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Pearce et al.

[11] **3,897,048**

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[54] **METALLURGICAL VESSEL AND METHOD OF OPERATING SAME**

[75] Inventors: **Jai K. Pearce; Eberhard G. Schempp,** both of Pittsburgh; **Walter Sieckman,** Bridgeville, all of Pa.

[73] Assignee: **Pennsylvania Engineering Corporation,** Pittsburgh, Pa.

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[52] **U.S. Cl.** **266/35;** 266/41

[51] **Int. Cl.** **C21c 5/48**

[58] **Field of Search** ..... 266/35, 36 P, 41; 75/51, 75/52, 59, 60

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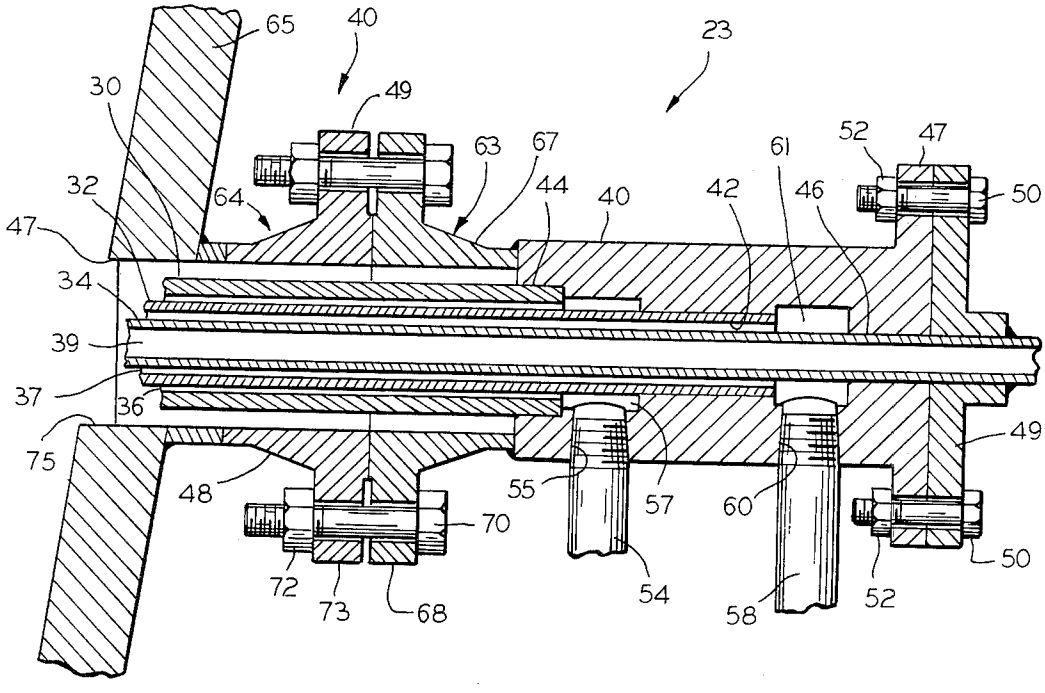
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Primary Examiner—Gerald A. Dost
Attorney, Agent, or Firm—Fred Wiviott

[57] **ABSTRACT**

A vessel for treating molten ferrous metal includes at least one tuyere for injecting process gases below the level of molten metal. The tuyere includes three pipes arranged in a concentric relation to define a first passage between the outer and intermediate pipes, a second passage between the intermediate and inner pipes and a third passage within the inner pipe. The pipes are sized to permit the volumetric percentage of gas delivered from the first passage to be about 2–10% of that delivered from the second and third passages and to permit the gas delivered from two of the passages to be about 15–60% of that delivered from the other passage. A quantity of metal is charged into the vessel for being preheated by the combustion of fuel delivered through a pair of passages and oxygen delivered through the remaining passage to provide an oxygen-to-fuel ratio which exceeds that required for stoichiometric combustion. After preheat and in preparation of the main blow, a shielding gas is delivered to the first passage and oxygen delivered through the inner two passages or the inner pipe is removed and oxygen provided through the interior of the intermediate pipe.

6 Claims, 5 Drawing Figures



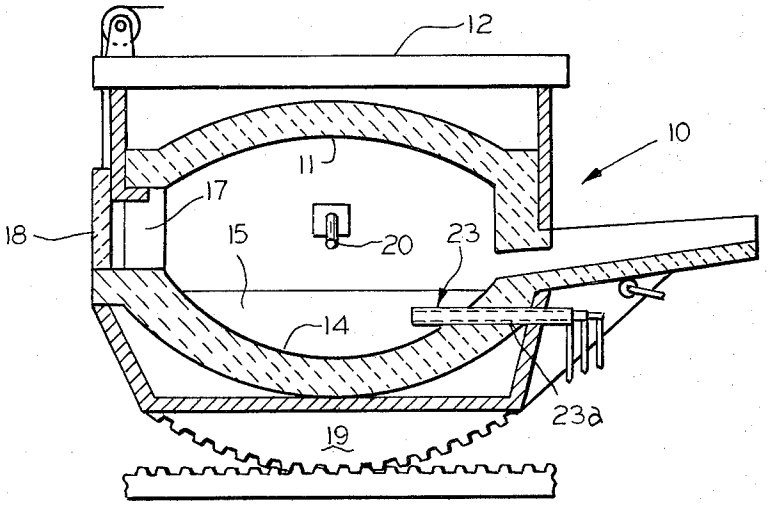

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FIG.1

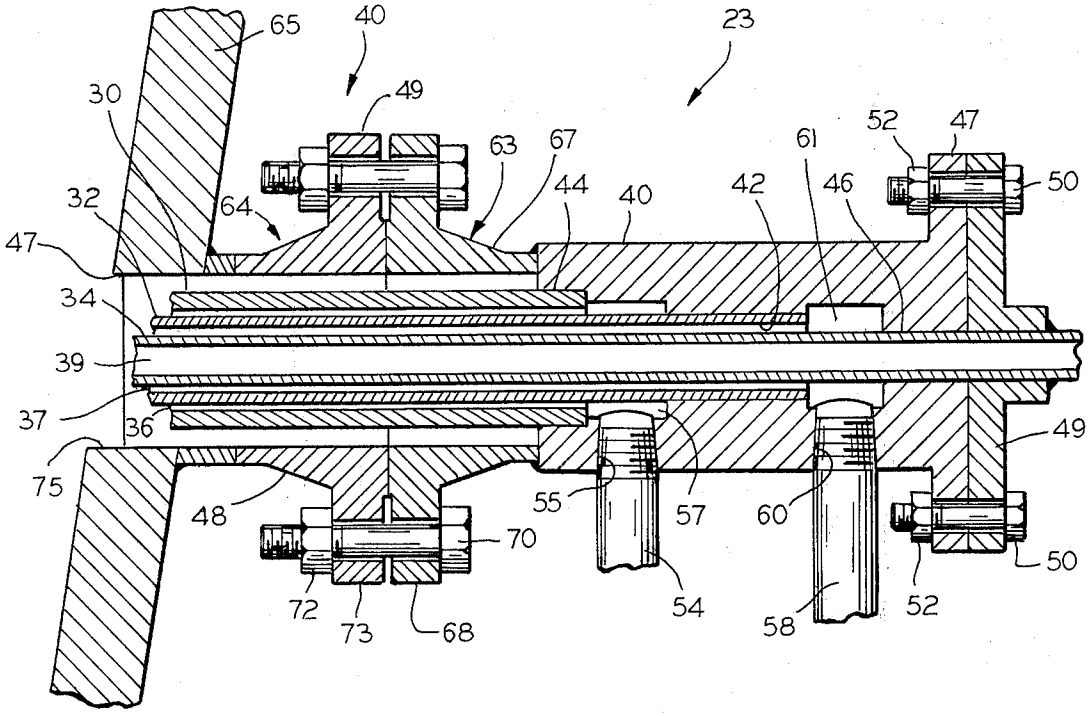

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FIG.2

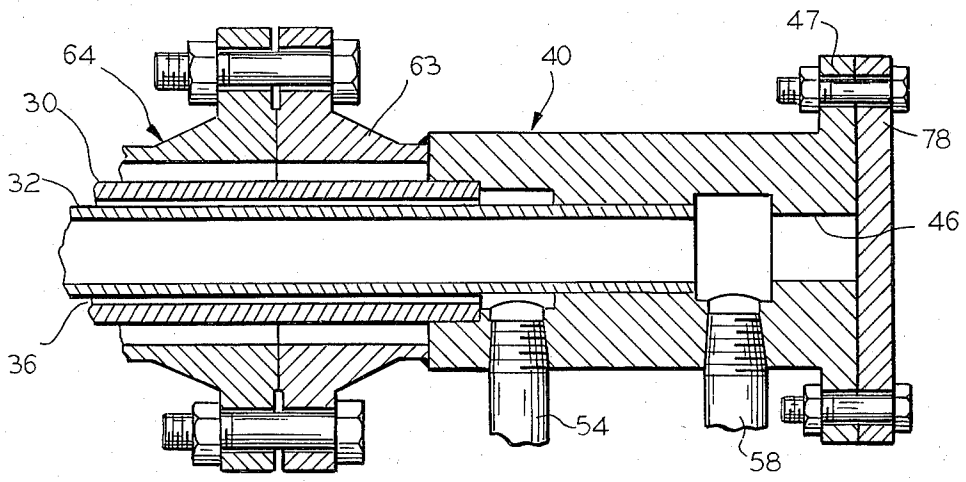


FIG. 3

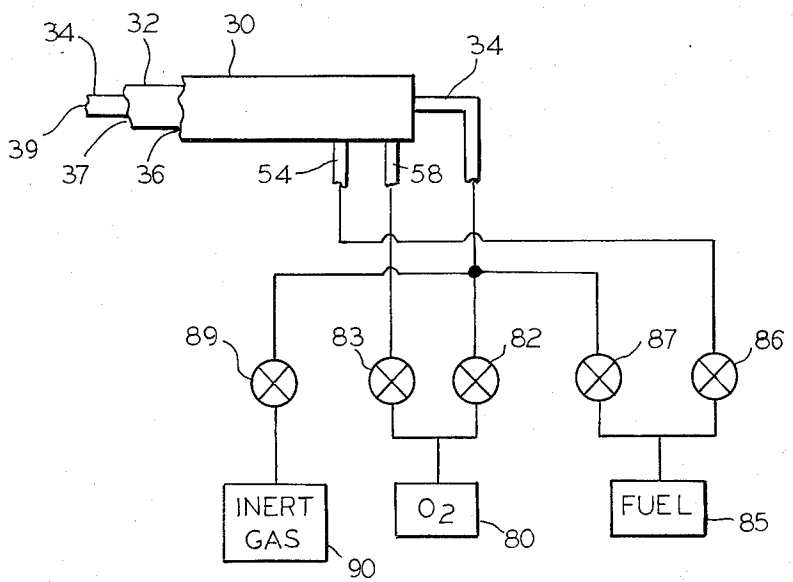


FIG. 4

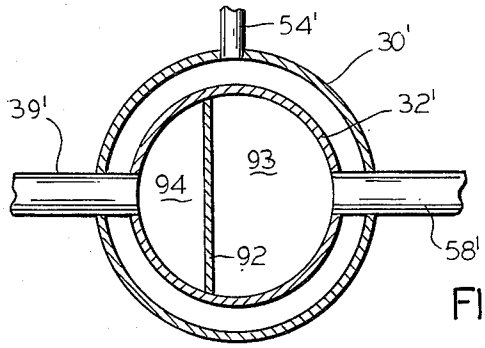


FIG. 5

METALLURGICAL VESSEL AND METHOD OF OPERATING SAME

BACKGROUND OF THE INVENTION

This invention relates to pneumatic steel making vessels and processes of the type wherein process gases are blown beneath the level of molten metal in a metallurgical vessel.

Converter vessels have been developed for treating molten metal by the injection of oxygen or other gases directly into the molten metal by means of tuyeres located in the bottoms or sides of the vessels. In order to prolong the life of the vessel's refractory and the tuyeres themselves, each of the oxygen tuyeres may be surrounded by a second tuyere for injecting a shielding fluid such as propane, manufactured gas, natural gas, hydrocarbon gases or light oils. Depending upon the composition of the shielding fluid, the volumetric percentage of the shielding gas is normally about 2–10% of the volume of oxygen. As an example, for an oxygen volume of about 200,000 standard cubic per hour, a propane shielding gas volume of about 6,000 standard cubic feet per hour would be required, while if manufactured gas is employed, the required shielding gas volume would be about 14,000 standard cubic feet per hour. Tuyeres of this type normally comprise concentric pipes with the oxygen being delivered through the inner pipe and the shielding gas being delivered in the annulus formed between the two tuyere pipes. The relative sizes of the tuyere pipes are such as to permit the desired ratio of gases to be delivered.

In pneumatic steel making process, the vessel may be charged with hot metal, scrap or a mixture of the two. When significant quantities of scrap are employed, it may be necessary or desirable to preheat the metal prior to the initiation of the main oxygen blow. Heretofore, this has usually been accomplished by auxiliary burners and lances.

SUMMARY OF THE INVENTION

It is an object of the invention to provide a new and improved tuyere system for pneumatic steel making processes.

A further object of the invention is to provide a tuyere for pneumatic steel making processes which may be employed both for preheating the metal charge and for the main oxygen blow.

These and other objects and advantages of the invention will become more apparent from the detailed description thereof taken with the accompanying drawings.

In general terms, the invention comprises a tuyere system for use in pneumatic metallurgical vessels and including a gas delivery means for delivering oxygen beneath the level of the metallic charge in the vessel and passage means surrounding the gas delivery means for providing a shielding fluid around the oxygen input and means for subdividing the gas delivery means to permit an increase in the quantity of shielding fluid provided through the tuyere system for preheating a molten metal charge.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a metallurgical vessel in which the tuyere system according to the invention may be employed;

FIG. 2 illustrates the tuyere system according to the invention in greater detail;

FIG. 3 illustrates an alternate embodiment of the present invention;

FIG. 4 shows yet another embodiment of the present invention; and

FIG. 5 shows a still further alternate embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 schmatically illustrates an open hearth furnace 10 which may be employed with the system according to the present invention. Vessel 10 generally includes a refractory shell 11 surrounded by a supporting framework generally designated by the reference numeral 12. The refractory lining 11 generally defines a vessel having a shallow hearth 14 for containing the bath of molten metal 15. A plurality of charging openings 17 are formed along one side of the vessel 10 and each is provided with a charging door 18 which may normally be raised and lowered when desired in any suitable manner. The vessel 10 may itself be mounted on stationary concrete or steel supports (not shown) or it may be mounted on rockers 19 whereby the vessel may be tilted about an axis perpendicular to the plane of FIG. 1 for purposes of charging, pouring and deslagging. A burner 20 may extend through one or both ends of the vessel 11 in a manner well known in the art.

A plurality of tuyeres 23 may extend through at least one side of the vessel 10 with their inner ends below the level of bath 15. As will be described more fully below, the tuyere 23 will generally include a first passage for delivery of oxygen during the main oxygen blow and a second passage surrounding the first passage for injecting a shielding fluid such as propane, hydrocarbon gas, light oil, natural gas, and the like. As those skilled in the art appreciate, the shielding fluid prolongs the refractory and tuyere life. In addition to oxygen and propane, other process gases such as argon and nitrogen may be blown through one or both of the tuyere passages and finely divided materials such as lime, limestone, iron oxide, fluorspar, burnt lime and other materials may be entrained in the gas stream to provide the desired metallurgical reactions.

In normal operation of the vessel 10, it will typically be charged with scrap and hot metal which must then be melted and/or preheated. The tuyere system 23 according to the present invention, permits the required ratio of fluids for both the preheat and main oxygen blowing periods.

The tuyere assembly 23 according to the preferred embodiment of the invention is shown in FIG. 2 to include three tuyere pipes 30, 32 and 34 arranged in a coaxial relation. The inner diameter of the outermost tuyere pipe 30 is larger than the outer diameter of the intermediate tuyere pipe 32 to define a first gap or tuyere passage 36 therebetween and the inner diameter of the intermediate pipe 32 is larger than the outer diameter of the innermost tuyere pipe 34 to define a second gap or tuyere passage 37 therebetween. A third tuyere passage 39 is defined by the interior of the innermost tuyere pipe 34.

The tuyere pipes 30, 32 and 34 are mounted in spaced apart relation by means of a hollow, generally tubular tuyere pipe support body 40. As seen in FIG. 2, the body 40 is formed with a cylindrical bore 42 in-

termediate its ends and to which the outer end of the intermediate tuyere pipe **32** is secured in any suitable manner, such as by welding. At the vessel end of the body **40**, a counter-bore **44** is formed for fixedly receiving the end of the outermost tuyere pipe **30**. In this manner, the tuyere pipes **30** and **32** are affixed in spaced relation to form the gap **36**. At the opposite end of the body **40**, a concentric, smaller diameter opening **46** is formed for slidably receiving the innermost tuyere pipe **34** therethrough. In addition, a radially outwardly extending flange **47** is formed on the body **40** adjacent opening **46** for mating with a similarly configured radial flange **49** affixed to tuyere pipe **34**. The flanges **47** and **49** may be secured in any suitable manner such as by bolts **50** and nuts **52**. This positions the innermost tuyere pipe **34** in spaced relation from the intermediate tuyere pipe **32** to define the gap **37** therebetween.

An external gas connection is provided to the tuyere passage **36** by means of a pipe **54** having a threaded end which is received in an internally threaded aperture **55** formed through body **40** adjacent the end of tuyere pipe **30**. An annular groove **57** may also be formed in bore **42** and in an intersecting relation to the inner end of aperture **55**. A similar external gas connection is provided to the tuyere passage **37** by means of a pipe **58** which is threaded into aperture **60** formed in body **40** adjacent the end of tuyere pipe **32** and an annular groove **61**.

The tuyere assembly **23** may be supported on the vessel **10** in any suitable manner such as by means of a first mounting member **63** affixed to body **40**, a second mounting member **64** affixed at one end to member **63** and at its other end to a mounting plate **65** which is secured to the vessel **10** by means not shown. The first mounting member **63** includes a hollow body portion **67** which is affixed at one end of the vessel end of body **40** and in a concentric surrounding relation to the outer tuyere pipe **30**. A radially extending flange **68** is integrally formed at the other end of body member **67** for being secured by bolts **70** and nut **72** to a similar flange **73** which extends integrally from one end of the hollow body member **64**. The other end of the body **64** is secured in a concentric surrounding relation to an aperture **75** formed in plate **65**. Aperture **75** is sized to receive tuyere **30** therethrough and the latter extends through vessel refractory **11** with the ends of pipes **30**, 32 and **34** opening into vessel **10** and beneath the level of the charge **15**.

When the vessel **10** is to be placed in operation, it will initially be charged with hot metal and scrap through charging doors **17**. In order to raise the temperature of the metal charge **15** to that necessary prior to the beginning of the main oxygen blow, a melt down and/or preheat period will initially commence. In order to employ the tuyere **23** as a preheat torch, it is desirable to provide oxygen and fuel in such proportions that the oxygen fuel ratio will be slightly greater than that required for stoichiometric combustion. Toward this end, a fuel such as propane will be delivered through pipe **54** to the outer tuyere passage **36** and oxygen will be delivered to tuyere passage **37** through pipe **58**. In addition, the propane or other fuel will be provided through the inner tuyere pipe **39**. By proportioning the relative sizes of the tuyere pipes **30, 32** and **34**, the correct proportions of fuel and oxygen will be provided. With the fuel volume being approximately **15–60%** that of the oxygen, depending on the fuel employed.

After the completion of the melt down or preheat period, it is desirable to commence the main oxygen blow during which the oxygen is to be delivered to the bath through a center jet surrounded by an outer sheath of shielding fluid which is provided to prolong the life of the tuyeres and their surrounding refractory. During the main oxygen blow, the volume of shielding fluid required is about **2–10%** of the volume of oxygen depending upon the fluid to be employed. For example, if propane is used, the shielding gas volume should be about **3%** of the oxygen volume. In order to provide the greater volume of oxygen required according to the preferred embodiment of the invention, the centermost tuyere pipe **34** is removed by removing nuts **52** and bolts **50** and withdrawing tuyere pipe **34** along with flange **49**. The opening **46** in body **40** is then closed in any suitable manner such as by means of a plate **78**. The main oxygen blow may then commence with the shielding gas being provided to the passage **36** through pipe **54** and the oxygen being provided to the interior of pipe **32** through pipe **58**.

An alternate embodiment of the invention is shown in FIG. **4** wherein an oxygen source **80** is shown to be connected to pipes **34** and **58** through valves **82** and **83** respectively. In addition, a source of hydrocarbon fuel, such as propane **85** is respectively connected to pipes **54** and **34** through valves **86** and **87**. Also, a source **90** of inert gas such as argon or nitrogen is connected to pipe **34** through valve **89**. During the preheat period, as discussed above, the valve **83** is opened to deliver oxygen to pipe **58** and valves **86** and **87** are opened to deliver propane to pipes **34** and **54**. Valves **82** and **89** are closed. This provides fuel to the tuyere passages **36** and **39** and oxygen to the tuyere passage **37** as discussed above. At the completion of the preheat period, and prior to the commencement of the main blow, valves **83, 86** and **87** are closed and valve **89** is opened to purge the pipe **39** of propane. Thereafter, valves **82** and **83** are opened to provide oxygen to the tuyere passage **37** and **39** and valve **86** is opened to provide propane to the outer tuyere passage **36**. In this manner, it is possible to proceed from the preheat to the main blow without physically removing the center tuyere pipe **34**.

FIG. **5** illustrates a still further embodiment of the invention wherein an outer tuyere pipe **30'** is disposed in concentric surrounding relation to a central tuyere pipe **32'** to define a gap **36'** therebetween. The gap **36'** is sized to provide the correct proportion of shielding gas to oxygen during the main oxygen blow. The pipe **32'** is subdivided by a longitudinal partition wall **92** to divide the interior of pipe **32'** into passages **93** and **94**. During the warmup period, the tuyere passages **36'** and **94** may be provided with a fuel such as propane through the pipes **54'** and **39'** and the passage **93** may be provided with oxygen through pipe **58'**. At the completion of the preheat period, a gas supply and valve system similar to that shown in FIG. **4** may be employed to first purge pipe **94** of propane and then to provide passages **93** and **94** with oxygen and passage **36'** with the hydrocarbon shielding fluid for the main oxygen blow.

While only a few embodiments of the invention have been shown and described, it is not intended to be limited thereby but only by the scope of the appended claims.

We claim:

1. A metallurgical vessel constructed and arranged to receive a metallic charge,

a tuyere assembly including first means defining a first tuyere passage for delivering oxygen to the interior of said vessel and beneath the level of said charge,

second means for defining a second tuyere passage in surrounding relation to the first tuyere passage for providing a hydrocarbon shielding fluid around the oxygen, third means for subdividing the first tuyere passage into a pair of tuyere passages to permit an increase in the quantity of shielding gas provided to the tuyere for preheating a metal charge in the vessel,

a source of hydrocarbon fluid and a source of oxygen,

first valve means for selectively coupling said oxygen source to one of said pair of tuyere passages and said hydrocarbon fluid source to said second tuyere passage and second valve means for selectively coupling one of said sources to the other of said pair of tuyere passages.

2. The vessel set forth in claim 1 and including a source of an inert gas, third valve means operative to selectively couple said inert gas source to the other of said pair of tuyere passages prior to the operation of said second valve means to purge said other one of said pair of tuyere passages before the same is coupled to the other one of said sources.

3. The vessel set forth in claim 2 wherein said second tuyere passage is sized to provide a fuel volume which is about 2% to 10% of the volume of oxygen provided through said pair of tuyere passages, said pair of tuyere passages being sized to provide a total fuel volume substantially greater than 10% of said oxygen volume when said second valve means couples the other one of said tuyere passages to said source of hydrocarbon fluid.

4. The vessel set forth in claim 3 wherein said third means is removably disposed in said first tuyere means, and tuyere body means for mounting said tuyere assembly to said vessel, said tuyere body means having an opening formed therein for receiving said third means therethrough, and closure means for said opening after removal of said third means.

5. The vessel set forth in claim 1 wherein said first means comprises a first tuyere pipe defining said first tuyere passage and said second means comprises a second tuyere pipe disposed in closely surrounding relation and spaced from said first tuyere pipe to define said second tuyere passage, said third means comprising a third tuyere pipe insertable into said first tuyere pipe and having an outer surface spaced from the inner surface of said first tuyere pipe when mounted therein to define therewith one of said pair of tuyere passages, the inner surface of said third tuyere pipe defining the other of said pair of tuyere passages, securing means for removably securing said third tuyere pipe in said first tuyere pipe.

6. The vessel set forth in claim 5 wherein said first tuyere pipe has an open end external of said vessel said securing means being operable to secure said third pipe means in said open end for sealing the same, and cover means for closing said open end after removal of said third pipe means.

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