PATENT SPECIFICATION

Convention Date (Germany) : Sept. 27, 1937.
Application Date (in United Kingdom) : July 26, 1938.
Complete Specification Accepted : April 26, 1939.

504,529
No. 22260/38.

2243

COMPLETE SPECIFICATION

Process for producing Synthesis Gas by Gasification of Fuels Under Elevated Pressure

We, METALLGESELLSCHAFT AKTIENGESELLSCHAFT, a Corporation organised under the Laws of Germany, of 45, Bockenheimer Anlage, Frankfurt-on-the-Main, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained and in by the following statement:—

This invention relates to a process for producing synthesis gas by gasification of fuels under elevated pressure.

It is known to gasify solid fuels under elevated pressures of several atmospheres by means of oxygen and ample quantities of steam, with or without the addition of carbon dioxide, to form a gas high in methane and suitable for town gas supply after removal of the carbon dioxide and other impurities particularly tar, benzine and sulphur compounds.

In the gasification of fuels with gasification media consisting of mixtures of air and steam it has already been proposed to add carbon dioxide to such gasification media in order to increase the yield of combustible gases produced per unit quantity of fuel treated.

The present invention aims at producing synthesis gas practically free methane and having a carbon monoxide to hydrogen ratio of, for example, 1:2 by the gasification of fuels under an elevated pressure of for example 5 to 50 atmospheres.

To this end, according to the present invention carbonaceous fuels are gasified by means of oxygen-steam mixtures containing about 0.1 to 0.2 N.T.P. cubic metres of oxygen per N.T.P. cubic metre of gas produced, and carbon dioxide is added to the gasification medium in amounts ranging from about half to three times the volume of oxygen employed, so as to reduce the formation of methane and to adjust the ratio of carbon monoxide to hydrogen in the end gas to a determined volume amounting to upwards of about one volume of carbon monoxide to two volumes of hydrogen.

The advantages of the process of the present invention will be explained by comparing two examples of working, with and without the addition of carbon dioxide.

If, for example, low-temperature coke produced from mineral coal be gasified under a pressure of 10 atms. with oxygen and steam, about 0.13 cubic metre of oxygen and 0.93 k.g. of steam being needed per cubic metre of crude gas, without adding carbon dioxide, a gas of the following composition is obtained:
CO_2=25.5%, CH_4=6.5%, CO=19.5%, H_2=47.0%, N_2+remainder=1.5%.
If a part of the steam (about 0.28 kg.) be replaced—under otherwise identical working conditions—by 0.2 cubic metre of CO_2, the gas composition is changed in approximately the following manner:—
CO_2=35.0%, CH_4=1.0%, CO=21.0%, H_2=42.0%, N_2+remainder=1.0%.
The methane content—upon which the solution of the problem underlying the invention is substantially dependent—is thus reduced from 6.5% to 1%, and the ratio of CO to H_2 is adjusted to the desired stoichiometric condition. The resulting crude gas is cooled in the usual manner and freed from condensable constituents. The carbon dioxide is then separated from the crude gas. This can be done, for example, by employing the per se known pressure water washing. The separation of the carbon dioxide furnishes a gas immediately suitable for the synthesis. The removal of the sulphur from the gas is effected in known manner, for example by the use of a purifying mass or together with the carbon dioxide in the pressure water washing. Part of the carbon dioxide separated is returned to the gas producer for adding to the gasification medium, after it has first been compressed to the gasification pressure.

Under certain conditions, for example when the gasification is carried out under high pressure, it is convenient to produce the carbon dioxide under pressure, since in that case separate compression of the carbon dioxide is not necessary. For this purpose processes such as purifying the gas with the aid of organic or inorganic solutions are suitable. The carbon dioxide is taken up by these solutions and

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can be driven off therefrom under pressure by heating. It is produced under a pressure that is slightly lower than the gasification pressure, owing to the resistances to flow in the apparatus; a simple circulating pump is then sufficient to return the carbon dioxide to the gas producer. The carbon dioxide is preferably heated, for example to temperatures of 500° C. before its entry into the gas producer, either alone or mixed with the steam. This results in a saving of oxygen. At the same time, this measure also provides a means of additionally influencing the gas composition. Since the addition of carbon dioxide has a cooling action on the gasification zone, in the same way as excess steam, the addition of steam to the oxygen may be reduced accordingly.

Together with the carbon dioxide, inferior tars and oils, or the like, or hydrocarbons produced in the synthesis—particularly gaseous ones, such as methane—may be returned to the gas producer, in order to split them. The carbon dioxide may also be more or less saturated with steam, by irrigation with hot water vapour condensate produced during the cooling of the gas, so that further steam is saved. Combustible gases also produced when separating the carbon dioxide from the crude gas are rendered re-utilisable by their return to the gas producer. It is possible, in known manner, to add substances having a catalytic action, such as metal oxides or carbonates or the like, to the fuel, in order to influence the gasification reactions in the desired direction.

With the present process it is possible, while utilising the great advantages of gasification under a pressure of several atmospheres, to suppress the otherwise unavoidable formation of methane, and at the same time to adjust, to a considerable extent, the proportion of carbon monoxide and hydrogen to the most favourable value for the subsequent synthesis.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1). A process for producing synthesis gas by the gasification of fuels under pressures of several atmospheres by means of oxygen-steam mixtures, containing about 0.1 to 0.2 N.T.P. cubic metres of oxygen per N.T.P. cubic metre of gas produced, which process comprises adding carbon dioxide to the gasification medium in amounts ranging from about half to three times the volume of oxygen employed so as to reduce the formation of methane and to adjust the ratio of carbon monoxide to hydrogen in the end gas to determine value, amounting to upwards of about 1 volume of carbon monoxide to 2 volumes of hydrogen.

2). Process as claimed in claim 1, in which the carbon dioxide separated from the crude gas, or a part thereof, is added to the gasification medium.

3). Process as claimed in claims 1 and 2, in which inferior liquid hydrocarbons, produced in the cooling of the gas or from an extraneous source, or hydrocarbons produced in the subsequent synthesis, particularly gaseous ones, such as methane, are returned with the carbon dioxide to the gas producer, and split.

4). Process as claimed in claims 1 to 3, in which the carbon dioxide is irrigated with hot water vapour condensate from the gas cooling and more or less saturated with steam, before it is returned to the gas producer.

5). Process as claimed in claims 1 to 4, in which the carbon dioxide is heated, alone or together with steam, before introduction into the gas producer.

6). The process of producing synthesis gas, substantially as described.

Dated this 26th day of July, 1938.

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Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1939.

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