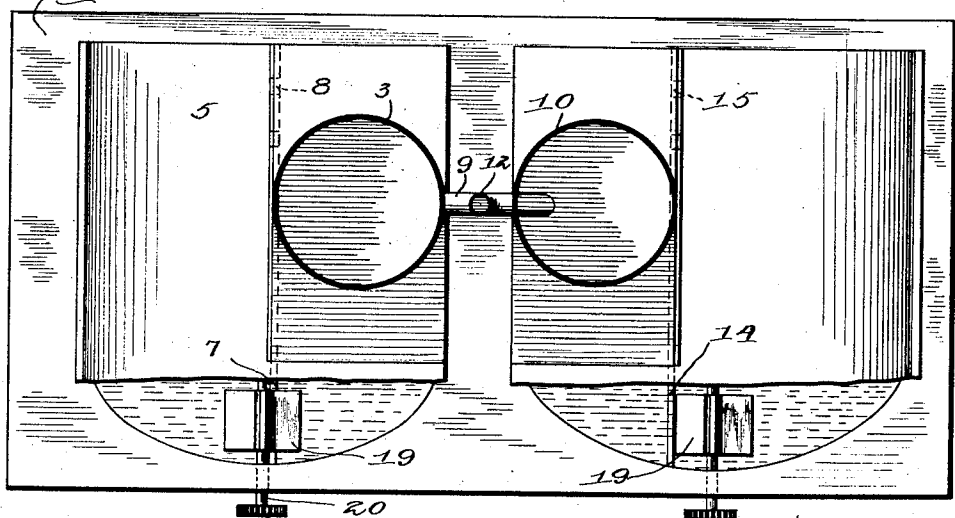
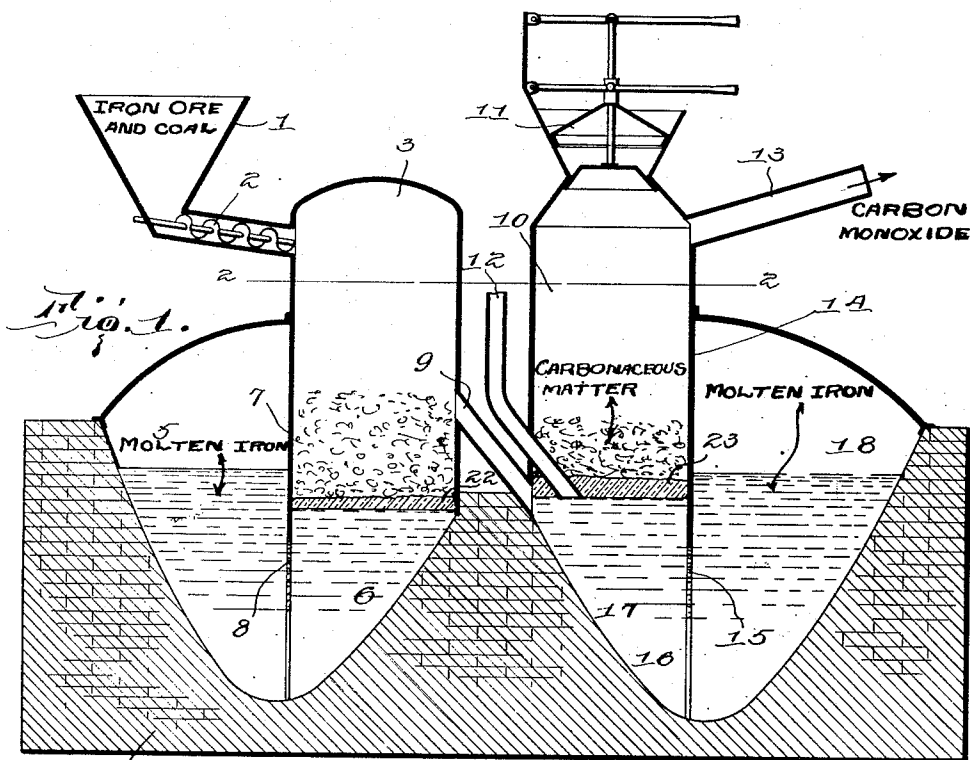


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PRODUCTION OF CARBON MONOXIDE
Filed Sept. 10, 1921



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JOHANN EMIL LEONARZ, OF TACUBAYA, MEXICO.

PRODUCTION OF CARBON MONOXIDE.

Application filed September 10, 1921. Serial No. 499,674.

My invention provides for the production of reducing gases, and in particular carbon monoxide. It is found that the reaction between carbon dioxide or carbonic acid and free carbon may be readily carried out in the presence of a molten bath. Among the metals which in solution are adapted for serving as mediums for converting carbonic acid and carbon into carbon monoxide, iron is found to be particularly suitable. In its molten state iron may be said to be a catalytic agent in the sense that it serves to dissolve the carbon and in turn, to cause its combination with carbonic acid to produce carbon monoxide.

It is further an object of my invention to utilize for this purpose the carbonic acid resulting from the direct reduction of iron or other metals from the ore. It is found that heating a mixture of metallic oxide and carbon is sufficient to sustain the continued reaction whereby the oxide is reduced and a mixture of carbonic acid and carbon monoxide produced. The necessary heat to maintain this reaction is furnished through the heating of the molten bath, described hereinafter.

Any reaction by which carbonic acid is produced, may be utilized to furnish this material as the first step in the process.

For purposes of illustration one form of apparatus for carrying out my invention is shown diagrammatically in the accompanying drawing, in which—

Fig. 1 is a vertical section through the gas producer, and

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1.

A hopper 1 delivers a charge of mixed ore and carbon through a suitable conveyer 2, into tower 3. This tower is built upon a base 4, forming a suitable chamber 5, and a metal container or trough 6. One wall 7 of the tower 3 forms a partition between the chamber structure and the molten bath in the trough 6. A suitable communicating arch 8 is formed in the wall 7. The chamber 5 is adapted to be heated by any convenient means, not shown in the drawing.

A conduit 9 extends from the tower 3 downwardly and into an adjacent tower 10. The tower 10 forms the gas reducer. A charging device denoted generally by the numeral 11 is used to deliver coal or other carbonaceous material to the tower 10. An inlet pipe 12 is carried through the lower

wall of the tower 10 and terminates at the surface of the molten bath in the base of the tower.

A gas outlet pipe 13 leads from the upper wall of the tower 10.

One wall 14 of the tower 10 is extended downward to the supporting base 4 and has a communicating arch 15. The trough 16 is divided by the partition 14 into a reaction chamber 17 beneath the tower 10 and a heating chamber 18 beyond the wall 14. Suitable means are employed to provide adequate heat for the molten bath in the trough 16, preferably through the heating chamber 18.

In order to insure constant and uniform circulation of the molten metal between the two divisions formed by the partitions 7 and 14, agitating means are provided, as for example the mechanical agitators illustrated at 19 in Fig. 2. These may be mounted upon shafts 20 and operated from mechanism 21 outside of the furnace structure. Molten metal is maintained at the requisite temperature in the various troughs by suitable heating arrangements.

A charge of mixed ore and coal or other fuel is fed into the tower 3 and rests upon the surface of the molten bath. Carbon from the fuel is taken into solution by the molten metal of the bath while reduction takes place between the ore and the main body of fuel. The reduced metal is taken up by the molten bath. A certain amount of slag results from the reaction and forms upon the surface of the bath as shown at 22. Carbonic acid and carbon monoxide are given off during the metal reduction operation and fill the chamber of the tower 3. Under the pressure attained during this step these mixed gases are forced through pipe 9 into the molten bath 17 beneath the tower 10.

The molten bath 16 carries a relatively high percentage of carbon in solution. This percentage is maintained by the addition of carbonaceous material through the charging device 11 or by blowing finely divided fuel through the pipe 12 by any customary pneumatic feeding means, not shown. The gases coming from the pipe 9 are blown into intimate contact with the molten metal of the bath. This results in the reduction of the gases to carbon monoxide with subsequent absorption of additional carbon from the bath or from free carbon as the same

may be added to the bath. As the gas rises it must pass through a body of highly heated carbonaceous material which is maintained in the tower 10. This serves as a washer of
5 gas returning any flue dust that may have been carried along. Slag 23 will form on the surface of the bath. At the same time the highly heated carbon mass in the tower 10 is a further reducing agent for improv-
10 ing the quality of the gas. It will be apparent that the molten baths may be connected or exist as a single body of material and that suitable means will be provided for the withdrawal of surplus metal and of slag
15 where the same accumulates.

By the procedure outlined above carbonic acid is utilized as an initial ingredient it being apparent that any source of the same, or any reaction whereby it is produced
20 may serve equally well. The carbonic acid produced in the manner above set out will develop such pressure that it is forced into the reaction chamber 17 and into contact with the contained carboniferous molten
25 iron which operates as a catalytic agent. Under the conditions of temperature existing in this chamber the carbonic acid is converted to carbon monoxide, the necessary carbon being supplied either from the car-

bonaceous material present or from the carbon contained in the bath. The reduced gas passes upwardly, being improved in its quality by passing through the body of highly heated carbon. The gas is then
30 drawn off for cooling and use. 35

While I have shown and described one mode of carrying out my invention, it will be apparent that many changes may be made in minor details and steps and it is to be understood that the invention is as defined
40 in the following claims.

What I claim is:

1. The production of carbon monoxide by heating an oxide of iron with carbon without access of air, passing the resultant gas
45 through a molten bath and adding carbon to said bath.

2. The production of carbon monoxide by heating an oxide of iron with carbon without access of air, passing the resultant gas
50 through a molten bath by the pressure developed by the reaction of the oxide and the carbon, and maintaining carbon in the molten bath.

In testimony whereof, I have hereunto
55 affixed my signature.

JOHANN EMIL LEONARZ.