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Wells et al.

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[54] **TAPPING OF A BLAST FURNACE**

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[51] **Int. Cl.** **C21b 7/12**

[58] **Field of Search** ..... 266/25, 34 PP, 38, 41, 266/42, 29, 30

[56] **References Cited**

UNITED STATES PATENTS

2,468,738	5/1949	Durfee et al.	266/41
3,149,959	9/1964	Nicholson	266/38 X
3,199,977	8/1965	Phillips et al.	266/33 R
3,581,948	6/1971	Detalle	266/34 PP
3,706,549	12/1972	Knuppel et al.	266/35 X

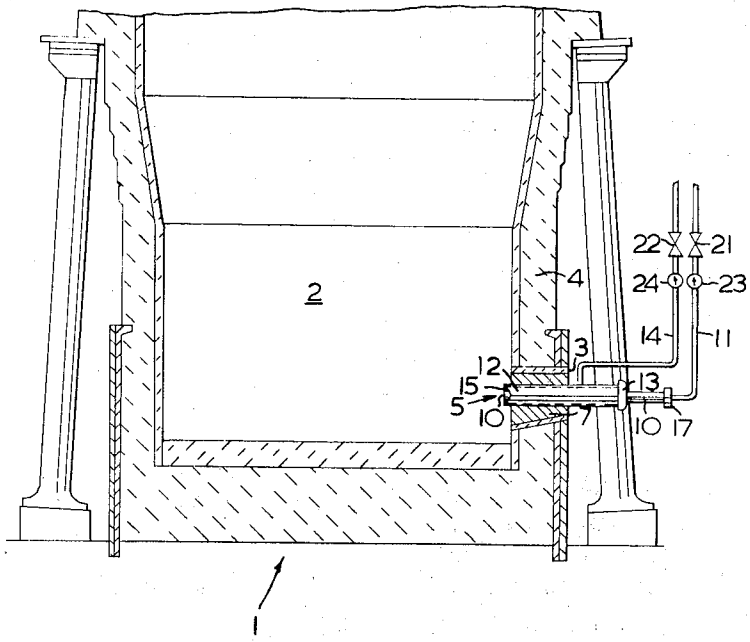
Primary Examiner—Gerald A. Dost

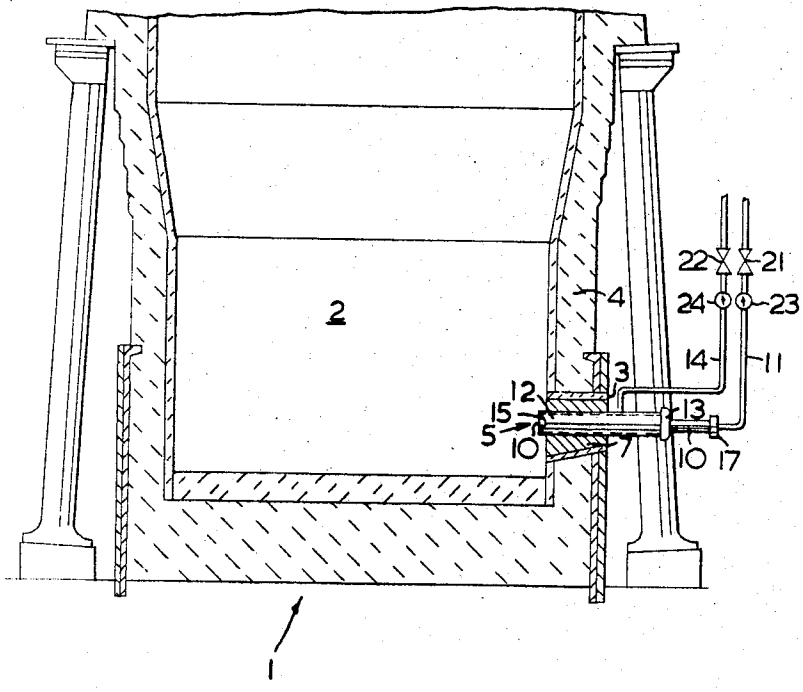
Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

The use of a tuyere comprising an inner tube and an outer tube spaced from the inner tube and preferably coaxial therewith, a gas being passed through the inner tube and a hydrocarbon fuel such as propane, being passed through the outer tube, in tapping a metal refining furnace, particularly a blast furnace. The tuyere is cemented in a tapping notch and at the selected tapping time the hydrocarbon fuel flow is reduced and preferably stopped, oxygen being passed through the inner tube whereby the tuyere disintegrates providing direct communication between the hearth of the furnace and the exterior of the furnace.

6 Claims, 1 Drawing Figure




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TAPPING OF A BLAST FURNACE

The present invention relates to the operation of a metal refining furnace, particularly a blast furnace in the production of pig iron and in particular to a method of tapping a furnace, particularly a blast furnace, which is simple and rapid.

In the tapping of molten metal from a conventional blast furnace which tapping occurs on average four to ten times a day, the molten metal is removed through the iron notch which is an opening normally plugged with clay. In normal tapping and disclosed for example in U.S. Pat. No. 2,705,630, the clay is drilled out with a pneumatic drill until the skull of iron is met when an oxygen lance is used to burn through the iron skull. Subsequent to tapping, the notch is closed by means of a clay gun. The opening of the notch in this manner involving drilling of the clay and burning of the skull with an oxygen lance is a time consuming, expensive, difficult and sometimes hazardous operation.

The present invention provides a method of tapping a metal refining furnace, particularly a blast furnace at a selected tapping time which is rapid, does not involve any drilling or cutting operations with attendant requirements of labour and eliminates hazardous operations in such tapping.

It has now been found that rapid and efficient tapping of a metal refining furnace, particularly a blast furnace, may be achieved by installing in a tapping notch, preferably in a conventional iron notch, a tuyere comprising an inner tube and an outer tube surrounding said inner tube providing a space therebetween and during operation of said furnace passing a gas through said inner tube and a hydrocarbon fuel through said space between said inner and outer tubes and at a selected tapping time passing oxygen through the inner tube and reducing the hydrocarbon fuel flow through said space sufficient to cause rapid disintegration of said tuyere to provide liquid communication between the hearth of the furnace or flow of molten metal out of the furnace through the tapping notch.

According to the present invention therefore, there is provided in the operation of a metal refining furnace in which a molten metal is periodically tapped from said furnace, a method of tapping said furnace which comprises installing a tuyere in a tapping notch in said furnace so as to provide communication with the hearth of said furnace, said tuyere comprising an inner tube and an outer tube surrounding said inner tube and providing a space therebetween, passing a gas stream into said furnace through said inner tube and passing a hydrocarbon fuel stream into said furnace through said space between said inner and outer tubes such that said hydrocarbon stream surrounds said gas stream and protects said tuyere from disintegration during said operation of said furnace, said gas stream at least at a selected time of tapping said molten iron being oxygen, and at the selected time of tapping said molten metal from said furnace reducing the flow of hydrocarbon fuel to an extent sufficient to cause disintegration of said tuyere and establish liquid communication with said furnace hearth through said tapping notch.

The present invention also provides in combination with a metal refining furnace, particularly a blast furnace, for the production of pig iron, a tuyere mounted in a tapping notch in said blast furnace, said tuyere comprising an inner tube for the flow of gas therethrough and an outer tube surrounding said inner tube and providing a space therebetween for the flow of hydrocarbon gas therethrough.

It is a feature of the present invention that the tuyere and the refractory lining of the furnace surrounding the tuyere during operation of the furnace be protected from erosion and in order to provide for this the inner stream of gas is surrounded by a stream of hydrocarbon fuel such as propane. This is achieved by providing a tuyere in the form of inner and outer spaced tubes which are preferably coaxial, a stream of hydrocarbon fuel passing through the space between the inner and outer tubes and surrounding the gas stream passing through the inner tube. The tuyere is cemented in position in the tapping notch of the furnace which is preferably the iron notch by a refractory material such as a cement or clay. Suitable tuyeres are those disclosed in U.S. applications Nos. 821,802 and 800,892 filed Dec. 12, 1970 by MaxHutte.

It is a feature of the present invention that the hydrocarbon fuel, e.g. propane, flow through the tuyere at a rate sufficient to provide on dissociation of the fuel on entry into the furnace, sufficient cooling to protect the end of the tuyere and adjacent refractory lining of the furnace chamber from erosion. It is generally found that the fuel, e.g. propane, should constitute less than 6% by volume of the gas stream and at least 3½% by volume of the gas stream, e.g. oxygen stream, and is suitably in the range 3½% to 5% by volume of the gas stream. These ratios are, however, not fixed and are determined by the size of the tuyere and the furnace.

The gas passing through an inner tuyere may be a non-reactive gas such as argon or nitrogen but it is an essential feature of the present invention that at the tapping time of the furnace, the gas passing through the inner tube, be oxygen such that when the hydrocarbon fuel gas flow is reduced and preferably stopped, the tuyere will rapidly disintegrate due to an unprotected oxygen flow. If it is desired to oxygenate the molten metal in the furnace during the normal operation the gas passing through the inner tube may be oxygen during the operation of the furnace, other than at the tapping time.

The present invention will be further illustrated by way of the accompanying drawing in which the single FIGURE is a vertical sectional elevation partially broken away of the hearth of a conventional blast furnace including a tuyere cemented in the iron notch for use in tapping the furnace.

Referring to the FIGURE the blast furnace **1** is a conventional blast furnace and the only part of the blast furnace shown is the iron notch **3** with which the present invention is concerned.

A tuyere **5** extends into the hearth two of the blast furnace **1** through the iron notch **3** in the furnace wall **4.** The tuyere is cemented at **7** in position in the iron notch **3** by a mud gun (not shown). The tuyere **5** comprises inner tube **10** formed of steel through which an inert gas or oxygen may be passed into the hearth **2** of the furnace **1** from line **11** and outlet tube **12** formed of steel coaxial with the inner tube **10** and providing an annular space **15** therebetween through which space **15** propane gas if fed to the hearth two of the furnace **1** from line **14** and gases from lines **11** and **14** are metered into the furnace by means of check valves **21** and **22** respectively, the gas flow being registered on meters **23** and **24** respectively. The rear ends of the outer and

inner tubes respectively are closed by plugs **13** and **17.**

The propane gas on entry into the hearth two of the furnace **1** surrounds the stream of gas passing through the inner tube **10** and protects the tuyere **5** and the surrounding wall **4** from erosion and disintegration particularly when the gas passing through the tube **10** is oxygen.

When it is desired to tap the hearth two of the furnace **1** oxygen is passed through the inner tube **10** and the propane stream passing through the annular space **15** is stopped by means of the check valve **22** whereby the tuyere **5** rapidly disintegrates through opening up the iron notch **3** for tapping. When the tapping of the molten metal is completed, another tuyere **5** in a refractory sleeve **6** is cemented in the iron notch **3** and connected to the gas lines **11** and **14** and the next molten metal hear prepared.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In the operation of a metal refining furnace in which molten metal is periodically tapped from said furnace, a method of tapping said furnace which comprises installing a tuyere in a tapping notch in said furnace so as to provide communication with the hearth of said furnace, said tuyere comprising an inner tube and an outer tube surrounding said inner tube and providing a space therebetween, passing a gas stream into said furnace through said inner tube, and passing a hydrocarbon fuel stream into said furnace through said space between said inner and outer tubes, such that said hydrocarbon stream surrounds said gas stream and protects the end of the tuyere from disintegration during said operation of said furnace, said gas stream at least at the selected time of tapping said molten metal being oxygen, and at the selected time of tapping said molten metal from said furnace, reducing the flow of hydrocarbon fuel to an extent sufficient to cause disintegration of said tuyere and establish liquid communication with said furnace hearth through said tapping notch.

2. The operation as claimed in claim **1** in which said gas passed through said inner tube is oxygen.

3. The operation as claimed in claim **1** in which the inner and outer tubes are coaxial.

4. The operation as claimed in claim **1** in which the hydrocarbon fuel stream is stopped at said selected tapping time.

5. The operation as claimed in claim **1** in which the hydrocarbon fuel is propane.

6. The operation as claimed in claim **1** in which the furnace is a blast furnace.

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