

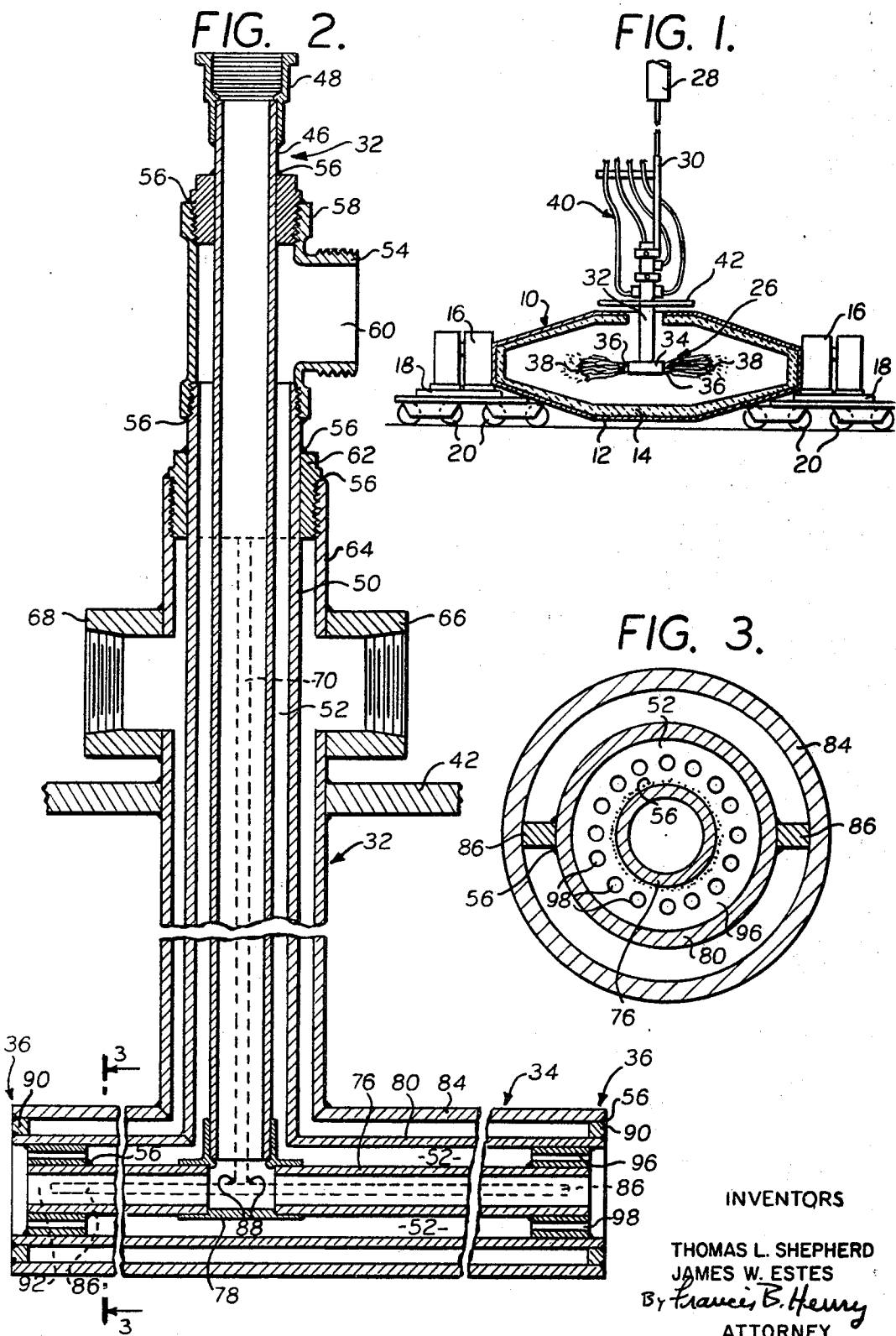
Nov. 26, 1968

T. L. SHEPHERD ET AL

3,412,986

DOUBLE-ENDED OXY-FUEL BURNER

Filed April 17, 1967



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DOUBLE-ENDED OXY-FUEL BURNER

Thomas L. Shepherd, Essex Fells, and James W. Estes, Piscataway, N.J., assignors to Air Reduction Company, Incorporated, New York, N.Y., a corporation of New York

Filed Apr. 17, 1967, Ser. No. 631,210
10 Claims. (Cl. 263—4)

ABSTRACT OF THE DISCLOSURE

This specification discloses a double-ended oxy-fuel burner which is intended especially for heating ladles that are used in iron and steel works for transporting molten metal from a blast furnace to another location at which the metal must be delivered while still in a molten condition. The burner is not used when the ladle is loaded with molten metal. It is used to pre-heat the ladle, and it can be used where necessary to keep the ladle from cooling between successive loads of metal. The burner is proportioned to the ladle and has oppositely directed orifices for producing long flames and for projecting them in opposite directions. The burner is constructed with cooling jackets extending all the way to the ends of the tips so that the burner can withstand the high temperature within the ladle.

Brief description of the invention

This invention relates to oxy-fuel burners and more especially to burners for heating long surfaces and particularly the inside surface of objects such as steel ladles, where the burner is subjected to extremely high temperatures.

The preferred embodiment of the invention is a double-ended oxy-fuel burner proportioned to a steel ladle such as a "torpedo" ladle; and constructed to project flames in opposite directions toward both ends of the ladle to concentrate the heat on those parts of the ladle from which the heat loss is the highest, while heating the mid portion of the ladle by contact with hot combustion products.

Another feature of the invention is the construction of the burner with cooling jackets extending to and around the tips of the burner so that the burner can withstand continued exposure to the high temperature encountered in a ladle or similar semienclosed space.

The fuel passages are correlated with oxygen jet passages and provision is made to obtain high flame temperatures and high velocities to heat the ladle quickly and thus shorten the cycle of the transfer of molten metal by the ladle. A ring of oxygen ports surrounding the fuel ports stabilizes the flames and causes them to adhere closely to the burner tips.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

Brief description of the drawing

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views:

FIGURE 1 is a diagrammatic sectional view of a steel ladle and a burner made in accordance with this invention and disposed in condition for heating the ladle;

FIGURE 2 is a greatly enlarged sectional view of the ladle shown in FIGURE 1; and

FIGURE 3 is a sectional view taken on the line 3—3 of FIGURE 1, and on an enlarged scale.

Detailed description of the invention

FIGURE 1 shows a torpedo ladle 10 such as is used in steel mills for transporting molten metal from a blast

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furnace. Such a ladle has a steel shell 12 and a refractory lining 14. The ladle has trunions 16 on its opposite ends and these trunions are pivotally connected with supporting trucks 18 which have wheels 20 that run on a track 22.

The trucks 18 are provided with means for holding the ladle against tilting movement during transport and power means are provided for tilting the ladle when desired; but the ladle is conventional and no further description of it is necessary for a complete understanding of this invention.

A burner 26 is lowered into the ladle 10 by a mechanical hoist 28 which is shown diagrammatically as connected with the burner 26 by a supporting bracket 30.

The burner 26 is constructed with a vertical body portion 32 and a T head 34. The head 34 extends in the direction of the longitudinal length of the ladle 10 and there are tips 36 at opposite ends of the head 34 from which flames 38 are projected.

If the ladle 10 has a length of approximately 15 feet, then the head 34 of the burner is approximately two feet in length. The flames 38 are projected from the tips towards the ends of the ladle; that is, the flames are of a length adequate to project hot gases into the ends of the ladle. These values are given merely by way of illustration. There are a number of tubing connections to the burner 26 and while the tubing, designated generally by the reference character 40, is located above the ladle, it is protected from the heat of the ladle by a baffle 42 attached to the burner body 32; and all ports of the burner body 32 and the head 34 below the baffle 42 are provided with coolant jackets, such as water jackets.

When the ladle is to be loaded with molten metal, the burner 26 is raised clear of the ladle by means of the hoist or motor 28 which is representative of mechanical means such as a pneumatic ram for raising and lowering the burner. The preheated ladle is then moved to the blast furnace where it is loaded and then transported to the location to which the molten metal is to be delivered. If it is desired to keep the ladle at an elevated temperature during a waiting period, it can be brought back into position under the burner 26 and the burner can be lowered into heating position, as when originally preheating the ladle.

FIGURE 2 shows the construction of the burner 26. The body 32 consists of a center tube 46 having a fitting 48 at its upper end for connection with tubing that supplies fuel to the burner. The fuel used may be natural gas or oil, or powdered coal carried in a suitable gas stream. An intermediate tube 50 surrounds the center tube 46 and is of larger diameter than the tube 46 so as to leave an annular passage 52 between the outside of the center tube 46 and the inside surface of the intermediate tube 50. There is a fitting 54 at the upper end of the intermediate tube 50. In the preferred construction this fitting 54 is a T which has its lower end threaded over the upper end of the intermediate tube 50, and this threaded connection is supplemented by a brazed connection 56. A bushing 58 is screwed into the upper end of the fitting 54 and connected to the fitting by a brazed connection 56. The bushing 58 is attached to the center tube 46 by brazing 56. In the construction illustrated, all of the connections, even though threaded, are supplemented with silver braze connections to insure a gas-tight construction. Welding or other gas-tight connections can be substituted.

The fitting 54 has a threaded inlet 60 for connection with tubing which supplies oxygen to the burner. Below the fitting 54, the intermediate tube 50 extends into a bushing 62 to which the tube is connected by a brazed connection 56. This bushing 62 closes the upper end of an outer tube 64 which forms the water jacket for the body of the burner. The tube 54 has openings at opposite sides with water connections including a water inlet fitting

66 and a water outlet fitting 68. There is a radial partition 70 between the intermediate tube 50 and the outer tube 64 at both the front and back of the burner so that no water can flow from the inlet fitting 66 directly to the outlet fitting 68.

The head 34 of the burner includes a center tube 76 which is attached to the lower end of the center tube 46 by a T fitting 78. Fuel passing down the center tube 46 divides at the T fitting 78 and flows through the center tube 76 toward opposite ends of the head 34.

The intermediate tube 50 is connected with another intermediate tube 80 of the head 34 with extensions of annular passage 52 between the tubes 76 and 80 extending in opposite directions toward the tips at both ends of the burner head 34.

In similar manner, an outer tube 84 is connected with the lower end of the outer tube 64 to provide a water jacket for the head 34 and the tips, which will be described. There are radial partitions 86 on opposite sides of the intermediate tube 80 and extending across the space between the tube 80 and the outer tube 84. These radial partitions 86 are best shown in FIGURE 3. They are connected to the outside of the tube 80 by brazed connections 56, or in any other suitable way. Each of the partitions 86 is connected with the lower end of one of the vertical partitions 70 by brazed connections 88, shown in FIGURE 1.

The water jackets between the tubes 80 and 84 are closed at the tip ends of these tubes by a closure ring 90 which is secured to the tubes by welding or brazing 56. The radial baffles 86 terminate before reaching the ring 90 and the clearance between the ends of these baffles 86 and the ring 90 provides the connecting passage by which water flows downward from the inlet fitting 66 and to the right through the upper part of the water jacket in the head 34 can enter the lower part of the water jacket and flow to the left to the opposite end of the burner head 34. The clearance between the ring 90 and the radial partition 86 at the left-hand end of the head 34 provides a passage 92 through which the water in the lower half of the head 34 can flow into the upper half at the left-hand end of the burner head. In the upper left-hand part of the burner head 34, the water in the cooling jacket flows toward the right in FIGURE 1 and then upward to the water outlet fitting 68.

The extensions of the passage 52, in the burner head, have rings 96 which fill the annular clearance between the center tube 76 and the intermediate tube 80. Each of these rings 96 includes a circle of jet orifices 98 which are shown as parallel to the common axis of the tubes 76, 80 and 84, and of uniform diameter throughout their length. These orifices 98 can, however, be of different contour if desired.

The center tube 76 is shown open at both ends with no obstruction. This is advantageous when using gas as the fuel; but it will be understood that nozzles can be inserted into the ends of the center tube 76 for atomizing oil fuels and for obtaining whirling motion of the ejected oil.

The ends of the burner head 34 at which the fuel and oxygen are ejected constitute the tips of the burner. It is a feature of the preferred construction that the end face of the ring 96 and the end of the center tube 76, which constitute the tip face, are set back from the ends of the tubes 80 and 84 so that the water jacket surrounds the tip for the full length of the tip. This protects the tip face from deterioration resulting from high temperature of the flames. The set-back is shown as equal to the length of the ring 90, but the set-back can be somewhat greater, or in the case of smaller burners, where the heat conduction to the water is through shorter distances, the set-back can be less. It has been found that the set-back creates a "skirted" configuration which assists in keeping the flame seated on the tip face.

In the construction illustrated, with the fuel ejected parallel to the orifices 98, the oxygen streams produce

flames which direct hot gases to the surfaces to be heated at a substantial distance from the tip faces. The use of the circle orifices 98 around the stream of fuel serves to stabilize the flame and cause the flame to closely adhere to the burner tip. The velocities are controlled with reference to the flame stability limit of the burner tip design so that the flames don't blow away.

It is preferable to use proportions of oxygen and fuel which produce substantially luminous flames so that heat may be transferred by radiation as well as convection.

The flame temperature is between 3600° and 4500° F. at optimum operating conditions. These temperatures can be obtained with either natural gas, oil or powdered coal in a stream of suitable conveying gas, preferably natural gas or air. When using natural gas, or fuel oil, the oxygen flow should be adjusted so as to provide 50-100% of the stoichiometric requirement of the fuel. Whereas in the case of coal, it has been found that the oxygen flow should be set so as to provide 75-100% of the stoichiometric requirement of the fuel. This is due to a slower rate of combustion.

The burner is lighted by igniting an oil-soaked rag and dropping it into the ladle. If the ladle is already heated to a high temperature, the heat of the ladle itself is sufficient to ignite the oxy-fuel jets.

The preferred embodiment of the invention has been illustrated and described, but changes and modifications can be made and some features can be used in different combinations without departing from the invention as defined in the claims.

What is claimed is:

1. A double-ended oxy-fuel burner including a body portion comprising two concentric tubes, one for oxygen and the other for fuel, the outer of said tubes being of substantially larger diameter than the inner tube so as to leave an annular passage in the outer tube around the outside of the inner tube, a head portion at the lower end of the body portion and including two concentric tubes, the inner of which connects with the inner tube of the body portion at a T connection, and the outer of which connects with the outer tube of the body portion at another T connection which encloses the first T connection, tips of the burner at opposite ends of the head portion and means for cooling the tubes in both the body portion and head portion of the burner.

2. The oxy-fuel burner described in claim 1 characterized by the outer tube being the oxygen passage of the burner, and a ring spanning the annular space between the inner and outer tubes at each end of the head portion of the burner to form at least a part of a tip face of the burner, each ring having a circle of jet orifices opening through it for oxygen jets around the end of the inner tube.

3. The oxy-fuel burner described in claim 2 characterized by the oxygen jet orifices extending substantially parallel to the axis of the inner tube.

4. The oxy-fuel burner described in claim 3 characterized by the inner tube being open across its full cross section all the way to the discharge ends of said inner tube, and the end of said inner tube being in substantially the same plane with the outer face of the ring through which the oxygen jet orifices open.

5. The oxy-fuel burner described in claim 1 characterized by the means for cooling the burner being a water jacket comprising another tube outside of and spaced from the outer of the first two tubes of the body portion and another tube outside of and spaced from the outer of the first two tubes of the head portion of the burner, these water jacket tubes being connected at a center T connection that surrounds and encloses the other T connections of the body and head portions of the burner and partition means in the water jacket tubes for requiring longitudinal flow of cooling water in the water jacket.

6. The oxy-fuel burner described in claim 5 characterized by a water inlet on one side of the body portion near

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the upper end thereof, a water outlet on the other side of the body portion substantially opposite the water inlet, the partition means in the water jacket including partitions extending across from the outer of the first two tubes to the inside surface of the water jacket tube of the body portion at locations on both sides of the water jacket and between the inlet and outlet and extending for the full length of the water jacket in the body portion, and the partition means including also a partition in the head portion of the burner at the bottom of each of the partitions of the body portion and dividing the water jacket in the head portion into upper and lower chambers, end walls closing the opposite ends of the water jacket of the head portion, the partitions in the head portion terminating at a distance back from the end wall whereby the upper and lower chambers are in communication with one another at opposite ends of the head portion of the burner.

7. The oxy-fuel burner described in claim 2 characterized by the means for cooling the burner being a water jacket around the outer of the tubes of both the body portion and the head portion of the burner, the jacket extending all the way to the tip face of the burner at both ends thereof, and partitions in the water jacket forming a passage that requires the water to flow down the body portion and then along the head portion to one end thereof, then along a reverse passage to the other end of the head portion, and then back to the body portion and upward in the body portion.

8. The oxy-fuel burner described in claim 7 character-

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ized by the water jacket being formed by a water jacket tube outside of the outer of the first two tubes of both the body portion and the head portion of the burner, the water jacket at opposite ends of the burner being closed by an annular wall extending from the outer of the first two tubes of the head portion to the surrounding water jacket tube, tip faces at both ends of the burner with orifices through which oxygen and fuel are discharged, the outer face of the annular wall of the water jacket at each end of the burner being beyond the tip face in that end of the burner.

9. The oxy-fuel burner described in claim 1 characterized by the burner being combined with an elongated ladle for transporting molten metal, means positioning said burner in the ladle so that the head portion of the burner extends in the direction of the long length of the ladle, and means for supplying oxygen and fuel to the burner at pressures which project flames from the opposite ends of the burner.

10. The combination described in claim 9 in which said positioning means comprises motor means.

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JOHN J. CAMBY, *Acting Primary Examiner.*