United States Patent

[11] 3,559,974

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Continuation-in-part of application Ser. No. 445,100, Apr. 2, 1965, now Patent No. 3,430,939.

[54] **OXYGEN LANCES HAVING A HIGH RESISTANCE TO DETERIORATION AND MULTIPIECE NOZZLE HEADS THEREFOR**

12 Claims, 5 Drawing Figs.

[52] U.S. Cl. 266/34
[51] Int. Cl. C21c 13/02
[50] Field of Search 75/60; 266/34, 34.1, 34.2, 35

[56] References Cited

UNITED STATES PATENTS

3,201,104	8/1965	Berry	266/34
3,322,348	5/1967	Vonnemann	266/34
3,322,419	5/1967	Smith et al.	266/34
3,385,587	5/1968	Smith	266/34

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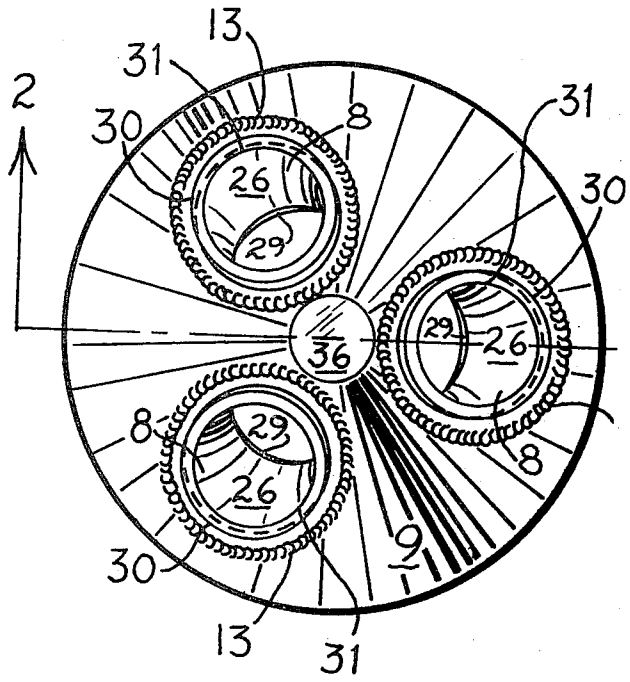
ABSTRACT: Oxygen lances having a high resistance to deterioration comprising a shank and a multipiece nozzle connected thereto wherein the multipiece nozzle includes a worked metal, e.g. copper, base portion, worked metal, e.g. copper, oxygen conduits and a cast metal, e.g. copper, body portion including oxygen conduit means connected to said worked metal, e.g. copper, oxygen conduits. The terminology "worked" means forged or pressed or formed or extruded or swaged. The so-worked copper utilized herein is free from oxygen hydrogen, sulfur and any elements considered to be "tramp" elements with respect to copper, which elements by themselves, or in combination, could form precipitates that would migrate to the grain boundaries to lower the physical properties or cause grain separation.



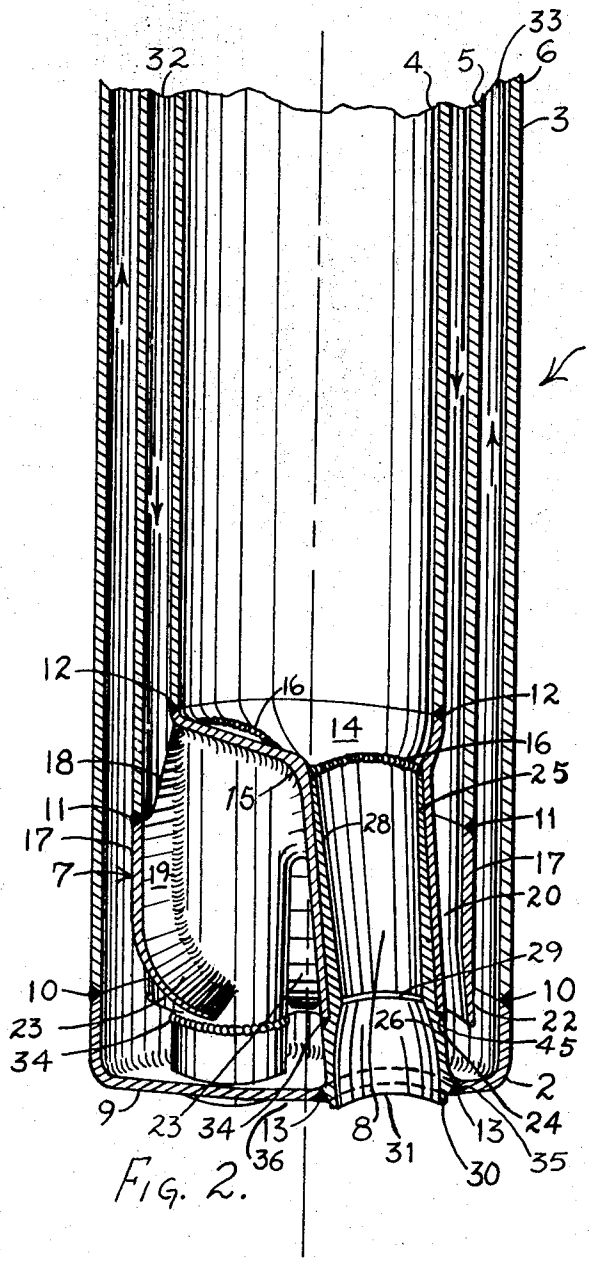


FIG. 2.

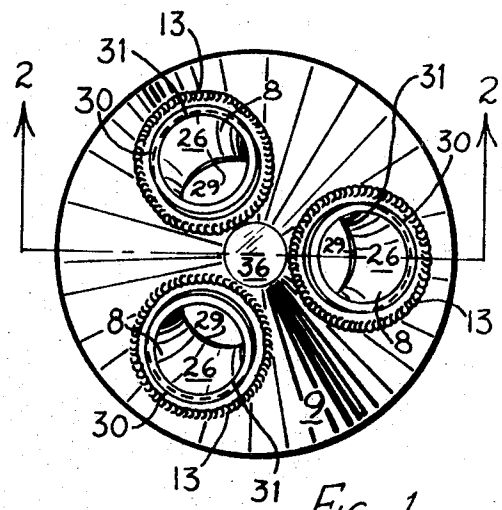


FIG. 1

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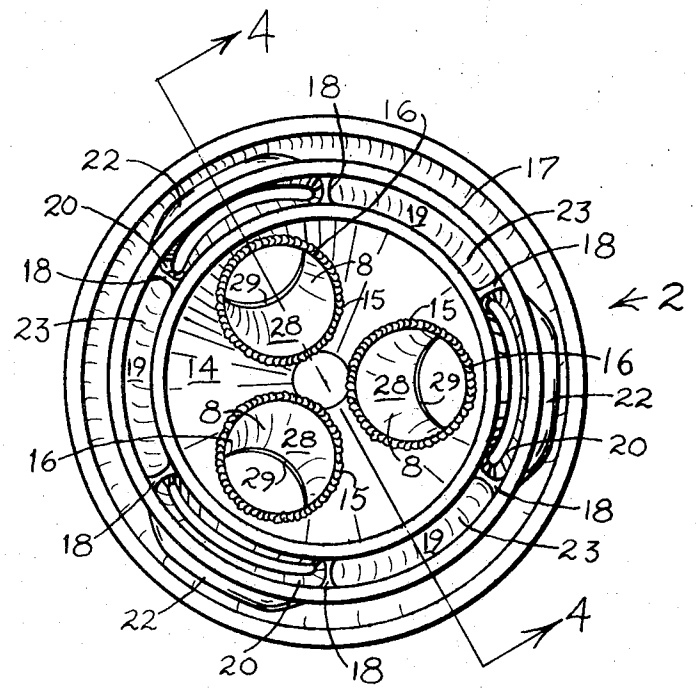

FIG. 3

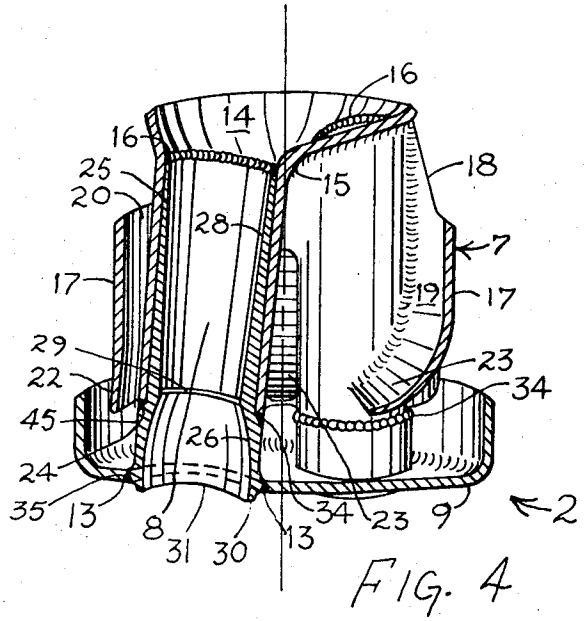

FIG. 4

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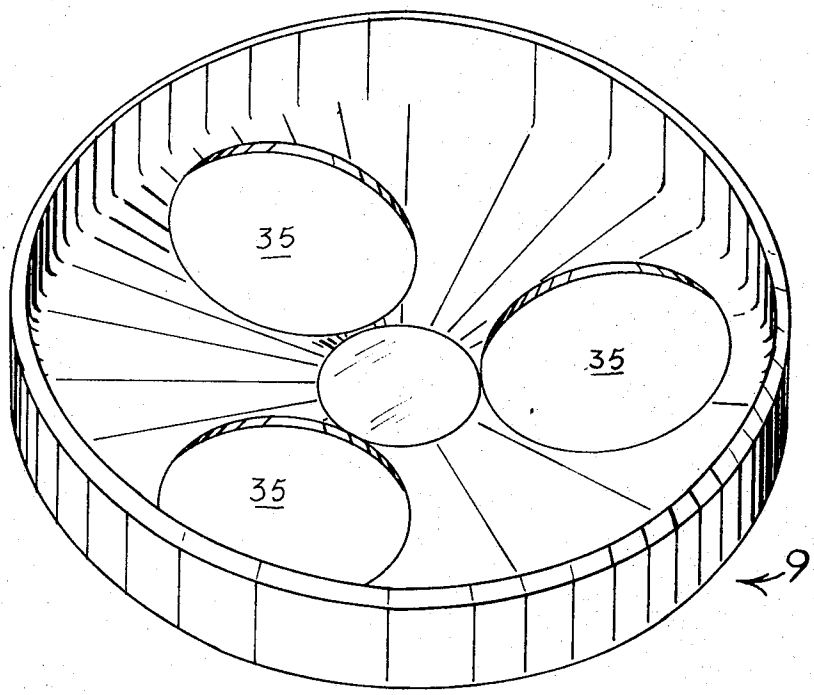

FIG. 5

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OXYGEN LANCES HAVING A HIGH RESISTANCE TO DETERIORATION AND MULTIPIECE NOZZLE HEADS THEREFOR

This application is a continuation-in-part of my application Ser. No 445,100 filed on Apr 2, 1965 and now U.S. Pat. No 3,430,939

BACKGROUND OF THE INVENTION

1 Field of the Invention

This invention relates to oxygen lances having a high resistance to deterioration and also to multipiece nozzles or heads therefor having a high resistance to deterioration. Oxygen lances, as is well known, are utilized for injecting oxygen into open hearth furnaces and also basic oxygen furnaces. It is likewise well known that the nozzle or head portion of the lance is relatively rapidly deteriorated, as compared to the other portions of the lance, and that such deterioration takes place at the nose portion of the nozzle particularly around the nozzle exit openings from which the oxygen passes or is ejected into the furnace. In attempts to solve such deterioration problems heretofore various types of materials having high-temperature resistance and high resistance to oxidation have been used. However, such attempts have been unsatisfactory because such materials still oxidize and otherwise deteriorate substantially as rapidly as does copper, the most widely used nozzle material. Also, the nozzle head and the entire lance have, in some instances, been redesigned with respect to the cooling system therein and therefor, that is, a better circulation of the coolant water in the region of the oxygen conduits at the nose portion of the nozzle has been accomplished, but the problem of, in many instances, rapid deterioration has not been completely solved. The lance and the multipiece nozzle of this invention are such that the number of heats accomplished therewith are substantially increased, for example, as high as 100 percent, or more. As is well known, copper, the most widely used nozzle material, has a relatively low melting point and is used widely in its cast form for nozzles.

The oxygen lance and the multipiece nozzle of this invention have a high resistance to deterioration, and the high deterioration resistant nozzle of this invention has a worked metal, e.g. copper, base or nose portion and worked metal, e.g. copper, oxygen conduits and a cast metal, e.g. copper, body portion including oxygen conduit means connected to said worked metal, e.g. copper, oxygen conduits. As is well known, such materials as aluminum, copper and forging brass are readily worked. The word "worked" herein means forged or pressed or formed or extruded or swaged. The copper herein utilized in its worked state is copper free from oxygen, hydrogen, sulfur and any elements considered to be "tramp" elements with respect to copper, which by themselves, or in combination, could form precipitates that would migrate to the grain boundaries to lower the physical properties or cause grain separation. Because of the use of the worked copper as hereinbefore set forth and as shall be hereinafter more particularly described the multipiece nozzles and, of course, the lances of this invention are highly resistant to deterioration. The cast copper and the worked copper used are both high-conductivity copper.

2. Description of the Prior Art

Oxygen injection lances and nozzles or heads therefor, as presently known, are disclosed in many U.S. patents. Such patents include the Berry U.S. Pat. No. 3,201,104 wherein ceramic sleeves are used in the single-cast, high-conductivity copper nozzle and the Berry U.S. Pat. No. 3,043,577 wherein the cooling system has been modified for preventing heat deterioration of the lance. Also included amongst related prior art patents are the Berry U.S. Pat. No. 3,118,608, the Kurzinski U.S. Pat. No. 3,065,916 and the Vonnemann U.S. Pat. No. 3,322,348.

In the prior art either the coolant system and/or ceramic inserts for the nozzle oxygen conduits are used to make the lance and of course the nozzle therefor somewhat deterioration resistant However, the deterioration-resistant lance and nozzle of this invention is relatively simple and economical to manufacture and does not require any substantial change in the lance and nozzle coolant circulation system Likewise, no exotic temperature-resistant and oxidation-resistant materials, such as ceramic materials, are required The combination of the cast copper and the worked copper as hereinbefore set forth and as shall be hereinafter more particularly described enables the attainment of a high deterioration-resistant lance and nozzle therefor capable of accomplishing an increase of 100 percent, or more, in the number of heats as compared with the attainment of prior art lances and nozzles therefor.

SUMMARY OF THE INVENTION

The oxygen injection lances and the multipiece nozzles therefor of this invention are such that have a high resistance to deterioration, that is, they are capable of accomplishing an increase of 100 percent, or more, in the number of heats without any substantial deterioration of the nozzle, particularly at the nose portion thereof around the nozzle exit openings, by the use of the worked copper for the base or nose portion and for the nozzle oxygen conduits and the use of the cast copper for the nozzle body portion including the oxygen conduits thereof connected to the worked copper nozzle oxygen conduits.

One of the objects of this invention is to provide an oxygen lance having a high resistance to deterioration including a shank and a multipiece nozzle connected thereto, said nozzle having a worked copper base or nose portion and worked copper oxygen conduits and a cast copper body portion.

Another object of this invention is to provide an oxygen lance multipiece nozzle having a high resistance to deterioration, said nozzle having a worked copper base or nose portion and worked copper oxygen conduits and a cast copper body portion.

Other objects and features will be readily apparent from the following detailed description which is not limiting but only illustrative of the preferred embodiment of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a bottom view of the oxygen lance of this invention and also of the multipiece nozzle of this invention.

FIG. 2 is a longitudinal cross-sectional view taken on line 2–2 of FIG. 1, showing a portion of the oxygen lance.

FIG. 3 is a top view of the multipiece nozzle of this invention.

FIG. 4 is a longitudinal cross-sectional view taken on line 4–4 of FIG. 3.

FIG. 5 is a perspective view of a component part of the oxygen lance and of the multipiece nozzle of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Elements or groups of elements which are conventional and generally widely known in the field to which the oxygen injection lance and the multipiece nozzle of this invention relates of course form a part of the lance and also a part of the nozzle of this invention herein described, and their exact nature or type is not here described in detail for the reason that persons skilled in the art can understand and use the lance and nozzle of this invention without a detailed recitation of such conventional and generally widely known elements or groups of elements.

More particularly, oxygen lance **1** includes a top adapter assembly (not shown), multipiece nozzle or head **2** and shank portion **3** including the three concentrically positioned pipes, namely centrally positioned pipe **4**, intermediate pipe **5**, and outer pipe **6**.

Multipiece nozzle **2** includes cast copper body member **7**, worked copper oxygen exit conduits **8**, **8**, **8** and worked copper base or nose portion **9**. Nose portion **9** is joined to outer pipe **6** by circumferential weld **10**, and cast copper body member **7** is joined to intermediate pipe **5** by circumferential

weld 11 and to centrally positioned pipe 4 by circumferential weld 12, as is clearly apparent from the appended drawings. Nose portion 9 is likewise joined to worked copper oxygen exit conduits 8, 8, 8 in openings 35, 35, 35 thereof by circumferential welds 13, 13, 13, as is clearly apparent from the appended drawings. Cast copper body member 7 includes duct portion 14 and entry conduit portions 15, 15, 15 integral therewith, as is clearly apparent from the appended drawings. Worked copper oxygen exit conduits 8, 8, 8 are joined to cast copper oxygen entry conduit portions 15, 15, 15 (which are integral with cast copper duct portion 14) by circumferential welds 16, 16, 16 at approximately the respective portions thereof where duct portion 14 is integral with cast copper entry conduit portions 15, 15, 15, as is clearly shown in the appended drawings. Cast copper body member 7 also includes cast copper wall member 17 spaced from cast copper duct portion 14 and cast copper oxygen entry conduit portions 15, 15, 15, by means of connecting cast copper wall members 18, 18, 18, 18, 18, 18 integral therewith, as clearly shown in the appended drawings. Thereby are formed coolant passageways 19, 19, 19 and coolant passageways 20, 20, 20. Coolant passageways 20, 20, 20 are formed, as clearly shown in the appended drawings, by cast copper wall member 17 and cast copper wall portions 22, 22, 22 integral with cast copper wall 17 and connecting cast copper wall members 18, 18, 18, 18, 18, 18, and cast copper duct portion 14 and also cast copper entry conduit portions 15, 15, 15, all as clearly shown in the appended drawings. Each of worked copper oxygen exit conduits 8, 8, 8 includes circumferential shoulder portion 24, top portion 25, and bottom portion 45, and each of cast copper oxygen entry conduit portions 15, 15, 15, in the assembly of multipiece nozzle 2, is in fluidtight relation with and is joined by circumferential welds 34, 34, 34 to each of said worked copper oxygen exit conduits 8, 8, 8 at said shoulder portions 24, 24, 24, as clearly shown in the appended drawings. As is also clearly shown in the appended drawings, each of worked copper oxygen exit conduits 8, 8, 8 diverges from the vertical axis of nozzle 2 and preferably includes the parabolic profiled lower inner wall surfaced portion 26, as clearly shown in the appended drawings, the throat portion 29 and portion 28 inclined from the top thereof to and toward throat portion 29, as clearly shown in the appended drawings. Preferably, each of worked copper oxygen exit conduits 8, 8, 8 includes a portion 30 which extends beyond worked copper base or nose portion 9 of nozzle 2 in its assembled condition. Also, each of worked copper oxygen exit conduits 8, 8, 8 can be of a converging-diverging shape (not shown herein) as shown in my application Ser. No. 445,100. In addition, each of worked copper oxygen exit conduits 8, 8, 8 can terminate to be coextensive with the flat portion 36 of base portion 9 instead of including portion 30 extending beyond base or nose portion 9.

In the operation of oxygen lance 1 oxygen passes through centrally positioned pipe 4, duct portion 14 of cast copper body member 7 of nozzle 2, entry conduit portions 15, 15, 15 of cast copper body member 7 and worked copper oxygen exit conduits 8, 8, 8 out through oxygen exit ports 31, 31, 31 of portions 30, 30, 30 into the furnace. Likewise, in the operation of oxygen lance 1 coolant water passes downwardly through annular passageway 32, coolant passageways 19 and 20 past wall member 17 and wall portions 22, 22, 22 and apron members 23, 23, 23 and, of course, connecting wall members 18, 18, 18, 18, 18, 18 past duct portion 14 and oxygen entry conduit portions 8, 8, 8 and back upwardly, through nozzle 2 and annular passageway 33, all as clearly shown by the directional arrows in the appended drawings and the appended drawings themselves.

As is clear from the description herein and also from the appended drawings herein, nozzle 2 is capable of easy and economical manufacture and of easy and economical repair. Worked copper base or nose portion 9 and each of worked copper oxygen exit conduits 8, 8, 8 can be easily replaced as the need arises merely by cracking the circumferential welds, and exit conduits and a nose portion of various dimensions can be thereby utilized.

As hereinbefore set forth, the worked copper is free from oxygen, hydrogen, sulfur and any elements considered to be "tramp" elements with respect to copper, which by themselves, or in combination, could form precipitates that would migrate to the grain boundaries to lower the physical properties or cause grain separation. Preferably the worked copper herein is forged copper. However, pressed copper or formed copper or extruded copper or swaged copper can likewise be used as the worked copper.

Many alterations and changes may be made without departing from the spirit and scope of this invention which is set forth in the appended claims which are to be construed as broadly as possible in view of the prior art.

I claim:

1. An oxygen lance having a high resistance to deterioration comprising, in combination;
- a shank and a multipiece nozzle head connected to said shank;
- said shank including:
  - duct means for passing oxygen therethrough and into said nozzle head and duct means for passing coolant therethrough and into said nozzle head and returning said coolant from said nozzle head therethrough;
- said nozzle head including:
  - duct means for passing oxygen therethrough and then therefrom;
    - said oxygen duct means having cast metal entry conduit means and worked metal exit conduit means;
  - a worked metal base portion, and cast metal means for circulating said coolant therethrough in heat exchange relationship with said oxygen duct means and said base portion; and
    - said worked metal exit conduit means being connected at one end portion thereof to said worked metal base portion and at the other end portion thereof to said cast metal entry conduit means.

2. The oxygen lance of claim 1 wherein said cast metal is cast copper and said worked metal is worked copper.

3. The oxygen lance of claim 2 wherein said worked copper exit conduit means extends beyond said base portion.

4. The oxygen lance of claim 2 wherein said worked copper exit conduit means includes a plurality of worked copper exit conduit members each diverging from the lance vertical axis.

5. The oxygen lance of claim 2 wherein:
- said worked copper exit conduit means includes a plurality of worked copper exit conduit members each diverging from the lance vertical axis;
  - each of said conduit members including a portion having a parabolic profile.

6. The oxygen lance of claim 5 wherein each of said conduit members extends beyond said base portion.

7. A multipiece nozzle head for an oxygen lance having a high resistance to deterioration, comprising, in combination:
- duct means for passing oxygen therethrough and then therefrom, said duct means including:
  - cast metal entry conduit means and worked metal exit conduit means;
- a worked metal base portion;
- cast metal means for circulating coolant therethrough in heat exchange relationship with said oxygen duct means and said base portion;
  - said worked metal exit means being connected at one end portion thereof to said worked metal base portion and at the other end portion thereof to said cast metal entry conduit means.

8. The nozzle head of claim 7 wherein said cast metal is cast copper and said worked metal is worked copper.

9. The nozzle head of claim 8 wherein said worked copper exit conduit means extends beyond said base portion.

10. The nozzle head of claim 8 wherein said worked copper exit conduit means includes a plurality of worked copper exit conduit members each diverging from the nozzle head vertical axis.

11. The nozzle head of claim 8 wherein:

said worked copper exit conduit means includes a plurality of worked copper exit conduit members each diverging from the nozzle head vertical axis; and

each of said conduit members including a portion having a parabolic profile.

12. The nozzle head of claim 11 wherein each of said conduit members extends beyond said base portion.