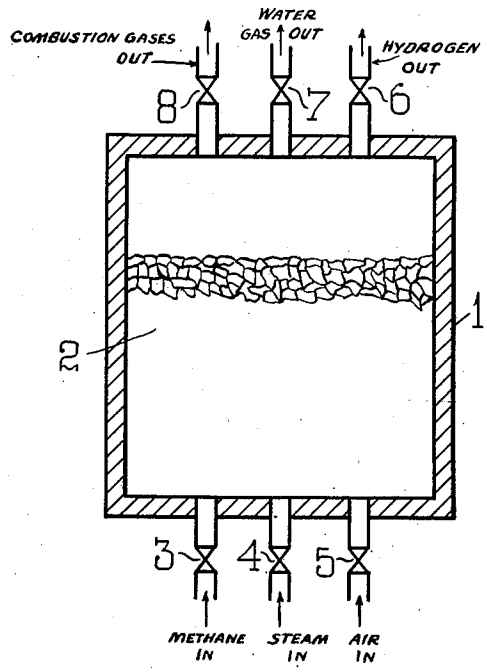
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PRODUCTION OF HYDROGEN

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PRODUCTION OF HYDROGEN

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This invention relates to the production of hydrogen by the thermal decomposition of methane and similar hydrocarbons and also by the decomposition of steam with carbon.

It is known that hydrogen may be obtained by passing methane or a gas containing methane such as coke oven gas through a bed of incandescent coke. It is also known that a mixture of hydrogen and water gas may be obtained by passing a mixture of methane and steam through a bed of incandescent coke, and that the temperature of the coke bed may be maintained by intercalary blowing periods with air.

According to the present invention hydrogen is obtained by the separate and consecutive passage through an incandescent coke bed of a methane-containing gas and steam respectively. The temperature of the coke bed is restored as required by blowing with air. The invention further includes processes in which a refractory inert material is used for storage of heat as hereafter described. Powdered carbonaceous material may be used for the water gas reaction and/or for combustion.

When using a coke bed, at the commencement, the temperature of the coke bed should be as high as possible, e. g. 1500°. The supply of methane gas is then turned on and a gas consisting practically entirely of hydrogen is collected. When the temperature of the coke bed has fallen to such a degree that unchanged methane commences to appear in the exit gas, the methane supply is cut off and steam is substituted. The temperature at this point of the cycle may be about 1100°. The production of water gas is then carried on until the temperature of the coke bed has fallen to say 900°, when the steam supply is cut off and an air blast substituted. This carries the temperature again to a very high level and enables the cycle to start again with the introduction of methane gas.

The hydrogen gas obtained in the run with methane is collected separately from the water gas obtained in the run with steam. The water gas may be catalysed with steam in known manner to obtain a further amount of hydrogen.

The methane gas used in the process may be a gas containing a high proportion of methane, e. g. natural gas, coal gas, or especially the gas obtained in processes in which methane is removed from gases under pressure by means of absorbents, such as liquid kerosene or active carbon. The gas obtained on regenerating such absorbents contains a high proportion of methane and is well adapted for use in the process of this invention.

The process of the invention is particularly important in conjunction with processes for the destructive hydrogenation of coal, etc. as in these processes large quantities of methane are produced and can be separated by solution in kerosene for example, whereupon the methane can be disposed of in the manner already described with the production of practically pure hydrogen which can be used in the hydrogenation process. As the whole of the hydrogen requirements of a coal hydrogenation process can be met by this method, it is evident that the combination of the present process with destructive hydrogenation is of great economic importance.

The process can be carried on without the addition of coke to the coke bed since the carbon resulting from the decomposition of methane is sufficient to supply the normal requirements but in some cases it may be necessary to add a further supply of coke during operation.

The process may also be carried out using a mass of refractory material for example chequer-brickwork as a means for conveying heat to the methane. In this case the brickwork should be heated up initially with a mixture of pulverized fuel and air.

The reaction may then be self-supporting, or alternative powdered fuel may be supplied with the steam, and with the air, in amounts depending on the amount of carbon deposited during the period of methane decomposition.

The gases coming to and from the reaction chamber should be led through regenerators or recuperators to recover their sensible heat.

A purge of steam may be intercalated between the air blast and the methane blast, to eliminate the risk of explosion.

The invention may be carried out in the apparatus shown in the accompanying diagram.

Here 1 is a chamber filled with coke or refractory material 2. Methane is introduced by pipe 3 and the hydrogen produced leaves by pipe 6. Steam is introduced by pipe 4 and the water gas produced leaves by pipe 7. Air is introduced by pipe 5 and the gases of combustion leave by pipe 8.

I declare that what I claim is:

1. In the production of hydrogen, the combination of the thermal decomposition of methane by passing it over a heated refractory material, the water gas reaction using the carbon deposited from said methane and the combustion of the carbon by means of air, said processes being performed successively in cyclic order in an apparatus.

2. The process for the production of hydrogen which comprises heating up coke to about 1500° C. by means of a current of air cutting off said air, passing in methane until the temperature falls to about 1100° C. cutting off said methane, passing in steam until the temperature falls to about 900° C. cutting off said steam, and then repeating the cycle.

3. The process of producing hydrogen which comprises the successive steps of passing methane through a highly heated refractory material to convert it into hydrogen and carbon, shutting off said methane, passing in steam to react with carbonaceous material in the same apparatus, shutting off said steam and raising the temperature of the apparatus by combustion.

4. The process of producing hydrogen which comprises the successive steps of heating up a refractory material by burning powdered fuel and air, shutting off said powdered fuel and air, passing methane into said refractory material to decompose it into carbon and hydrogen, shutting off said methane, and passing in steam to react with said carbon and produce water gas, shutting off said steam and repeating the cycle.

5. The process of producing hydrogen which comprises the successive steps of heating up a refractory material by burning powdered fuel and air, shutting off said powdered fuel and air, passing methane into said refractory material to decompose it into carbon and hydrogen, shutting off said methane, injecting a mixture of steam and powdered fuel to produce water gas, shutting off said mixture and repeating the cycle.

6. The process of producing hydrogen which comprises passing air through a bed of incandescent coke, shutting off said air, passing steam for a short time to purge out said air, shutting off said steam, passing methane through said coke, to decompose it into carbon and hydrogen, shutting off said methane, passing steam through said coke, to form water gas, shutting off said steam and repeating the cycle.

In witness whereof, I have hereunto signed my name this 18th day of March, 1930.

CHARLES FREDERICK REED HARRISON.