(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 486 565 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
22.05.2019 Bulletin 2019/21

(21) Application number: **18186510.6**

(22) Date of filing: **31.07.2018**

(51) Int Cl.:
F23K 5/22 *(2006.01)* ***F23N 1/02*** *(2006.01)*
F23D 11/44 *(2006.01)* ***F23D 11/46*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **21.11.2017 CN 201711167886**

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(54) HIGH EFFICIENCY COMBUSTION CONTROL SYSTEM AND METHOD THEREOF

(57) The invention discloses a high efficiency combustion control system and a method thereof. A high-efficiency combustion control system includes a gasification unit, a gas remixing zone coupled to the gasification unit, a combustion unit coupled to the gas remixing zone; a first gas detecting unit disposed in the gasification unit; a second gas detecting unit disposed in the remixing gas region; and an air supply unit coupled to the gas remixing zone. The first gas detecting unit and the second gas detecting unit detect the concentration of a specific gas of the first gaseous fuel or the second gaseous fuel respectively. And air is supplied to the liquid fuel or the first gaseous fuel according to the gas concentration, so that the gasification rate is changed, and the calorific value is changed accordingly to obtain the optimal calorific value and the optimal combustion efficiency.

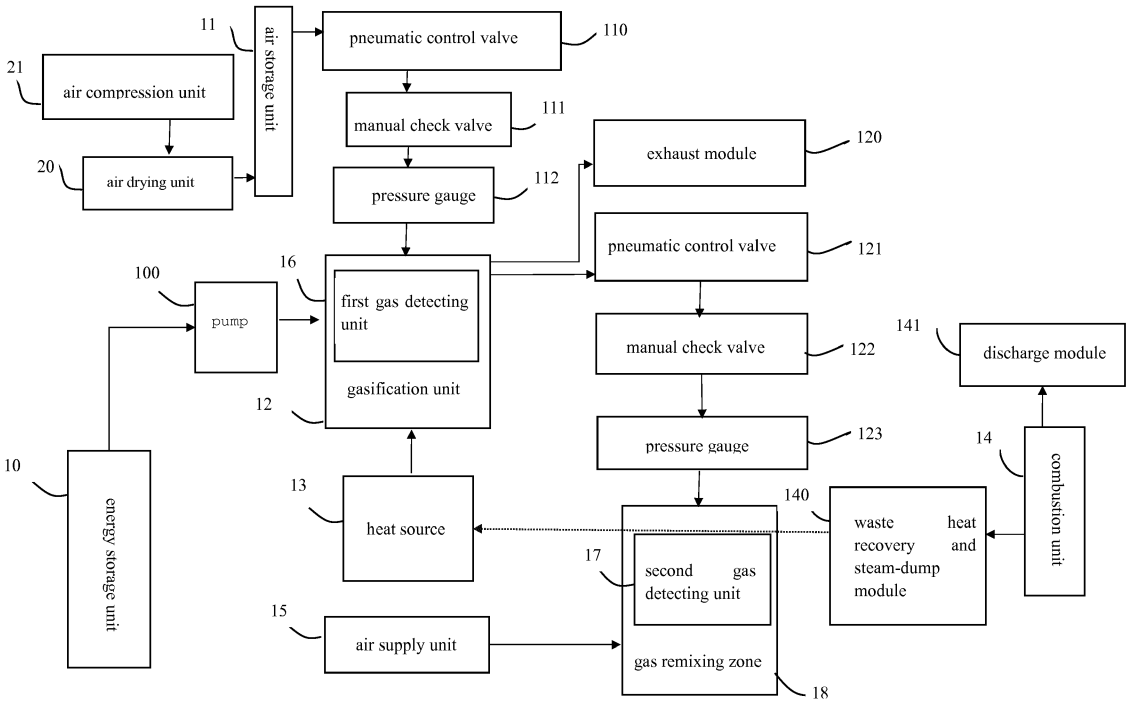

Figure 1

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Description

Technical Field

[0001] The invention relates to a high efficiency combustion control system and a method thereof, in particular to a control system and a method which can improve gasification rate and obtain optimal calorific value.

Background

[0002] Gaseous fuel or premixed fuel high efficiency combustion control technology, which gasifies liquid fuel into gaseous fuel for combustion. The existing control technology is pressure and temperature control, during the gasification, the higher the gasification rate, the more is the energy consumed for the heating; the higher the pressure, the lower is the gasification rate.

[0003] Therefore, in the industry, pressure is generally used for gas supply control to adjust the fuel flow rate. When the fuel flow rate decreases, the work of the air compressor is increased to drive more air into the gasification tank, reducing the gasification rate, causing incomplete gasification, directly ejecting the liquid fuel and resulting in incomplete combustion.

Summary

[0004] In view of this, the invention aims to improve the disadvantages of the existing gas supply device or gas supply control, thereby achieving the effect of improving the gasification rate and the combustion rate.

[0005] To achieve the above objectives, the present invention provides a high efficiency combustion control system, including:

a gasification unit;

a gas remixing zone coupled to the gasification unit;

a combustion unit coupled to the gas remixing zone;

a first gas detecting unit arranged in the gasification unit;

a second gas detecting unit arranged in the gas remixing zone; and an air supply unit coupled to the gas remixing zone.

[0006] The high efficiency combustion control system, further includes an air storage unit, an air compression unit and an air drying unit, the air compression unit is coupled to the air drying unit, the air drying unit is coupled to the air storage unit, and the air storage unit is coupled to the gasification unit through a pipeline having a pneumatic control valve, a manual check valve and a pressure gauge.

[0007] The high efficiency combustion control system, further includes an energy storage unit coupled to the gasification unit through a pipeline having a pump, the pump is a pneumatic diaphragm pump.

[0008] In the high efficiency combustion control system, the gasification unit is coupled to the gas remixing zone through a pipeline having a pneumatic control valve, a manual check valve and a pressure gauge.

[0009] The high efficiency combustion control system, further includes a heat source coupled to the gasification unit.

[0010] In the high efficiency combustion control system, the gasification unit has an exhaust module, the combustion unit has a waste heat recovery and steam-dump module and a discharge module, and the waste heat recovery and steam-dump module passes through the gas remixing zone through a pipeline and is coupled to the heat source.

[0011] The present invention also provides a high efficiency combustion control method, including the following steps:

detecting the gas concentration of the first gaseous fuel, the first gas detecting unit detects the first gas concentration of a specific gas in the first gaseous fuel of the gasification unit;

providing the air to the first gaseous fuel, the gasification unit provides the first gaseous fuel to the gas remixing zone, and the air supply unit supplies air to the first gaseous fuel according to the first gas concentration, the first gaseous fuel is mixed with the air to form the second gaseous fuel; and

detecting the gas concentration of the second gaseous fuel, the second gas detecting unit detects the second gas concentration of the specific gas in the second gaseous fuel, if the second gas concentration is lower than or beyond

the setting range, the air supply unit stops supplying air to the first gaseous fuel.

[0012] The high efficiency combustion control method, further includes the step of gasifying the liquid fuel, the air storage unit supplies the stored air to the gasification unit, and the energy storage unit supplies the stored liquid fuel to the gasification unit, and the liquid fuel and the air are mixed in the gasification unit to form the first gasifying fuel.

[0013] The high efficiency combustion control method, in the step of gasifying the liquid fuel, the air compression unit pressurizes the air and sends the air to the air drying unit, the air drying unit dries the air, and the dried air is sent to the air storage unit, and the air storage unit stores the air; the liquid fuel can be heavy oil, diesel oil, petroleum gas, natural gas or hexane; the specific gas can be oxygen, hydrogen, hydrocarbon, or inert gas.

[0014] The high efficiency combustion control method, further includes the step of supplying the second gaseous fuel to the combustion unit, the second gaseous fuel in the gas remixing zone enters the combustion unit for combustion.

[0015] In summary, the present invention uses the first gas detecting unit and the second gas detecting unit to detect the concentration of the specific gas of the first gaseous fuel or the second gaseous fuel respectively. And air is supplied to the liquid fuel or the first gaseous fuel according to the gas concentration, so that the gasification rate is changed, and the calorific value is changed accordingly to obtain the optimal calorific value and the optimal combustion efficiency.

Brief Description of the Drawings

[0016]

FIG. 1 is a schematic diagram of a high efficiency combustion control system of the present invention.

FIG. 2 is a flowchart of a high efficiency combustion control method of the present invention.

[0017] Description of reference numerals: 10 - energy storage unit; 100 - pump; 11 - air storage unit; 110 - pneumatic control valve; 111 - manual check valve; 112 - pressure gauge; 12 - gasification unit; 120 - exhaust module; 121 - pneumatic control valve; 122 - manual check valve; 123 - pressure gauge; 13 - heat source; 14 - combustion unit; 140 - waste heat recovery and steam-dump module; 141 - discharge module; 15 - air supply unit; 16 - first gas detecting unit; 17 - second gas detecting unit; 18 - gas remixing zone; 20 - air drying unit; 21 - air compression unit; S1~S5 - steps.

Detailed Description

[0018] Detailed implementation of the present invention is described with reference to the following specific embodiments, those of ordinary skill in the art can easily understand the other advantages and effects of the present invention by the contents disclosed in this specification.

[0019] With reference to FIG. 1, the present invention is a high efficiency combustion control system including the energy storage unit 10, the air storage unit 11, the gasification unit 12, the heat source 13, the combustion unit 14, the air supply unit 15, the first gas detecting unit 16, the second gas detecting unit 17, and the air remixing zone 18.

[0020] The energy storage unit 10 is a storage unit for a liquid hydrocarbon fuel (also simply referred to as liquid fuel). The hydrocarbon fuel can be heavy oil, diesel oil, petroleum gas, natural gas, or hexane. The energy storage unit 10 is coupled to the gasification unit 12 through a pipeline. The pipeline is provided with the pump 100, and the pump 100 is a pneumatic diaphragm pump.

[0021] The air storage unit 11 is coupled to the gasification unit 12 through a pipeline. The pipeline is provided with the pneumatic control valve 110, the manual check valve 111 and the pressure gauge 112. The air storage unit 11 is coupled to an air drying unit 20 through a pipeline. The air drying unit 20 is coupled to the air compression unit 21 through a pipeline. The air compression unit 21 can be an air compressor.

[0022] The gasification unit 12 includes the exhaust module 120 used for maintaining and cleaning the gasification unit 12. The gasification unit 12 is coupled to the heat source 13. The gasification unit 12 is coupled to the gas remixing zone 18 through a pipeline. The pipeline is provided with the pneumatic control valve 121, the manual check valve 122 and the pressure gauge 123.

[0023] The combustion unit 14 includes the waste heat recovery and steam-dump module 140 and the discharge module 141. The waste heat recovery and steam-dump module 140 passes through the gas remixing zone 18 through a pipeline and is coupled to the heat source 13.

[0024] The air supply unit 15 is coupled to the gas remixing zone 18 through a pipeline. The air supply unit 15 can be an air compressor.

[0025] The first gas detecting unit 16 is arranged in the gasification unit 12; the second gas detecting unit 17 is arranged in the gas remixing zone 18;

[0026] With reference to FIG. 2, the present invention is a high efficiency combustion control method, including the

following steps:

step S1, gasifying the liquid fuel. The air compression unit 19 pressurizes the air and sends the air to the air drying unit 18. The air drying unit 15 dries the air, and the dried air is sent to the air storage unit 11. The air storage unit 11 stores this air.

[0027] The air storage unit 11 sends the stored air to the gasification unit 12. The energy storage unit 10 sends the stored liquid fuel to the gasification unit 12. The liquid fuel and the air are mixed in the gasification unit 12 to form the first gaseous fuel.

step S2, detecting the gas concentration of the first gaseous fuel. The first gas detecting unit 16 detects the first gas concentration of the specific gas in the first gaseous fuel. The specific gas can be oxygen, hydrogen, hydrocarbons or inert gas.

step S3, providing the air to the first gaseous fuel. The gasification unit 12 provides the first gaseous fuel to the gas remixing zone 18. The air supply unit 15 provides air to the first gaseous fuel according to the first gas concentration. The first gaseous fuel is mixed with the air to form a second gaseous fuel.

step S4, detecting the gas concentration of the second gaseous fuel. The second gas detecting unit 17 detects the second gas concentration of the specific gas in the second gaseous fuel. If the second gas concentration is lower than or beyond the setting range, the air supply unit 15 stops the air supply or adjusts the supply flow rate to the first gaseous fuel.

step S5, providing the second gaseous fuel to the combustion unit. The second gaseous fuel in the gas remixing zone 18 enters the combustion unit 13 for combustion.

[0028] In summary, when the air of the air storage unit 11 enters the gasification unit 12, the pneumatic control valve 110 controls whether the air can flow into the gasification unit 12 or controls the flow rate of air into the gasification unit 12; the manual check valve 111 prevents the air or the first gaseous fuel of the gasification unit 12 from flowing back to the air storage unit 11; the pressure gauge 112 detects the pressure of the air flowing into the gasification unit 12.

[0029] When the liquid fuel enters the gasification unit 12 from the energy storage unit 10, the pump 100 pressurizes the liquid fuel to gasify.

[0030] When the first gaseous fuel enters the gas remixing zone 18, the pneumatic control valve 110 controls whether air can flow into the gas remixing zone 18 or the flow rate of air flowing into the gasification unit 12; the manual check valve 111 prevents the air or the first gaseous fuel of the gas remixing zone 18 from flowing back to the air storage unit 11; the pressure gauge 112 detects the pressure of the air flowing into the remix zone 18.

[0031] After the second gaseous fuel is combusted in the combustion unit 14, the second gaseous fuel after combusting generates exhaust gas and steam. The exhaust gas is discharged to the outside of the combustion unit 14 by the discharge module 141. The steam is directed to the heat source 13 by the waste heat recovery and steam-dump module 140 to heat the first gaseous fuel in the gasification unit 12 and the second gaseous fuel in the gas remixing zone 18.

[0032] In the present embodiment, the above mentioned specific gas can be oxygen, and the first gas concentration and the second gas concentration are the oxygen concentrations in the first gaseous fuel or the second gaseous fuel.

[0033] As described above, the change of the first gas concentration or the second gas concentration affects the gasification rate, when the gasification rate increases, the fuel heating value also increases.

[0034] The following table shows an example where hexane is used:

Gasification unit pressure(kg/cm^2)	1.4	1.4	1.6
Combustion efficiency index	0.68±0.17	0.5±0.09	0.92±0.15
Combustion average consumption(m^3/min)	1.27	1.25	1.32
Average air-fuel ratio (m^3/m^3)	5.06±0.71	4.2±0.19	7.5±0.5
Fuel calorific value (kcal/ m^3)	7647	8912	5452
Gas fuel density (kg/m^3)	1.7	1.77	1.59
Fuel gasification rate (m^3/min)	0.209	0.240	0.155

[0035] As can be seen from the above table, when the fuel gasification rate increases, the fuel calorific value also increases. The present invention uses the first gas detecting unit 16 and the second gas detecting unit 17 to detect the concentration of the specific gas of the first gaseous fuel or the second gaseous fuel respectively. And air is supplied to

the liquid fuel or the first gaseous fuel according to the gas concentration, so that the gasification rate is changed, and the calorific value is changed accordingly to obtain the optimal calorific value and the optimal combustion efficiency.

[0036] The above description is merely illustrative and not restrictive of the invention, and it can be understood by those of ordinary skill in the art that many modifications, variations or equivalents can be made without departing from the spirit and scope defined by the claims, which is still within the protection scope of the invention.

Claims

1. A high efficiency combustion control system, comprising:

   a gasification unit;
   a gas remixing zone coupled to the gasification unit;
   a combustion unit coupled to the gas remixing zone;
   a first gas detecting unit arranged in the gasification unit;
   a second gas detecting unit arranged in the gas remixing zone; and
   an air supply unit coupled to the gas remixing zone.

2. The high efficiency combustion control system according to claim 1, further comprising:

   an air storage unit,
   an air compression unit, and
   an air drying unit; wherein
   the air compression unit is coupled to the air drying unit, the air drying unit is coupled to the air storage unit, and the air storage unit is coupled to the gasification unit through a first pipeline, the first pipeline comprises a pneumatic control valve, a manual check valve and a pressure gauge.

3. The high efficiency combustion control system according to claim 1, further comprising an energy storage unit coupled to the gasification unit through a second pipeline, the second pipeline comprises a pump, the pump is a pneumatic diaphragm pump.

4. The high efficiency combustion control system according to claim 1, wherein the gasification unit is coupled to the gas remixing zone through a third pipeline, the third pipeline comprises a pneumatic control valve, a manual check valve and a pressure gauge.

5. The high efficiency combustion control system according to claim 1, further comprising a heat source, the heat source is coupled to the gasification unit.

6. The high efficiency combustion control system according to claim 5, wherein the gasification unit comprises an exhaust module, the combustion unit comprises a waste heat recovery and steam-dump module and a discharge module, and the waste heat recovery and steam-dump module passes through the gas remixing zone through a fourth pipeline and the waste heat recovery and steam-dump module is coupled to the heat source.

7. A high efficiency combustion control method, comprising the following steps:

   detecting a first gas concentration of a first gaseous fuel, a first gas detecting unit detects the first gas concentration of a specific gas in the first gaseous fuel of a gasification unit;
   providing air to the first gaseous fuel, the gasification unit provides the first gaseous fuel to a gas remixing zone, and an air supply unit supplies air to the first gaseous fuel according to the first gas concentration; the first gaseous fuel is mixed with the air to form a second gaseous fuel; and
   detecting a second gas concentration of the second gaseous fuel, a second gas detecting unit detects the second gas concentration of the specific gas in the second gaseous fuel, if the second gas concentration is lower than or beyond a setting range, the air supply unit stops supplying the air to the first gaseous fuel.

8. The high efficiency combustion control method according to claim 7, further comprising a step of gasifying a liquid fuel, wherein an air storage unit supplies stored air to the gasification unit, and an energy storage unit supplies a stored liquid fuel to the gasification unit, and the stored liquid fuel and the stored air are mixed in the gasification unit to form the first gaseous fuel.

9. The high efficiency combustion control method according to claim 8, wherein in the step of gasifying the liquid fuel, an air compression unit pressurizes the air to form pressurized air, and sends the pressurized air to an air drying unit, the air drying unit dries the pressurized air, and the dried pressurized air is sent to the air storage unit, and the air storage unit stores the dried pressurized air; the liquid fuel can be heavy oil, diesel oil, petroleum gas, natural gas or hexane; the specific gas can be oxygen, hydrogen, hydrocarbon, or an inert gas.

10. The high efficiency combustion control method according to claim 7, further comprising a step of supplying the second gaseous fuel to a combustion unit, wherein the second gaseous fuel in the gas remixing zone enters the combustion unit for combustion.

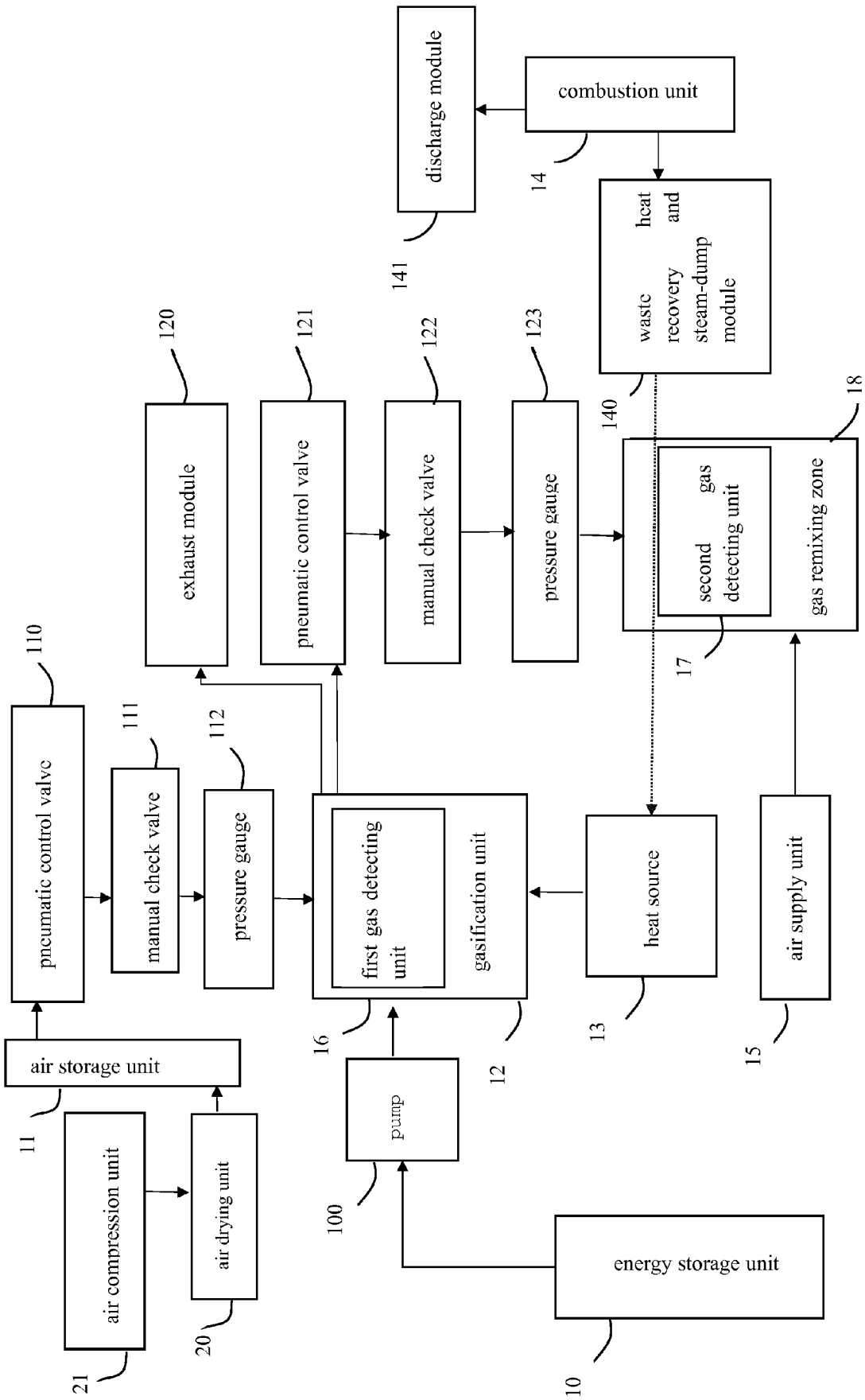
air compression unit
air drying unit
air storage unit
pneumatic control valve
manual check valve
pressure gauge
first gas detecting unit
gasification unit
pump
heat source
air supply unit
energy storage unit
exhaust module
pneumatic control valve
manual check valve
pressure gauge
second gas detecting unit
gas remixing zone
waste heat recovery and steam-dump module
combustion unit
discharge module
21
20
11
110
111
112
16
12
100
13
15
10
120
121
122
123
17
18
140
14
141

Figure 1

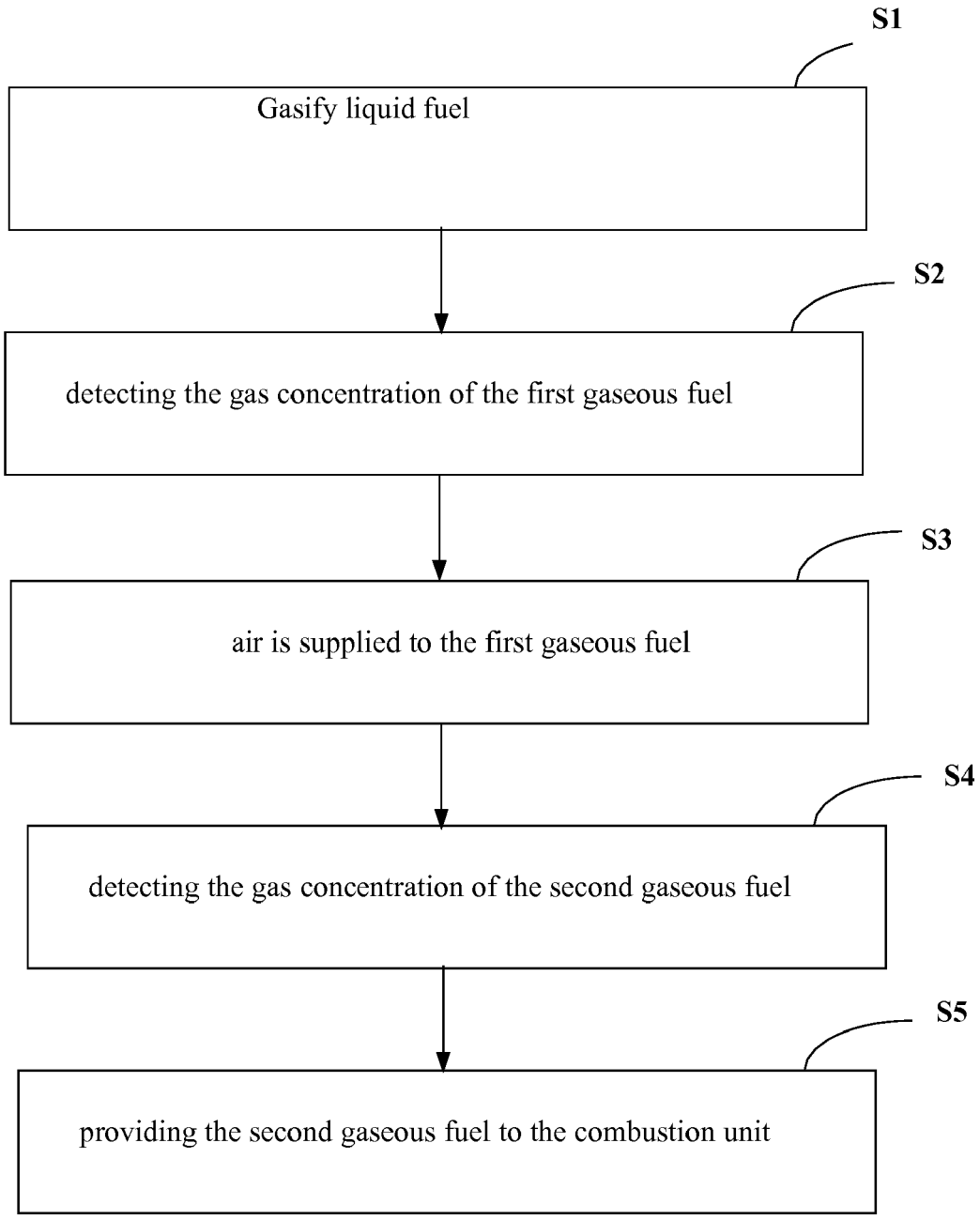
S1
Gasify liquid fuel
S2
detecting the gas concentration of the first gaseous fuel
S3
air is supplied to the first gaseous fuel
S4
detecting the gas concentration of the second gaseous fuel
S5
providing the second gaseous fuel to the combustion unit

Figure 2

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EUROPEAN SEARCH REPORT

Application Number
EP 18 18 6510

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 January 2019	Gavriliu, Costin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 18 6510

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