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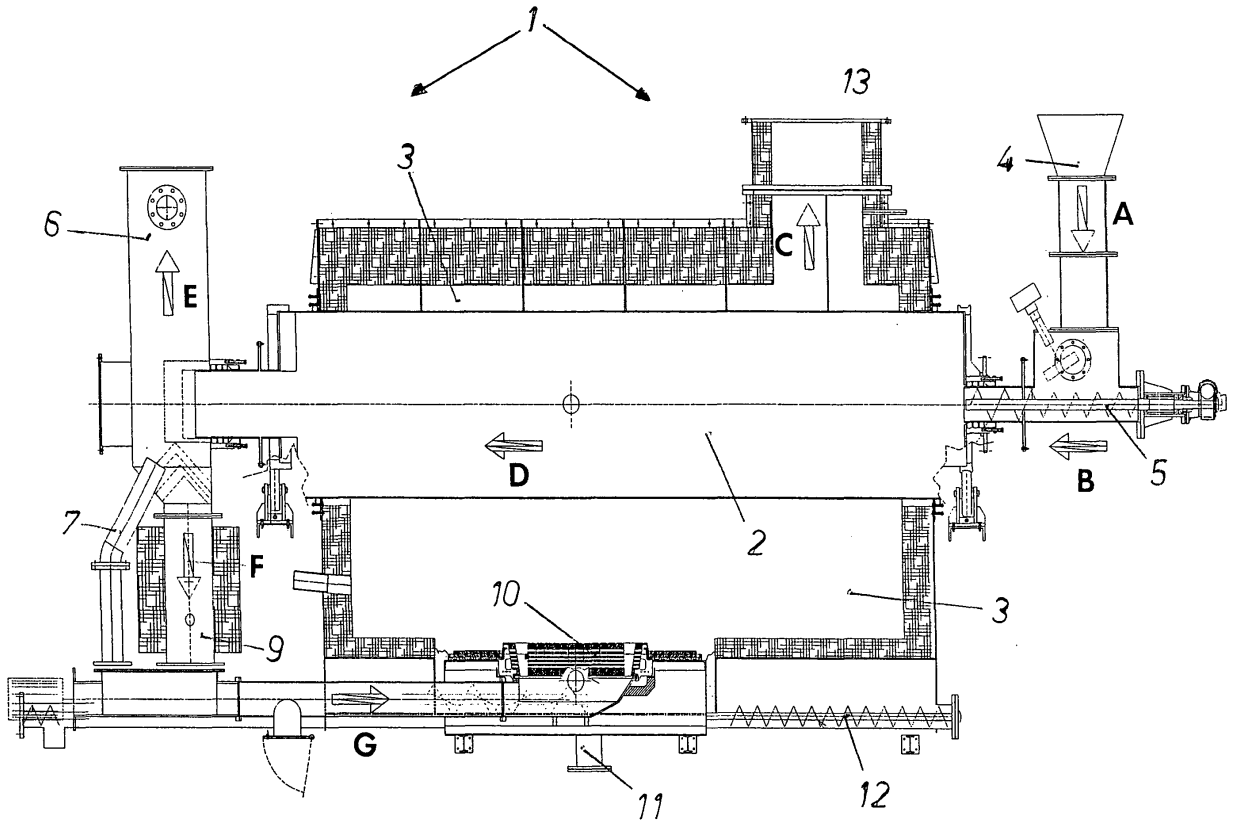
(54) **Method and apparatus for converting organic materials into gas and charcoal**

(57) A method for converting organic materials into gas and charcoal is described, whereby the said organic materials are subjected to heating at predefined temperatures inside a pyrolysis reactor (2); in the method according to the invention the said reactor (2) is heated by causing fumes produced by the post-combustion of at least a part of the charcoal produced therein to flow over it, which charcoal, after being removed therefrom, is partly gasified and partly post-combusted by blowing into it a comburent gas in order to cause it to generate the said fumes.



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Description

[0001] The present invention relates to the sector of methods and plants used to convert organic materials (also called "biomass") into gas and charcoal by subjecting them to heat treatment, the most well-known form of which is pyrolysis.

[0002] As is known by persons skilled in the art, in a pyrolysis method the organic materials are heated to temperatures of between about 500 and 850°C, keeping them in these conditions for a period of time sufficient to cause their complete conversion into combustible gas and charcoal. The charcoal may then be gasified in order to produce further combustible gas. Similar types of treatment are at present performed in urban waste disposal plants.

[0003] Said waste is introduced into a container called a pyrolysis reactor and is subjected to the abovementioned treatment, providing the reactor with the necessary quantity of heat by acting on its outer surface.

[0004] This heat is normally supplied by an external source, which is also remote in the case where it is derived from electrical energy, and therefore supplying thereof always involves various factors which reduce the final efficiency of heat exchange as a whole.

[0005] The inventor of the subject of the present application has devised a new method and a new type of plant able to implement said method, in which the abovementioned heat supplied to the pyrolysis reactor is obtained by completing the combustion of the charcoal produced by it and causing its fumes to circulate inside the said reactor. A higher overall energy efficiency is thus obtained, and only a very small quantity of ash and other solid residue, and not large quantities of charcoal, must be disposed of or transferred.

[0006] Other measures for rendering more efficient the method according to the invention and the associated plant will be described in the remainder of the present description.

[0007] The present invention therefore relates to a method for converting organic waste into gas and charcoal as described in the accompanying Claim 1, as well as to a plant designed to implement it.

[0008] A more detailed description of a preferred example of embodiment of the method of the invention and a plant designed to implement it will now be provided, with reference also to the accompanying figure which shows a longitudinal section through this plant during execution of the method in question.

[0009] The material to be treated is supplied to the plant 1 (arrow A) via an inlet 4 provided with means (rotary vanes, double guillotines, double clapper valves, etc.) able to ensure a hermetic seal with respect to the surrounding environment. A feeder apparatus 5 is installed downstream of the said inlet 4 and conveys the material (arrow B), by means of a feeder screw system, comprising pusher pistons or the like, towards the inside of a pyrolysis reactor consisting of a lined rotating drum 2, along the walls of which combustion fumes flow, passing through the space situated between the said rotating drum 2 and a heat-insulated chamber 3 which contains the latter and emerging (arrow C) through a discharge duct 13 (an explanation regarding the generation of these combustion fumes will be provided in the continuation of the present description.

[0010] These fumes release most of their heat to the pyrolysis reactor 2, inside which the material to be treated, reaching temperatures greater than or equal to about 500°C, undergoes a pyrolysis process, during which, as mentioned, gas and charcoal are produced.

[0011] While the pyrolysis gas emerges (arrow E) through an outlet duct 6, the charcoal, as a result of rotation of the drum (where necessary combined with a suitable inclination of its longitudinal axis) moves (arrow D) towards a gasification chamber 9 inside which it is deposited (arrow F) and inside which, by blowing in comburent air (oxygen, air, oxygen and/or steam enriched air), partial combustion with associated partial gasification of the said pyrolysis charcoal is obtained.

[0012] While the synthesis gas produced emerges together with the pyrolysis gas (arrow E) through the already mentioned outlet duct 6, the non-gasified charcoal passes (also by means of gravity) through a bypass plant 7 provided with extraction means 8 which deposit it (arrow G) onto a post-combustion grid 10 situated in the bottom zone of the said heat-insulated chamber 3 containing the pyrolysis reactor 2.

[0013] By means of a blowing-in apparatus 11 (not fully visible in the drawing) the post-combustion grid and the charcoal bed deposited on it are passed through by a variable quantity of additional comburent gas which, causing combustion of the charcoal, produces fumes which, being directed upwards through the heat-insulated chamber 3, flow along the walls of the pyrolysis reactor before being directed towards the already mentioned discharge duct 13, and release to the said reactor 2 the heat necessary to perform therein the described process of pyrolysis of the materials to be treated contained inside it.

[0014] The ash and the inert matter produced by the abovementioned post-combustion are then removed by means of an extraction apparatus 12 of the known type, for example of the feeder screw type as shown in the drawing.

[0015] Some characteristic features of the plant 1 which implements the method according to the invention are described.

[0016] Firstly, by regulating the speed of rotation of the rotating drum 2 forming the pyrolysis reactor and/or the inclination of its axis it is possible to vary the time which the material remains inside it, thereby obtaining a desired degree of pyrolysis.

[0017] Secondly, by suitably varying the quantity of comburent gas introduced into the gasification chamber 9 it is possible to ensure that a quantity of charcoal less than or at the most equal to that produced inside the pyrolysis reactor 2 is obtained, so that inside the said

gasification chamber 9 there always remains a bed of charcoal having a thickness most suitable for achieving a desired partial combustion thereof.

[0018] Thirdly, by varying the quantity and/or the quality of the comburent gas blown in through the said post-combustion grid 10, it is possible to generate fumes of varying volume and/or temperatures, so as to influence in the desired manner the degree of pyrolysis achieved inside the pyrolysis reactor 2 heated by it.

[0019] In the case of plants intended to treat large quantities of materials, in view of their high thermal capacity and the greater difficulties associated with heating them, the inventor has envisaged, the possibility of conveying the synthesis gas which emerges from the gasification chamber 9 towards the pyrolysis reactor 2 in the opposite direction of flow, with subsequent removal thereof via an outlet duct arranged with respect to the reactor on the side where entry of the material occurs (i.e. right-hand side in the drawing). This solution has not been illustrated with drawings since it may be easily deduced and realized by a person skilled in the art.

Claims

1. Method for converting organic materials into gas and charcoal, in which the said organic materials are subjected to heating at predefined temperatures inside a pyrolysis reactor (2), **characterized in that** the said reactor (2) is heated by causing fumes produced by the post-combustion of at least a part of the charcoal produced therein to flow over it, which charcoal, after being removed therefrom, is partly gasified and partly post-combusted by blowing into it a comburent gas in order to cause it to generate the said fumes.

2. Method according to Claim 1, in which the said pyrolysis reactor (2) is made to rotate while the fumes generated by the combustion of the charcoal produced therein flow around it.

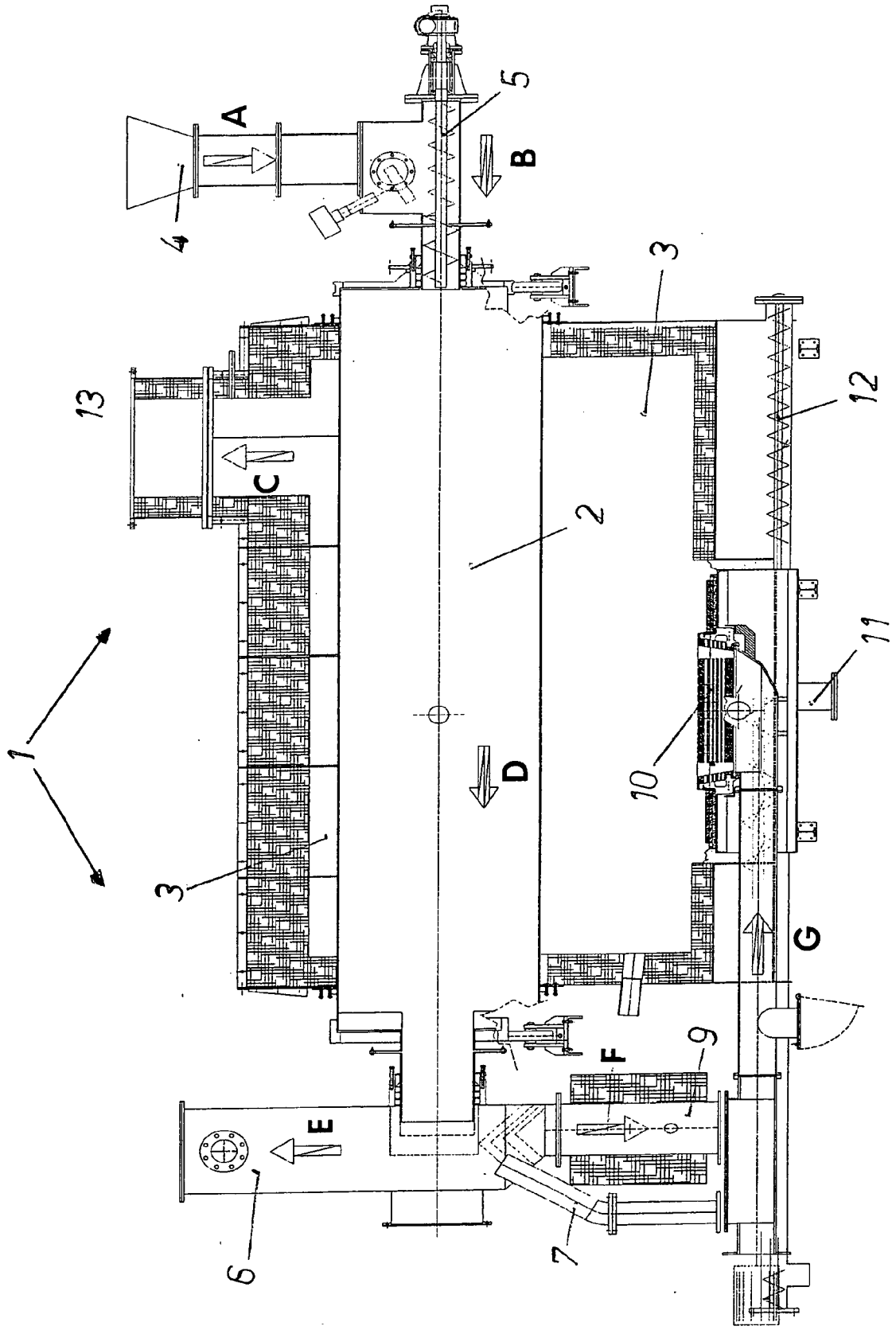
3. Method according to one of the preceding claims, in which the synthesis gas which is produced by means of gasification after it has been removed from the said pyrolysis reactor (2) is made to pass, before being extracted, through the said pyrolysis reactor (2), where it releases part of its heat.

4. Method according to one of the preceding claims, in which the gas produced by the said gasification of part of the charcoal is made to pass through the said pyrolysis reactor (2) so as to heat the material which is being treated therein.

5. Method according to one of the preceding claims, in which the residual heat of the fumes which perform heating of the said pyrolysis reactor (2) is recovered by means of heat exchange.

6. Plant (1) designed to implement the method described in one of the preceding claims, **characterized in that** it comprises:

   - a pyrolysis reactor, consisting of a rotating drum (2) housed inside a heat-insulated chamber (3);
   - a hermetically sealed feeding system (4) for the material to be treated, provided with a feeder apparatus (5) which conveys the latter inside the said rotating drum (2);
   - a gasification chamber (9) inside which the material which emerges from the pyrolysis reactor (2) is deposited as a result of rotation thereof, being provided with an outlet duct (6) for the pyrolysis gas, the charcoal produced by the pyrolysis inside the said reactor (2) accumulating inside the said gasification chamber (9) into which a desired quantity of air which may or may not be enriched with oxygen and/or steam is introduced, the gas thus produced being added to the pyrolysis gas and flowing out with it through the said outlet duct (6);
   - a bypass plant (7) with extraction means (8) which convey the charcoal part which has not been gasified in the said gasification chamber (9) onto a post-combustion grid (10) situated in the bottom zone of the said heat-insulated chamber (3).
   - a blowing apparatus (11) which blows a comburent gas towards the heat-insulated chamber (3) through the said post-combustion grid (10);
   - an apparatus (12) for extracting ash and inert matter produced by the post-combustion on the associated grid (10).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