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[54] **PROCESS OF MANUFACTURING PIG IRON**

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[52] **U.S. Cl.** **75/42**, 55/75

[51] **Int. Cl.** **C21b 5/06**

[58] **Field of Search** 75/35, 41, 42; 55/75, 389

[56] **References Cited**

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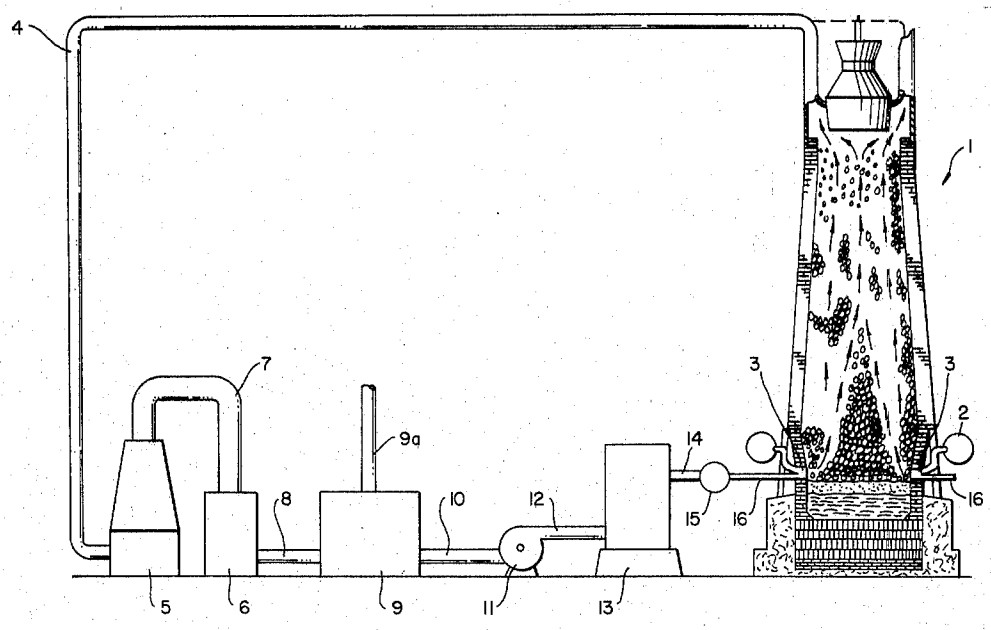
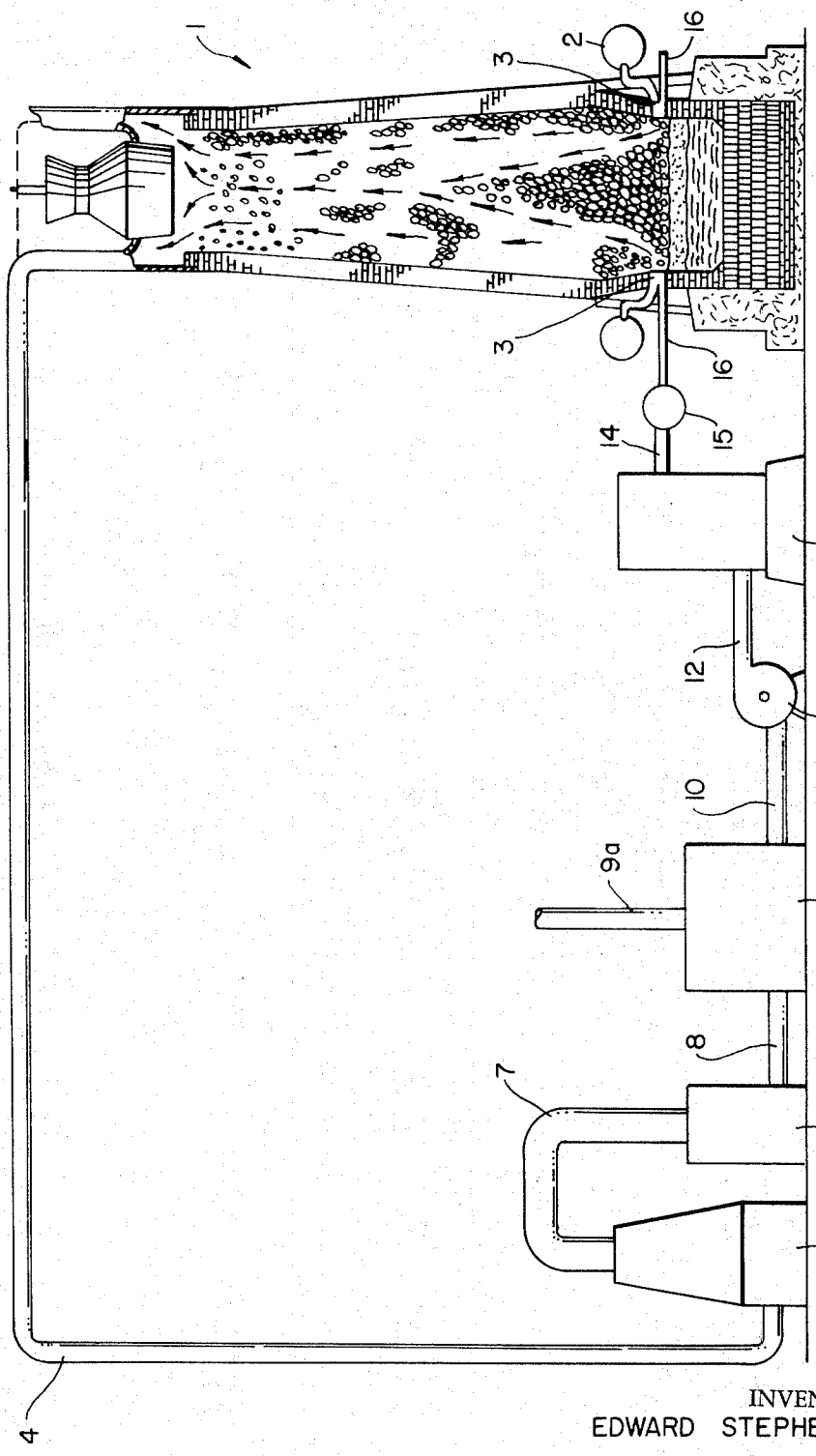
[57] **ABSTRACT**

A method of operating a blast furnace in which the blast furnace gas is stripped of nitrogen by the use of a molecular sieve and recycled.

4 Claims, 1 Drawing Figure





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PROCESS OF MANUFACTURING PIG IRON

BACKGROUND AND SUMMARY OF THE INVENTION

In ordinary practice, a blast furnace is operated by feeding iron ore, metallurgical coke and flux such as lime-stone into the top of the furnace while a preheated air blast is fed into the bottom to react with the coke forming the hot carbon monoxide. The carbon monoxide reduces the ore and releases the iron which accumulates at the bottom of the furnace. A vast amount of blast furnace gas having a large proportion of carbon monoxide and an even larger portion of nitrogen is produced as a result of this reaction.

One object of this invention is to strip the nitrogen from the blast furnace gas and recycle or inject the stripped gas back into the blast furnace. The gas is recycled to make use of the carbon monoxide in the gas in the reduction process, and the nitrogen is stripped before recycling because it represents a large volume of material which performs no function in the reduction process.

Another object of the invention is to reduce the amount of metallurgical coke necessary to operate the blast furnace. Since a substantial amount of carbon monoxide required in the reduction process is recovered and recycled, the amount of metallurgical coke required is proportionately reduced.

Other objects and features of the invention will become apparent as the description proceeds, especially when taken in conjunction with the accompanying drawing, wherein:

The single FIGURE is a semi-diagrammatic view of a blast furnace and supporting apparatus which may be used with the blast furnace to strip and recycle the blast furnace gas, in accordance with my invention.

Referring now more particularly to the drawing, a blast furnace which may be employed to carry out the method of my invention is generally designated **1**. The blast furnace **1** is a tall vertical shaft adapted to have a charge of iron ore, metallurgical coke and flux such as limestone fed into the top. Air preheated to about 2,000° F. and under a pressure of around 40 psi is fed into the bottom of the furnace through a bustle pipe **2** around the bottom of the furnace by way of tuyeres **3**. The air blast reacts with the coke forming hot carbon monoxide which reduces the ore to iron. The molten iron gradually accumulates at the bottom of the furnace. The blast furnace gas produced as a result of the reaction is withdrawn from the top of the furnace through a downcomer pipe **4**. The analysis of this raw blast furnace gas by volume averages:

CO — 25%
CO_2 — 14%
H_2 — 5%
N_2 — 56%

In accordance with my invention, this blast furnace gas is stripped of the nitrogen and recycled to utilize its carbon monoxide in the continuing reduction process. The nitrogen is stripped from the gas because it has no function in the reduction process. Rather, it represents a large volume of material that would have to be heated, and would therefore reduce the efficiency of the operation.

Raw blast furnace gas is delivered by the downcomer pipe **4** to a dust collector **5** which may be a coarse or preliminary cleaner. The dust collector **5** may be of a type which causes the gas on passing therethrough to expand in volume and decrease in velocity, so that the larger particles of dirt fall out.

The gas may next be conveyed to an electronic or static filter **6** by means of a conduit **7** which is provided to take out the finer particles of dirt.

The filtered or cleaned blast furnace gas is conveyed from the electronic filter by pipe **8** to a molecular sieve **9** which strips the nitrogen from the gas and carries it away through pipe **9***a*. The molecular sieve is a well known device and may for example be of the type disclosed in U.S. Pat. Nos. 2,603,553 and 2,842,219.

The stripped gas is next conveyed by pipe **10** to the compressor **11** which raises the pressure of the gas to substantially that of the pressure of the air entering the blast furnace from bustle pipe **2** or slightly higher. Optionally, the compressor may be placed before rather than after the molecular sieve.

From the compressor **11** the gas is conveyed by pipe **12** to the stove or heater **13** where its temperature is raised to approximately 2,000° F., the temperature of the hot air, and then conveyed by pipe **14** to bustle pipe **15** which has tubes **16** leading to tuyeres **3** for the introduction of the stripped blast furnace gas back into the furnace at the point where the air enters.

The stripped blast furnace gas is thus recycled through the furnace making available its large amount of carbon monoxide to assist in the process of reducing the ore to iron. As a result of the stripping of the nitrogen, the proportion of carbon monoxide in the gas recycled is more than doubled, increasing from about 25 percent by volume in the raw blast furnace gas to about 57 percent in the stripped gas. Moreover, the amount of coke required in the operation of the furnace is substantially reduced.

What I claim as my invention is:

1. In the operation of a blast furnace in which iron ore is reduced by the combustion of coke and hot air to produce iron and blast furnace gas and in which the hot air is admitted to the blast furnace continuously, the improvement comprising withdrawing the blast furnace gas resulting from the reduction process from the blast furnace, stripping nitrogen from at least a portion of the blast furnace gas by the use of a molecular sieve, and injecting the stripped portion of the blast furnace gas back into the blast furnace while continuing to admit the hot air to assist in the reduction process.

2. The method defined in claim **1**, including heating the stripped portion of the blast furnace gas to about 2,000° F. prior to injecting it back into the blast furnace.

3. The method defined in claim **1**, including compressing the stripping portion of the blast furnace gas and heating it to about 2,000° F. and injecting the same back into the blast furnace at the same point as the hot air.

4. The method defined in claim **1**, wherein the blast furnace gas contains dust particles, including cleaning the portion of the blast furnace gas to be stripped prior to stripping in order to remove the dust particles therefrom, compressing the stripped portion of the blast furnace gas to about the pressure of the hot air and heating it to about 2,000° F. and injecting the same back into the blast furnace at the same point as the hot air.

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