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2,447,426

PRODUCTION OF CARBON MONOXIDE

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Fig. 1.

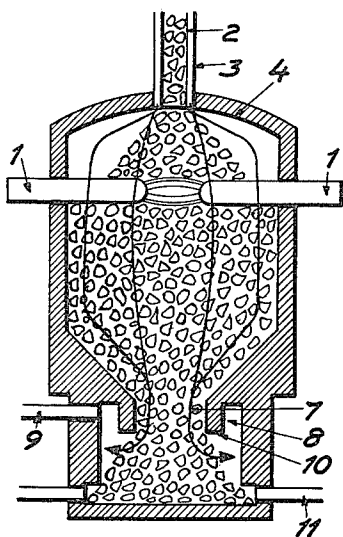
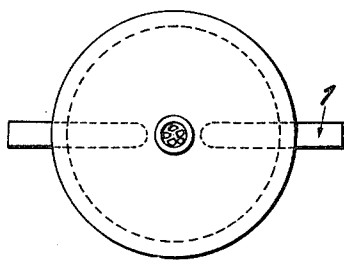


Fig. 2.



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PRODUCTION OF CARBON MONOXIDE

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3 Claims. (Cl. 204—165)

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In the production of a gas rich in carbonmonoxide, e. g., from gas comprising a mixture of carbon dioxide and carbon monoxide, there is used a cupola filled with coal which is heated, generally by means of an electric arc extending between two or more electrodes inserted in the coal. Said electrodes are generally located in such a way that the arc is formed in the middle of the cupola. The gas to be reduced is blown into the cupola and, if the gas thereby obtains a sufficiently high temperature the carbon dioxide of the gas reacts with the carbon of the coal to form carbon monoxide according to the reaction $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$. In order to obtain a rapid and effective heating the inflowing gas has hitherto been caused to flow towards the arc, which seems to be the right principle of obtaining a good reduction of the gas.

However, the arc consists of a series of arcs between the different coal pieces, and consequently the electric current in the arc becomes dependent on the conductivity of the coal and the gas between the coal pieces. Since the conductivity of coal as well as of gas decreases according as the temperature falls, the electric current will be decreased in those portions of the arc which are most exposed to the cooling action of the gas, and in lieu thereof flow through places which are more protected against the gas current. Consequently, the arc will move away from the gas current and approach the wall of the cupola, said wall being thereby damaged by the high temperature. The losses by radiation will also be increased. The gas current also changes its direction through the almost explosive expansion of those portions of the gas which are pressed against the arc. Consequently, gas and arc tend to leave one another, and one does not obtain the effect which one intended to gain by allowing the gas to flow towards the arc. The result will be an incomplete reduction. In those cases in which one has obtained a fairly satisfactory conversion of the carbon dioxide according to this principle, this has been obtained by supplying considerable quantities of electric energy which has resulted in short duration of the walls of the cupola and a very great power consumption.

The principle now proposed for carrying out the conversion will eliminate the above mentioned drawbacks. As in earlier constructions the coal is hereby heated by an arc extending between two or more electrodes. On the other hand the gas is introduced in such a way that it substantially will move along the walls and surround the arc. Consequently, the coal layer at

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the walls will be a relatively bad conductor of electric current, and the arc will, thus, be compelled to remain in the middle of the cupola, and the walls will be protected and the losses by radiation will be small. A certain quantity of the gas flows in the range between the arc and the relatively cold gas current adjacent the walls, said gas quantity being heated to a very high temperature and thus completely reduced. The two gas currents are then forced to mix with one another prior to leaving the cupola, the hot gas current thereby heating the relatively cold gas current to such a temperature that the carbon dioxide thereof reacts with the coal in the cupola, and reduction takes place. The coal sinking from the top downwards and the gas current are moved substantially parallel through the cupola in the same direction.

As regards the practical embodiment of cupolas according to the present principle one example is described below, reference being had to the accompanying drawing. However, the invention is not restricted to said example only, but comprises all the various constructions based upon the previously mentioned new principle.

Fig. 1 shows an example of a cupola in which the gas flows from the top to the bottom. Fig. 2 shows a top view of the cupola according to Fig. 1. The reference numeral 1 designates the electrodes, 2 the pipes for supplying the coal pieces, and 3 a pipe line for supplying the gas to the cupola. By introducing the coal in this way the layer of coal in the cupola will be formed with a frustoconical top portion which together with the roof and the side walls of the cupola forms an annular space into which the gas is introduced.

According to Fig. 1 the gas is supplied through the annular opening between the coal pipe 2 and the gas pipe 3 located outside thereof.

The mixing of the cold gas current along the wall and the hot gas current flowing closer to the direct heated zone and the final reduction take place at the constriction 7. The reduced gas is collected in the annular drum 8 and leaves through the gas pipe 9. When the gas current flows around the edge 10 a further mixing takes place so that the hotter and consequently lighter gas coming from the central zone of the constriction 7 tends to rise and pass as close to said edge as possible. At 11 there should preferably be a device for discharging slag because the slag will gradually gather in the lower portion of the cupola and have an obstructive influence on the gas.

The invention is not restricted to the use of two electrodes as shown in Fig. 1 as it is also possible to use more electrodes, for instance three pairs, each pair being connected to one phase.

The location of the electrodes, the feeding of the coal and the removal of the gas may be combined in other ways than those indicated in the above example without changing the nature of the invention.

The invention may be applied with advantage in connection with the manufacture of iron sponge, but it may also be used for many other purposes.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The process of producing gas rich in carbon monoxide in a vertical cupola furnace provided with electrodes for forming an arc in the central portion of the cupola comprising the steps of supplying solid fuel to the top portion of the cupola to form a vertical column of fuel with a frustoconical top portion in said cupola, passing the fuel continuously downwardly in said cupola, heating a central zone in said column of fuel by means of electrical arcs so that this central zone becomes incandescent, feeding a gas rich in carbon dioxide into the annular space formed between the frustoconical top portion of the fuel column and the walls of the cupola and withdrawing a gas rich in carbon monoxide at the lower portion of the reduction chamber, in order to cause the gas to flow through the fuel column substantially between the vertical walls of the chamber and the central, electrically heated zone.

2. The process of producing gas rich in carbon monoxide in a vertical cupola furnace provided with electrodes for forming an arc in the central portion of the cupola comprising the steps of supplying solid fuel centrally to the top portion of the cupola to form a vertical column of fuel with a frustoconical top portion in said cupola, passing the fuel continuously downwardly in said cupola, heating a central zone in said column of fuel by means of electrical arcs so that this central zone becomes incandescent, feeding a gas rich in carbon dioxide into the annular space formed between the frustoconical top portion of the fuel column and the walls of the cupola, and

withdrawing a gas rich in carbon monoxide symmetrically from the cupola substantially below the electrically heated zone, in order to cause the gas to flow through the fuel column substantially between the vertical walls of the chamber and the central, electrically heated zone.

3. The process of producing gas rich in carbon monoxide, in a vertical cupola furnace provided with electrodes for forming an arc in the central portion of the cupola comprising the steps of supplying solid fuel centrally to the top portion of the cupola to form a vertical column of fuel with a frustoconical top portion in said cupola, passing the fuel continuously downwardly in said cupola, heating a central zone in said column of fuel by means of electrical arcs so that this central zone becomes incandescent, feeding a gas rich in carbon dioxide into the annular space formed between the frustoconical top portion of the fuel column and the walls of the cupola, passing the downwardly moving gas flow below the electrically heated zone through a portion of the cupola with reduced cross section for further reduction of the gas, and withdrawing a gas rich in carbon monoxide from the cupola substantially below the portion with reduced cross section, in order to cause the gas to flow through the fuel column substantially between the vertical walls of the chamber and the central, electrically heated zone.

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