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(71) Applicant: PLASMATEN, LLC [US/US]; 131 West
Burke Street, Easton, PA 18042 (US).

(72) Inventors: THOMPSON, Barry; 131 W. Burke Street,
Easton, PA 18042 (US). EDWARDS, Bradley; 2414 1st
Avenue, Apt. 417, Seattle, WA 98121 (US). NOLAN, Le-
land; 90 Prince Street, New York, NY 10012 (US).

(74) Agents: PHAM, Chinh H. et al.; Greenberg Traurig, LLP,
1 International Place, Boston, MA 02110 (US).

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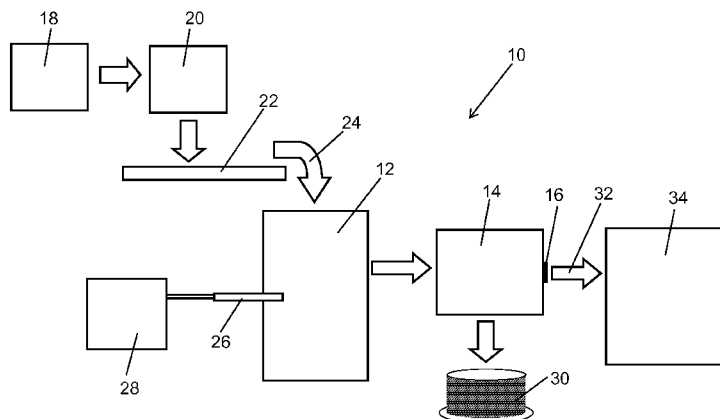
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FIG. 1



(57) Abstract: Systems and methods for processing and converting organic material, such as waste material, coal or other carbon containing material, into useful products and resources are disclosed. The system includes a first chamber (12) for receiving organic material and designed to provide heat at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen; a second chamber (14) in fluid communication with the first chamber (12) for capturing the carbon compound from the gas flow and converting the carbon compound into carbon nanotubes; and an outlet in fluid communication with the second chamber (14) or the first chamber (12) through which the gas flow substantially absent of carbon compound passes. An energy generating system (34) may be in fluid communication with the outlet for generating electricity from the gas flow with hydrogen.

SYSTEMS AND METHODS OF CONVERTING ORGANIC MATERIAL INTO USEFUL PRODUCTS

RELATED APPLICATIONS

[0001] This application claims priority to U.S. Patent Application No. 13/934,113, filed on July 2, 2013, which claims priority to U.S. Provisional Patent Application Serial No. 61/667,624, filed on July 3, 2012, each of which is hereby incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] This application is directed to systems and methods for processing organic materials, and more particularly, converting waste materials into useful products and resources.

BACKGROUND

[0003] Disposing of waste materials has presented many challenges. Large volumes of waste are generated daily, and have been disposed regularly in landfills. However, landfills are reaching capacity or not available particularly in urban areas. Transporting waste to landfills can be costly. The large demand far exceeds supply. Also, waste in landfills has resulted in contamination of soil and water supplies due to hazardous materials.

[0004] Other methods of disposing of waste have been utilized such as incineration. But such methods have also caused environmental problems including air pollution from the release of greenhouse gases. Attempts have been made to convert waste into useful products, but often such attempts have also resulted in products that have little useful value, that produce greenhouse gases, or otherwise harm the environment. For example, waste conversion systems may produce carbon that needs to be sequestered and lacks any beneficial use.

[0005] It would be desirable to have a system that can process waste materials or other carbon containing materials to produce valuable products efficiently while minimizing production of greenhouse gases or the need to sequester the resulting carbon that may have little value.

SUMMARY OF THE INVENTION

[0006] The present invention is directed to systems and methods for converting organic material into useful products and resources in a cost-effective, reliable and efficient manner, while minimizing harm to the environment.

[0007] In one embodiment, the system includes a first chamber for receiving organic material and designed to provide heat at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen; a second chamber in fluid communication with the first chamber for capturing the carbon compound from the gas flow and converting the carbon compound into carbon nanotubes; and an outlet in fluid communication with the second chamber through which the gas flow substantially absent of carbon compound passes. The organic material may be a waste material, coal, or other carbon containing material. The waste material, in an embodiment, may be solid or semi-solid. The temperature in the first chamber may be in the range from about 3,000 °C to about 25,000 °C. The second chamber may also include a catalyst for use in connection with formation of carbon nanotubes.

[0008] The system may also include an energy generating system in fluid communication with the outlet from the second chamber for generating electricity from the gas flow with hydrogen. The energy generating system, in one embodiment, may be a fuel cell or a steam turbine.

[0009] In another embodiment, the system includes a first chamber for receiving organic waste material and designed to provide heat at a temperature sufficient to convert the organic waste material to a gas flow having a carbon compound and hydrogen; a second chamber in fluid communication with the first chamber for capturing the carbon compound and converting the carbon compound into carbon nanotubes; and an outlet in fluid communication with the first chamber through which the gas flow with hydrogen passes. The organic material may be a waste material, coal, or other carbon containing material. The waste material, in an embodiment, may be solid or semi-solid. The temperature may be in the range from about 3,000 °C to about 25,000 °C. The second chamber may include a catalyst for use in connection with formation of carbon nanotubes.

[00010] The system may also include an energy generating system in communication with the outlet from the first chamber for generating electricity from the gas flow with hydrogen,

wherein the energy generating system, in one embodiment may be a fuel cell system or a steam turbine system.

[0010] In another embodiment, a method for converting material into useful products is provided. The method includes: depositing organic material into a first chamber and providing heat in the first chamber at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen; capturing the gas in a second chamber that is in fluid communication with the first chamber and converting the carbon compound into carbon nanotubes; and passing the gas flow with hydrogen through an outlet that is in fluid communication with the second chamber. The organic material may be a waste material, coal, or other carbon containing material. The waste material may be solid or semi-solid. The temperature may be in the range from about 3,000 °C to about 25,000 °C. The second chamber may include a catalyst for use in connection with formation of carbon nanotubes.

[0011] The outlet may be in fluid communication with an energy generating system for generating electricity from the gas flow with hydrogen. The method may further include directing the hydrogen gas to the energy generating system after passing through the outlet from the second chamber. The energy generating system, in one embodiment, may include a fuel cell or a steam turbine.

[0012] In another aspect, the method includes: depositing organic material into a first chamber and providing heat in the first chamber at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen; capturing the carbon compound in a second chamber that is in fluid communication with the first chamber and converting the carbon compound into carbon nanotubes; and capturing the gas flow with hydrogen and passing the gas flow with hydrogen through an outlet that is in fluid communication with the first chamber.

[0013] The organic material may be a waste material, coal, or other carbon containing material. The waste material may be solid or semi-solid. The temperature may be in the range from about 3,000 °C to about 25,000 °C. The second chamber may include a catalyst for use in connection with generation of carbon nanotubes.

[0014] The outlet may be in fluid communication with an energy generating system for generating electricity from the gas flow with hydrogen. The method may further include directing the gas flow with hydrogen to the energy generating system after passing through the

outlet from the first chamber. The energy generating system, in one embodiment, may include a fuel cell or a steam turbine.

[0015] These and other features and advantages of the present invention will become more apparent from the following description taken in conjunction with the accompanying drawings wherein like reference characters denote corresponding parts throughout the several views.

DESCRIPTION OF THE DRAWINGS

[0016] Fig. 1 is a schematic diagram of a system for converting organic material into useful products using a single pathway.

[0017] Fig. 2 is a schematic diagram of a system for converting organic material into useful products using more than one pathway.

[0018] Fig. 3 is a schematic diagram of a further embodiment of a system for converting organic material into useful products using more than one pathway.

[0019] Fig. 4 is a flowchart of a method for converting organic material into useful products using a single pathway.

[0020] Fig. 5 is a flowchart of a method for converting organic material into useful products using more than one pathway.

DETAILED DESCRIPTION

[0021] Systems and methods for converting organic material into useful products are disclosed. In general, the system includes a first chamber for receiving organic material, a second chamber in fluid communication with the first chamber, and at least one outlet in fluid communication with the first chamber or second chamber. Organic material may be received into the first chamber where it can be incinerated and from which a gas flow is generated. The gas flow from the first chamber may be directed into the second chamber, or it may be bifurcated as it exits the first chamber with one flow direction moving across at least one outlet and while another flow direction may be directed into the second chamber. The gas flow may be processed in the second chamber to produce a useful product. These useful products include, for example, environmentally-friendly products such as carbon nanotubes. The gas flow exiting through the

outlet from the first chamber, on the other hand, may be utilized as an additional resource, for example, in the generation of energy.

[0022] Fig. 1 illustrates an embodiment of a system 10 for converting organic material such as organic waste material into useful products and/or additional resources. The system 10 includes, in one embodiment, a first chamber 12 for receiving organic material, such as waste material, a second chamber 14 in fluid communication with the first chamber 12, and at least one outlet 16 in fluid communication with the second chamber 14. Any suitable waste material may be used including solid, semi-solid, liquid, or gas waste. The waste material may be from any source including, for example, municipal waste material, sewage, sludge, hazardous waste, recycled or non-recycled materials, and organic or inorganic material.

[0023] In addition to organic materials such as waste materials, various other sources of carbon may be used. For example, coal may be used as a source of carbon. Accordingly, waste material, coal or any other carbon containing materials may be used as input material with the systems and methods described herein.

[0024] Prior to being received in the first chamber 12, the organic material such as waste material may be subject to one or more pre-processing steps. For example, the waste material may first be received into a shredder or other mechanism for breaking the bulk waste material into smaller components and reducing the size of the waste materials. Thus, the system 10 may further include a waste input station 18 and a waste reduction system 20 in fluid communication with the waste input station 18. The waste reduction system 20 may be a shredder or other mechanism for reducing the volume of waste material. Suitable shredding systems are commercially available. For example, Taskmaster® Industrial Shredders by Franklin Miller or any shredders manufactured by SSI Shredding Systems, Inc. may be used. The system 10 may include other systems for reducing the waste material, such as grinders or crushers, in addition to or instead of system 20.

[0025] The waste material may be subject to additional pre-processing steps. In one embodiment, the waste material may be dried out or water may be added to the waste material before it is further processed.

[0026] The system 10 may further include a transport and pre-processing system 22 for transporting and further processing the waste material. For example, after being shredded, the waste material may be transported to another pre-processing station (not shown) before being

transported to the first chamber 12. The waste material may be transported, in one embodiment, by a conveyor belt system or any other suitable method. The transport and pre-processing system 22 may also include a sorting station or process. For example, certain materials may be removed from the waste material including, but not limited to, metals or other non-recyclables; PVC, Teflon, and other plastics; and any other materials that include fluoride or chloride. The sorting process may be manual or automated. In an embodiment, it is desirable to remove inorganic materials from the waste material so that the waste material processed in the present system is substantially organic material.

[0026] The system 10 may also include a feed port 24 for receiving the waste material which may or may not have been pre-processed and feeding the waste material into the first chamber 12. The feed port 24 may be any suitable pathway for feeding the waste material into the first chamber 12. The feed port 24 may include a seal (not shown) that is substantially fluid or air-tight. The feed port 24 may also be designed to allow for the feed rate to be adjusted. The feed rate may be at a steady rate or the feed rate may be adjusted or optimized depending on the type of waste material being fed into the first chamber 12 and the temperature at which the first chamber 12 is operating. To achieve an optimized feed rate, the waste material may, for instance, be fed in a certain order, such as solid, liquid and then gas waste materials, if desired.

[0027] The first chamber 12 for receiving organic waste material may be designed to provide heat to the interior of the first chamber 12 and the organic waste material therein. The first chamber 12 may be any structure able to withstand heat at a temperature sufficient to convert the waste material to a gas. The first chamber 12 may also be designed to provide heat at a temperature sufficient to convert the organic waste material to a gas including a carbon compound and hydrogen. The carbon compound may, in one embodiment, include any carbon containing compound including carbon monoxide and carbon dioxide. The gas may be a combination of gases such as a synthetic gas (syngas), which includes a mixture of carbon monoxide, hydrogen, and water.

[0028] The first chamber 12 may be of any suitable dimensions, shape or material. In one embodiment, the first chamber 12 may be about 2 meters to about 3 meters in diameter. Of course, the size of the first chamber 12 can be modified depending on the application. The inside of the first chamber 12, in an embodiment, may be lined with a material that can withstand sufficiently high temperatures, for instance, fire brick or any material that can withstand high

temperatures. Alternatively, commercially available gasification or plasma chambers may be used as a first chamber 12.

[0029] The first chamber 12 may be designed to permit entry of waste material while minimizing the escape of hot gases generated within the first chamber 12. The first chamber 12 may also include a drainage system to collect slag or other byproducts. Slag or rock slag may include non-hazardous inorganic materials and chemically bonded, non-leachable heavy metals. Other byproducts produced in the first chamber 12 may include rock wool and sulfur which are useful products.

[0030] Heat provided to the first chamber 12 may be at any suitable temperatures including about 3,000 °C or greater. In one embodiment, a suitable temperature range may be from about 3,000 °C to about 25,000 °C. These high temperatures cause the organic material to break down and decompose, leaving the elemental components of the molecules, such as carbon. The organic molecules volatilize and become gases. The organic material gasified in the first chamber 12 may become high temperature hydrogen, carbon and oxygen ions.

[0031] When heat is provided to the first chamber 12, the center of the first chamber 12 may be at a temperature higher than that of the walls of the first chamber 12. To that end, the first chamber 12 may have a cooling system such as a water cooling system or any other suitable cooling system to allow the first chamber 12 to withstand the high temperatures.

[0032] The system 10 may also include a heat source 26 and a power supply 28 for the heat source 26. Heat may be provided to the first chamber 12 using a plasma torch, RF (microwave), electric arc, or other heat sources and an appropriate power supply such as a plasma torch power supply. Commercially available technologies may be used to provide heat using these methods, such as plasma torches made by Applied Plasma Technologies or plasma arc torches by High Temperature Technologies Corp. Power may be generated by an electric grid, a diesel generator, or other source. The power supply and heat source may also require the use of a cooling supply and a cooling water supply.

[0033] The hot gases (*i.e.*, gas flow) generated from the organic material within the first chamber 12 may be subject to subsequent processing, such as filtering or quenching. The system 10, in one embodiment, may include a filter or means for quenching in communication with the first chamber 12. Additionally or alternatively, the gas flow may be filtered to remove certain particulates from the gas flow.

[0034] The first chamber 12, as designed, may be in fluid communication with the second chamber 14. The first chamber 12 may be connected to the second chamber 14 by any suitable passageway to allow the processed waste material from the first chamber 12 to exit the first chamber 12 and pass to the second chamber 14 or an outlet 16. Preferably, the passageway may be sealed and may be fluid and/or airtight to minimize leakage of the processed waste material which has been gasified, and which may include solids and/or liquids. The first chamber 12 may also have a vent (not shown) through which the gasified waste may pass and be directed to the second chamber 14 or one or more outlets.

[0035] There may be a temperature gradient between the first chamber 12 and the second chamber 14 where the temperature in the first chamber 12 is at a higher than that in the second chamber 14. The higher temperature in the first chamber 12, in an embodiment, may result in a relatively high pressure in the first chamber 12 in comparison to the pressure in the second chamber 14. This pressure differential between the first chamber 12 and the second chamber 14 can allow the gas from the first chamber 12 to pass to the second chamber 14.

[0036] In one embodiment, the second chamber 14 may be provided with a temperature sufficient to allow for carbon nanotube growth. A suitable temperature range may range from about 650 °C to about 1100 °C. To form carbon nanotubes, the second chamber 14 may be designed to utilize, for example, a chemical vapor deposition process in the formation of the carbon nanotubes. Other processes for forming the carbon nanotubes may include laser ablation and arc deposition methods.

[0037] To form carbon nanotubes, the second chamber 14 may include a catalyst on which the carbon atoms formed from the carbon compound may be deposited and form carbon nanotubes. Suitable catalysts include, for example, ferrocene, an iron plate or rod, Co-Mo/SiO₂, Pd/La₂O₃ or other catalyst. Thus, as the hot gas flow from the first chamber 12 is directed into the second chamber 14, the carbon compound within the gas flow may be decomposed into carbon atoms and allowed to seed onto the catalyst to initiate the formation of carbon nanotubes. Individual carbon atoms may then continued to be deposited on to the catalyst to grow a carbon nanotube.

[0038] Carbon nanotubes 30 formed in the second chamber 14 may be collected in another area inside or outside of the second chamber 14.

[0039] The second chamber 14, in one embodiment, may be of any dimensions, shape or

materials as long as it can provide appropriate conditions for growing nanotubes, such as carbon nanotubes.

[0040] Still looking at Fig. 1, system 10 may also include at least one outlet 16 that can be in fluid communication with the second chamber 14. In that way, the gas flow passing through the second chamber 14, now substantially absent of carbon compound, can continue downstream of system 10. In one embodiment, the gas flow exiting outlet 16 of second chamber 14, includes hydrogen gas and water. The outlet 16, in an embodiment, may be a pathway between the second chamber 14 and another system within system 10, for example, an energy generating system. Second chamber 14 may be provided with more than one outlet 16. The additional outlets may be in fluid communication with additional energy generating systems or may be used as a vent to release gases which would not be harmful to the environment.

[0041] Gas flow 32 from the second chamber 14, as noted, may include hydrogen and water with minimal carbon monoxide contaminants. The hydrogen, in one embodiment, may be used efficiently in an energy generating system 34, such as a fuel cell or steam turbine system. Small amounts of carbon compounds such as carbon dioxide and carbon monoxide may exit the second chamber 14 with the gas flow, but such compounds may be removed by a particulate removal system 46 (see Fig. 2), such as a filter. Further, hydrogen, carbon monoxide, and carbon dioxide may be deposited into a boiler and burned to form carbon dioxide and water. The hot water may be directed, for instance, into a steam turbine and then cycled through in a loop to generate electricity.

[0042] As described above, Fig. 1 shows a system 10 that includes a single pathway where the waste material flows from the first chamber 12 to the second chamber 14 through an outlet.

[0043] Figs. 2 and 3 show other systems 200, 300 that include more than one pathway where the waste material gasified in the first chamber 12 may be separated to different pathways, such as the second chamber 14 and an outlet 44.

[0044] The components described above with respect to waste material, preprocessing of the waste, and the first chamber 12 are applicable to the embodiments shown in Figs. 2 and 3 and described below.

[0045] As shown in Figs. 2 and 3, heat may be provided to the first chamber 12 using a heat source 28 such as a plasma torch. The heat source 26 may be powered by a power supply

28 that may be connected to an energy source 36, such as an electric grid or outlet. The power supply 28 may further be connected to a generator 38, such as a diesel generator. In addition, to control the temperature of the power supply 28 and heat source 26, a cooling source 40 or cooling supply may be in fluid communication with the power supply 28 and a cooling water supply 42 may be in fluid communication with the heat source 26. Any suitable generators, cooling sources, and cooling water supplies may be used in the present systems.

[0046] Fig. 2 shows a system 200 in which the waste material may be heated and converted to a gas flow in the first chamber 12. The gas flow may include carbon compounds, hydrogen and other gases. The carbon compounds in the first chamber 12 may be captured in the second chamber 14 and converted to carbon nanotubes, as described above. The remaining gas and other materials may be separately captured and directed to an outlet 44 in fluid communication with the first chamber 12. The outlet 44 may be in fluid communication with a particulate removal system 46 such as a filter.

[0047] The particulate removal system 46 may be used to remove any hazardous particulates from the gas flow passing therethrough. The particulate removal system 46 may also include any other particulate removal separators, such as those utilizing a centrifugal system. A suitable centrifugal system may have a conical shape where the flow is fed into the top and the particulates may be separated from the gas, while the particulates may be settling to the bottom of the centrifugal system and the gas rising to the top of the centrifugal system. Suitable particulate removal separators are commercially available. One example may be the XQ Series High Efficiency Cyclone Dust Collectors manufactured by Fisher Klosterman, Inc.

[0048] In another embodiment, still looking at Fig. 2, the gas flow generated in the first chamber 12 may be directed to an outlet 44 that is in fluid communication with an energy generating system, such as a steam turbine. In another embodiment, as shown in Fig. 2, the gas flow from the first chamber 12, which may include hydrogen, can be directed into a boiler 48 via the particulate removal system 46. In the boiler 48, the heated gas flow may act to heat water to form steam. The steam may then be used to run a steam turbine 50 to generate electricity. The steam turbine 50, in an embodiment, may be in fluid communication with a generator 52, which may be connected to an electric grid 54 or other outlet for the energy generated. In one embodiment, gas flow from the boiler 48 may be directed through a quenching station 56 and then passed through a filter 58 and released through a vent 60 as exhaust.

[0049] Fig. 3 shows another system 300 where carbon compounds may be separated from other materials before leaving the first chamber 12. In this system 300, inorganic materials such as silicates, metals and other non-volatile materials may be deposited in the bottom of the first chamber 12. In this embodiment, after particulates carried along in the gas flow are removed in a particulate removal system 46, the gas stream may flow into a carbon recycling station 62 where remaining carbon may be removed through carbon nanotube production. The carbon nanotubes may be produced in the carbon recycling station 62 using any suitable method, including those described above.

[0050] After the carbon recycling process, hydrogen gas may be directed to an energy generating system 34, such as a fuel cell system. Energy generating system 34, in one embodiment, may include a fuel cell used to convert hydrogen into electricity. In particular, the fuel cell may be designed to convert hydrogen into electricity through a chemical reaction utilizing oxygen or another oxidizing agent. For example, the fuel cell may be filled with liquid metal and hydrogen may enter the fuel cell and react with the components therein to generate electricity. A fuel cell is similar to a battery with two terminals. In the present system, hydrogen produced from waste materials and substantially absent of carbon compounds may be fed into a fuel cell to produce electricity with water as the byproduct.

[0051] In another aspect, the system may further include a switch or other mechanism for directing the material released from the particulate removal system to either a boiler system as shown in Fig. 2 or a carbon recycling station as shown in Fig. 3. In another embodiment, the system may include two outlets in fluid communication with the first chamber 12 for directing the material via the particulate removal system to the boiler or carbon recycling station.

[0052] Figs. 4 and 5 show methods for processing and converting organic material into useful products using the systems described above. The organic material may be waste material, coal, or other material containing carbon.

[0053] With reference now to Fig. 4, there is shown a method 400 that may include depositing organic material into a first chamber (step 402) and providing heat in the first chamber (step 404) at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen (step 406). The method may also include capturing the gas flow in a second chamber that is in fluid communication with the first chamber (step 408) and converting the carbon compound within the gas flow into a carbon nanotubes (step 410); and

passing the gas flow having hydrogen through an outlet that is in fluid communication with the second chamber (step 412).

[0054] The outlet may be in fluid communication with an energy generating system for generating electricity from the hydrogen gas. The method may further include directing the hydrogen gas to an energy generating system that is in fluid communication with the outlet. The energy generating system may include a fuel cell or a steam turbine.

[0055] The method may also include the pre-processing steps described above including, for example, inputting the waste material, shredding or reducing the size or volume of the waste material by inputting the waste material into a shredder or other system, drying or moistening the waste material, separating or sorting the waste material to remove certain types of waste such as metals and other inorganic materials, and depositing the waste material in the first chamber using a feed port.

[0056] As shown in Fig. 5, a method 500 may include depositing organic material into a first chamber (step 502) and providing heat in the first chamber (step 504) at a temperature sufficient to convert the organic material to a gas comprising a carbon compound and hydrogen (step 506); capturing the carbon compound within the gas flow in a second chamber that is in fluid communication with the first chamber (508) and converting the carbon compound into a carbon nanotubes (step 510); and passing gas flow having hydrogen through an outlet that is in fluid communication with the first chamber (512). This embodiment may also include any of the pre-processing steps described above. The method may also include directing the hydrogen gas through the outlet to an energy generating system for generating electricity.

[0057] In use, the present systems and methods may process and convert organic material such as waste material into useful and environmentally friendly products including: slag, rock wool, carbon nanotubes, electricity, water, some carbon dioxide and other trace residuals.

[0058] While the present invention has been described with reference to certain embodiments thereof, it should be understood by those skilled in the art that various changes may be made and equivalents may be substituted without departing from the true spirit and scope of the invention. In addition, many modifications may be made to adapt to a particular situation, indication, material and composition of matter, process step or steps, without departing from the spirit and scope of the present invention. All such modifications are intended to be within the scope of the claims appended hereto.

We claim:

1. A system for converting organic material into useful products comprising:
 - a first chamber for receiving organic material and designed to provide heat at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen;
 - a second chamber in fluid communication with the first chamber for capturing the carbon compound from the gas flow and converting the carbon compound into carbon nanotubes; and
 - an outlet in fluid communication with the second chamber through which the gas flow substantially absent of carbon compound passes.
2. The system of claim 1, wherein the organic material is waste material, coal, or other carbon containing material.
3. The system of claim 2, wherein the waste material is solid or semi-solid.
4. The system of claim 1, wherein the temperature in the first chamber is in the range from about 3,000 °C to about 25,000 °C.
5. The system of claim 1, wherein the second chamber includes a catalyst for use in the formation of carbon nanotubes.
6. The system of claim 1, further comprising an energy generating system in fluid communication with the outlet for generating electricity from the gas flow with hydrogen.
7. The system of claim 1, wherein the energy generating system includes a fuel cell.
8. The system of claim 1, wherein the energy generating system includes a steam turbine.
9. A system for processing organic material into useful products comprising:

a first chamber for receiving organic material and designed to provide heat at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen;

a second chamber in fluid communication with the first chamber for capturing the carbon compound from the gas flow and converting the carbon compound into carbon nanotubes; and

an outlet in fluid communication with the first chamber through which the gas flow substantially absent of carbon compound passes.

10. The system of claim 9, wherein the organic material is waste material, coal, or other carbon containing material.

11. The system of claim 10, wherein the waste material is solid or semi-solid.

12. The system of claim 9, wherein the temperature in the first chamber is in the range from about 3,000 °C to about 25,000 °C.

13. The system of claim 9, wherein the second chamber includes a catalyst for use in the formation of carbon nanotubes.

14. The system of claim 9, further comprising an energy generating system in communication with the outlet for generating electricity from the gas flow with hydrogen.

15. The system of claim 9, wherein the energy generating system comprises a fuel cell system.

16. The system of claim 9, wherein the energy generating system comprises a steam turbine system.

17. A method for converting organic material into useful products comprising:

depositing organic material into a first chamber and providing heat in the first chamber at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen;

capturing the gas flow in a second chamber that is in fluid communication with the first chamber 12 and converting the carbon compound within the gas flow into carbon nanotubes; and passing the gas flow having hydrogen through an outlet that is in fluid communication with the second chamber.

18. The system of claim 17, wherein the organic material is waste material, coal, or other carbon containing material.

19. The method of claim 18, wherein the waste material is a solid or semi-solid.

20. The method of claim 17, wherein the temperature in the first chamber is in the range from about 3,000 °C to about 25,000 °C.

21. The method of claim 17, wherein the second chamber includes a catalyst for use in the formation of carbon nanotubes.

22. The method of claim 17, wherein the outlet from the second chamber is in fluid communication with an energy generating system for generating electricity from the hydrogen gas, and further comprising directing the hydrogen gas to the energy generating system after passing through the outlet.

23. The method of claim 17, wherein the energy generating system includes a fuel cell.

24. The method of claim 17, wherein the energy generating system includes a steam turbine.

25. A method for converting organic material into useful products comprising:

depositing organic material into a first chamber and providing heat in the first chamber at a temperature sufficient to convert the organic material to a gas flow having a carbon compound and hydrogen;

capturing the carbon compound within the gas flow in a second chamber that is in fluid communication with the first chamber and converting the carbon compound into carbon nanotubes; and

passing the gas flow having hydrogen through an outlet that is in fluid communication with the first chamber.

26. The method of claim 25, wherein the organic material is waste material, coal, or other carbon containing material.

27. The method of claim 26, wherein the waste material is solid or semi-solid.

28. The method of claim 25, wherein the temperature is in the range from about 3,000 °C to about 25,000 °C.

29. The method of claim 25, wherein the second chamber includes a catalyst for use in the formation of carbon nanotubes.

30. The method of claim 25, wherein the outlet from the first chamber is in fluid communication with an energy generating system for generating electricity from the hydrogen gas, and further comprising directing the hydrogen gas to the energy generating system after passing through the outlet.

31. The method of claim 25, wherein the energy generating system includes a fuel cell.

32. The method of claim 22, wherein the energy generating system includes a steam turbine.

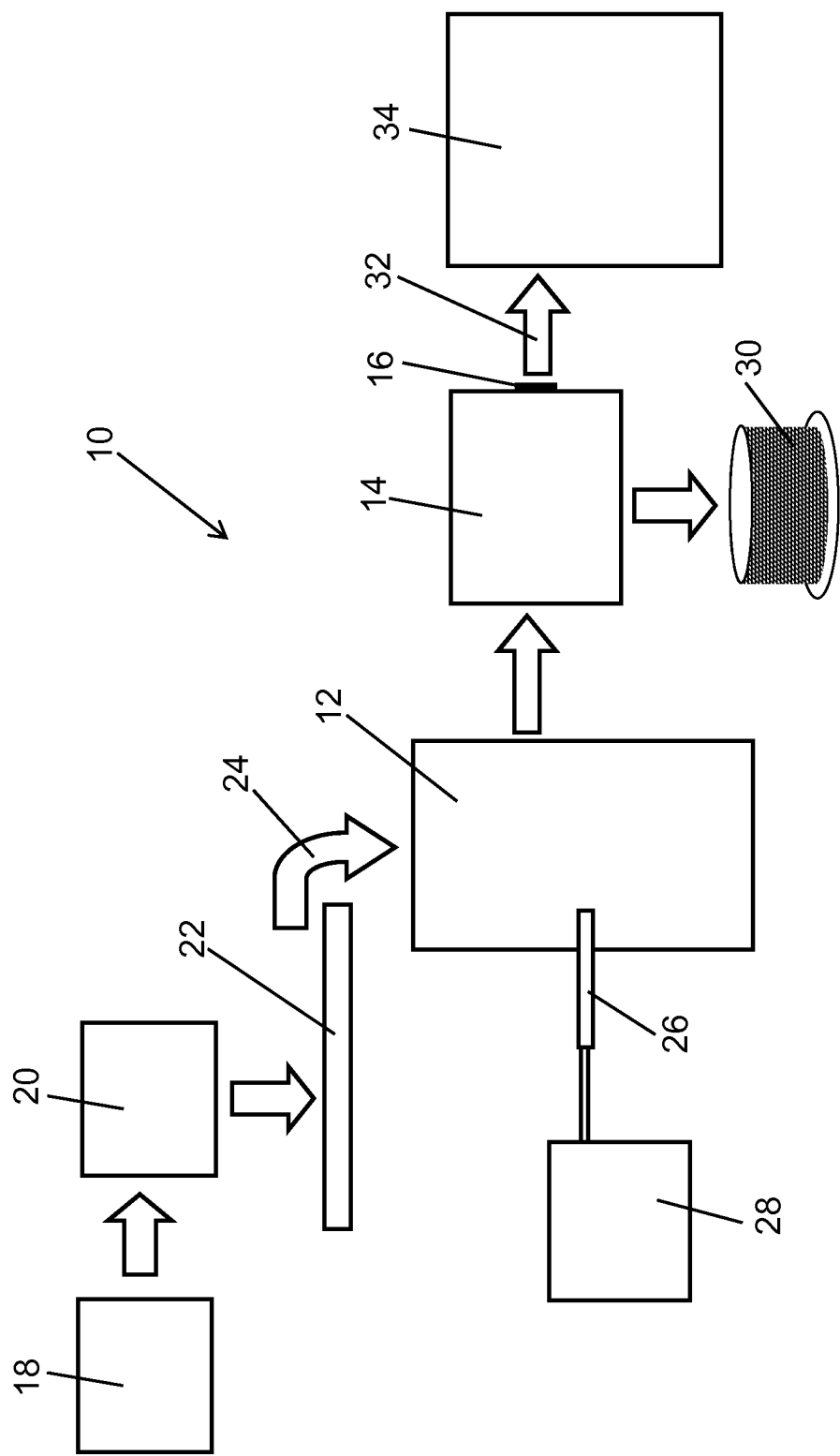


FIG. 1

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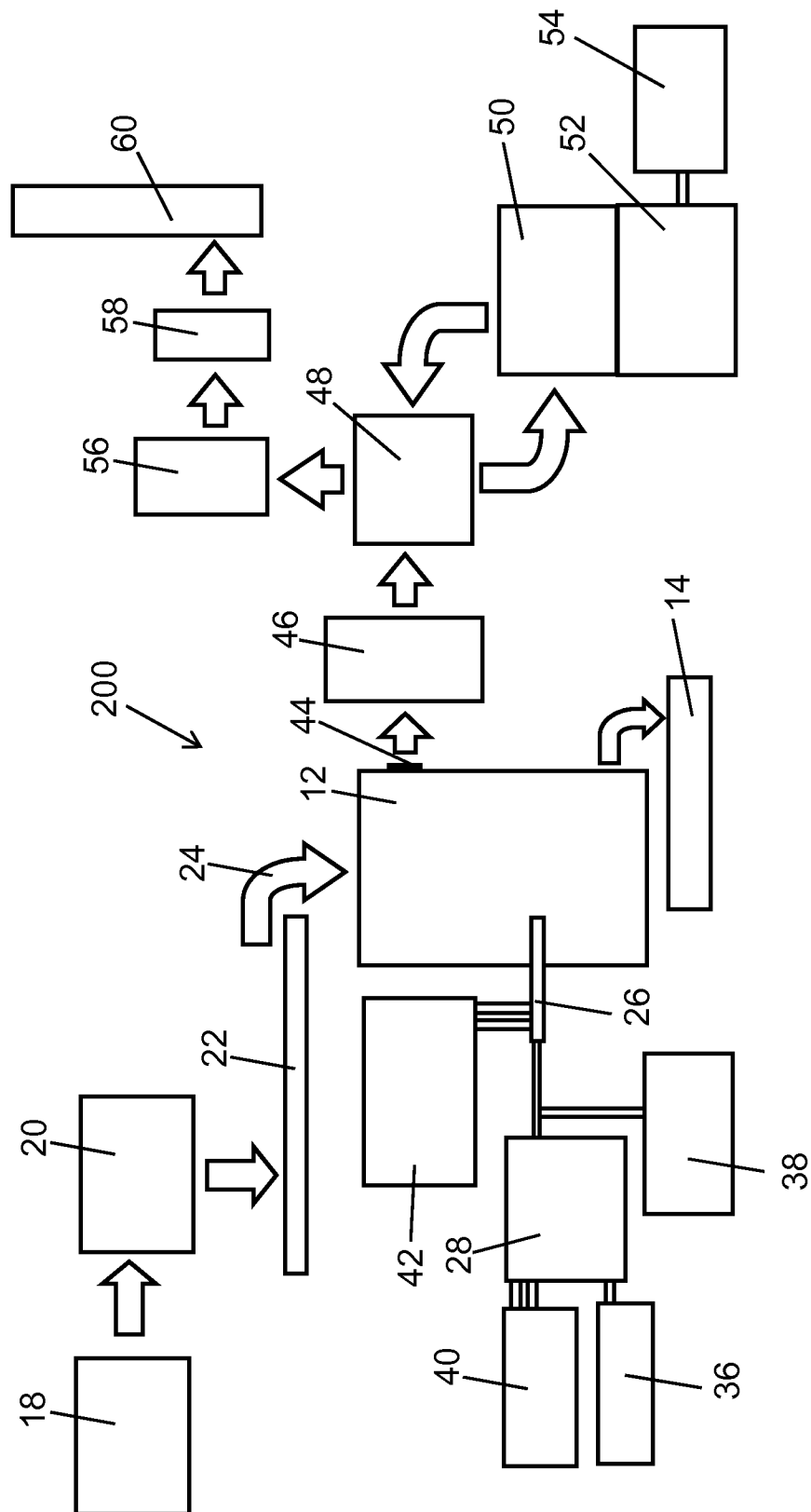


FIG. 2

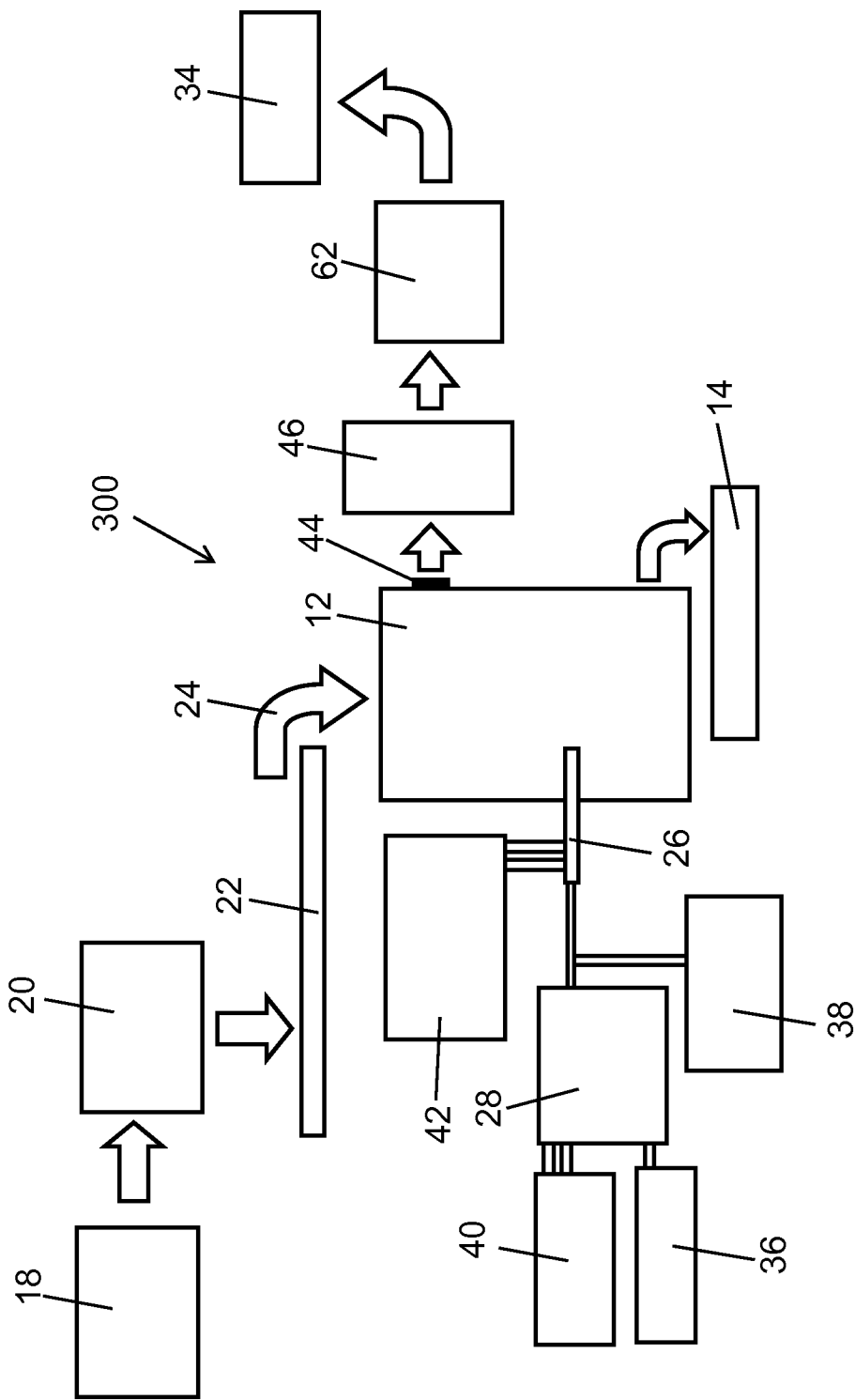


FIG. 3

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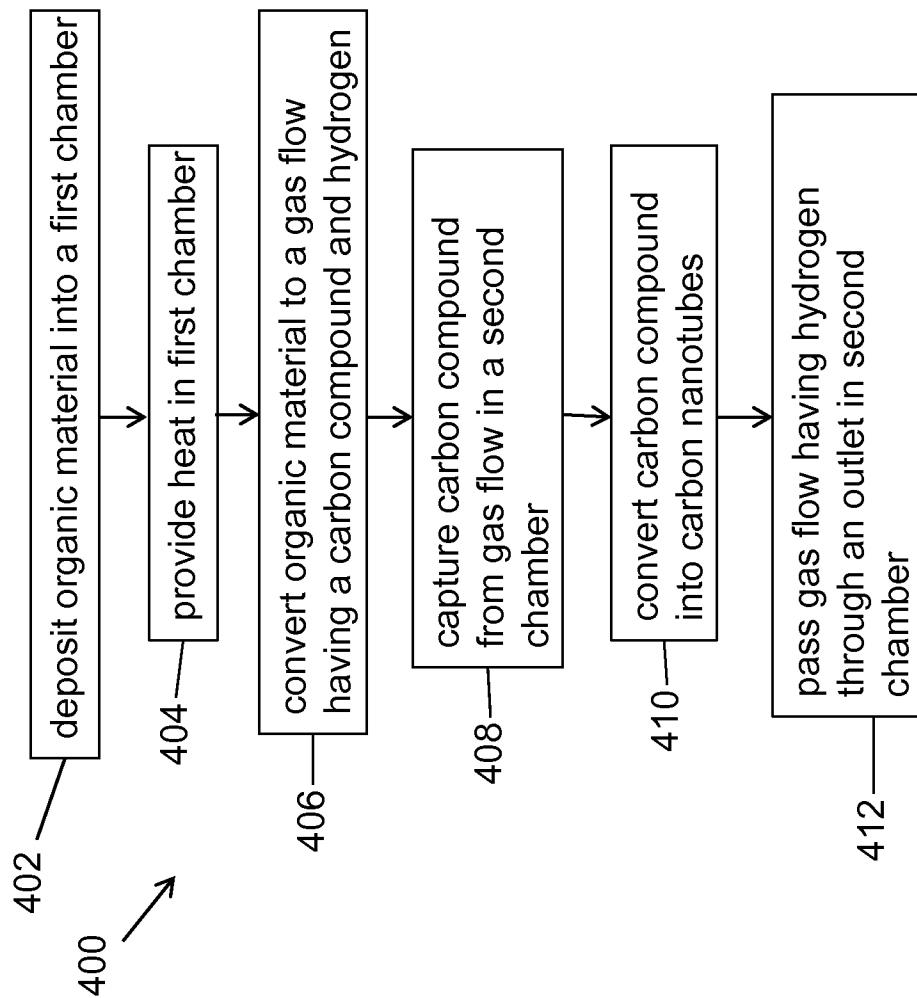


FIG. 4

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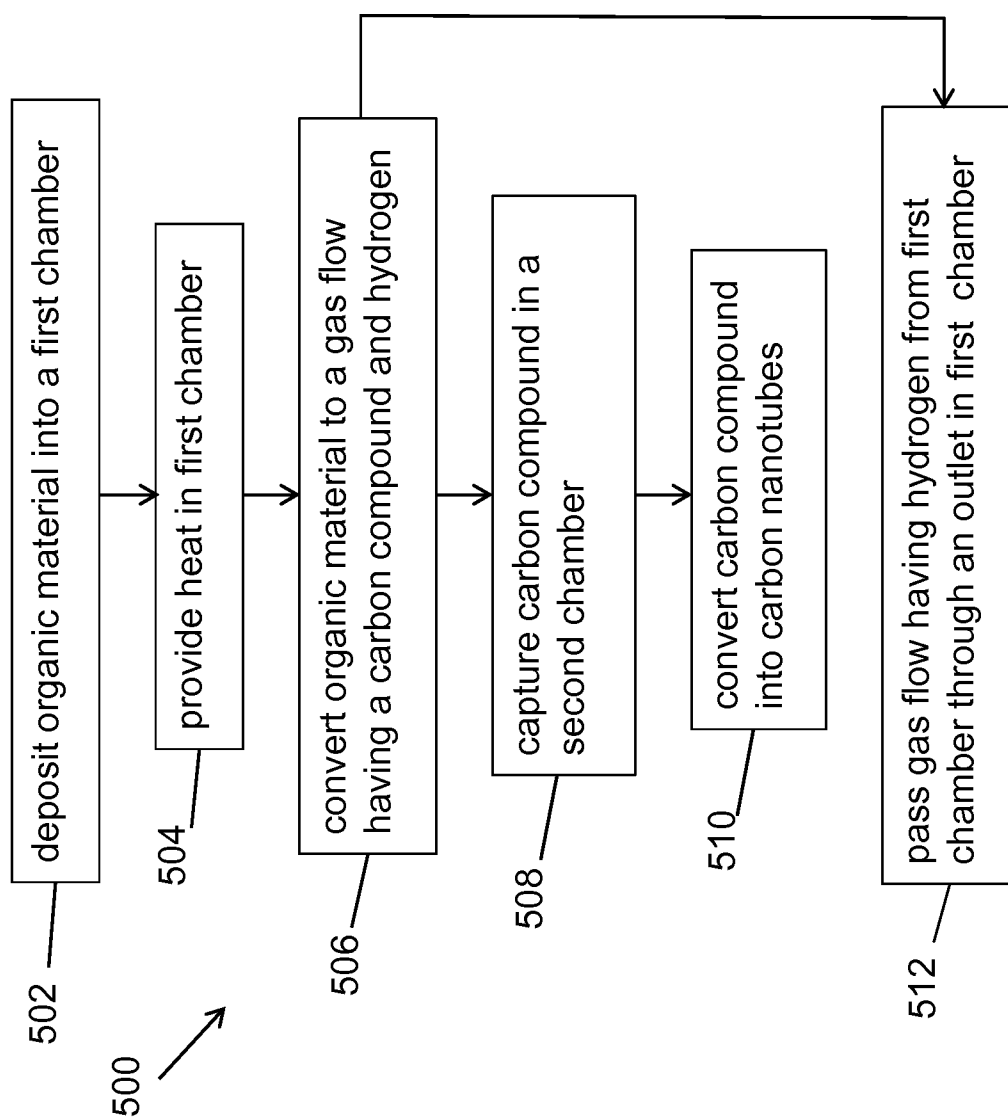


FIG. 5