Feb. 7, 1967 L. H. HUTTON 3,302,882

OXYGEN LANCE CONSTRUCTION

Filed July 1, 1964 2 Sheets-Sheet 1

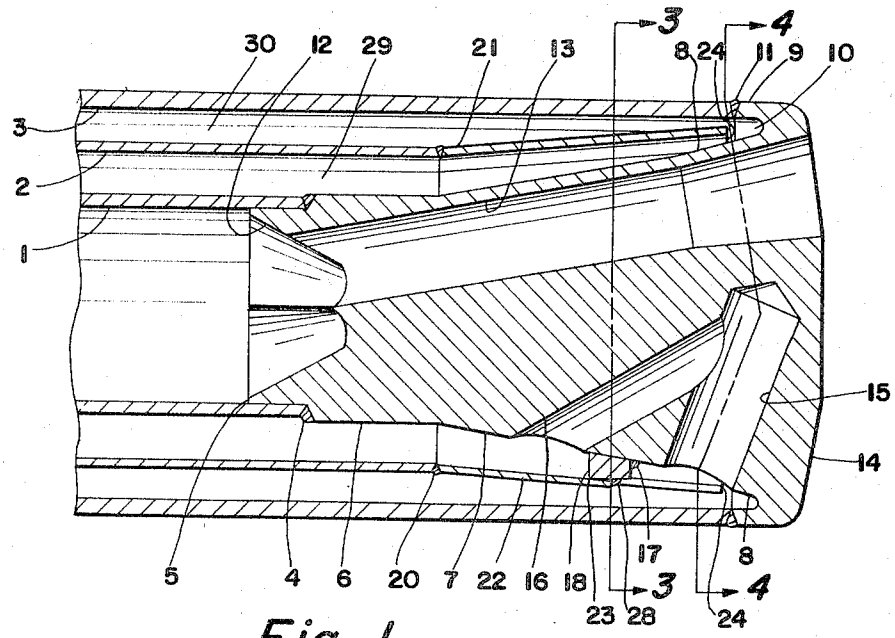

Fig. 1

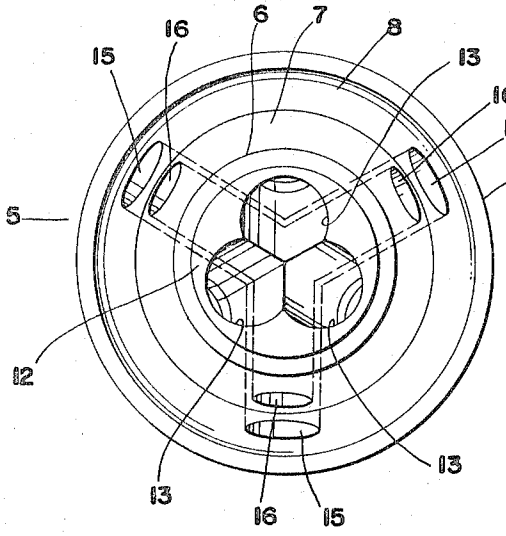

Fig. 2

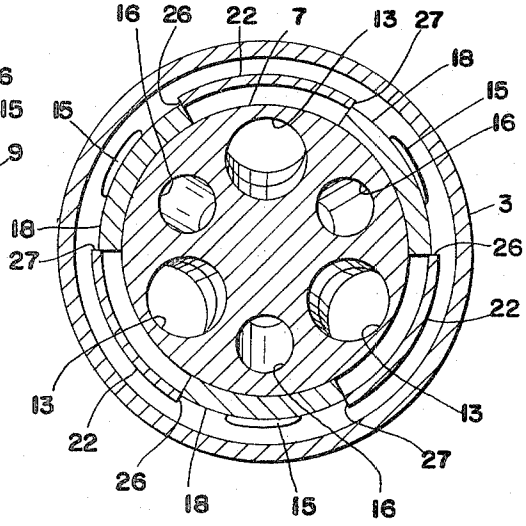

Fig. 3

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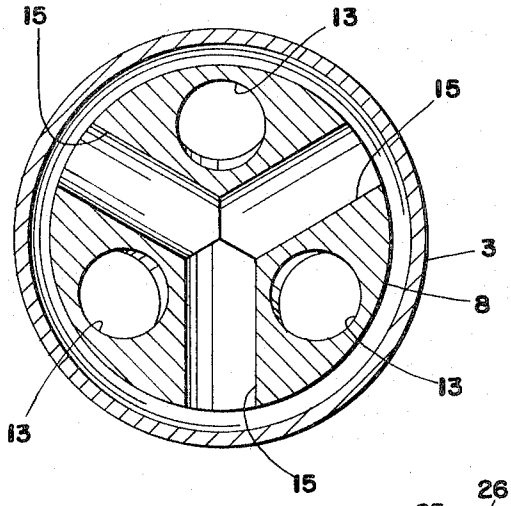

Fig. 4

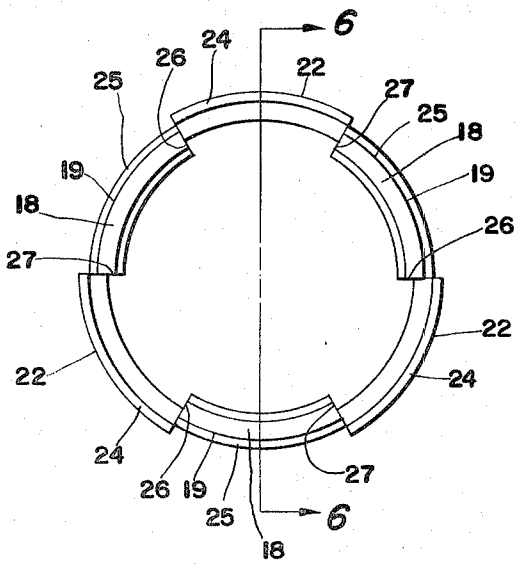

Fig. 5

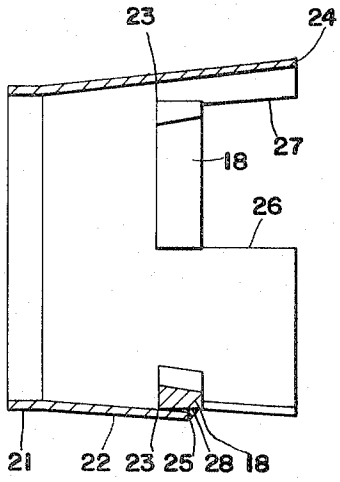

Fig. 6

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OXYGEN LANCE CONSTRUCTION

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9 Claims. (Cl. 239—132.3)

This invention relates generally to the construction of the discharge end portions of oxygen lances, but has reference more particularly to improvements in the type of lances disclosed in my U.S. Patent No. 2,979,270.

A primary object of the invention is to provide an oxygen lance of the character described, which has a novel construction designed to produce a highly effective and efficient water-cooling of the lance nozzle or tip during use of the same.

Another object of the invention is to provide an oxygen lance of the character described, having a novel and useful arrangement of water-circulating passageways.

A further object of the invention is to provide an oxygen lance of the character described, having a novel water directing skirt member and a novel arrangement of water diverting segments or baffles.

Other objects and advantages of my invention will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification, and in which like numerals are employed to designate like parts throughout the same,

FIG. 1 is a fragmentary cross-sectional view through the lower portion of an oxygen lance embodying the invention;

FIG. 2 is a top plan view of only the tip or nozzle of the lance;

FIG. 3 is a cross-sectional view, taken on the line 3—3 of FIG. 1;

FIG. 4 is a cross-sectional view, taken on the line 4—4 of FIG. 1;

FIG. 5 is a bottom plan view of the collar and segment portion of the lance, and

FIG. 6 is a cross-sectional view, taken on the line 6—6 of FIG. 5.

Referring more particularly to the drawings, there is disclosed the fragmentary lower portion of an oxygen lance consisting of tubular steel members 1, 2 and 3, in concentric spaced relation to each other, with the lower end of the member 1 at a higher level than the lower end of the member 2, and the lower end of the member 3 at a lower level than the lower end of the member 2.

Secured to the lower end of the member 1, as by welding 4, is a tip or nozzle 5, preferably made or machined in one piece from copper, which is 99.5% pure and is free from occluded oxygen.

The tip or nozzle 5 has a cylindrical upper external wall 6, a conical external wall 7 extending below the wall 6, and a conical external wall 8 which extends below the wall 7 and at a greater inclination to the axis of the nozzle than does the wall 7.

Below the wall 8, the nozzle is provided with an upwardly extending annular flange 9, which provides with the wall 8 an annular trough 10.

The lower end of the tubular member 3 is welded to the upper end of the flange 9, as at 11.

The tip or nozzle 15 is provided in its upper end with a central conical recess 12, from which is a series of circumferentially-spaced passageways 13 extend, through the nozzle, in a downwardly and outwardly inclined direction, communicating the lower end of the member 1 with the space below the nozzle or tip. Three such passageways are shown in the drawings, spaced apart circumferentially 120 degrees. The passageways 13 are inclined at an angle of approximately 10 degrees to the axis of the nozzle or

tip 5. The walls of the lower ends of the passageways 13 are flared outwardly about 5 degrees, and the nozzle or tip has a conical end face 14 disposed in a plane which is substantially perpendicular to the axes of the passageways 13.

The tip or nozzle 5 is also provided with a series of circumferentially-spaced passageways 15, which are arranged alternately with the passageways 13, and extend downwardly and inwardly from the walls 7 and 8 toward the center of the tip, the inner ends of these passageways communicating with each other. The axes of the passageways 15 are inclined at an angle of approximately 70 degrees to the axis of the tip or nozzle 5.

The tip or nozzle 5 is further provided with a series of circumferentially-spaced passageways 16, also arranged alternately with the passageways 13 and extending downwardly and inwardly from the wall 7, the inner ends of The passageways 16 are of somewhat lesser diameter 15 at points 16a adjacent the inner ends of the latter. The passageways 16 are of somewhat lesser diameter than the passageways 15, and the axes of the passageways 16 are inclined at an angle of approximately 30 degrees to the axis of the tip or nozzle 5.

Secured to the wall 7 of the nozzle, as by welding 17, are three circumferentially-spaced arcuate segments 18.

Each of the segments 18 is disposed just below the inlet end of a passageway 16, and extends 60 degrees horizontally about the nozzle, that is to say, it extends 30 degrees horizontally from each side of a vertical plane which passes through the axes of each pair of associated passageways 15 and 16.

The segments 18 are preferably cut from a ring having the outside diameter of the radially-outer surface 19 of the segment 18, and since the segments are 60° segments, as a practical matter, six such segments can be cut from a single ring of the dimension referred to.

Secured to the lower end of the tubular member 2, as by welding 20, is a collar having a short cylindrical upper end 21 and a conical skirt portion 22 which bears against and extends downwardly past the outer and upper edges 23 of the segments 18 and to a point 24 which is in spaced relation to the bottom of the annular trough 10.

Circumferentially-spaced portions of the skirt portion 22 of the collar, are removed, to provide recesses, the upper edges of which are indicated by reference numeral 25, and the side edges of which are designated by reference numerals 26 and 27. The edges 25 of the collar are welded to the segments 18, as at 28, and the edges 26 and 27 of the recesses are in vertical planes which are coplanar with the ends of the segments 18.

In the use of the oxygen lance, as thus described, oxygen is supplied to the tubular member or conduit 1, and thence through the passageways 13 to the molten metal in the open hearth furnace.

As oxygen is thus supplied to the furnace, water for cooling the tip or nozzle 5 is supplied continuously to the space 29 between the members 1 and 2, the water circulating downwardly to the annular trough 10 and then upwardly through the space 30 between the members 2 and 3.

A portion of the water in the space 29 strikes the upper surfaces of the segments 18, which thus constitute baffles, and is diverted by these baffles to the inlet ends of the passageways 16, such diverted water passing through the passageways 16, thence through passageways 15, and outwardly into the space below the segments 18, where it mingles with the water which passed directly into the trough 10.

The conjoint action of the water passing directly into the trough 10 and that diverted through the nozzle and then into the trough produces a desired turbulence or flow of the circulating water which is highly effective to produce an efficient cooling of the nozzle, maintaining

the nozzle at a non-destructive temperature throughout long periods of use.

The cooling action is further enhanced by the fact that the cooling water takes a somewhat circuitous path in passing through the passageways 16 and 15, which passageways conjointly have a large cubical volume.

Furthermore, the spaces between the segments 18 act as passageways or channels to direct the cooling water directly into the trough 10, and this, also, has been found to be effective in producing an efficient, desired, cooling of the tip.

It is thus seen that I have provided a novel construction for an oxygen lance, which is advantageous from all of the above described viewpoints.

It is to be understood that the form of my invention, herewith shown and described, is to be taken as a preferred example of the same, and that various changes may be made in the shape, size and arrangement of parts thereof, without departing from the spirit of the invention or the scope of the subjoined claims.

Having thus described my invention, I claim:

1. In a device of the character described, three concentrically spaced tubular members, a nozzle supported by the innermost of said members, said nozzle made as a one-piece member of copper having a series of passageways consisting of circumferentially-spaced inclined bores diverging downwardly and outwardly through said nozzle for the passage of oxygen therethrough, said nozzle having a second series of passageways consisting of cylindrical bores arranged circumferentially alternately with said first-named passageways and extending upwardly and outwardly from a region within the nozzle to the external wall of the nozzle, said nozzle having a third series of passageways consisting of cylindrical bores arranged circumferentially alternately with said first-named passageways and disposed above said second-named passageways and extending upwardly and outwardly from said second-named passageways to the external wall of said nozzle, but at an angle to the axis of said nozzle different from that of said second-named passageways, the inner ends of said second and third-named passageways having fluid communication with each other at points adjacent the inner ends of said second-named passageways, whereby a cooling fluid passing through said second or third-named passageways passes through the other of said series of second or third-named passageways.

2. A device, as defined in claim 1, wherein said nozzle is provided at its lower end with an upturned annular flange which is secured to the lower end of the outermost of said tubular members, said flange providing an annular trough for flow of said cooling fluid.

3. In a device of the character described, three concentrically arranged spaced tubular members, a nozzle supported by the innermost of said members, said nozzle made as a one-piece member of copper having a series of passageways consisting of circumferentially-spaced inclined bores diverging downwardly and outwardly through said nozzle for the passage of oxygen therethrough, a second series of circumferentially-spaced passageways therein for the passage of a cooling fluid, said second series of passageways consisting of bores arranged circumferentially alternately with said first-named passageways, and extending inwardly and downwardly toward the center of said nozzle and converging in a common junction near the center of said nozzle, and a third series of circumferentially-spaced passageways for the passage of cooling fluid, said third series of passageways consisting of bores arranged alternately with said first-named passageways and extending from the external wall of said nozzle inwardly and downwardly, and communicating with said second series of passageways, said nozzle provided at its lower end with an upturned annular flange which is secured to the lower end of the outermost of said tubular members and provides an annular trough, said nozzle having circumferentially-spaced arcuate segments secured to the external wall of the nozzle below the outer ends of said third-named passageways.

4. A device, as defined in claim 3, in which a collar is secured to the lower end of that tubular member which is intermediate the innermost and outermost tubular members, said collar bearing against and extending downwardly past the upper and outer edges of said segments to a point which is in spaced relation to the bottom of said annular trough.

5. A device, as defined in claim 4, in which circumferentially-spaced portions of said collar are removed to provide recesses in the lower portion of the collar, the upper edges of said recesses being welded to said segments, and the side edges of said recesses disposed in vertical planes substantially coplanar with the ends of said segments, said segments constituting baffles for diverting cooling fluid into the outer ends of said third series of passageways.

6. In a device of the character described, three concentrically-spaced tubular members, a nozzle supported by the innermost of said members, said nozzle comprising a one-piece member having a series of passageways consisting of inclined bores diverging downwardly and outwardly through said nozzle for the passage of oxygen therethrough, said nozzle having a second series of passageways consisting of cylindrical bores arranged circumferentially alternately with said first-named passageways and extending upwardly and outwardly from a region within the nozzle to the external wall of the nozzle, said nozzle having a third series of passageways consisting of cylindrical bores arranged circumferentially alternately with said first-named passageways and disposed above said second-named passageways and extending upwardly and outwardly from points adjacent the inner ends of said second-named passageways to the external wall of the nozzle but at an angle to the axis of the nozzle different from that of said second-named passageways, the inner ends of said second and third series of passageways having fluid communication with each other whereby a cooling fluid passing through said third-named passageways passes through said second-named passageways, and means for diverting said cooling fluid into the outer ends of said third-named passageways, said means comprising arcuate segments bearing on the external wall of said nozzle and disposed below said outer ends of said third-named passageways, and a collar in spaced relation to the external wall of said nozzle and coacting with said segments to cause said diversion of cooling fluid.

7. In a device of the character described, three concentric spaced tubular members, a nozzle supported by the innermost of said tubular members, said nozzle comprising a one-piece member having a series of oxygen conducting passageways and a series of passageways for conducting a cooling fluid, circumferentially-spaced arcuate segments bearing on the external wall of said nozzle adjacent certain of said second series of passageways, and a collar secured to the lower end of that tubular member which is intermediate the innermost and outermost tubular members, said collar bearing against said arcuate segments and coacting therewith to divert said cooling fluid into certain of said second-named series of passageways.

8. A device, as defined in claim 7, in which circumferentially-spaced portions of said collar are removed to provide recesses in the lower portion of the collar through which cooling fluid from certain of said second-named passageways may pass into the space between the intermediate and outermost of said tubular members.

9. In a device of the character described, three concentrically spaced tubular members, a nozzle supported by the innermost of said members, said nozzle made as a one-piece member of metal having a series of passageways consisting of circumferentially-spaced inclined bores diverging downwardly and outwardly through said

nozzle for the passage of oxygen therethrough, said nozzle having a second series of passageways consisting of bores arranged circumferentially alternately with said first-named passageways and extending upwardly and outwardly from a region within the nozzle to the external wall of the nozzle, said nozzle having a third series of passageways consisting of bores arranged circumferentially alternately with said first-named passageways and extending upwardly and outwardly from said second-named passageways to the external wall of said nozzle, but at an angle to the axis of said nozzle different from that of said second-named passageways, the inner ends of said second and third-named passageways having fluid communication with each other at points adjacent the

inner ends of said second-named passageways, whereby a cooling fluid passing through said second or third-named passageways passes through the other of said series of second or third-named passageways.

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