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(54) **GAS GENERATOR SUITABLE FOR COGENERATION SYSTEMS, ESPECIALLY STIRLING COGENERATION SYSTEMS**

(57) Gas generator (1) adapted for cogeneration systems, particularly for Stirling cogeneration systems, comprising a main body (2) demarcating a combustion chamber (3), a fuel inlet (6) for the entry of fuel into said combustion chamber (3), a secondary body (4) surrounding the main body (2) demarcating a secondary chamber (5),

and an outlet conduit (9) for the exit of combustion gases. The gas generator (1) comprises a discharge conduit (8) communicating the combustion chamber (3) with the secondary chamber (5), said discharge conduit (8) communicating tangentially with the combustion chamber (3).

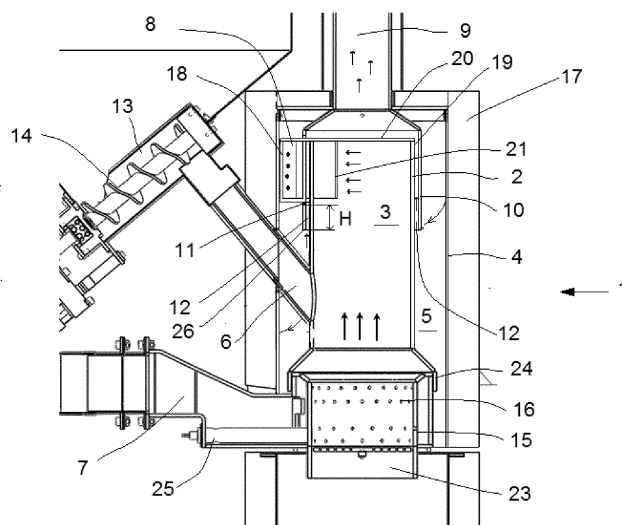


FIG. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to a gas generator adapted for cogeneration systems, particularly for Stirling cogeneration systems.

PRIOR ART

[0002] Gas generators in which a fuel, such as for example biomass, is transformed into combustion gases through a thermochemical process are known. This thermochemical process generates a large amount of particles which, when not filtered, leave the gas generator together with combustion gases. Combustion gases can be harnessed in cogeneration systems to produce electricity and/or thermal energy. The particles of combustion gases gradually deposit on the conduits, exchanger fins, or other apparatus connected to the gas generator, blocking them and reducing their efficiency, therefore the cogeneration system must include cleaning devices that regularly eliminate said particles.

[0003] Mechanical cleaning devices comprising coils that move vertically along the conduits through which combustion gases circulate, entraining solid particles adhered to the walls are known in the state of the art, such as disclosed in DE19828767A1 and KR2013071530A. The mechanical cleaning devices are arranged in an area reached by low temperature combustion gases, such that the thermomechanical stresses that they have to withstand are lower.

[0004] On the other hand, cogeneration systems such as those described in WO2013122291A1 and WO2009020442A1 comprising a cyclone connected to the gas generator or to the boiler, wherein the combustion gases generated are clean of particles of combustion generated during the thermochemical process, are known in the state of the art. That is due to the effect produced in the cyclone causing the particles of combustion to be separated from combustion gases, depositing them on the lower conical part of the cyclone.

[0005] In application WO2009020442A1, the gas generator is a fixed bed gas generator wherein the fuel is fed into the generator from the upper part and the air is fed from the lower part, the gasification system further comprising a particle separator extending like a jacket over the gas generator, and initially filtering the combustion gases that are obtained in the generator and will subsequently be cleansed in the cyclone connected to the generator.

DISCLOSURE OF THE INVENTION

[0006] The object of the invention is to provide a gas generator adapted for cogeneration systems, particularly for Stirling cogeneration systems, as described below.

[0007] The gas generator of the invention comprises

a main body demarcating a combustion chamber, a fuel inlet for the entry of fuel into said combustion chamber, a secondary body surrounding the main body demarcating a secondary chamber, and an outlet conduit for the exit of the combustion gases.

[0008] The gas generator of the invention comprises a discharge conduit communicating the combustion chamber with the secondary chamber, said discharge conduit communicating tangentially with the main body. Combustion gases are discharged through the discharge conduit to the secondary chamber forming helical paths generating a cyclone effect, cleaning the combustion gases of particles.

[0009] A gas generator is thus obtained with an integrated particle cleaning system making use of the acceleration and directional effect of combustion gases with particles so that said particles are separated from the combustion gases as a result of the centrifugal forces generated.

[0010] In addition to being compact, the obtained gas generator allows combustion gases leaving the gas generator to be clean of particles at the maximum possible temperature, such that it can be used for Stirling cogeneration systems in which gases must reach Stirling while they are very hot. In the known cleaning systems, combustion gases leaving the gas generator are conducted to another device for cleaning, whereby said gases cool down during the cleaning process and may not be used for Stirling cogeneration applications.

[0011] The integrated cleaning system is also static, i.e., it does not include elements movable with respect to one another, so the components thereof do not suffer mechanical wear, the noise generated in the conventional systems also being reduced.

[0012] These and other advantages and features of the invention will become evident in view of the drawings and the detailed description of the invention.

DESCRIPTION OF THE DRAWINGS

[0013]

Figure 1 shows a cross-section view of a gas generator of an embodiment according to the invention.

Figure 2 is a cross-section view through a horizontal plane of the gas generator shown in Figure 1.

Figure 3 shows a perspective view of a main body of the gas generator shown in Figure 1.

DETAILED DISCLOSURE OF THE INVENTION

[0014] Figure 1 shows an embodiment of a gas generator 1 according to the invention. The gas generator 1 comprises a main body 2 demarcating a combustion chamber 3, a fuel inlet 6 for the entry of fuel into said combustion chamber 3, a fuel oxidizing fluid inlet 7 and

an outlet conduit 9 for the exit of the combustion gases.

[0015] In the gas generator 1, the fuel is transformed into combustion gases through a thermochemical process. Such thermochemical processes are known in the state of the art and as such are not an object of the invention, so it is not considered necessary to describe them.

[0016] Coal, wood, pellets, household waste can be used as fuel, biomass preferably being used. In the embodiment that will be described below, the fuel comprises pellets.

[0017] The fuel oxidizing fluid can be air, oxygen, vapor, or mixtures of said fluids. In the embodiment shown in the drawings, the oxidizing fluid is air.

[0018] The gas generator 1 comprises feeding means 13 including a conveyor 14 driving the pellets to the fuel inlet 6, in the embodiment shown in Figure 1 said fuel inlet 6 being a conduit communicating the conveyor 14 with the combustion chamber 3.

[0019] The gas generator 1 shown in Figure 1 further comprises a burner vessel 15 in which the feeding means 13 deposit the pellets through the fuel inlet conduit 6, said burner vessel 15 being arranged in the lower part of the gas generator 1. The air inlet 7 is made in the lower part of the gas generator 1 through a corresponding conduit communicating with the burner vessel 15. The burner vessel 15 comprises orifices 16 through which air necessary for burning the fuel comprised in the burner vessel 15 passes.

[0020] The gas generator 1 comprises a crate 23 below the burner vessel 15, crate in which ashes generated during the thermochemical process are collected. It further comprises an igniter 25 adapted for triggering the combustion of the pellets in the burner vessel 15.

[0021] In the embodiment shown in the drawings, the main body 2 has a substantially cylindrical geometry closed at an upper end 19 and open at a lower end 24 for communication with the burner vessel 15. The main body 2 comprises a cover 20 closing the upper end 19. In other embodiments not depicted in the drawings, the cover 20 and the main body 2 can be made as a single part.

[0022] The gas generator 1 comprises a secondary body 4 surrounding the main body 2 demarcating a secondary chamber 5. The secondary body 4 has a substantially cylindrical geometry and is arranged substantially concentric to the main body 2. The combustion chamber 3 communicates with the secondary chamber 5 through a discharge conduit 8, said discharge conduit 8 communicating tangentially with the combustion chamber 3.

[0023] The discharge conduit 8 communicates with the combustion chamber 3 above the fuel inlet 6. Furthermore, the discharge conduit 8 extends laterally from the upper end 19 of the main body 2.

[0024] The discharge conduit 8 is housed in the secondary chamber 5 following a curved path. In the embodiment shown in the drawings, the path of the discharge conduit 8 is helical. The discharge conduit 8 has

a geometry such that the outlet section 18 of said discharge conduit 8, arranged at one end of the discharge conduit 8, is arranged substantially orthogonal to the main body 2. Furthermore, the outlet section 18 has a smaller surface than the surface of the inlet section 21 of the discharge conduit 8, arranged at the opposite end of the discharge conduit 8. Both sections 18 and 21 are substantially rectangular in the embodiment shown in Figures 1 and 3, but they can have other geometric shapes, such as square or circular, for example.

[0025] The geometry and arrangement of the discharge conduit 8 with respect to the main body 2 cause the combustion gases to be discharged from the discharge conduit 8 forming helical paths. The combustion gases tangentially enter the secondary chamber 5 through the discharge conduit 8, following a helical path, against the inner surface of the secondary body 4. The particles present in the combustion gases are thus separated from the combustion gases, being collected in the lower part of the gas generator 1. The narrowing of the discharge conduit 8 towards the outlet means that the speed with which the combustion gases leave the discharge conduit 8 is greater and, therefore, the efficiency of the particle cleaning system is also greater. Furthermore, the location of the discharge conduit 8 at the end 19 of the main body 2 allows maximizing the helical path the combustion gases follow before leaving the gas generator 1 so that the combustion gases can be cleansed more efficiently.

[0026] Additionally, the outlet conduit 9 comprises a nozzle 10 arranged concentric to the main body 2 and communicating the secondary chamber 5 with the outlet conduit 9 through which clean gases leave. The discharge conduit 8 laterally goes through the outlet conduit 9. Thus, the outlet conduit 9 comprises an opening 11 in the nozzle 10 with the discharge conduit 8 going through it, the first body 2 and the discharge conduit 8 being coupled to one another. The opening 11 is arranged a longitudinal distance H from a free end 26 of the nozzle 10.

[0027] The upper end 19 of the main body 2 is housed inside the nozzle 10. The nozzle 10 assures that dirty gases with particles of combustion do not directly leave the discharge conduit 8 to the outlet conduit 9. As a result of the nozzle 10, dirty gases follow a helical path in the second chamber 5, depositing the particles in said second chamber 5. Particularly, the part of the nozzle 10 having a length H prevents dirty gases with particles of combustion from directly leaving the discharge conduit 8 to the outlet conduit 9.

[0028] The combustion gases cleansed along their helical path leave the secondary chamber 5 as clean gases through a gap 12 present between the nozzle 10 and the main body 2. The nozzle 10 has a substantially cylindrical geometry and is arranged substantially concentric to the main body 3, generating a substantially ring-shaped gap 12 between the inner surface of the nozzle 10 and the outer surface of the main body 2.

[0029] After leaving the discharge conduit 8, the com-

bustion gases tend to travel very close to, almost against, the inner wall of the secondary body 4. Once they reach the end of the nozzle 10, the free end 26 of the nozzle 10 forces the combustion gases to abruptly change their travelling direction. When the clean combustion gases leave through the gap 12, they come into contact with the outside of the main body 3, which is subject to a higher temperature than the secondary body 4, such that temperature drop in the clean combustion gases from the time they are generated to the time they leave through the outlet conduit 9 is minimized. The nozzle 10 is designed such that the length H of the portion from the free end 26 to the opening 11 is such that the effect of temperature increase during the circulation of clean gases through the gap 12 compensates for pressure drops that occurred during the abrupt change of direction caused by the nozzle 10.

[0030] The outlet conduit 9 communicates directly only with the secondary chamber 5, the combustion chamber 3 communicating with the secondary chamber 5 only through the discharge conduit 8.

[0031] Finally, the gas generator 1 comprises an insulator 17 externally surrounding the secondary body 4 and the outlet conduit 9 to prevent heat transfer to the outside.

Claims

1. Gas generator adapted for cogeneration systems, particularly for Stirling cogeneration systems, comprising a main body (2) demarcating a combustion chamber (3), a fuel inlet (6) for the entry of fuel into said combustion chamber (3), a secondary body (4) surrounding the main body (2) demarcating a secondary chamber (5), and an outlet conduit (9) for the exit of combustion gases, **characterized in that** it comprises a discharge conduit (8) communicating the combustion chamber (3) with the secondary chamber (5), said discharge conduit (8) communicating tangentially with the combustion chamber (3).
2. Gas generator according to the preceding claim, wherein the discharge conduit (8) is housed in the secondary chamber (5) following a curved path.
3. Gas generator according to claim 1 or 2, wherein the discharge conduit (8) has a geometry such that the outlet section (18) of said discharge conduit (8) is arranged substantially orthogonal to the main body (2).
4. Gas generator according to the preceding claim, wherein the inlet section (21) of the discharge conduit (8) has a larger surface than the outlet section (18).
5. Gas generator according to any of the preceding claims, wherein the discharge conduit (8) extends

laterally from an upper end (19) of the main body (2).

6. Gas generator according to any of the preceding claims, wherein the main body (2) has a substantially cylindrical geometry closed at the upper end (19), the combustion chamber (3) communicating with the secondary chamber (5) only through the discharge conduit (8).
7. Gas generator according to any of the preceding claims, wherein the discharge conduit (8) communicates with the combustion chamber (3) above the fuel inlet (6).
8. Gas generator according to any of the preceding claims, wherein the outlet conduit (9) for the exit of combustion gases comprises a nozzle (10) surrounding the main body (2) such that the combustion gases are discharged through the discharge conduit (8) to the secondary chamber (5) forming helical paths, cleaning the combustion gases of particles, clean combustion gases leaving through a gap (12) between the nozzle (10) of the outlet conduit (9) and the main body (2).
9. Gas generator according to the preceding claim, wherein the discharge conduit (8) laterally goes through the nozzle (10) of the outlet conduit (9).
10. Gas generator according to claim 8 or 9, wherein the nozzle (10) has a substantially cylindrical geometry and is arranged substantially concentric to the main body (2).
11. Gas generator according to any of the preceding claims, wherein the secondary body (4) has a substantially cylindrical geometry and is arranged substantially concentric to the main body (2).
12. Gas generator according to any of the preceding claims comprising an insulator (17) externally surrounding the secondary body (4) and the gas outlet conduit (9).
13. Stirling-type cogeneration system, **characterized in that** it comprises a gas generator (1) according to any of the preceding claims.

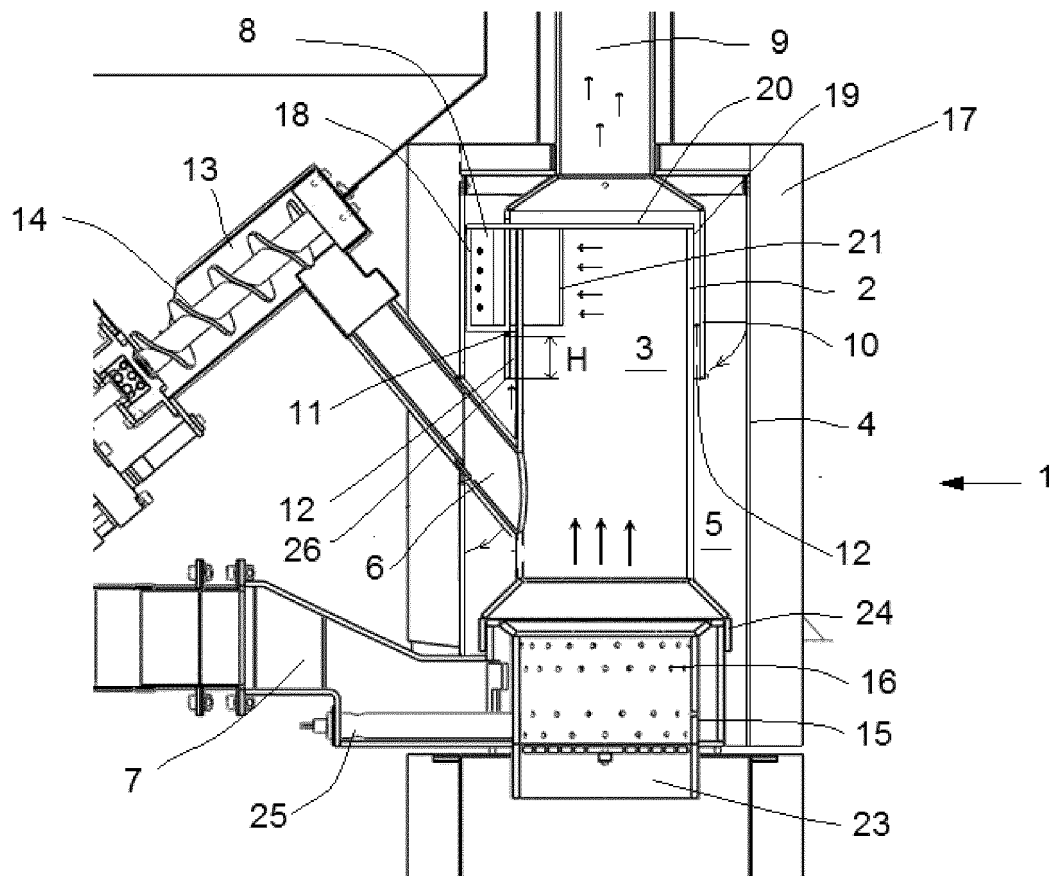


FIG. 1

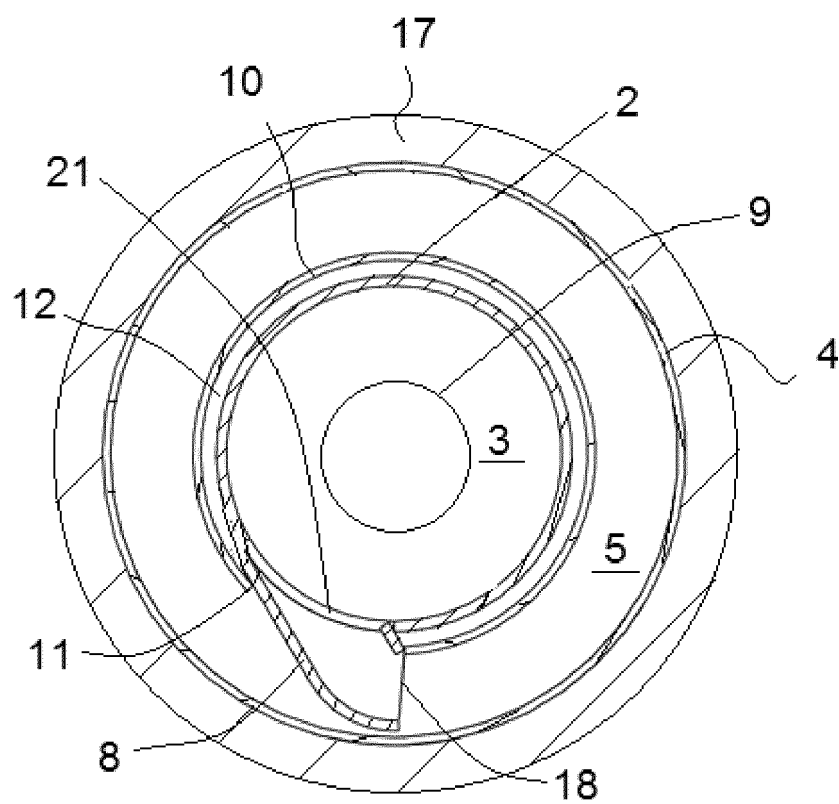


FIG. 2

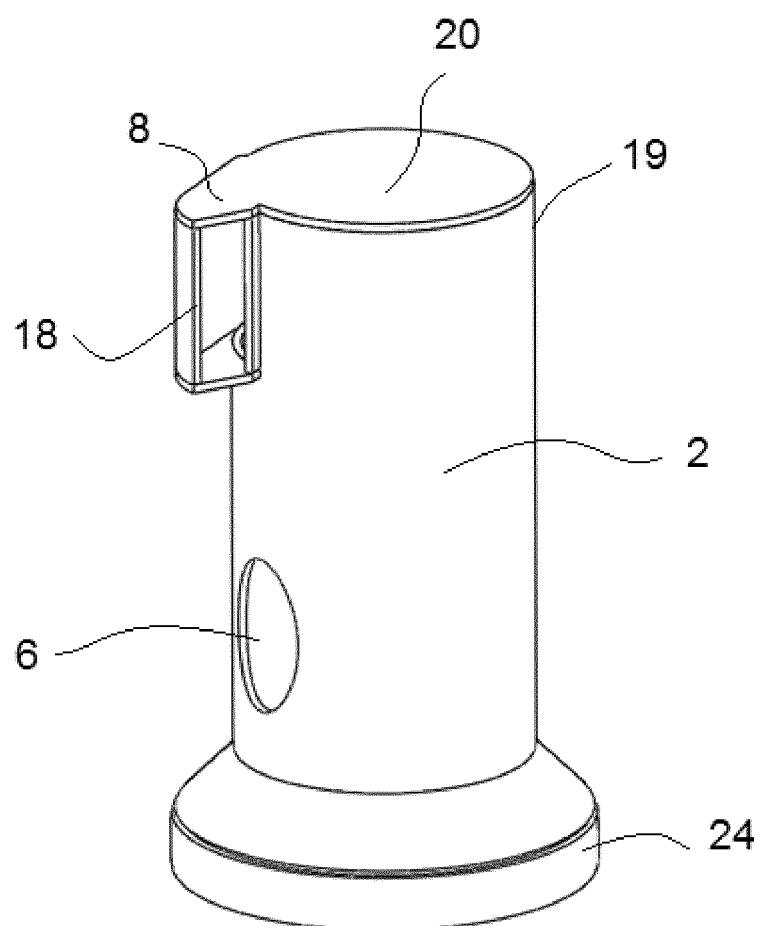


FIG. 3

INTERNATIONAL SEARCH REPORT

ISR

International application No 14739860
PCT/ES2014/070472

A. CLASSIFICATION OF SUBJECT MATTER		
INV.	F23B80/04	F23B30/00
ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) F23B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/132596 A1 (LONGATTE SYLVIAN [FR]) 3 June 2010 (2010-06-03) paragraph [0058] - paragraph [0077]; figures 1-3	1-7, 11-13
A	US 2009/078176 A1 (WEBER ECKHART [DE]) 26 March 2009 (2009-03-26) paragraph [0022] - paragraph [0028] paragraph [0032] - paragraph [0035]; figures 1,2,4,5	1,13
A	FR 2 919 711 A1 (E U R L JEAN MARIE THEVENON SA [FR]) 6 February 2009 (2009-02-06) page 4, line 5 - page 10, line 2; figures 1-3	1,8
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 19 August 2014		Date of mailing of the international search report 27/08/2014
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Theis, Gilbert

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No 14739860
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