

Nov. 25, 1969

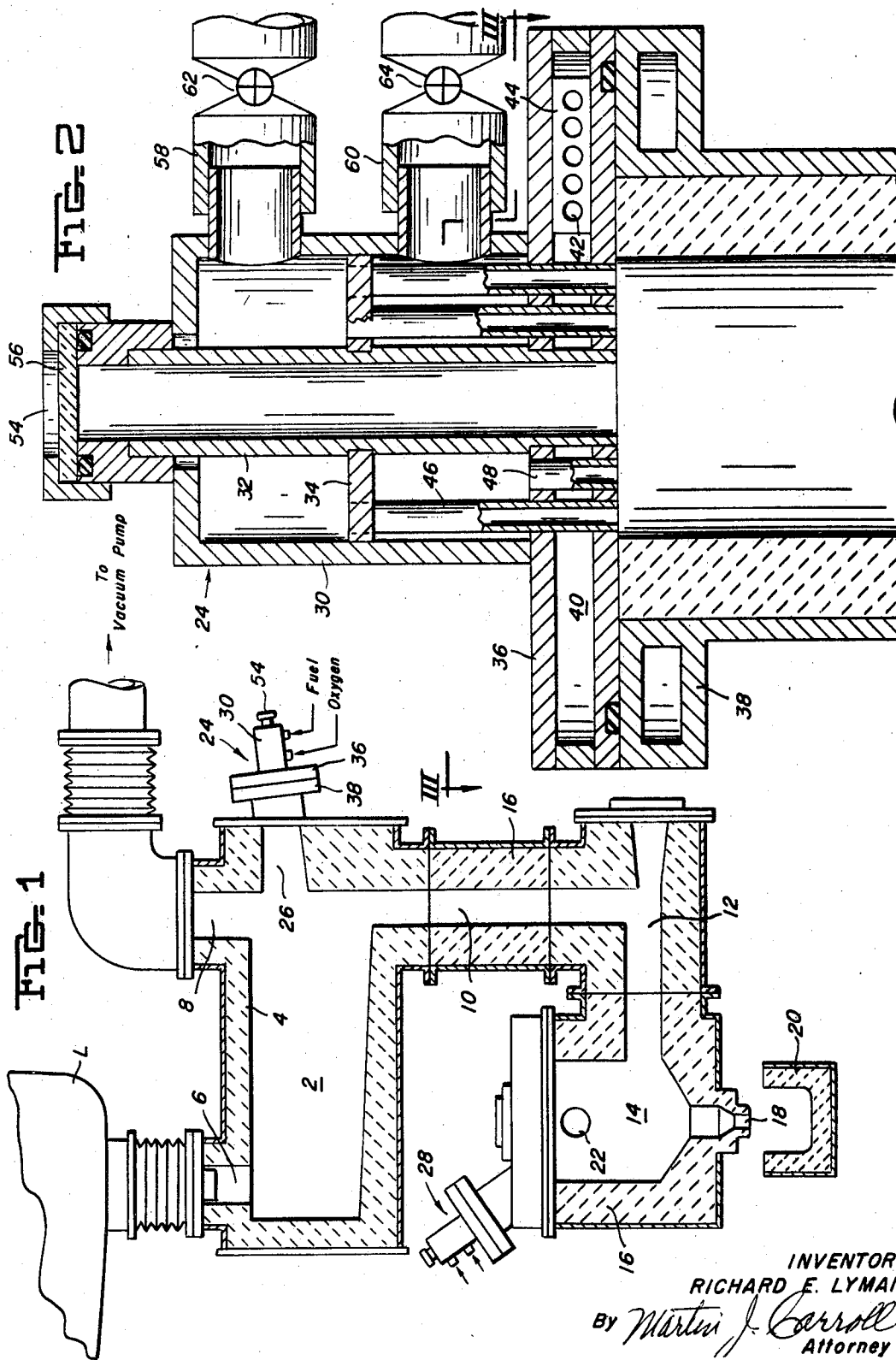
R. E. LYMAN

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BURNER FOR PRE-HEATING A REFRACTORY LINED VESSEL

Original Filed May 23, 1967

2 Sheets-Sheet 1



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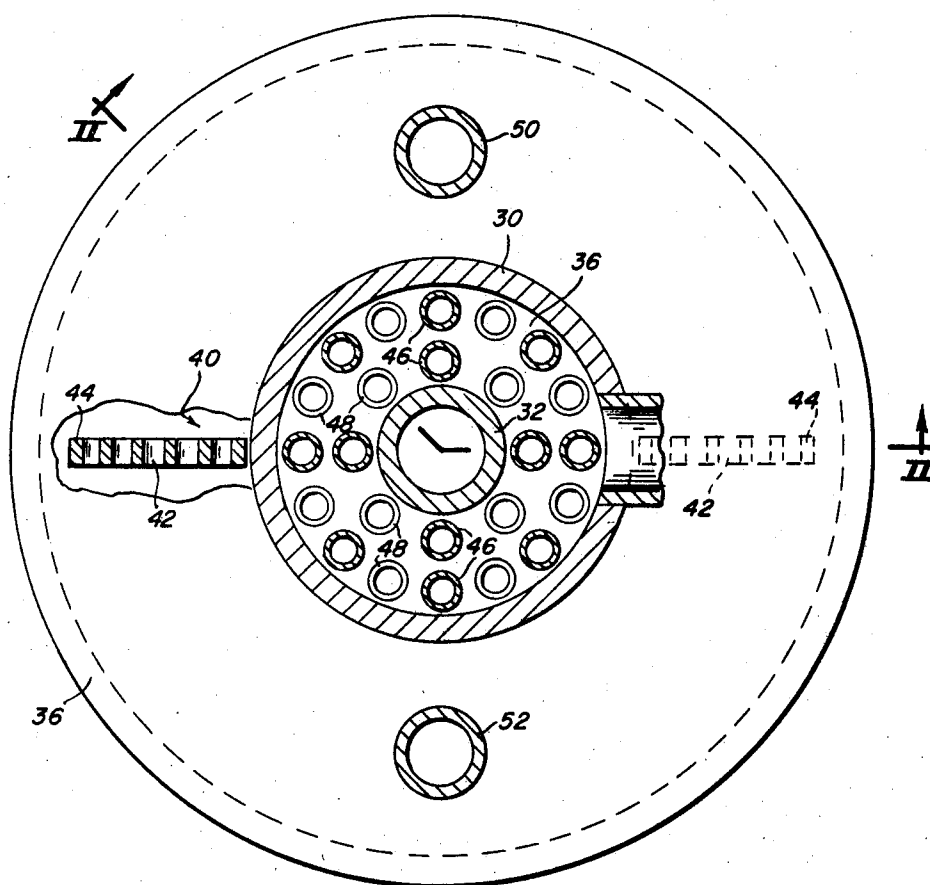
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FIG. 3



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BURNER FOR PRE-HEATING A REFRACTORY LINED VESSEL

Richard E. Lyman, Homewood, Ill., assignor to United States Steel Corporation, a corporation of Delaware
Original application May 23, 1967, Ser. No. 640,749.
Divided and this application June 24, 1968, Ser. No. 739,464

Int. Cl. F23d 13/40

U.S. Cl. 431—353

8 Claims

ABSTRACT OF THE DISCLOSURE

A burner for injecting a fluid hydrocarbon fuel and oxygen into a refractory lined vessel including coaxial inner and outer tubes with a partition between the inside of the outer tube and the outside of the inner tubes intermediate their ends dividing the outer tube into a fuel receiving chamber at the end remote from the vessel and an oxygen receiving chamber at the end adjacent the vessel, a collar having spaced transverse walls at the discharge end of the burner with long tubes extending through the partition and spaced walls and short tubes extending through the walls between the long tubes, means for delivering oxygen to the outer tube between the partition and collar, and means for delivering fuel to the outer tube on the inlet side of the partition.

This application, which is a division of my co-pending application Ser. No. 640,749 filed May 23, 1967, now Patent No. 3,439,072 dated Apr. 15, 1969, relates to a burner particularly adapted for pre-heating a refractory lined vessel prior to filling it with molten steel or other ferrous metal. The burner is particularly applicable for use with continuous in-line liquid steel degassing apparatus which is preferably pre-heated to a temperature between 2700 and 3000° F. I do not know of any other burner that can efficiently introduce fuel and oxygen into a combustion chamber in such a manner as to heat the walls uniformly with products of combustion which are reducing to iron oxides.

It is therefore an object of my invention to provide a burner suitable for efficiently injecting fuel and oxygen into refractory lined vessels which are to be pre-heated.

This and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIGURE 1 is a schematic view of apparatus used in degassing molten steel;

FIGURE 2 is an enlarged view of the burner of my invention taken on line II—II of FIGURE 3; and

FIGURE 3 is a view taken on the line III—III of FIGURE 2.

Referring more particularly to FIGURE 1 of the drawings, reference numeral 2 indicates a degassing chamber having a refractory lining 4 and an inlet 6 for receiving molten steel. An outlet 8 is connected to a vacuum pump, not shown. The degassing chamber 2 is connected by means of a vertical duct 10 and a horizontal duct 12 to a pouring box or tundish 14. The ducts 10 and 12 and tundish 14 are lined with refractory 16. An opening 18 in the bottom of the tundish 14 is located above a runner 20. An overflow opening 22 is provided in the tundish 14. No novelty is claimed for this apparatus which may be considered conventional insofar as the present invention is concerned. Apparatus such as shown in my co-pending application Ser. No. 511,513 filed Dec. 3, 1965, now abandoned, is illustrative of vessels which may be pre-heated according to the present invention.

According to my invention I provide a burner or gas injector 24 for delivering fuel and oxygen through a port 26 into the degassing chamber 2 and a similar burner 28 for introducing fuel and oxygen into the tundish 14. Since the burners 24 and 28 are essentially duplicates, only burner 24 will be described in detail. As shown in FIGURES 2 and 3, burner 24 includes two concentric tubes 30 and 32 with a partition 34 extending between the inner wall of tube 30 and the outer wall of tube 32 intermediate their ends. A collar 36 is attached to the forward end of tubes 30 and 32 and bears against a water cooled collar 38 at the entry end of port 26. Collar 36 is provided with a cooling water chamber 40 having diametrically aligned partitions 44 therein with openings 42 therethrough. Tubes 46 extend through partition 34 and collar 36 to the discharge end of the burner. Shorter tubes 48 extend through and are supported by the walls of collar 36. Cooling water enters chamber 40 through inlet 50 and passes between and around tubes 46 and 48 and through openings 42 to outlet 52. A sight opening 54 in line with tube 32 is covered with a sight glass 56.

Fuel is introduced through conduit 58 into tube 30 and passes through tubes 46 into the chamber 2. Oxygen is introduced through conduit 60 into tube 30 around tubes 46 and passes through tubes 48 into the chamber 2. Valves 62 and 64 are provided for controlling flow of fuel and oxygen to the burner. The fuel used is preferably natural gas which is substantially all methane, but may also be any suitable fluid hydrocarbon fuel such as atomized fuel oil or fluidized powdered coal. The oxygen need not be pure oxygen, but must be a gas containing at least 50% oxygen. It is preferred that commercially pure oxygen be used. The oxygen-to-fuel ratio is adjusted to a value that will result in a combustion product composition that is reducing to iron oxides at high temperatures and yet sufficient to provide the necessary heat of combustion. With any fluid hydrocarbon fuel the CO₂ to CO ratio is maintained between 0.06 and 0.22. When natural gas is the fuel, the volumetric oxygen-to-fuel ratio is between 0.8 and 1.1. With this ratio being maintained the gas firing rate is set at a value that will provide the desired pre-heating temperature. The injection velocities of the fuel and oxygen are maintained above the rate of flame propagation and should be maintained well below sonic velocities. It is preferred to have the velocities between 50 and 600 ft. per second. Burning of the fuel and oxygen is continued until the refractory lining has been heated to the desired temperature which is generally between 2700 and 3000° F. The products of combustion pass out through opening 6. The firing is then discontinued and a ladle L filled with molten steel is then positioned over opening 6 and the chamber 2 and tundish 14 evacuated in the usual manner.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. A burner for injecting a fluid hydrocarbon fuel and oxygen into a refractory lined hollow structure comprising a first tube, a transverse partition dividing said tube into a fuel receiving chamber and an oxygen receiving chamber axially spaced from the fuel receiving chamber, a collar having spaced walls arranged transversely of said first tube at the discharge end of the burner, a plurality of open ended long tubes extending through said partition and spaced walls to the discharge end of said burner, means for delivering said fuel to the fuel receiving chamber, a plurality of open ended short tubes arranged in between and adjacent said long tubes and extending through the walls of said collar, and means for delivering said oxygen to the oxygen receiving chamber, said fuel

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and oxygen combining to burn when they are discharged from said burner.

2. A burner according to claim 1 in which the diameter of said collar is substantially greater than the outer diameter of said first tube and a cooling water chamber is provided within the walls of said collar.

3. A burner according to claim 2 including diametrically aligned partitions in said cooling water chamber with openings therethrough, means for introducing cooling water into said chamber on one side of said partitions, and means for removing cooling water from said chamber on the other side of said partitions.

4. A burner according to claim 1 including an inner tube within said first tube extending from the discharge end of said burner through said chambers, and a closure for the end of said inner tube remote from said discharge end.

5. A burner according to claim 4 in which the diameter of said collar is substantially greater than the outer diameter of said first tube and a cooling water chamber is provided within the walls of said collar around said inner tube.

6. A burner according to claim 5 including diametrically aligned partitions in said cooling water chamber with

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openings therethrough, means for introducing cooling water into said chamber on one side of said partitions, and means for removing cooling water from said chamber on the other side of said partitions.

7. A burner according to claim 6 including flow control means for said fuel, and separate flow control means for said oxygen.

8. The combination of claim 1 including a refractory lined hollow structure at the discharge end of said burner, said hollow structure having an opening therein for receiving said fuel and oxygen from said tubes.

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U.S. Cl. X.R.

239—132.3