

Feb. 23, 1965

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3,170,977

OXYGEN LANCE WITH DETACHABLE BARREL

Filed Nov. 16, 1961

5 Sheets-Sheet 1

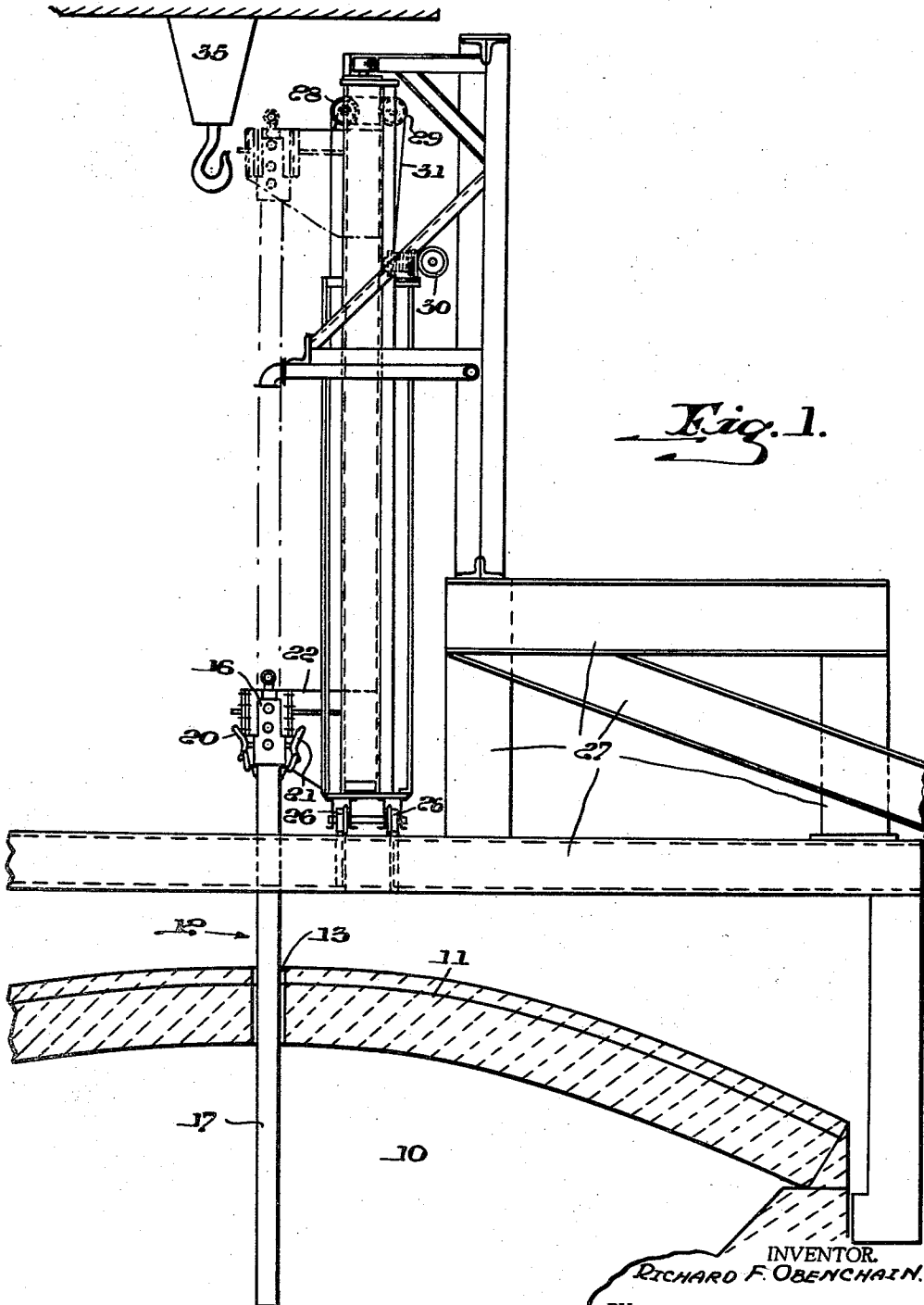


Fig. 1.

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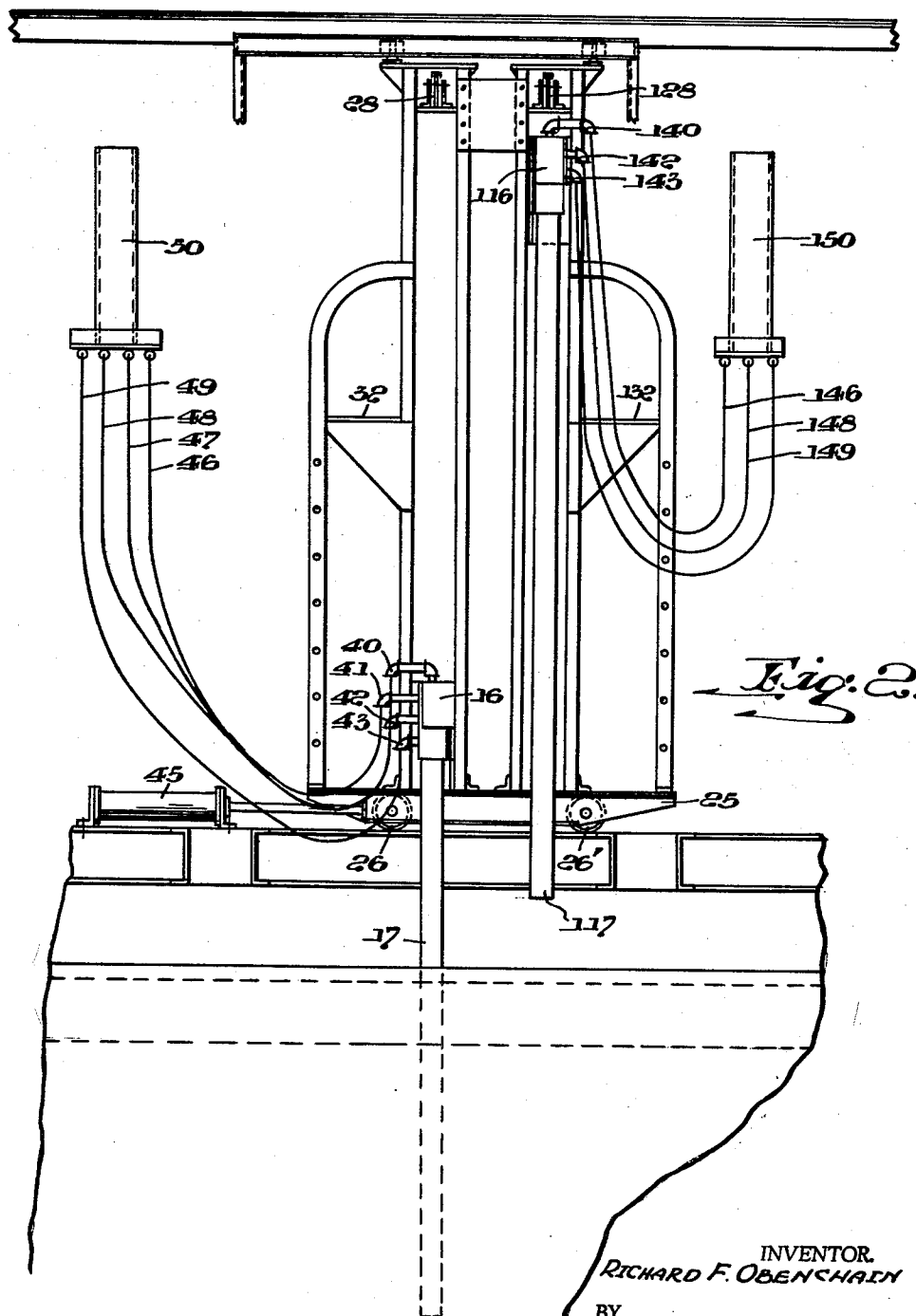
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5 Sheets-Sheet 2



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OXYGEN LANCE WITH DETACHABLE BARREL

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5 Sheets-Sheet 3

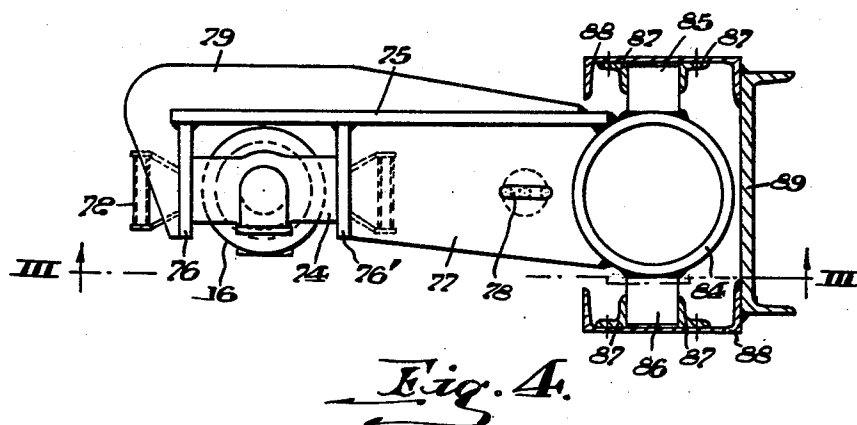


Fig. 4.

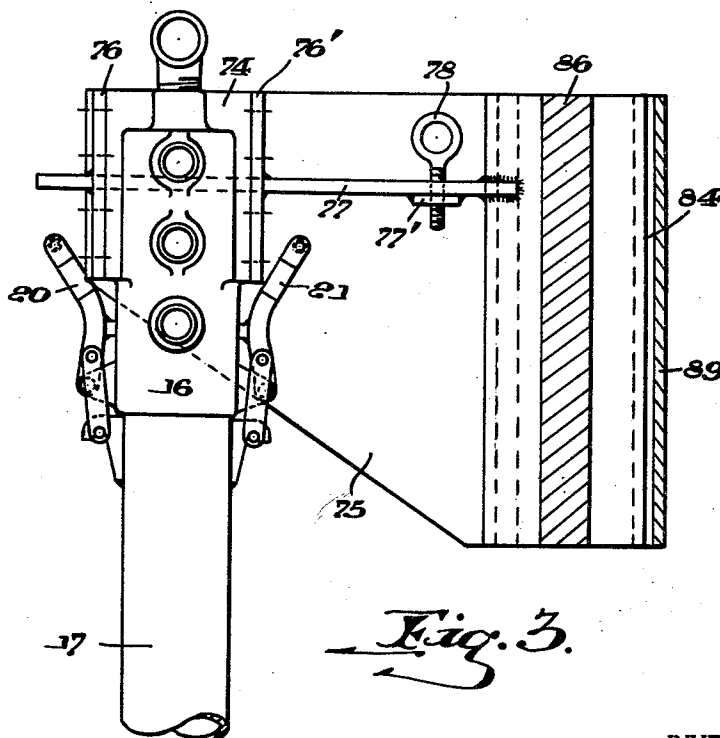


Fig. 3.

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5 Sheets-Sheet 4

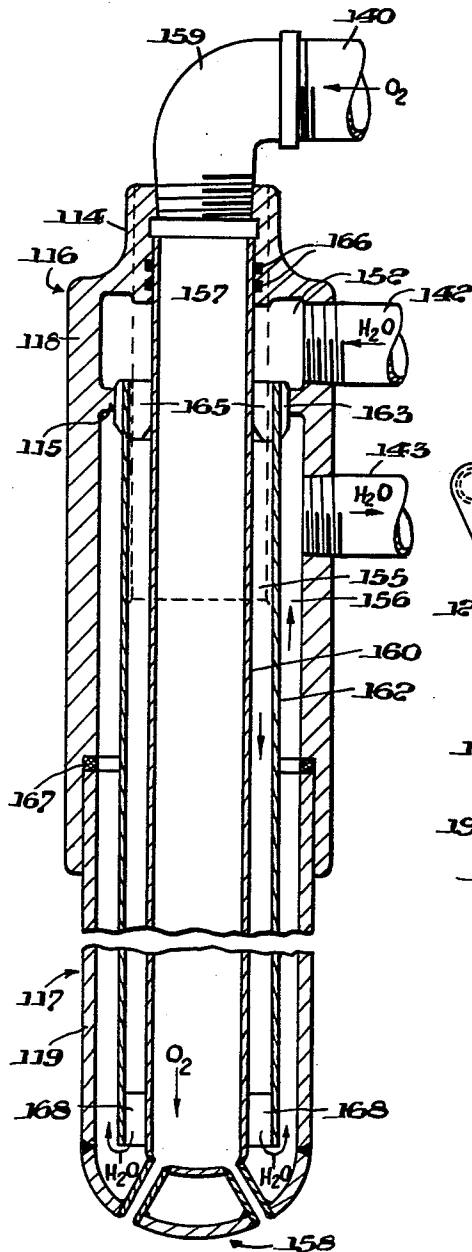


Fig. 5.

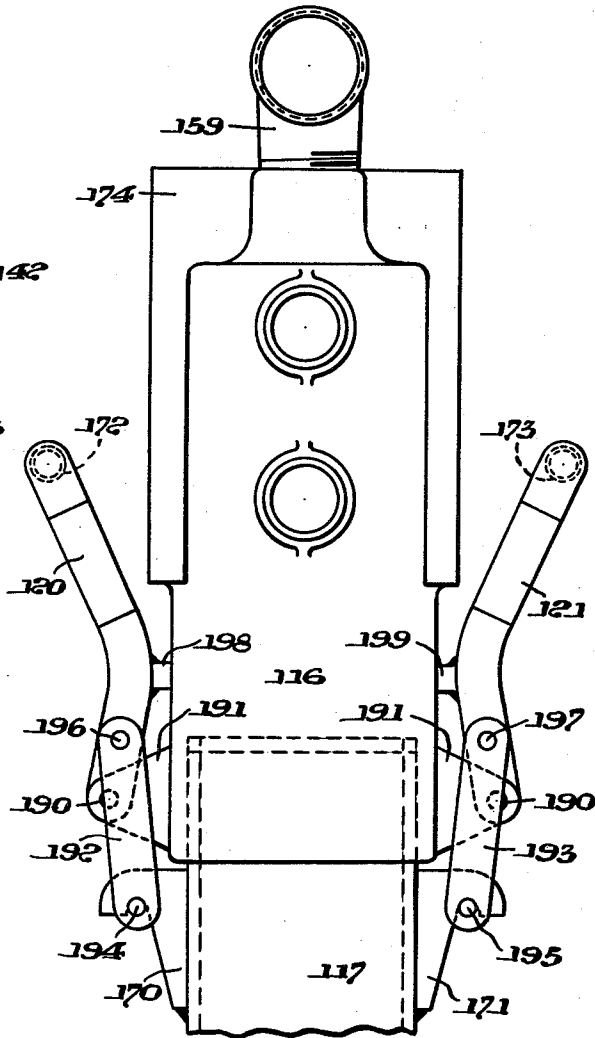


Fig. 6.

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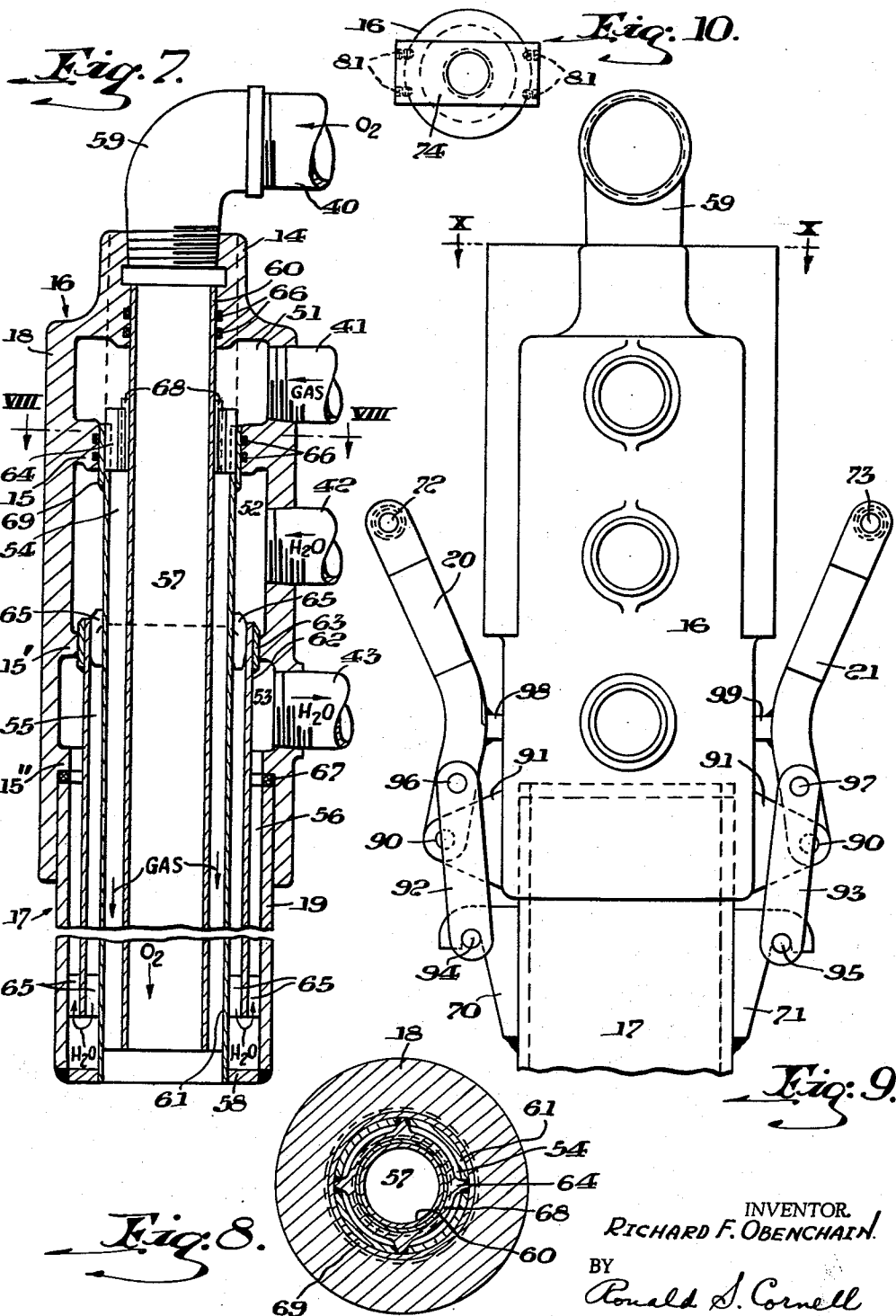
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5 Sheets-Sheet 5



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3,170,977

OXYGEN LANCE WITH DETACHABLE BARREL

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4 Claims. (Cl. 266—34)

This invention relates to feed apparatus for the introduction of oxygen or fuel-oxygen mixtures in processes for refining metal such as in the Basic Oxygen Furnace or Open Hearth steelmaking processes and more particularly to an improved lance for supplying fuel and oxygen or oxygen in such processes.

A long tube or lance is frequently used to introduce oxygen into molten pig iron as is required in conventional steelmaking practice to provide heat and reaction of the impurities as required for the refining of the metal. The lance is usually inserted into the open upper end of a closed bottom converter and a jet of substantially pure oxygen or an oxygen-fuel mixture is fed from an orifice at the end of the lance against the metal in the converter. Such lances are exposed to intense heat in the order of 4,000° F.

One of the principal short comings of the lances of the prior art has been their inability to withstand for any reasonable length of time the effect of the high temperatures obtaining in steel processing furnaces. The difficulty of replacing an improperly functioning lance has been a prime problem. Suitable means for supporting the lances has also been a problem in this connection. These difficulties are clearly shown in a typical lance of the prior art such as that shown in U.S. Patent No. 2,829,960 issued to Vogt and dated April 8, 1958. The lance of this patent is illustrative of the prior art lances and it includes a number of connections which must be removed in order to replace the lance.

Since the outer shell of the lance is subjected to extremely high temperatures which vary over the length of the lance, and since varying heat conditions exist in the internal portions of the lance, provision must be made to allow the various components of the lance to expand and contract independently of each other. In present practice this has resulted in a lance having a nose designed for proper application of gases to the unrefined metal, a barrel composed of pipes or conduits for conducting the gases and cooling mediums to the nose, and a head serving as a multiple passage manifold to deliver fluids and gases to the barrel and containing piping connections for receipt of fluids and gases from an external piping system. Heretofore, the nose, barrel and head have been joined together to form a one-piece lance with glands and sliding devices to allow independent movement of the various internal components.

Lances commonly fail in the nose or lower barrel section as a result of: action of the intense heat upon this portion of the lance with resultant distortions caused by expansion and contraction, the changes in the physical metallurgical structure of the metal of the nose and barrel, the erosive or corrosive action of the gases upon the nose as the gases are delivered to the unrefined metal in the furnace and oxidation of the nozzle metals.

Lances as presently used have the disadvantage of requiring replacement of the entire lance because of nose failure. This replacement is costly and time consuming because the piping connections to the lance must be disconnected from the old lance and reconnected to the replacement.

By virtue of the instant invention these difficulties can now be disposed of in a practical and economical manner. When the devices of this invention require repair, maintenance or replacement, such can be easily effected at a small cost in both labor and time. This invention pro-

vides an apparatus which upon failure of the lance will require only the replacement of the barrel and nose sections of the lance, thereby reducing the cost of replacement because it eliminates the necessity of replacing the lance head. The present invention secures the nose and barrel of the lance to the lance head by a simple, quick-detach mechanism by virtue of which the barrel may be separated from the lance head in a simple, economical and facile way.

This invention further contemplates a supporting structure for the lance wherein the lance head is an integral part of a guided carriage which may be raised or lowered to adjust the lance height in relation to the level in the furnace and which also serves to maintain the lance in a vertical position.

With the foregoing and other objects in view which will all appear as the description proceeds the invention resides in a combination and arrangement of parts and in the details of construction hereinafter described, a preferred form of which is shown in the accompanying drawings in which:

FIGURE 1 is a side elevational view showing an embodiment of the lance carrying mechanism in conjunction with an Open Hearth furnace;

FIGURE 2 is a front elevational view showing the same structure as FIGURE 1;

FIGURE 3 is an enlarged view of a portion of FIGURE 1 showing the lance head and lance carriage and taken on lines III—III of FIGURE 4;

FIGURE 4 is a top view of the apparatus of FIGURE 3;

FIGURE 5 is a cross-sectional view of an oxygen lance;

FIGURE 6 is a view of an oxygen lance head showing the clamping mechanism in detail;

FIGURE 7 is a cross-sectional view of a fuel-oxygen lance head;

FIGURE 8 is a horizontal cross-sectional view along lines VIII—VIII of FIGURE 7;

FIGURE 9 is a side elevational view of the lance head of FIGURE 7; and,

FIGURE 10 is a plan view taken along lines X—X of FIGURE 9.

This invention is advantageously used with an Open Hearth furnace but may also be used with other types of furnaces; for example, may be used to introduce oxygen into a Basic Oxygen furnace.

The furnace 10, FIGURE 1, is a conventional Open Hearth furnace having a silica brick roof 11. A hole 13 in roof 11 provides for insertion of the fuel-oxygen lance 12 that has lance head 16 and barrel 17.

The barrel 17 is removable from the lance head 16 by a simple manipulation of levers 20, 21 as shown hereinafter. The barrel 17 is inserted through the roof 11 of the furnace 10 for introducing a jet of oxygen and fuel from a suitable source 50 (FIGURE 2) against the material charged into the furnace.

Lance 12 is supported by a lance carriage 22 which includes lance head holding means 74 supported by plates 76, 76' (FIGURES 3 and 4) welded to backplate 75. Reinforcing members 77 and 79 support the lance head in proper alignment. Plates 75 and 77 are welded to pipe 84 which in turn is welded to sliding members 85, 86. Sliding members 85, 86 run vertically between angle irons 87 which are secured to channels 88 which are fastened to the outer part of channel 89. Eye bolt 78 is secured to plate 77 by nut 77'. A hoist cable 31 (FIGURE 1) is secured to eye bolt 78 to provide for vertical positioning of the lance. Electric hoist 30 operates hoist cable 31 over pulleys 29, 28 to raise and lower the lance carriage by means of eye bolt 78. Means such as overhead crane 35 is utilized to support, remove and replace lance barrel 17 when necessary. The entire structure is

supported by carriage 25 which is movable horizontally on wheels 26, 26' upon the actuation of air cylinder 45. Carriage 25 is in turn supported upon structural members 27. As can be seen in FIGURE 2, when air cylinder 45 is actuated carriage 25 moves horizontally to place either the fuel-oxygen lance or the oxygen lance in proper position for insertion into the hole in roof 11.

Fuel is supplied to the lance head from a suitable source of supply such as means 50 through flexible pipe means 47 and connection means 41. Oxygen in a similar manner is supplied from means 50 through flexible pipe means 46 and connecting means 40. Cooling water is supplied from source 50 through flexible pipe means 48 and connecting means 42. The cooling water after traveling through the lance barrel emerges from connecting means 43 through flexible pipe means 49 and means 50 to discard.

When it is desired to use oxygen instead of a fuel-oxygen mixture air cylinder 45 is actuated whereby carriage 25 is reciprocated on wheels 26, 26' to position lance barrel 117 over the hole in roof 11. As may be readily seen the structure of the oxygen lance is analogous to that of the fuel-oxygen lance. When the lance barrel 117 is properly positioned above the roof 11, an electric hoist (not shown) operates a hoist cable (not shown) over pulley 128 whereby lance barrel 117 is lowered into the furnace.

Oxygen may be supplied to oxygen lance barrel 117 from a source of supply such as means 150 through connecting means 140, flexible pipe 146, and lance head 116. Cooling water is supplied from means 150 through flexible pipe 148 and connecting means 142. The cooling water runs through the lance barrel 117 and emerges from connecting means 143 through flexible pipe 149 and means 150 to discard.

The oxygen lance head 116, FIGURE 5, is comprised of a substantially cylindrical outer shell 118 having a neck 114. A flange 115 divides shell 118 into two sections 152 and 156. Pipe connecting means 142, 143 are operatively associated with sections 152, 156 respectively of the lance head shell 118.

The lance barrel 117 is comprised of an outer shell 119 and pipe means 160, 162 concentrically arranged within the outer shell 119. The lance barrel 117 is inserted into the outer shell 118 of lance head 116 whereby oxygen pipe 160 extends into the neck 114 of shell 118. Seal rings 166 maintain a seal between the neck 114 and the pipe 160 yet allow the oxygen pipe to move longitudinally upon expansion or contraction.

Water baffle pipe means 162 extends to the flange 115 and cylindrical member 163 maintains pipe 162 abutted against flange 115 thereby forming a seal between sections 152 and 156 of the lance head outer shell 118. Spacers 165 maintain the spacing between pipes 160 and 162, and means 168 maintains pipe 162 affixed to pipe 160. If desired, pipe 162 may be affixed to the outer shell 119 of the barrel in lieu of fastening it to the pipe 160. Pipe 162 is therefore free to float longitudinally with respect to elements 119 and 160. Gasket means 167 completes the seal of the inside of the lance from the atmosphere.

At the nose of the lance barrel, pipe 160 is connected to outer shell 119 whereby cooling water entering section 152 through connecting means 142 flows down the lance through interjacent cavity 155 between pipes 160 and 162. At the nose of the lance barrel the water reverses its direction of flow and flows upwardly in interjacent cavity 156 between pipe 162 and outer shells 119, 118 and out through connecting means 143.

Oxygen is introduced through connecting means 140 and elbow 159 into cavity 157 inside of pipe 160. The oxygen flows downwardly through the lance barrel to the nose. The lance nose 158 is shaped and machined to deliver the desired pattern and velocity of oxygen to the refining process and is welded to the outer shell 119 of the barrel and to the oxygen blow pipe 160.

The clamping mechanism whereby the lance barrel

may be easily removed from the lance head is shown in FIGURE 6. This structure includes levers 120, 121 having handles 172, 173 respectively. In operation, an attendant standing on platform 132 pulls on handles 172, 173 whereby levers 120, 121 move outwardly and downwardly on pivots 190 which are set in fulcrum means 191. This movement allows links 192, 193 to pivot on rods 196, 197 and move downwardly and outwardly thus releasing latch bars 194, 195 from clasp members 170, 171. When the lance barrel 117 has thus been released, it may be removed from the lance head by means such as crane 35. A new lance barrel may then be inserted by reversing the above series of steps whereby latch bars 194, 195 are inserted into clasp members 170, 171 and the handles 172, 173 are moved upwardly until levers 120, 121 are halted by stops 198, 199.

According to this invention, the lance barrel can be quickly inserted into the lance head and held firmly in place. The latch bars 194, 195 pull the outer shell tightly into gasket 167 to prevent leakage of cooling water from the lance and forms the two units into a lance ready for blowing oxygen.

FIGURES 7 and 8 show a fuel-oxygen lance of similar characteristics to the oxygen lance described above. The barrel and nose also may be attached as a unit to the lance head. In the design shown, a fourth pipe for fuel has been added, and is affixed to the oxygen blow pipe at the head end only to allow the oxygen blow pipe to float longitudinally at the nose end so as to allow for expansion and contraction.

In detail the fuel-oxygen lance comprises a head 16 and a barrel 17. The head is comprised of an outer shell 18 having a neck 14 and internal flanges 15, 15' and 15''. These flanges divide the head into three sections. These sections are used for distributing fuel, oxygen and water to the lance barrel 17. Pipe connecting means 41, 42 and 43 are operatively associated with sections 51, 52 and 53 respectively of the lance head shell 18.

The lance barrel 17 is comprised of an outer shell 19 and pipe means 60, 61 and 62 concentrically arranged within the outer shell 19. The lance barrel 17 is inserted into the outer shell 18 of lance head 16 whereby oxygen pipe 60 extends into the neck 14 of shell 18. Seal rings 66 maintain a seal between the neck 14 and the pipe 60 while allowing the oxygen pipe 60 to move longitudinally upon contraction or expansion due to changes in the temperature to which the lance is subjected.

Pipe means 61 extends to the flange 15. Cylindrical member 69 is affixed to the outside of pipe 61 and abuts against flange 15 having seal rings 66 therein whereby a seal is formed between chambers 51 and 52. Ring member 64 is located inside pipe 61 and has protuberances which are welded to pipe 61 as can be seen by reference to FIGURE 8. Ring member 64 is threaded around cylindrical member 68 which in turn is affixed to pipe 60 whereby a unit is formed of pipe 60, cylindrical member 68, ring 64 and pipe 61.

Water baffle pipe means 62 extends to the flange 15'. Cylindrical member 63 is affixed to pipe 162 and abuts against flange 15' thereby separating sections 52 and 53 of the lance head outer shell 18. Spacers 65 maintain the spacing between pipes 61, 62 and outer shell 19 of the lance barrel. Disc 58 is affixed to outer shell 19 and pipe 61 at the nose end of barrel 17. Gasket means 67 maintains a seal between the lance barrel to the lance head.

In operation of the embodiment shown in FIGURE 7, oxygen is fed into cavity 57 through elbow 59 and connecting means 40 wherein it flows down through pipe 60 to the nose of the barrel 17 and out into the furnace. Fuel is supplied through connecting means 41 into section 51 of the lance head, then downwardly through interjacent cavity 54 to the nose of the lance barrel whereat it is mixed with the oxygen and delivered to the refining

5

process to deliver the desired pattern and velocity of fuel and oxygen to the refining process. Cooling water is supplied through connecting means 42 into section 52 then downwardly through interjacent cavity 55 to the nose of the barrel where it impinges upon disc 58 and then reverses its direction of flow upwardly through interjacent cavity 56 to chamber 53 and then outwardly through connecting means 43 ultimately to discard or for cooling and recirculation.

FIGURE 9 shows the clamping mechanism for removing the lance barrel from the lance head in a simple, economical and facile way. This structure is similar to that shown in FIGURE 6 for the oxygen lance. An attendant on platform 32 pulls on handles 72, 73, FIGURE 9, whereby levers 20, 21 move outwardly and downwardly on pivots 90 which are set in fulcrum means 91. This movement allows links 92, 93 to pivot on rods 96, 97 and move downwardly and outwardly thus releasing latch bars 94, 95 from clasp members 70, 71. When the lance barrel 17 has thus been released, it may be removed from the lance head by means such as crane 35. A new lance barrel may then be inserted by reversing the above series of steps whereby latch bars 94, 95 are inserted into clasp members 70, 71 and the handles 72, 73 are moved upwardly until levers 20, 21 are halted by stops 98, 99.

FIGURE 10 shows the manner in which the lance head holding means may be secured to the lance head. The lance head 16 has lance head holding means 74 secured thereto by means of a plurality of set screws 81. The lance head holding means can then be supported by plates 76, 76' (FIGURES 3 and 4).

Heretofore, the changing of a lance necessitated a time consuming removal of all the piping connections to the lance head and required the substitution of a complete lance when a lance failed in use. With the novel apparatus of this invention, there no longer need by substantial expense and time loss because of the lance changing operation for, when a lance fails, the lance is raised from the furnace, the lance barrel is quickly removed, a new lance barrel is substituted, and the new lance may be lowered into the furnace to provide immediate introduction of oxygen to the metal bath.

This invention also eliminates the necessity of realigning the lance each time a lance is replaced. This advantage accrues from the initial aligning of the lance head which need not be removed.

The structure shown also has the advantage of allowing a rapid change-over from oxygen to a fuel-oxygen mixture or vice versa simply by actuating an air cylinder to place the proper lance over the furnace. If desired, it is also possible to use the fuel-oxygen lance to feed oxygen or fuel-oxygen mixtures to the refining process.

In another embodiment two oxygen lances or two fuel-oxygen lances may be used, whereby a minimum of time is consumed while changing lances. In this embodiment one lance is in operation while the other lance is being replaced.

The foregoing describes the preferred embodiments of the invention, but it should be understood that various modifications may be made therein within the spirit and scope of the appended claims.

What is claimed is:

1. A lance for applying oxygen to a metallic refining bath comprising:

- (a) a lance head,
- (b) a lance barrel, and
- (c) means for attaching said lance barrel to and detaching said lance barrel from said lance head,
- (d) said lance barrel comprising:
 - (1) an outer shell,
 - (2) a first conduit concentrically arranged within said outer shell and affixed thereto at one end thereof, and
 - (3) a second conduit concentrically arranged

6

intermediate said first conduit and said outer shell,

- (4) said first conduit being longer than said second conduit,
 - (5) said second conduit being longer than said outer shell,
 - (6) said second conduit being affixed to said first conduit at one end thereof and spaced from said first conduit at the other end thereof,
 - (e) said lance head comprising:
 - (1) a substantially cylindrical member,
 - (2) first pipe connecting means at one end of said cylindrical member,
 - (3) second pipe connecting means in said cylindrical member for feeding cooling medium into a cavity between said first conduit and said second conduit, and
 - (4) third pipe connecting means in said cylindrical member for receiving circulated cooling medium from the cavity between said second conduit and said outer shell,
 - (f) said first conduit cooperating with said first pipe connecting means to receive oxygen issuing therefrom whereby said oxygen flows through said first conduit and then out of said conduit into said metallic refining bath,
 - (g) said means for attaching said lance barrel to and detaching said lance barrel from said lance head comprising:
 - (1) a pair of clasp members arranged at opposite sides of said lance barrel,
 - (2) two pair of fulcrum means, one pair arranged at each side of said lance head,
 - (3) each pair of fulcrum means having a pivot set therein,
 - (4) a lever mounted on each of said pivots,
 - (5) two pair of links, each pair of links being pivotally attached at one end thereof to one of said levers intermediate the ends thereof,
 - (6) and a latch bar attached between the other ends of said pairs of links,
 - (7) said latch bars being adapted to cooperate with said clasp members to maintain said lance barrel secured to said lance head,
 - (h) whereby when said means for attaching said lance barrel to and detaching said lance barrel from said lance head is detached said lance barrel including said outer shell and said first and second conduits will slide out of said lance head.
2. Apparatus for applying gas to a metallic refining bath comprising:
- (a) a pair of lances,
 - (b) movable supporting means for said pair of lances,
 - (c) means for selectively reciprocating said supporting means, whereby a selected one of said pair of lances is positioned over said metallic bath, and
 - (d) means on said support means operatively connected to each of said lances to raise and lower said lances relative to said metallic bath,
 - (e) each of said lances comprising:
 - (1) a lance head having sections therein for separately receiving and distributing gases and cooling medium,
 - (2) a lance barrel comprising a plurality of concentric conduits joined together,
 - (3) said lance head cooperating with one end of said lance barrel to distribute said gases and cooling medium to one end of said lance barrel whereby said cooling medium circulates through said lance barrel and back to said lance head and said gases flow through said lance barrel to the other end thereof and then out of said lance barrel into said metallic bath,
 - (4) said conduits of said lance barrel being slid-

7

- ably associated with said sections of said lance head,
- (5) seal means operably associated with each of said conduits and said sections to maintain a seal between said sections and
- (6) lever actuated quick-detach clamp means for removably securing said lance head to said lance barrel.
3. A lance for applying gases to a metallic refining bath comprising:
- (a) a lance head having sections therein for separately receiving and distributing gases and cooling medium,
- (b) a lance barrel comprising a plurality of concentric conduits joined together,
- (c) said lance head cooperating with one end of said lance barrel to distribute said gases and cooling medium to one end of said lance barrel whereby said cooling medium circulates through said lance barrel and back to said lance head and said gases flow through said lance barrel to the other end thereof and then out of said lance barrel into said metallic bath,
- (d) said conduits of said lance barrel being slidably associated with said sections of said lance head,
- (e) seal means operably associated with each of said conduits and said sections to maintain a seal between said sections, and
- (f) lever actuated quick-detach clamp means for removably securing said lance head to said lance barrel.
4. A lance for applying oxygen to a metallic refining bath comprising:
- (a) a lance barrel comprising:
- (1) an outer shell,
- (2) a first conduit concentrically arranged within said outer shell and affixed to said shell at one end thereof,
- (3) a second conduit concentrically arranged intermediate said first conduit and said outer shell,
- (4) said first conduit being longer than said second conduit,

8

- (5) said second conduit being longer than said outer shell,
- (6) said second conduit being affixed to said first conduit at one end thereof and spaced from said first conduit at the other end thereof, and
- (b) a lance head comprising:
- (1) a substantially cylindrical member,
- (2) first pipe connecting means at one end of said cylindrical member, said first conduit cooperating with said first pipe connecting means to receive oxygen issuing therefrom whereby said oxygen flows through said first conduit and then out of said conduit into said metallic refining bath,
- (3) second pipe connecting means in said cylindrical member for feeding cooling medium into a cavity between said first conduit and said second conduit,
- (4) and third pipe connecting means in said cylindrical member for receiving circulated cooling medium from the cavity between said second conduit and said outer shell,
- (c) said first and second conduits and said outer shell being slidably associated with said lance head, and
- (d) seal means operably associated with each of said conduits to maintain a seal between said conduits and said lance head.

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