



(43) International Publication Date
29 December 2016 (29.12.2016)

- (51) International Patent Classification:
A62D 3/40 (2007.01) *A62D 101/20* (2007.01)
- (21) International Application Number:
PCT/PH2015/000009
- (22) International Filing Date:
23 June 2015 (23.06.2015)
- (25) Filing Language: English
- (26) Publication Language: English
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,

MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- of inventorship (Rule 4.17(iv))

Published:

- without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: METHOD AND APPARATUS FOR TREATING WASTE MATERIAL

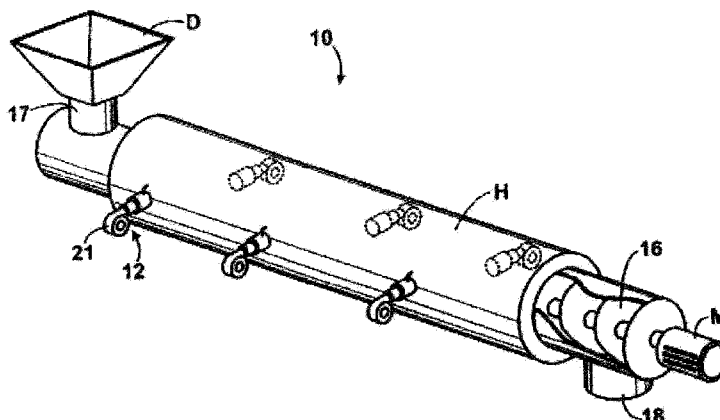


FIG. 2

(57) Abstract: An apparatus for treating waste comprising: an insulated structure having a plurality of heating assemblies being held thereof, each of said heating assemblies being arranged in a manner wherein it is capable of providing flame heat in said insulated structure, said insulated structure being made such that it is capable of accomodating and disposing waste materials being heated and carbonized therein, insulated structure includes an insulated hollow outer shell member and hollow inner shell member that defines a heating chamber disposed therebetween, a waste heating chamber being defined by said inner shell member, and conveying means provided within the inner shell member being held thereof in a manner wherein it is capable of providing movement and disposal of the heated and/or carbonized waste materials disposed in the inner shell member, each of said heating assemblies consisting of a pre-heating chamber in communication with said heating chamber, a superheated steam producing means in communication with said pre-heating chamber, and a burner fixedly held on said superheated steam producing means and being arranged such that it is capable of providing flame heat in said superheated steam producing means, pre-heating chamber and heating chamber, said superheated steam producing means being capable of transforming water contained therein into superheated steam through utilization of heat generated by said burner and facilitates introduction of hydrogen and oxygen gases derived from said superheated steam into the burner flame in the

[Continued on next page]



pre-heating chamber, and synthesis gas line in communication with said waste heating chamber being arranged such that it is capable of allowing the introduction into the burner flame the synthesis gas produced during heating of the waste material within the waste heating chamber.

METHOD AND APPARATUS FOR TREATING WASTE MATERIAL.

Technical Field:

The present invention relates generally to waste management and more specifically to
5 a method and apparatus for treating waste material.

BACKGROUND OF THE INVENTION

Waste materials, such as medical waste made of plastic, wood, paper, cellulose, etc.,
are usually burned in incinerators without any safety treatment processes that would ensure
environmental safety and protection. Besides the use of incinerators, another method of
10 treating medical waste is the use of an autoclave wherein steam is used to disinfect the
medical waste. The aforesaid introduction of steam to the medical waste has been observed
to be insufficient in disinfecting the waste since the distribution of heat and high heat
transfer is uneven during treatment. Furthermore, the steam being applied converts into
water at a fast rate such that the medical waste becomes wet, heavy and odorous. Other
15 medical and hazardous waste, such as plastic materials and other organic materials have
different heating value such that they react differently when subjected to burning, such that
exhaust gases discharged from this incinerators contain polluting components, like smoke
dust, hydrogen chloride, carbon monoxide, Sox, Nox, and heavy metals that includes
mercury, dioxin and furan, which are considered harmful pollutants. From the standpoint of
20 environmental protection, it is necessary that formation of these harmful substances should
be prevented during treatment.

Of these polluting components, dioxin and furan have extremely strong toxicity such
that collection and removal of these is extremely important. Plastics from medical waste
should therefore have to be reduced in gas form to achieved complete combustion along with
25 the other gases generated by the other organic materials. This will ensure reduction to safety
level the toxic gases coming from the exhaust of the incinerator.

Burning of these medical waste requires high temperature, preferably about 700
degree celsius, to facilitate combustion and elimination of toxic gases generated by such
medical waste. However, in conventional incinerators such temperature cannot be attained
30 since it will require tremendous amount of fuel, thus rendering it to be too costly to do.

An example of the incinerator of the prior art is the conventional refuse incinerator
facility, wherein a boiler and auxilliary burner is used. The refuse is directly burned in order
to raise the temperature of the incinerator and the temperature of boiling water in the boiler.

At the initial start of the operation, there is already a production of a low-temperature combustion gas which inflicts damage to the facility due to low-temperature corrosion build-up. To solve this problem, the common practice is to discharge this combustion gas by way of a bypass duct and stack. However, there is still the possibility that dust containing hazardous substances, such as dioxin, remaining in the incinerator and boiler. If such contamination substances are deposited and still remaining in the incinerator, there may be emitted and discharged as gaseous dioxin in the atmosphere even during normal operation.

Another example is an exhaust gas treating apparatus wherein the refuse is incinerated and then completely combusted by a secondary air in a secondary combustion chamber. The ashes is then discharged to the atmosphere while the exhaust gas generated by the combustion is subjected to heat recovery by waste heat boiler and waste heat reclaimers (pre-heater) as it flows towards a quenching reaction tower. The exhaust gas in the quenching reaction tower is sprayed with slaked lime slurry to remove hydrogen chloride (HCL) and sulfur oxide (SOx). Smoke dust, fly ash, HCL, SOx, heavy metals and dioxins, which remains in the exhaust gas, are then removed in a bag filter. The exhaust gas after treatment is then discharged to the atmosphere.

Although the exhaust gas from an incinerator is treated with the aforesaid process, there is the possibility that dioxin cannot be reduced to the desired low concentration. Dioxins generated during incineration are almost decomposed in the secondary combustion chamber, however, it is necessary to decrease the temperature of the exhaust gas from a high temperature of about 350 to 900 degree centigrade to a low temperature during every step of the process. However, there is still the tendency of dioxins regenerating at the vicinity of 300 degree centigrade during every step of the process such that the above-mentioned conventional exhaust gas treatment apparatus cannot effectively collect and remove dioxins at the desired low concentration.

In view of the aforesaid problems of the prior art, it is therefore the primary object of the present invention to provide a method and apparatus for treating waste materials which can remedy the above-drawbacks of the prior art including the drawbacks of the present non-burn technologies, such as autoclave and microwave method, which are expensive to manufacture and maintain.

The present invention as herein disclosed provides treatment of waste materials wherein biodegradable and non-biodegradable waste materials, in particular medical waste,

such as plastic, wood, paper, cellulose, etc. is subjected to disinfection process and high temperature and pyrolysis processes to facilitate effective treatment. Pyrolysis is defined in the present invention as the process of heating fuels and other combustible elements without oxidation, in which the thermally treated solid waste are reduced into fuel and change its phase into gaseous form without the presence of air and oxygen. The gas produced from the pyrolysis process is called synthesis gas that can be used as fuel. Furthermore, the present invention being capable of disinfecting and carbonizing such waste through utilization of heating temperature generated by the apparatus. The present invention further utilizes environmentally compatible catalyst, such as pyrolytic steam injection process in combination with a heating system assisted with water for high temperature burning. The air being emitted by the present apparatus is pollutant-free since only water and steam is used and no chemicals are added in the process.

A further object of the present invention is to provide an apparatus for treating waste which can be used for heating and treating other waste materials such as garbage and the like materials. The present invention is very easy to operate and can be used in cities and hospitals for their medical and garbage waste management.

Other objects and advantages of the present invention may be realized upon reading the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1 is an illustrative presentation of the invention being used in the treatment of waste materials,

Figure 2 is a perspective view of one of the embodiment of the present invention;

Figure 3 is a cross-sectional view taken along line 2-2 of Figure 1, and

Figure 4 is a cross-sectional view of another embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENT OF THE INVENTION

Referring to the drawings, there is shown an apparatus for treating waste, such as medical and hazardous waste and garbage waste, generally designated as 10 comprising an insulated structure 11 having a plurality of heating assemblies 12 fixedly held on said insulated structure. Said insulated structure being arranged such that it is capable of being held in an elevated manner by suitable conventional support structure (not shown). Insulated structure 11 includes an insulated hollow outer shell member 13 and hollow inner shell member 14, and a heat chamber 15 being defined by said outer and inner shell members and

disposed therebetween. Said inner shell member 14 defining a waste heating chamber H, wherein the waste material is capable of passing and indirectly heated therein such that it can be transformed into carbon and/or disinfected depending on the waste material being heated. A conveying means 16 disposed within inner shell member 14 being held thereof in a manner wherein it is capable of providing movement of waste material being heated for carbonization and/or disinfection. Conveying means is preferably a screw conveyor being capable of rotational movement by suitable prime mover, such as electric motor M. A waste material inlet 17 provided on one end of the inner shell member 14 being in communication with a waste hopper D fixedly held thereof, and a discharge port 18 provided at the opposite end of said inner shell member 14, wherein the carbonized and/or disinfected waste material is being discharged by said conveying means. Each of said heating assemblies 12 includes a pre-heating chamber 19 in communication with said heat chamber 15, a superheated steam producing means 20 being held on said pre-heating chamber 19, and a burner 21 fixedly held on said superheated steam producing means 20. Burner 21 being arranged in a manner wherein its capable of providing flame heat in said superheated steam producing means 20, pre-heating chamber 19 and heat chamber 15. Said superheated steam producing means 20 is preferably a boiler being made such that it is capable of transforming water contained therein into superheated steam through utilization of heat generated by the burner flame. Superheated steam producing means 20 being defined by a water containing means 21 mounted on a steaming chamber 22, a superheated steam line 23 having a coiled section C disposed within the steaming chamber 22 and in communication with said water containing means 21. Water flowing in said superheated steam line 23 being capable of transforming into superheated steam upon exposure to high temperature generated by the burner flame. Superheated steam line 23 is preferably made of chromium and nickel such that it can serve as catalyst in transforming the superheated steam into hydrogen and oxygen gases upon contact thereof. Said gases in then being introduced to the burner flame through gas discharge port P of the superheated steam line 23 to increase the heating value of the burner flame. A sythesis gas line 24 disposed within the pre-heating chamber 19 and in communication with said waste heating chamber H, such that the synthesis gas produced within the waste heating chamber is capable of flowing thereof and unto the pre-heating chamber 19. Sythesis gas line 24 having a coiled section 25 disposed within the pre-heating chamber 19 such that the synthesis gas is subjected to further heating by the flame of the

burner before being introduced to the heat chamber through a gas outlet provided thereof. Such introduction of synthesis gas in the heat chamber allows removal of toxic gases in the waste heating chamber and also provides additional means for further increasing the heating temperature during the heating process.

5 The insulated structure 10 may be made to communicate with at least another identical insulated structure such that further carbonization and/or disinfection can be facilitated. An air cooling chamber A may be provided and being made to communicate with one of said insulated structure to facilitate cooling and disposing the carbonized and/or
10 filtering means F may be provided and arranged to communicate with said insulated structure such that filtering of exhaust gases such as sythesis gas, carbon monoxide, hydrogen, produced in the waste chamber during the heating of the waste material may be converted into carbon dioxide and water. In one arrangement, gas filtering means includes a draft fan D for drawing the gases, an activated carbon filter E for filtering the gases and a
15 cyclonic enclosure N in communication with said filtering means for converting said gases to water and carbon dioxide.

 In another embodiment of the invention, apparatus for treating waste material 10a comprises an elevated insulated structure 11a having a rotary shell 12a mounted therein, and a heating assembly 13a in communication with said rotary shell 12a. An air chamber A being
20 defined by said rotary shell 12a and insulated structure 11a being in communication with a plurality of air inlets B and air outlet O provided on said insulated structure 11a. An air handling device D is in communication with said air outlet O, such that it is capable of drawing atmospheric air entering the air inlets B and allows it to flow within the air chamber A. The atmospheric air then circulates around rotary shell 12a before exiting in the
25 air outlet O during the rotary shell cooling process. Said rotary shell 12a having an inner door member 14a and a mechanically lockable outer door member 15a that defines a gas chamber 16a and a waste heating chamber 17a. Said lockable outer cover member 15a being made in a conventionally lockable manner as shown in Figure 4 of the drawings. Waste heating chamber 17a being in communication with said gas chamber 16a through a plurality
30 of gas passages 18a provided on the inner door member 14a. Rotary shell 12a further having a pre-heating chamber 19a fixedly held thereof and in communication with waste heating chamber 17a. Said heating assembly 13a includes a superheated steam producing means 20a

in communication with said pre-heating chamber 19a and a structurally-supported burner 21a in communication with said superheated steam producing means 20a. Said superheated steam producing means is preferably a boiler consisting of a water containing means 22a mounted on a steaming chamber 23a, a superheated steam line 24a having a coiled section C disposed within the steaming chamber 23a and communicating with said water containing means 22a. Burner 21a being in communication with said steaming chamber 23a and arranged such that it is capable of providing flame heat to said steaming chamber and to the pre-heating chamber and waste heating chamber 17a. Coiled section C of superheated steam line 24a is disposed in alignment with the flame path of burner 21a such that the water in the coiled section C is converted into superheated steam upon a pre-determined high temperature generated by the flame of the burner. Superheated steam line 24a is preferably made of chromium and nickel, such that it can serve as catalyst in generating hydrogen and oxygen from the superheated steam upon its reaction thereof. Said hydrogen and oxygen gases in turn is subsequently introduced in the flame of the burner through the outlet port of said superheated steam line 24a to further increase its heating value. At least a pair of gas lines 26a spacedly disposed from rotary shell 12a having their inlet ports 27a in communication with the gas chamber 16a. One of said gas lines 26a having its outlet port 28a in communication with the primary pre-heating chamber 19a and the other gas line having a coiled section B with an outlet port 29a disposed within said pre-heating chamber 19a. Said gas lines 26a being arranged such that the gas from the gas chamber is capable of flowing therein and subsequently introduced in the burner flame together with the hydrogen and oxygen gases being introduced by superheated steam line 24a. An electrically or mechanically-powered prime moving means, such as sprocket chain assembly 30a, being arranged in a manner wherein it is communicating with the pre-heating chamber to provide rotational movement of the rotary shell 12a attached thereof. Rollers 31a mounted on suitable conventional base frame may be provided to rotatably support the forward portion of rotary shell 12a.

The method for treating waste material of the present invention includes:

heating water at a high temperature until it is transformed into superheated steam. Said heating can be facilitated by suitable burning means, such as burner B. The superheated steam is then allowed to react with chromium and nickel such that hydrogen and oxygen gases is generated from said superheated steam which in turn is re-introduced in the burner

flame, thereby increasing the heating value of the heat generated by said flame. Said high temperature heat in the heat chamber is then indirectly transferred to the waste heating chamber to facilitate carbonization and/or disinfection of the waste being treated. When treating biodegradable and non-biodegradable medical or garbage waste material, such as plastic, wood, paper, cellulose, etc., the temperature within the waste heating chamber should be at least about 700 degree celsius such that the waste can be converted into carbonized form and there would be production of synthesis gas through high temperature pyrolysis process. The pyrolysis process is the process of heating fuels and other combustible elements without oxidation. The thermally treated solid waste in this case are converted into fuel form and change its phase into gaseous form without the presence of air and oxygen. The gas produced is called synthesis gas that can also be used as fuel. The synthesis gas produced in the waste chamber during the heating process of the waste materials is then introduced as fuel and allowed to mixed with the flame in combination with the hydrogen and oxygen gas of the superheated steam. The process effectively removes carbon monoxide + hydrogen (CO+H) which is considered as highly toxic pollutant. Since the treatment utilizes a combination of pyrolytic gas and steam injection process, a cleaner emission is achieved since it only uses water and steam and no chemicals are used in the process. Furthermore, such recycling of pyrolysis-generated sythesis gas further serves in reducing the amount of fuel spent during the burning process. In case the waste to be treated is infectious medical waste, the heating temperature in the waste heating chamber is regulated at about 121 degree celsius to facilitate disinfection and kill the pathogens in the waste. At this temperature, no synthesis gas is formed such that carbonization of the waste is directly done after disinfection.

We claim:

1. A method for treating waste material comprising the steps of:
 - a. heating water at a pre-determined high temperature until it is converted into superheated steam;
 - 5 b. allowing said superheated steam to react with a catalyst to generate hydrogen and oxygen gases;
 - c. introducing said hydrogen and oxygen gases into the flame being used for heating said water such that the heating value of the heat being generated by said flame is increased,
 - 10 d. heating waste material by said heat of increased heating value;
 - e. collecting synthesis gas produced during heating of said waste material;
 - f. introducing said synthesis gas into the said flame, thereby removing highly toxic pollutants in the waste being treated; and
 - g. carbonizing the waste materials.
- 15 2. A method for treating waste according to claim 1, wherein the temperature of said heat with high heating value is about 700 degree Celsius.
3. A method for treating waste material according to claim 1, wherein said waste material is medical waste.
4. A method for treating waste material according to claim 3, wherein the temperature
20 of heat with high heating value is 121 degree celsius when the waste material being heated is medical waste such that it can be disinfected and pathogens can be eliminated thereof.
5. A method for treating waste material according to claim 1, wherein the waste is indirectly heated by said heat with high heating value.
- 25 6. An apparatus for treating waste material comprising:
an insulated structure having a plurality of heating assemblies being held thereof, each of said heating assemblies being arranged in a manner wherein it is capable of providing flame heat in said insulated structure, said insulated structure being made such that it is capable of accomodating and disposing waste materials being heated
30 and carbonized therein, insulated structure includes an insulated hollow outer shell member and hollow inner shell member that defines a heating chamber disposed therebetween, a waste heating chamber being defined by said inner shell member,

and conveying means provided within the inner shell member being held thereof in a manner wherein it is capable of providing movement and disposal of the heated and/or carbonized waste materials disposed in the inner shell member, each of said heating assemblies consisting of a pre-heating chamber in communication with said heating chamber, a superheated steam producing means in communication with said pre-heating chamber, and a burner fixedly held on said superheated steam producing means and being arranged such that it is capable of providing flame heat in said superheated steam producing means, pre-heating chamber and heating chamber, said superheated steam producing means being capable of transforming water contained therein into superheated steam through utilization of heat generated by said burner and facilitates introduction of hydrogen and oxygen gases derived from said superheated steam into the burner flame in the pre-heating chamber, and synthesis gas line in communication with said waste heating chamber being arranged such that it is capable of allowing the introduction into the burner flame the synthesis gas produced during heating of the waste material within the waste heating chamber.

7. An apparatus for treating waste material according to claim 6, wherein said superheated steam producing means is a boiler.
8. An apparatus for treating waste material according to claim 6, wherein said superheated steam line being made of chromium and nickel such that it can serve as catalyst for speeding up the generation of hydrogen and oxygen gases upon contact of said superheated steam thereof.
9. An apparatus for treating waste material according to claim 6 wherein said conveying means is a screw conveyor.
10. An apparatus for treating waste material according to claim 8, wherein said superheated steam line having coiled section disposed within the pre-heating chamber.
11. An apparatus for treating waste material according to claim 6, wherein said synthesis gas line having a coiled section disposed within the pre-heating chamber.
12. An apparatus for treating waste material according to claim 6, wherein said insulated structure being in communication with an identical insulated structure such that further carbonization and/or disinfection of waste could be facilitated.
13. An apparatus for treating waste material according to claim 12, wherein an air

cooling chamber is in communication with one of said insulated structure being made such that it is capable of cooling and disposing of the carbonized and/or disinfected waste from said insulated structure.

14. An apparatus for treating waste material according to claim 12, wherein a gas filtering means is in communication with said insulated structure being made such that it is capable of filtering the gases produced in the said waste chamber during the heating of said waste materials, such as sythesis gas, carbon monoxide, hydrogen, thereby converting such gases into carbon dioxide and water.

15. An apparatus for treating waste material comprising:

an insulated structure having a rotary shell being held therein, said rotary shell having a waste heating chamber in communication with a gas chamber, and a pre-heating chamber fixedly held on said rotary shell, a heating assembly in communication with said rotary shell being arranged such that it is capable of providing flame heat to said rotary shell, said heating assembly being defined by a superheated steam producing means having a burner being held thereof, a superheated steam producing means in communication with said pre-heating chamber being made such that it is capable of transforming water into superheated steam through utilization of heat generated by said burner, said superheated steam producing means is further being made such that it is capable of allowing introduction of said superheated steam into the burner flame in said pre-heating chamber, an air chamber being defined by said insulated structure and rotary shell, wherein atmospheric air being capable of circulating therein before exiting to an air outlet in communication thereof, said waste heating chamber and gas chamber being arranged in a manner wherein synthesis gas produced by the heated waste material in the waste heating chamber is capable of flowing within the gas chamber. at least a synthesis gas line in communication with said gas chamber and pre-heating chamber being capable of introducing the sythesis gas from the gas chamber to the burner flame in the pre-heating chamber..

16. An apparatus for treating waste material according to claim 15, wherein said superheated steam producing means is a boiler.

17. An apparatus for treating waste material according to claim 15, wherein said superheated steam is being introduced into the burner flame in the pre-heating chamber by a superheated steam line provided on said superheated steam producing

means, said superheated steam line being made of chromium and nickel such that it can serve as catalyst for generating hydrogen and oxygen gases upon contact of said superheated steam thereof.

18. An apparatus for treating waste material according to claim 15, wherein said rotary
5 shell is capable of rotation by a prime moving means.

19. An apparatus for treating waste material according to claim 18, wherein said prime
moving means is a sprocket chain assembly.

20. An apparatus for treating waste material according to claim 17, wherein said
superheated steam line having a coiled section disposed within the pre-heating
10 chamber.

21. An apparatus for treating waste material according to claim 15, wherein said
synthesis gas line having a coiled section disposed within the pre-heating chamber.

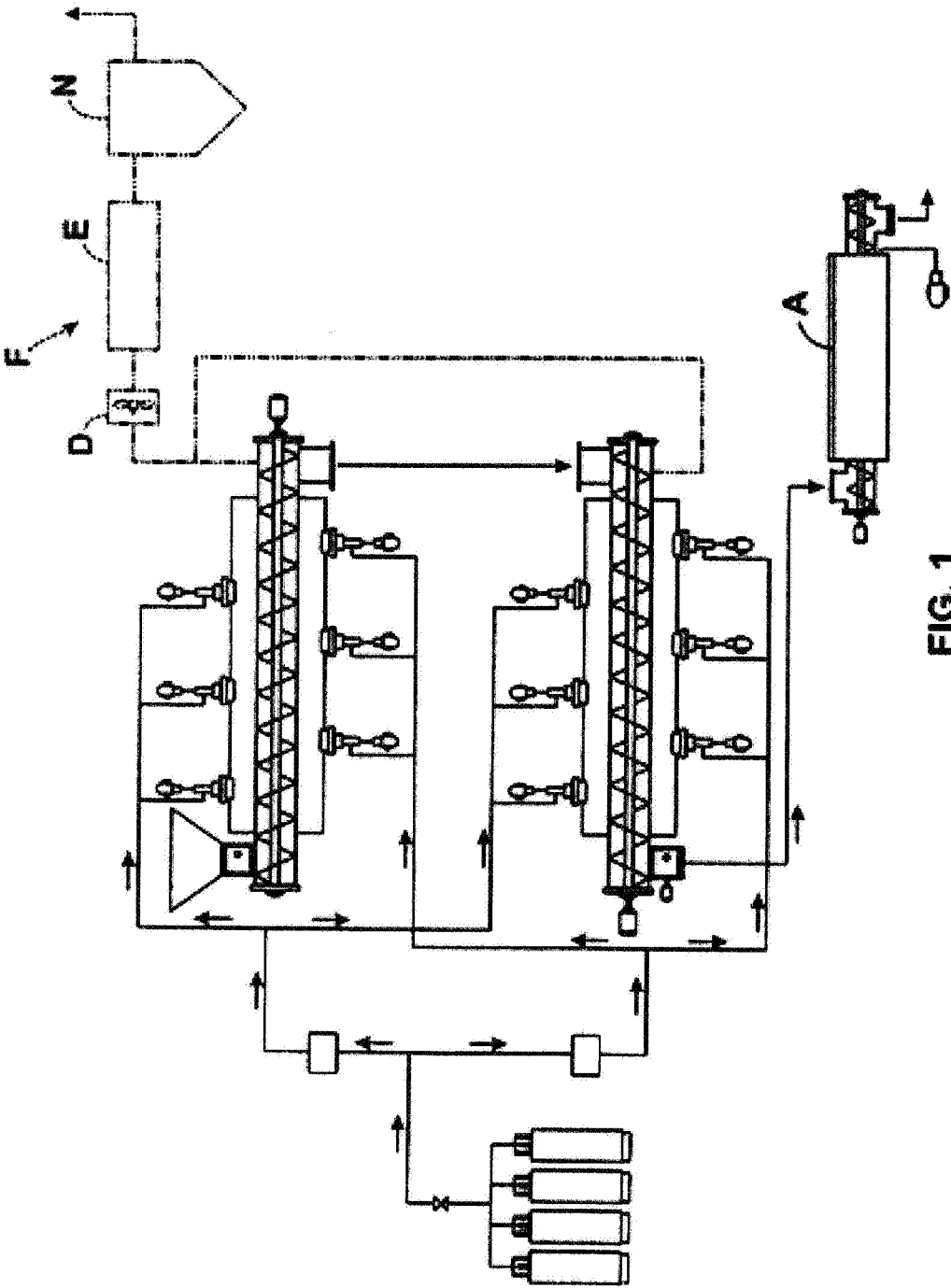


FIG. 1

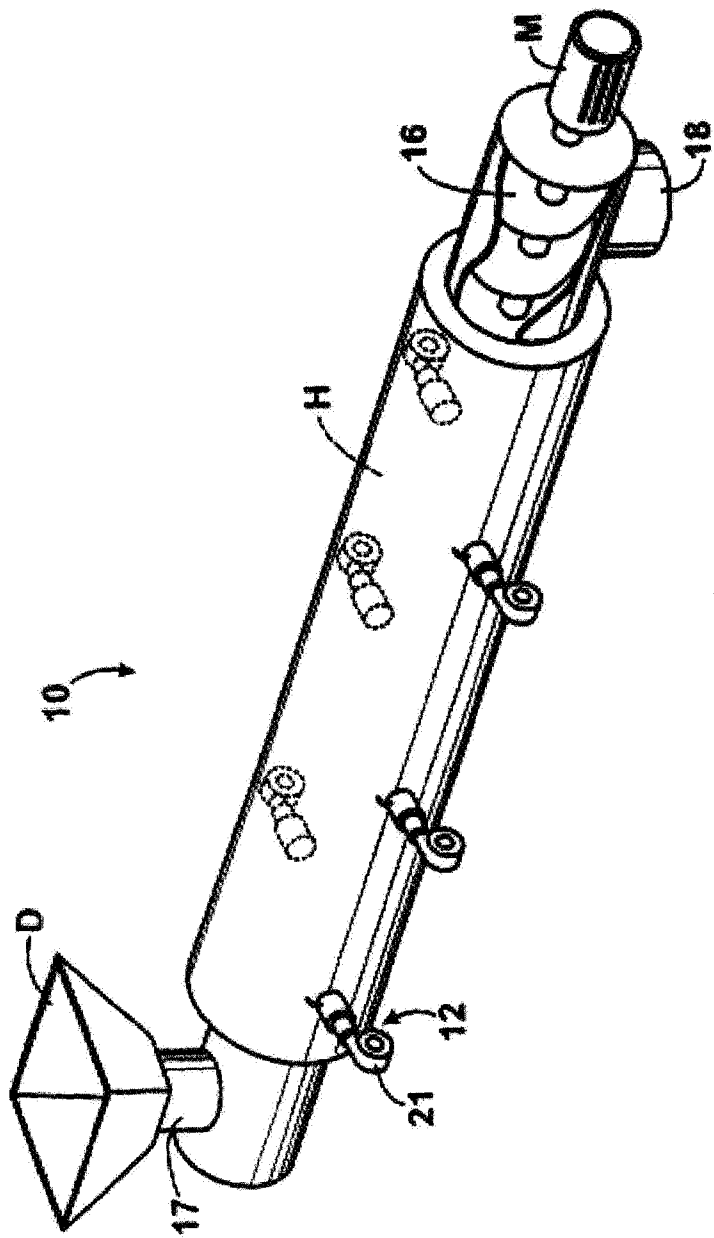


FIG. 2

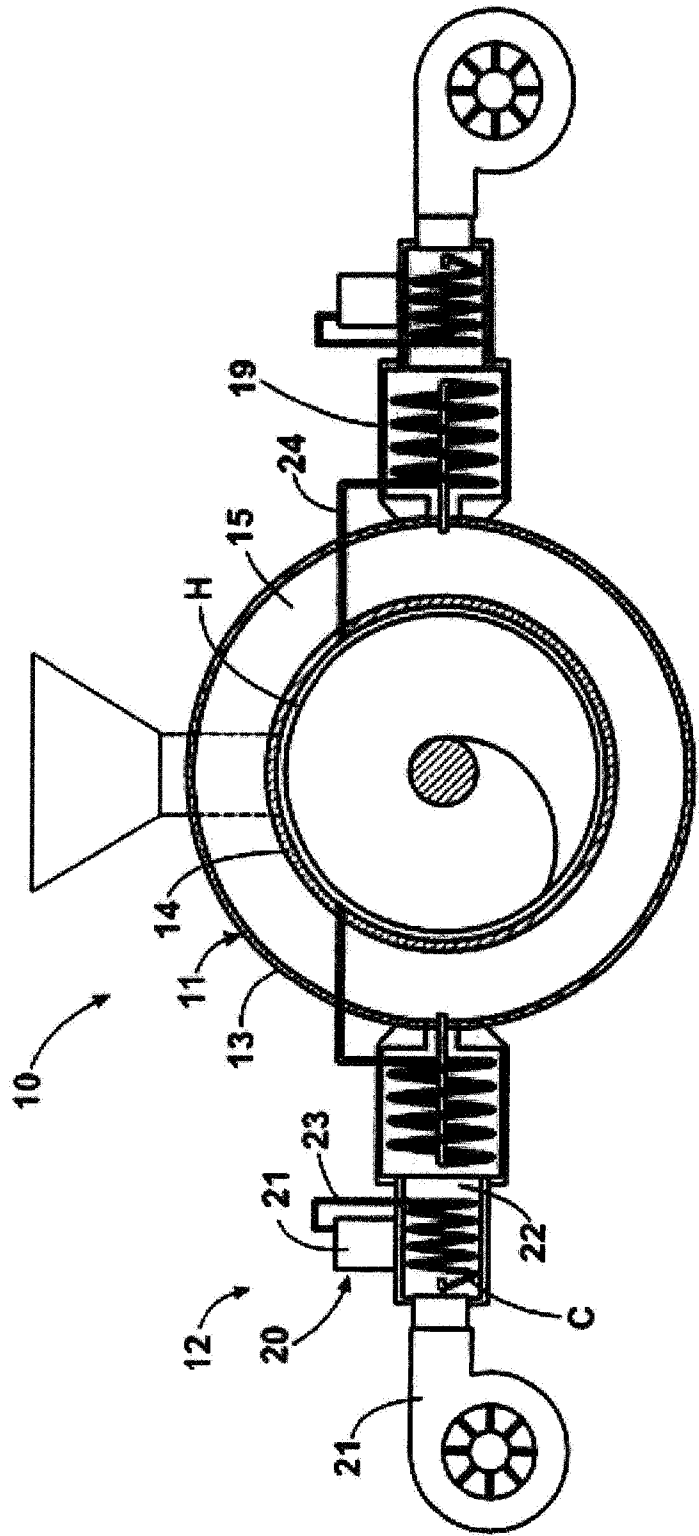


FIG. 3

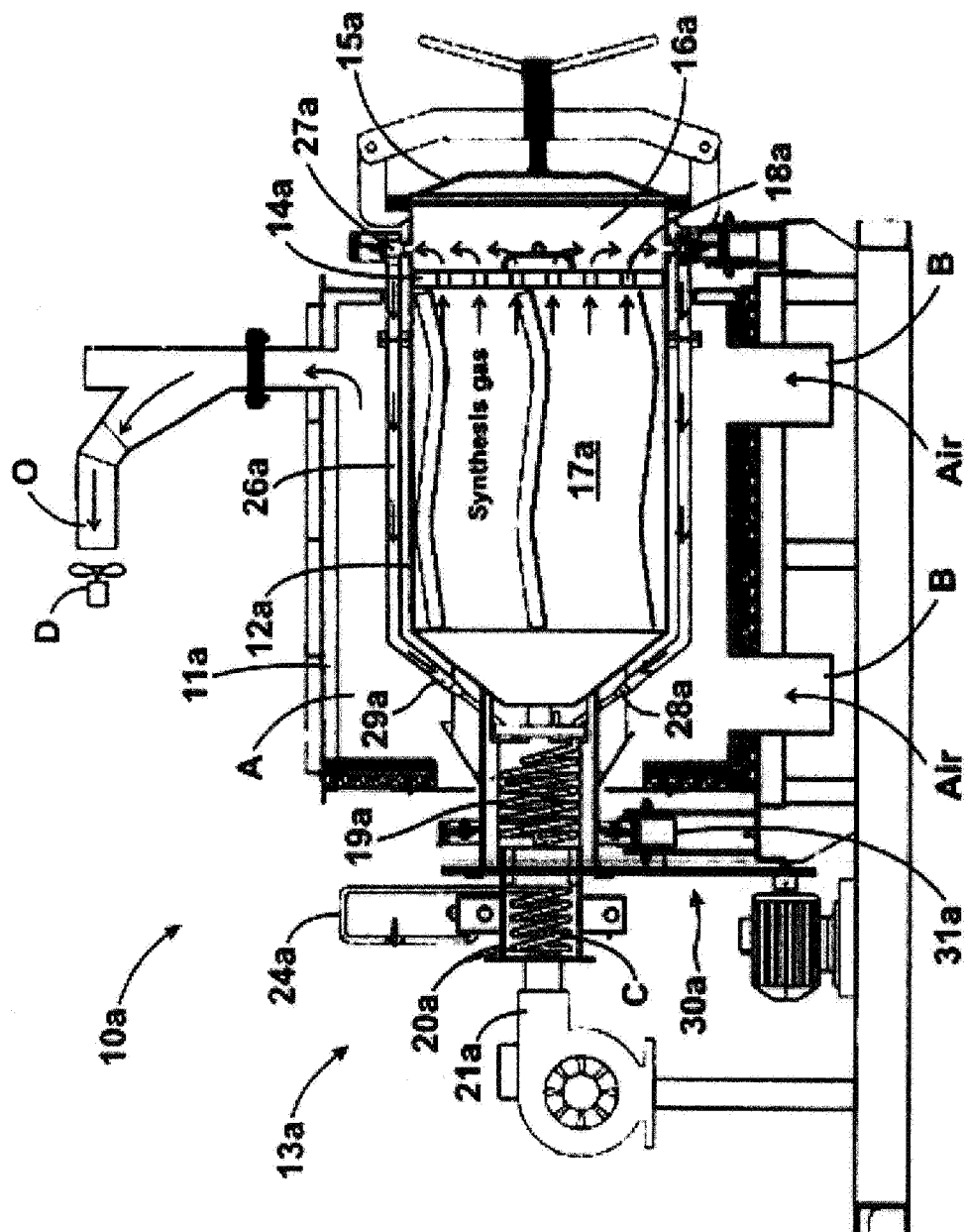


FIG. 4