hydrocarbon converter for decomposing a hydrocarbon containing fluid into carbon and hydrogen, wherein the hydrocarbon converter comprises at least one process chamber having at least one inlet for a hydrocarbon containing fluid and at least one outlet for carbon and/or hydrogen and at least one plasma unit for introducing energy into the process chamber, the energy consisting at least partially of heat. Further the apparatus comprises a CO_2 converter for converting CO_2 into CO, the CO_2 converter comprising at least one additional process chamber having at least one inlet for CO_2, at least one inlet for at least carbon and at least one outlet, wherein the inlet for at least carbon is directly connected to the at least one outlet of the hydrocarbon converter. Here, the term "directly connected" describes that carbon coming out of the hydrocarbon converter does not cool down by more than 50% of its temperature in °C, preferably not more than 20%, on its way to the CO_2 converter without the utilisation of additional energy to heat up the carbon. A separating unit, which separates the carbon from the hydrogen, may be provided between the location of the decomposing step and the at least one exit of the hydrocarbon converter. This separating unit may form a part of hydrocarbon converter or may be located outside the hydrocarbon converter as a separate unit. A separating unit between the exit of the hydrocarbon converter and the entrance of a C converter does not compromise a direct connection as long as the above condition is met.

Preferably, the at least one unit for introducing energy into the process chamber is constructed in such a way that it is able to at least locally generate temperatures above 1000°C, specifically above 1500°C. In one embodiment, the at least one unit for introducing energy into the process chamber is a plasma unit. Particularly, if the decomposing temperature shall be kept below 1000°C, the at least one unit for introducing energy into the process chamber preferably comprises a microwave plasma unit.

For a particularly simple embodiment of the apparatus, the process chamber of the CO_2 converter is formed by an outlet pipe of the hydrocarbon converter which is connected to a supply pipe for CO_2 gas.

In one embodiment of the invention, a separation unit for separating the carbon and the hydrogen generated by decomposing is provided in the vicinity of the hydrocarbon converter, and separate outlets from the separation unit are provided for the separated materials, wherein the outlet for carbon is connected to the CO_2 converter.

Preferably, the hydrocarbon converter is a Kvaerner reactor that can provide the necessary temperatures for a continuous decomposing of a hydrocarbon containing fluid for long operating periods.

process chamber having an inlet for a hydrocarbon containing fluid, at least one unit for introducing decomposing energy into the fluid and at least one outlet. The decomposing energy is provided at least partially by heat, which is provided by a plasma in an apparatus according to the invention. In an apparatus not covered by the claims, the decomposing energy may also be provided by other means. If decomposing is primarily effected by heat, the fluid should be heated to above 1000°C and particularly to a temperature above 1500°C.

In the described embodiment, a Kvaerner reactor is used, which provides the required heat by means of a plasma arc and a plasma torch. However, other reactors are known, which operate at lower temperatures, particularly below 1000°C, and introduce additional energy besides heat into the hydrocarbon, e.g. by means of a microwave plasma. As is further explained below, the invention considers both types of reactors (and also those which operate without plasma), in particular also both types of reactors in combination with each other. Hydrocarbon converters operating at a temperature above 1000°C are referred to as high temperature reactors, whereas those converters operating at temperatures below 1000°C, particularly at temperatures between 200°C and 1000°C, are referred to as low temperature reactors.

Within the hydrocarbon converter, hydrocarbons (C_nH_m) are decomposed into hydrogen and carbon by means of heat of a plasma. These hydrocarbons are preferably introduced into the reactor as gases. Hydrocarbons that are liquids under standard conditions may be vaporised prior to introduction into the reactor or they may be introduced as micro-droplets. Both forms are referred to as fluids in the following.

Decomposing of the hydrocarbons should be done, if possible, in the absence of oxygen in order to suppress the formation of carbon oxides or water. Nevertheless, small amounts of oxygen, which might be introduced together with the hydrocarbons, are not detrimental for the process.

The Kvaerner reactor described above decomposes hydrocarbon containing fluids in a plasma burner at high temperatures into pure carbon (for instance as activated coal, carbon black, graphite or industrial soot) and hydrogen and, possibly, impurities. The hydrocarbon containing fluids used as starting material for the hydrocarbon converter 3 are for instance methane, natural gas, biogases, wet gases or heavy oil. However, synthetic functionalised and/or non-functionalised hydrocarbons may also be used as starting material for the hydrocarbon converter 3. After the initial decomposing step, the elements are usually present as a mixture, particularly in form of an aerosol. This mixture may, as described below, be introduced into another process in this form, or the mixture may be separated into its individual elements in a separation unit, which is not shown. In the context of this application, such a separation unit is