comprising in combination:
 - an open ended generally cylindrical housing including means for admitting a first gas to an interior thereof;
 - a fluid cooling jacket including inlet and outlet means attached to the housing for continuously cooling a major portion of the housing when the burner is in service;
 - a cover closing one end of the housing;
 - a fuel conduit disposed within the housing and extending outwardly thereof through the cover, the fuel conduit including a nozzle in the form of an annular orifice at the end thereof within the housing, the nozzle end of the fuel

conduit set back from the open end of the housing; means within said housing to ignite the fuel outwardly of the nozzle;

5. a stator disposed around said nozzle containing blades for deflecting substantially all of the first gas admitted to the housing so that a swirling flow pattern is imparted to the first gas to insure intimate mixing of the first gas and the fuel within the housing.

2. A burner according to claim 1 wherein the stator blades extend between the fuel conduit and the interior surface of the housing and are disposed about the nozzle perpendicular thereto and at an angle to the longitudinal axis of the nozzle so that each blade overlaps a portion of the adjacent blade in order to cause substantially all of the first gas to strike the stator and have a swirling flow pattern imparted thereto.

3. A burner according to claim 1 wherein the distance of the nozzle from the open end of the housing divided by the diameter of the stator is between 0.6 to 1.5.

4. A burner according to claim 1 wherein the fuel ignitor comprises a tube with a spark ignitor therein for providing a supply of premixed pilot gas, the tube acting in combination with the fuel tube at the nozzle end thereof to form the annular orifice.

5. A burner according to claim 1 wherein the cooling jacket is a water jacket disposed within a substantial portion of the housing from the open end toward the covered end.

6. A burner according to claim 1 wherein the housing is made in at least two sections removably fastened together for easy access to the interior thereof.

7. An industrial burner comprising in combination:
 - an open-ended generally cylindrical housing including means for admitting a first gas to the interior thereof;
 - a fluid cooling jacket including fluid inlet and outlet means disposed within a major portion of the housing;
 - a cover closing one end of the housing, the cover including an aperture for receiving a fuel conduit, the aperture having flexible sealing means so that the fuel conduit can be slidably mounted therein;

8. A burner according to claim 7 wherein the stator blades extend between the fuel conduit and the interior surface of the housing and are disposed about the nozzle perpendicular thereto and are set at an angle to the longitudinal axis of the nozzle so that each blade overlaps a portion of the adjacent blade in order to cause substantially all of the first gas to strike the stator and have a swirling flow pattern imparted thereto.

9. A burner according to claim 7 wherein the stator blades extend between the fuel conduit and the interior surface of the housing and are disposed about the nozzle perpendicular thereto and are set at an angle to the longitudinal axis of the nozzle so that each blade overlaps a portion of the adjacent blade in order to cause substantially all of the first gas to strike the stator and have a swirling flow pattern imparted thereto.

10. A burner according to claim 7 wherein the stator blades extend between the fuel conduit and the interior surface of the housing and are disposed about the nozzle perpendicular thereto and are set at an angle to the longitudinal axis of the nozzle so that each blade overlaps a portion of the adjacent blade in order to cause substantially all of the first gas to strike the stator and have a swirling flow pattern imparted thereto.