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(54) **RETROFIT ASSEMBLY FOR A FUEL GAS BOILER AND METHOD FOR MODIFYING A FUEL GAS BOILER**

(57) Retrofit assembly for a fuel gas boiler; the fuel gas boiler (1, 201, 301, 401) comprising a fuel gas burner (2), a feeding assembly (3, 403) for supplying fuel gas to the burner (2), a control unit (4) for controlling the feeding assembly (3, 403); the retrofit assembly (100) comprising a processing unit (101) configured to acquire a first control signal (S1; S4) of the feeding assembly (3, 403) configured to control the feeding assembly (3, 403); a second signal (S2) correlated to the exhaust gas or fuel gas composition; the processing unit (101) being configured to define a third control signal (S3) of the feeding assembly (3, 403) configured to control the feeding assembly (3, 403) and based on the second signal (S2) and on the first signal (S1); the retrofit assembly (100) being configured to be installed in the boiler (1, 201, 301, 401) and to control the flow rate of the fuel gas by means of the third signal (S3).

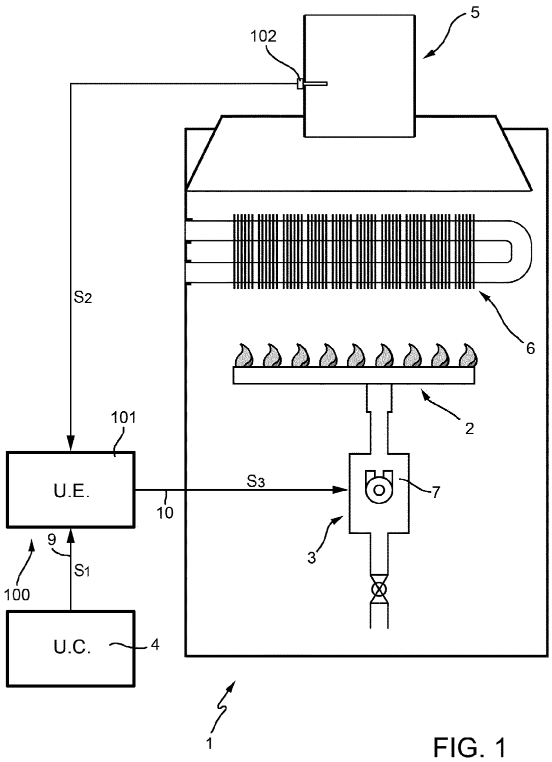

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a retrofit assembly for a fuel gas boiler and a method for modifying a fuel gas boiler installed in a heating plant.

[0002] In particular, the retrofit assembly adjusts the fuel gas flow rate in a fuel gas boiler.

BACKGROUND ART

[0003] As already known, the existing fuel gas boilers comprise a gas burner, a feeding assembly for feeding fuel gas to the burner, a control unit for controlling the feeding assembly and configured to regulate the combustion process according to the thermal power demand.

[0004] In most of the currently installed boilers, the combustion control unit is configured to operate according to a fixed Wobbe index, predefined in the planning phase. Consequently, the fuel gas boilers fed by methane tolerate small variations of the methane Wobbe index. As already known, the Wobbe index is the ratio between the maximum calorific value and the square root of the specific gravity of a fuel gas (density related to the one of the air), and is used to compare the calorific value of different fuel mixtures in a fuel gas boiler.

[0005] The European market is developing new regulations aiming to allow the supply of fuel gas from multiple sources. Unfortunately, not all of these sources are able to guarantee the same quality level of fuel gas, namely the same Wobbe index. In contrast, the variability of the Wobbe index can cause problems on the already installed fuel gas boilers. In fact, a significant variation in the Wobbe index determines a worsening of the yield, an increase of the polluting emissions, such as carbon monoxide, as well as problems in the ignition phase and noise.

DISCLOSURE OF INVENTION

[0006] The purpose of the present invention is to provide a retrofit assembly for a fuel gas boiler that mitigates at least one of the described drawbacks, in other words that reduces polluting emissions and/or increases the yield and/or reduces the problems in the ignition phase.

[0007] Therefore, the present invention provides a retrofit assembly for a fuel gas boiler; the fuel gas boiler comprising a fuel gas burner, a feeding assembly for supplying fuel gas to the burner, a control unit for controlling the feeding assembly; the retrofit assembly comprising a processing unit configured to acquire a first control signal of the feeding assembly configured to control the feeding assembly; a second signal correlated to the composition of the exhaust gas or fuel gas; the processing unit being configured to define a third control signal of the feeding assembly configured to control the feeding assembly and based on the second signal and on the first signal; the retrofit assembly being configured to be installed in the boiler and to control the fuel gas flow rate by means of the third signal.

[0008] Thanks to the present invention, the retrofit assembly increases the boiler yield and decreases the polluting emissions by acting on the feeding assembly to modify the supply of fuel gas according to the composition of the exhaust gas or the fuel gas, thus obtaining an optimum combustion and reducing fuel consumption and emissions.

[0009] According to a preferred embodiment, the processing unit is configured to define a theoretical value of the second signal according to the first signal; and to define the third signal according to the difference between the defined theoretical value of the second signal and the actual value of the second signal.

[0010] According to another preferred embodiment, the retrofit assembly comprises an oxygen sensor configured to detect the exhaust gases of the boiler and to define the second signal correlated to the composition of the exhaust gases.

[0011] Thanks to the present invention, the installed boiler is modified by inserting an oxygen sensor downstream of the fuel gas burner; in this way, the performance of the fuel gas boiler is improved by the use of the second signal, which is an index of the combustion quality. The processing unit thus modifies the type of control of the fuel gas boiler already installed in a heating plant from an open loop control to a closed loop control. In other words, the boiler will have a feedback control with respect to the combustion process.

[0012] According to another preferred embodiment, the boiler comprises a stack downstream of the burner and a first fitting element arranged between the burner and the stack; the retrofit assembly comprising a second fitting element comprising the oxygen sensor fixed thereto and configured to be installed between the burner and the stack to replace the first fitting element.

[0013] According to another preferred embodiment, the oxygen sensor is configured to be inserted in a hole of the stack. According to another preferred embodiment, the oxygen sensor comprises fastening means configured to be fixed to the outlet of the stack to hold firmly into position the oxygen sensor inside the stack.

[0014] According to another preferred embodiment, the feeding assembly of the boiler comprises a pneumatic valve; the retrofit assembly comprising a flow rate adjustment device configured to be installed downstream of the pneumatic valve to receive the third signal and to adjust a fuel gas flow rate according to the third signal.

[0015] According to another preferred embodiment, the feeding assembly of the boiler comprises a pneumatic valve; the retrofit assembly comprising a modulator valve configured to be installed instead of the pneumatic valve for receiving the third signal and for adjusting the flow rate according to the third signal.

[0016] According to another preferred embodiment, the feeding assembly of the boiler comprises a pneumatic valve; the retrofit assembly comprising a controllable pneumatic valve configured to be installed instead of the pneumatic valve for receiving the third signal and for adjusting the flow rate according to the third signal.

[0017] According to another preferred embodiment, the feeding assembly comprises a fan and the first signal is a value of the number of revolutions of the fan.

[0018] According to another preferred embodiment, the feeding assembly comprises a modulator valve; and the first signal and the third signal are current values of the modulator valve.

[0019] According to another preferred embodiment, the boiler comprises a watertight chamber housing the fuel gas burner and the feeding assembly for supplying fuel gas to the burner; the control unit being arranged outside the watertight chamber and being coupled with the feeding assembly through a watertight grommet configured to maintain the tightness of the watertight chamber; and wherein the retrofit assembly is preferably arranged outside the watertight chamber and is coupled with the feeding assembly through the watertight grommet.

[0020] Another object of the present invention is to provide a method for modifying a fuel gas boiler installed in a heating plant which is able to solve the aforesaid problems of currently installed boilers to increase the performance of the installed boiler.

[0021] The present invention therefore provides a method for modifying a fuel gas boiler installed in a heating plant; the boiler comprising a fuel gas burner, a feeding assembly for feeding fuel gas to the burner, a control unit for controlling the flow rate of fuel gas of the feeding assembly; the method comprising the following steps: intercepting a first control signal of the feeding assembly configured to control the feeding assembly; detecting a second signal correlated to the composition of the exhaust gas or fuel gas; supplying a third control signal of the feeding assembly configured to control the feeding assembly and defined according to the second signal and to the first signal; and controlling the feeding assembly by means of the third signal.

[0022] The present invention increases the performance of the installed boiler with respect to a combustion optimization without having to replace the boiler, thereby reducing intervention times and costs. Consequently, the thus modified boiler will have a higher yield and will release lower polluting emissions.

[0023] According to a preferred embodiment, the method comprises the step of defining a theoretical value of the second signal according to the first signal; and defining the third signal according to the difference between the defined theoretical value of the second signal and the actual value of the second signal.

[0024] According to another preferred embodiment, the method comprises the step of installing an oxygen sensor configured to define the signal correlated to the composition of the exhaust gas.

[0025] According to another preferred embodiment, the boiler comprises a stack downstream of the burner and a first fitting element between the burner and the stack; the method comprising the step of removing the first preinstalled fitting element and of installing a second fitting element comprising the oxygen sensor.

[0026] According to another preferred embodiment, the boiler comprises a stack downstream of the burner; the method comprising the step of drilling the stack and inserting the oxygen sensor in the hole.

[0027] According to another preferred embodiment, the boiler comprises a stack downstream of the burner; the method comprising the step of inserting the oxygen sensor inside the stack and rigidly coupling it with the outlet of the stack.

[0028] According to another preferred embodiment, the feeding assembly comprises a modulator valve, and the first signal is a modulation signal of the modulator valve of the feeding assembly; the method comprising the step of sending the third signal to the modulator valve.

[0029] According to another preferred embodiment, the boiler feeding assembly comprises a pneumatic valve; the method comprising the step of installing a flow rate adjustment device downstream of the pneumatic valve; and of providing the third signal to the flow rate adjustment device.

[0030] According to another preferred embodiment, the boiler feeding assembly comprises a pneumatic valve; the method comprising the step of replacing the pneumatic valve with a stepper valve and of supplying the third modified signal to the stepper valve.

[0031] According to another preferred embodiment, the boiler feeding assembly comprises a pneumatic valve; the method comprising the step of replacing the pneumatic valve with a modulator valve and of supplying the third signal to the modulator valve.

[0032] According to another preferred embodiment, the boiler feeding assembly comprises a pneumatic valve; the method comprising the step of replacing the pneumatic valve with a controllable pneumatic valve and of supplying the third signal to the controllable pneumatic valve.

[0033] According to another preferred embodiment, the feeding assembly comprises a fan, and the first signal is a signal correlated to the number of revolutions of the fan.

[0034] According to another preferred embodiment, the boiler comprises a watertight chamber housing the gas burner and the feeding assembly for supplying fuel gas to the burner; the control unit being arranged outside the watertight chamber and being coupled with the feeding assembly through a watertight grommet configured so as to maintain the tightness of the watertight chamber; the method comprising the step of opening the watertight chamber to intercept the first signal and of closing the watertight chamber and preferably using the grommet to transmit the third signal inside the watertight chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] Further characteristics and advantages of the present invention will become clear from the following description of its preferred embodiments, with reference to the figures of the accompanying drawings, wherein:

- Figure 1 is a schematic view, with parts removed for clarity's sake, of a fuel gas boiler with modified atmospheric combustion with a retrofit assembly according to a first embodiment of the present invention;
- Figure 2 is a schematic view, with parts removed for clarity's sake, of a modified watertight fuel gas boiler with atmospheric combustion with a retrofit assembly according to a second embodiment of the present invention;
- Figure 3 is a schematic view, with parts removed for clarity's sake, of a modified fuel gas boiler with atmospheric combustion with a retrofit assembly according to a third embodiment of the present invention;
- Figure 4 is a schematic view, with parts removed for clarity's sake, of a modified fuel gas boiler with premixed combustion with a retrofit assembly according to a fourth embodiment of the present invention;
- Figure 5 is a block diagram of a detail of Figure 4;
- Figure 6 is a block diagram of an alternative embodiment of Figure 5;
- Figure 7 is a block diagram of an alternative embodiment of Figure 5; and
- Figure 8 is a block diagram of an alternative embodiment of Figure 5.

BEST MODE FOR CARRYING OUT THE INVENTION

[0036] With reference to Figure 1, 1 indicates as a whole a fuel gas boiler installed in a heating plant. The boiler 1 comprises a fuel gas burner 2, a feeding assembly 3 for supplying the fuel gas to the burner 2, and a control unit 4 for controlling the fuel gas flow rate of the feeding assembly 3, a stack 5 to evacuate the exhaust gas of the burner 2 to the outside and a heat exchanger 6 for heating a fluid by means of the burner 2.

[0037] The boiler 1 is of the atmospheric combustion type, and the feeding assembly 3 comprises a modulator valve 7 which is configured to be controlled according to the values of the control signal S1, the control signal S1 preferably being a current or voltage signal of the fuel gas flow rate.

[0038] Again with reference to Figure 1, the number 100 indicates the retrofit assembly for the fuel gas boiler 1, which is installed in the boiler 1, in turn installed in a heating plant, to increase its performance. The retrofit assembly 100 comprises a processing unit 101 configured to acquire the signal S1 of the control unit 4; and an oxygen sensor 102 configured to be installed downstream of the burner 2 and to provide a signal S2 related to the composition of the exhaust gas.

[0039] The method for modifying the installed boiler 1 comprises the step of installing the processing unit 101 inside the boiler 1, and in particular of intercepting the control signal S1 of the feeding assembly 3; and of controlling the modulator valve 7 through a signal S3. In more detail, the method provides the step of disconnecting a cable 9 coupling the control unit 4 with the modulator valve 7 (connection of the original configuration of the installed boiler 1) to supply the signal S1 to the modulator valve 7 of the feeding assembly 3; of coupling said cable 9 with the processing unit 101 of the retrofit assembly 100; and of coupling an additional cable 10 between the processing unit 101 and the modulator valve 7 of the feeding assembly 3 to supply the signal S3 instead of the signal S1 to the modulator valve 7.

[0040] The processing unit 101 receives as an input the signal S1 and the signal S2, and outputs the signal S3 defined according to the signal S1 and the signal S2. The signal S3 is a control signal configured to control the flow rate of the fuel gas of the boiler 1. The processing unit 101 sets a theoretical value of the signal S2 according to the signal S1; and sets the signal S3 according to the difference between the theoretical value of the signal S2 and the actual value of the signal S2. By way of non-limiting example, the theoretical value of the signal S2 can be calculated through a look-up table that associates values of the signal S1 with theoretical values of the signal S2, or through one or more functions defining a theoretical value of the signal S2 starting from a signal value S1.

[0041] In an alternative embodiment of the present invention shown in Figure 2, the number 201 indicates a boiler having some components in common with the boiler 1 and indicated by the same reference numbers. In addition, the boiler 201 comprises a fan 11 arranged downstream of the burner 2 to evacuate the combustion exhaust gases.

[0042] The boiler 201 comprises a watertight chamber 20 (shown in Figure 2 with a double line) housing the fuel gas burner 2. The control unit 4 is arranged outside the watertight chamber 20 and is coupled with the oxygen sensor 102 through a watertight grommet 21 configured to maintain the tightness of the watertight chamber 20. In this case, the modification procedure includes some additional steps if compared with the procedure shown in Figure 1. The additional steps of the method are: opening the watertight chamber 20 to insert the oxygen sensor 102; passing the cable of the signal S2 within the grommet 21; and closing the watertight chamber 20.

[0043] The boiler 201 comprises a fitting element arranged between the burner 2 and the stack 5. The retrofit assembly 100 comprises a fitting element 103 comprising the oxygen sensor 102 secured thereto and having the same size of the fitting element. The method for the replacement of the fitting element includes the steps of removing the originally installed fitting element and installing the fitting element 103 comprising the oxygen sensor 102.

[0044] In an alternative embodiment of the present invention, the boiler 201 does not include the fitting element and the retrofit assembly 100 does not include the fitting element 103. The procedure for installing the oxygen sensor 102 involves the step of drilling the stack 5 and inserting the oxygen sensor 102 in the hole.

[0045] In another alternative embodiment of the present invention, the oxygen sensor 102 comprises fastening means configured to be fixed to the outlet of the stack 5 to hold firmly into position the oxygen sensor 102 inside the stack 5. In said embodiment, the procedure includes the step of inserting the oxygen sensor 102 inside the stack 5 and of rigidly coupling it with the outlet of the stack 5.

[0046] In an alternative embodiment with respect to the previous two embodiments, shown in Figure 3 and indicated with the reference number 301, the oxygen sensor is replaced by a mass flow rate sensor 302. The mass flow rate sensor 302 detects the mass flow rate (kg/s) of the fuel gas fed into the burner 2, and is arranged upstream of the burner 2. Accordingly, the signal S2 is correlated to the mass flow rate of the fuel gas at the inlet of the burner 2. In more detail, the mass flow rate sensor 302 is arranged between the modulator valve 7 and the burner 2.

[0047] Consequently, the method for modifying the gas boiler, already installed in a plant, comprises the step of inserting the mass flow rate sensor 302 between the modulator valve 7 and the burner 2, and coupling the mass flow rate sensor 302 with the processing unit 101. In an embodiment not shown in the attached figures, the boiler 301 has a watertight chamber like the boiler 201.

[0048] In an alternative embodiment of the present invention shown in Figure 4, the number 401 indicates a premixed boiler having some components in common with the boiler 201 and indicated by the same reference numbers.

[0049] The boiler 401 includes a feeding assembly 403 configured so that the oxygen and the fuel gas are mixed with a certain proportion prior to combustion. In this way, the combustion is optimally regulated with regard to the ratio between fuel gas and oxygen. This mixing is usually carried out through a venturi duct, where air enters on the one side and fuel gas enters on the other side, thus defining a precise proportion between the two fluids. The boiler 401 comprises a watertight chamber 420 housing the fuel gas burner 2 and the feeding assembly 403 for supplying fuel gas to the burner 2. The control unit 4 is arranged outside the watertight chamber 420 and is coupled with the feeding assembly 403 through a watertight grommet 421 configured to maintain the tightness of the watertight chamber 420. Moreover, the feeding assembly 403 is arranged inside a watertight chamber 420 and comprises a pneumatic valve 411 and a fan 412 arranged upstream of the burner 2 and downstream of the pneumatic valve 411. The fan 412 is controlled by the control unit 4 according to a signal S4 indicating the number of revolutions of the fan 412.

[0050] With reference to Figures 4 and 5, the feeding assembly 403 of the boiler 301 includes a pneumatic valve 411 (already installed in the boiler). The retrofit assembly 100 comprises a flow rate adjustment device 104 configured to be installed downstream of the pneumatic valve 411, to receive the signal S3 and to adjust a fuel gas flow rate according to the signal S3. In more detail, the method for modifying the boiler 401 in this case includes the following steps: opening the watertight chamber 420; inserting the oxygen sensor 102 downstream of the burner 2, in particular between the heat exchanger 6 and the outlet of the stack 5; inserting a flow rate adjustment device 104 into the feeding assembly 403 downstream of the pneumatic valve 411 along a conduit 425 connecting the pneumatic valve 411 to the burner 2; intercepting the signal S4 of the feeding assembly 403; connecting the signal S4 to the processing unit 101 and to the fan 412; connecting the oxygen sensor 102 to the processing unit 101 to supply the signal S2 to the processing unit 101; connecting the processing unit 101 to the flow rate adjustment device 104 to supply the signal S3 to the flow rate adjustment device 104 for controlling the fuel gas flow rate through the signal S3 and closing the watertight chamber 20. The signal S3 is a voltage or current signal.

[0051] In more detail, the signal S4 is simply taken without being replaced by other signals to the fan 412, in other words, the signal S4 is provided to both the fan 412 and the processing unit 102 of the retrofit assembly 100. The fan 412 is controlled by the signal S4 also after the modification of the boiler 401. In this case, the processing unit 101 receives as input the signal S4 and the signal S2 (supplied by the oxygen sensor 102) and outputs the signal S4 and the signal S3 processing the signal S4 and the signal S2. The signal S3 is a control signal for controlling the fuel gas flow rate of the boiler 301. The processing unit 102 defines a theoretical value of the signal S2 according to the signal S4; and defines the signal S3 according to the difference between the theoretical value of the signal S2 and the actual value of the signal S2. The theoretical value of the signal S2 can be calculated through a look-up table associating values of the signal S4 with theoretical values of the signal S2, or through one or more functions defining a theoretical value of the signal S2 starting from the value of the signal S4.

[0052] According to an alternative embodiment of the present invention shown in Figure 6, the retrofit assembly 100 comprises a stepper valve 105 instead of the flow rate adjustment device. The stepper valve 105 is configured to be installed instead of the pneumatic valve 411. The method for modifying the boiler 401 includes the step of replacing the pneumatic valve 411 with the stepper valve 105. The processing unit 101 is connected to the stepper valve 105 to supply the signal S3. The stepper valve 105 regulates the fuel gas flow rate according to the signal S3. The signal S3 is a digital signal, in particular a step pulse. The method for modifying the boiler 401 includes the steps of removing the pneumatic valve 411, installing the stepper valve 105 instead of the pneumatic valve 411 and supplying the signal S3 to the stepper valve 105. The stepper valve 105 is coupled with the processing unit 101 to receive the signal S3; and it regulates the fuel gas flow rate according to the signal S3.

[0053] According to an alternative embodiment of the present invention shown in Figure 7, the retrofit assembly 100 comprises a modulator valve 106 instead of the flow rate adjustment device. The modulator valve 106 is configured to be installed instead of the pneumatic valve 411. The method for modifying the boiler 401 includes the step of replacing the pneumatic valve 411 with the modulator valve 106. The processing unit 101 is connected to the modulator valve 106 to supply the signal S3. The modulator valve 106 regulates the fuel gas flow rate according to the signal S3. The signal S3 is preferably a current signal. The method for modifying the boiler 401 includes the steps of removing the pneumatic valve 411, installing the modulator valve 106 instead of the pneumatic valve 411 and supplying the signal S3 to the modulator valve 106. The modulator valve 106 is coupled with the processing unit 101 to receive the signal S3; and it regulates the fuel gas flow rate according to the signal S3.

[0054] According to an alternative embodiment of the present invention shown in Figure 8, the retrofit assembly 100 comprises a controllable pneumatic valve 108 configured to be installed instead of the pneumatic valve 411. The method for modifying the boiler 401 includes the steps of removing the pneumatic valve 411, installing the controllable pneumatic valve 108 instead of the pneumatic valve 411 and connecting the processing unit 101 to the controllable pneumatic valve 108 to supply the signal S3 to the pneumatic valve 108. The controllable pneumatic valve 108 regulates the fuel gas flow rate according to the signal S3. Finally, it is clear that the described retrofit assembly for a fuel gas boiler can be subject to modifications, variations and improvements without departing from the scope of the appended claims.

Claims

1. A retrofit assembly for a fuel gas boiler; the fuel gas boiler (1, 201, 301, 401) comprising a fuel gas burner (2), a feeding assembly (3, 403) for feeding fuel gas to the burner (2), a control unit (4) for controlling the feeding assembly (3, 403); the retrofit assembly (100) comprising a processing unit (101) configured to acquire a first control signal (S1; S4) of the feeding assembly (3, 403) configured to control the feeding assembly (3, 403); a second signal (S2) correlated to the exhaust gas or fuel gas composition; the processing unit (101) being configured to define a third control signal (S3) of the feeding assembly (3, 403) configured to control the feeding assembly (3, 403) and based on the second signal (S2) and on the first signal (S1); the retrofit assembly (100) being configured to be installed in the boiler (1, 201, 301, 401) and to control the flow rate of the fuel gas by means of the third signal (S3).

2. A retrofit assembly according to Claim 1, comprising an oxygen sensor (102) configured to detect the exhaust gases of the boiler and to define the second signal (S2) correlated to the composition of the exhaust gases.

3. A retrofit assembly according to claim 2, wherein the oxygen sensor (102) comprises fastening means configured to be fixed to the outlet of the stack (5) to hold the oxygen sensor (102) firmly into position within the stack (5).

4. A retrofit assembly according to Claim 1, wherein the retrofit assembly (100) comprises a mass flow rate sensor (302) configured to detect the fuel gas composition and to define the second signal (S2) correlated to the fuel gas composition; the mass flow rate sensor (302) being preferably arranged between the feeding assembly (3) and the burner (2).

5. A retrofit assembly according to any one of Claims 1 to 4, wherein the feeding assembly (403) of the boiler (1) comprises a pneumatic valve (411); the retrofit assembly (100) comprising a flow rate adjustment device (104) configured to be installed downstream of the pneumatic valve (411) to receive the third signal (S3) and to adjust a fuel gas flow rate according to the third signal (S3).

6. A retrofit assembly according to any one of Claims 1 to 3, wherein the feeding assembly (403) of the boiler (401) comprises a pneumatic valve; the retrofit assembly (100) comprising a stepper valve (105) configured to be installed instead of the pneumatic valve to receive the third signal (S3) and to adjust the flow rate according to the third signal (S3).

7. A retrofit assembly according to any one of Claims 1 to 3, wherein the feeding assembly (403) of the boiler (401) comprises a pneumatic valve; the retrofit assembly (100) comprising a modulator valve (106) configured to be installed instead of the pneumatic valve to receive the third signal (S3) and to adjust the flow rate according to the third signal (S3).

8. A retrofit assembly according to any one of Claims 1 to 3, wherein the feeding assembly (403) of the boiler (401) comprises a pneumatic valve; the retrofit assembly (100) comprising a controllable pneumatic valve (108) configured to be installed instead of the pneumatic valve to receive the third signal (S3) and to adjust the flow rate according to the third signal (S3).

9. A retrofit assembly according to any one of Claims 1 to 6, wherein the feeding assembly (403) comprises a fan (412); and wherein the first signal (S4) is an rpm value of the fan (12).

10. A retrofit assembly according to any one of Claims 1 to 3, wherein the feeding assembly (3) comprises a modulator valve (7); and wherein the first signal (S1) and the third signal (S3) are a current value of the modulator valve (7).

11. A method for modifying a fuel gas boiler installed in a heating plant; the boiler (1, 201, 301, 401) comprising a fuel gas burner (2), a feeding assembly (3; 403) for feeding fuel gas to the burner (2), a control unit (4) for controlling the flow rate of the fuel gas of the feeding assembly (3); the method comprising the steps of: intercepting a first control signal (S1; S4) of the feeding assembly (3; 403) configured to control the feeding assembly (3; 403); detecting a second signal (S2) correlated to the exhaust gas or fuel gas composition; supplying a third control signal (S3) to the feeding assembly (3; 403) configured to control the feeding assembly (3; 403) and defined according to the second signal (S2) and to the first signal (S1; S4); and controlling the feeding assembly (3; 403) by means of the third signal (S3).

12. A method according to Claim 11, comprising the step of installing an oxygen sensor (102) configured to define the signal correlated to the composition of the exhaust gases.

13. A method according to any one of Claims 11 to 12, wherein the boiler (1; 201, 301, 401) comprises a stack (5) downstream of the burner (2); the method comprising the step of inserting the oxygen sensor (102) within the stack (5) and of rigidly coupling it with the outlet of the stack (5).

14. A method according to Claim 11, wherein the method comprises the step of installing a mass flow rate sensor (302) configured to detect the fuel gas composition and to define the second signal (S2) correlated to the fuel gas composition; said method preferably comprising the step of arranging the mass flow rate sensor (302) between the feeding assembly (3) and the burner (2).

15. A method according to any one of Claims 11 to 14, wherein the feeding assembly (403) of the boiler (1) comprises a pneumatic valve (411); the method comprising the step of installing a flow rate adjustment device (104) downstream of the pneumatic valve (411); and of supplying the third signal (S3) to the flow rate adjustment device (104).

16. A method according to any one of Claims 11 to 14, wherein the feeding assembly (403) of the boiler (401) comprises a pneumatic valve; the method comprising the step of replacing the pneumatic valve (411) with a stepper valve (105) and of supplying the third signal (S3) to the stepper valve (105).

17. A method according to any one of Claims 11 to 14, wherein the feeding assembly (403) of the boiler (401) comprises a pneumatic valve; the method comprising the step of replacing the pneumatic valve with a modulator valve (106) and of supplying the third signal (S3) to the modulator valve (106).

18. A method according to any one of Claims 11 to 14, wherein the feeding assembly (403) of the boiler (401) comprises a pneumatic valve; the method comprising the step of replacing the pneumatic valve with a controllable pneumatic valve (108) and of supplying the third signal (S3) to the controllable pneumatic valve (108).

19. A method according to any one of Claims 11 to 14; wherein the feeding assembly (403) comprises a fan (412) and the first signal (S4) is the signal which controls the fan (12); the method comprising the step of intercepting the first signal (S4).

20. A method according to any one of the preceding Claims 11 to 14, wherein the feeding assembly (3) comprises a modulator valve (7) and the first signal (S1) is a modulation signal of the modulator valve (7) of the feeding assembly (3), the method comprising the step of sending the third signal (S3) to the modulator valve (7).

21. A method according to any one of the preceding Claims 11 to 20, wherein one or more of the preceding steps is carried out on the boiler (1; 201; 3021, 401), which has been previously installed in a heating plant and has been previously working, in order to improve its performance.

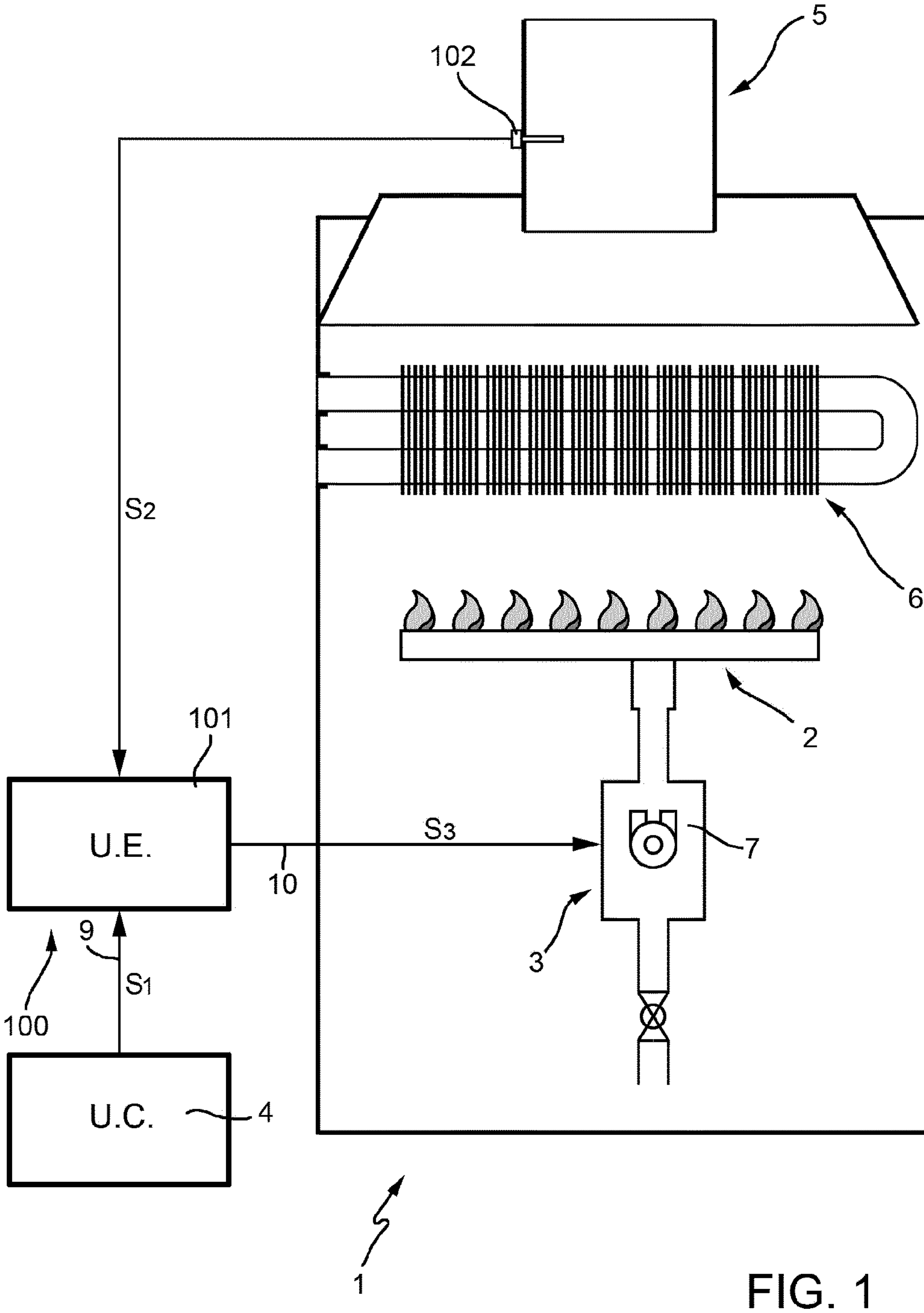

FIG. 1

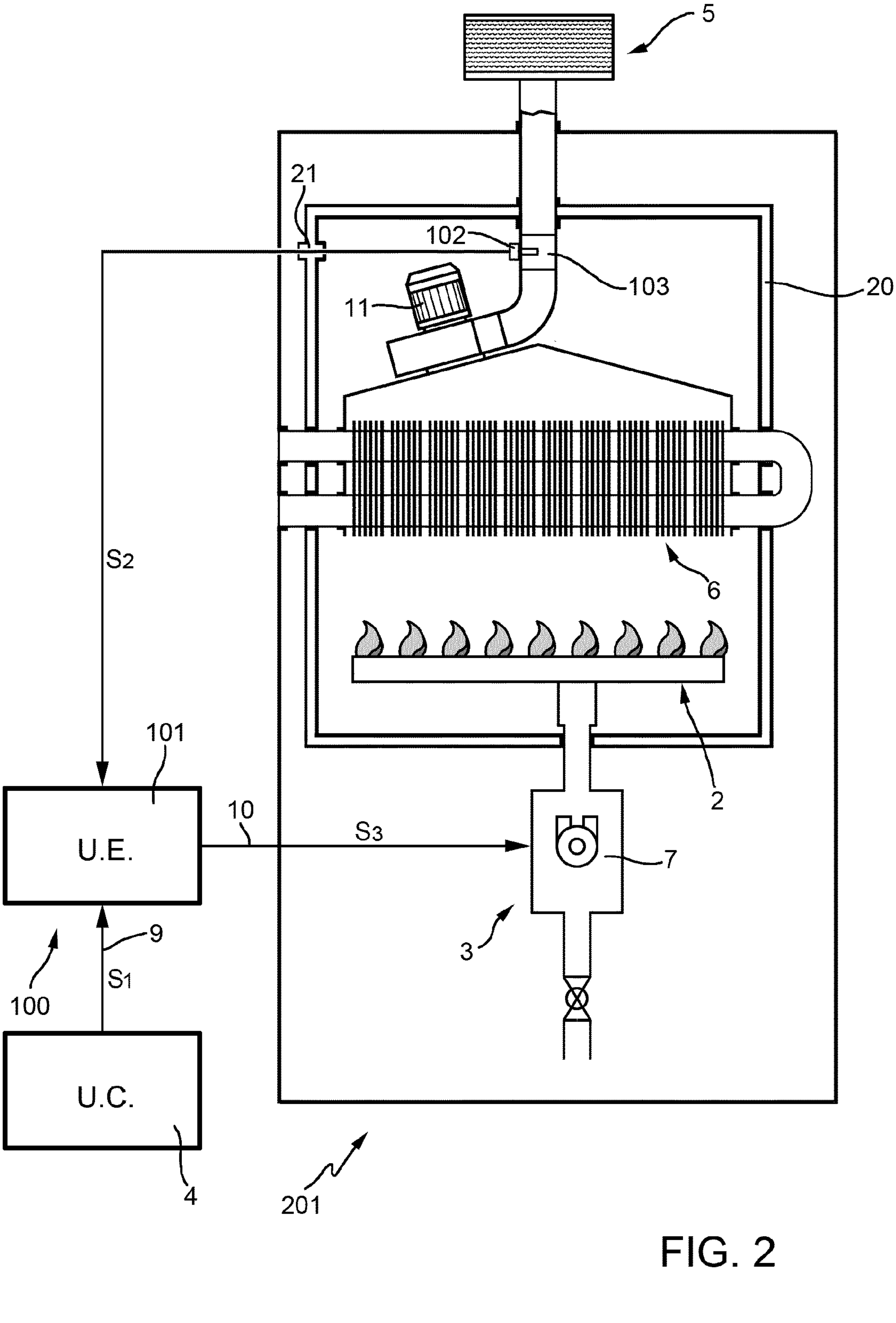

FIG. 2

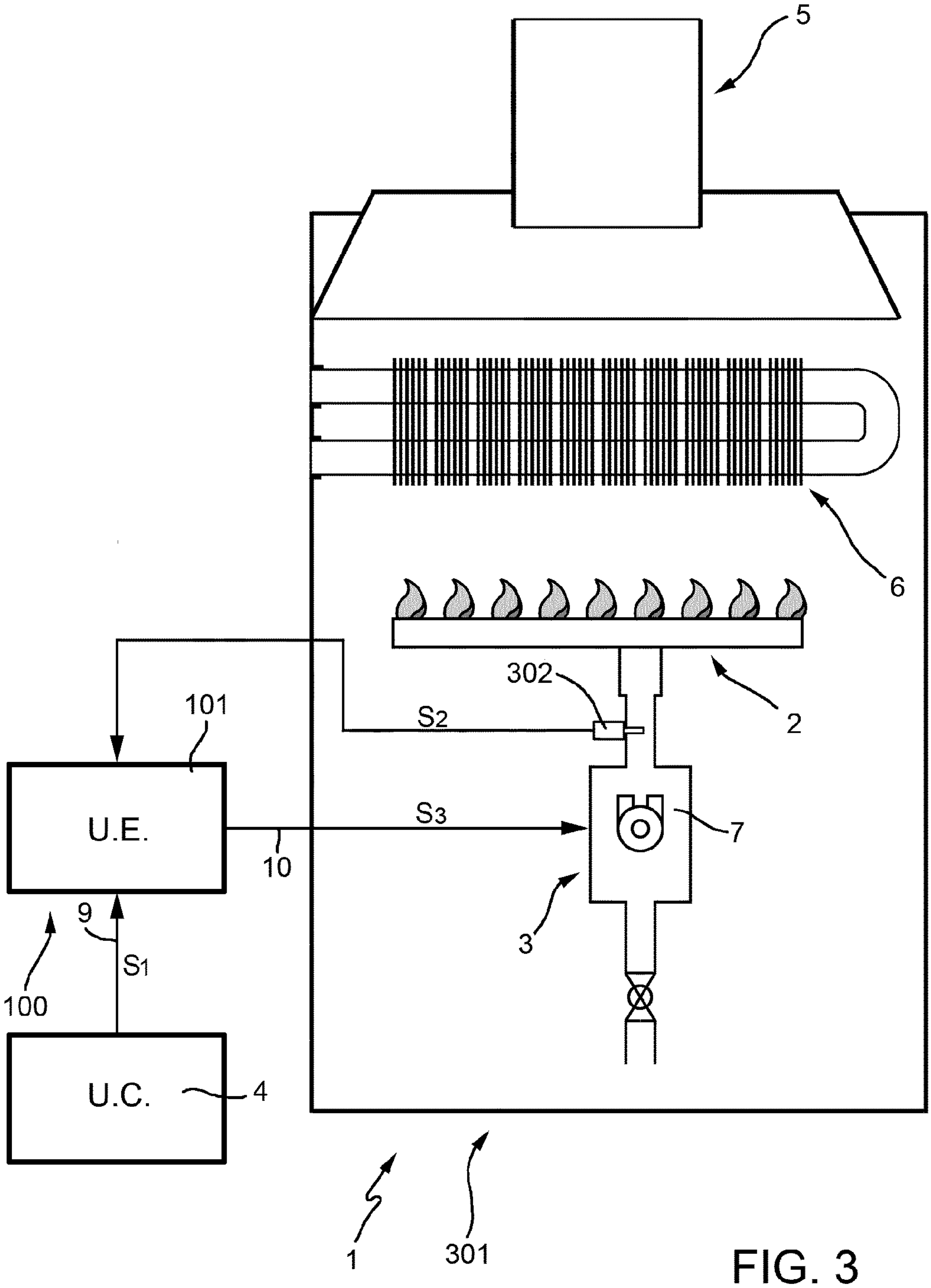

FIG. 3

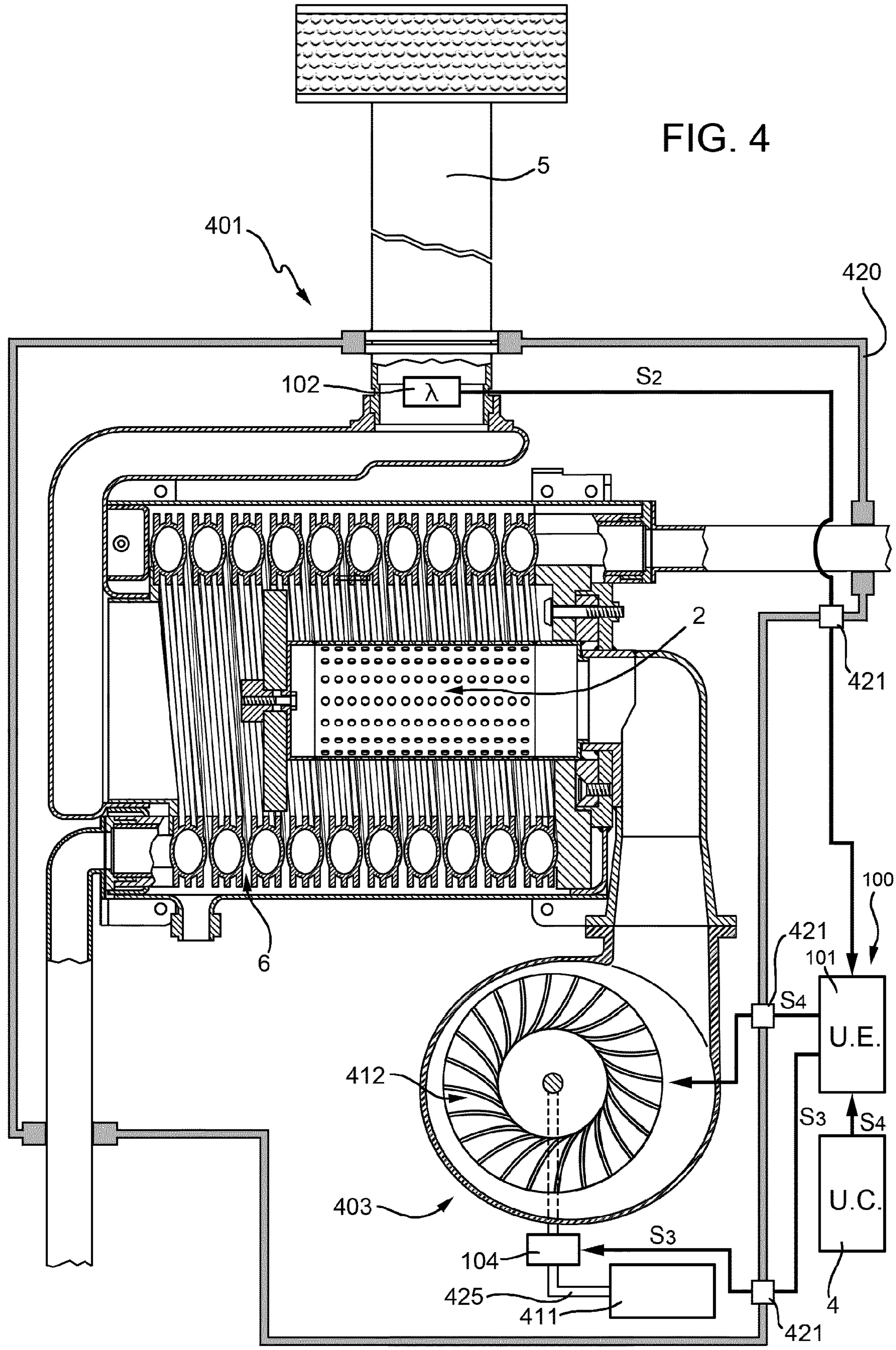
FIG. 4
5
401
420
102
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S2
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421
6
100
421
101
S4
U.E.
412
S3
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S3
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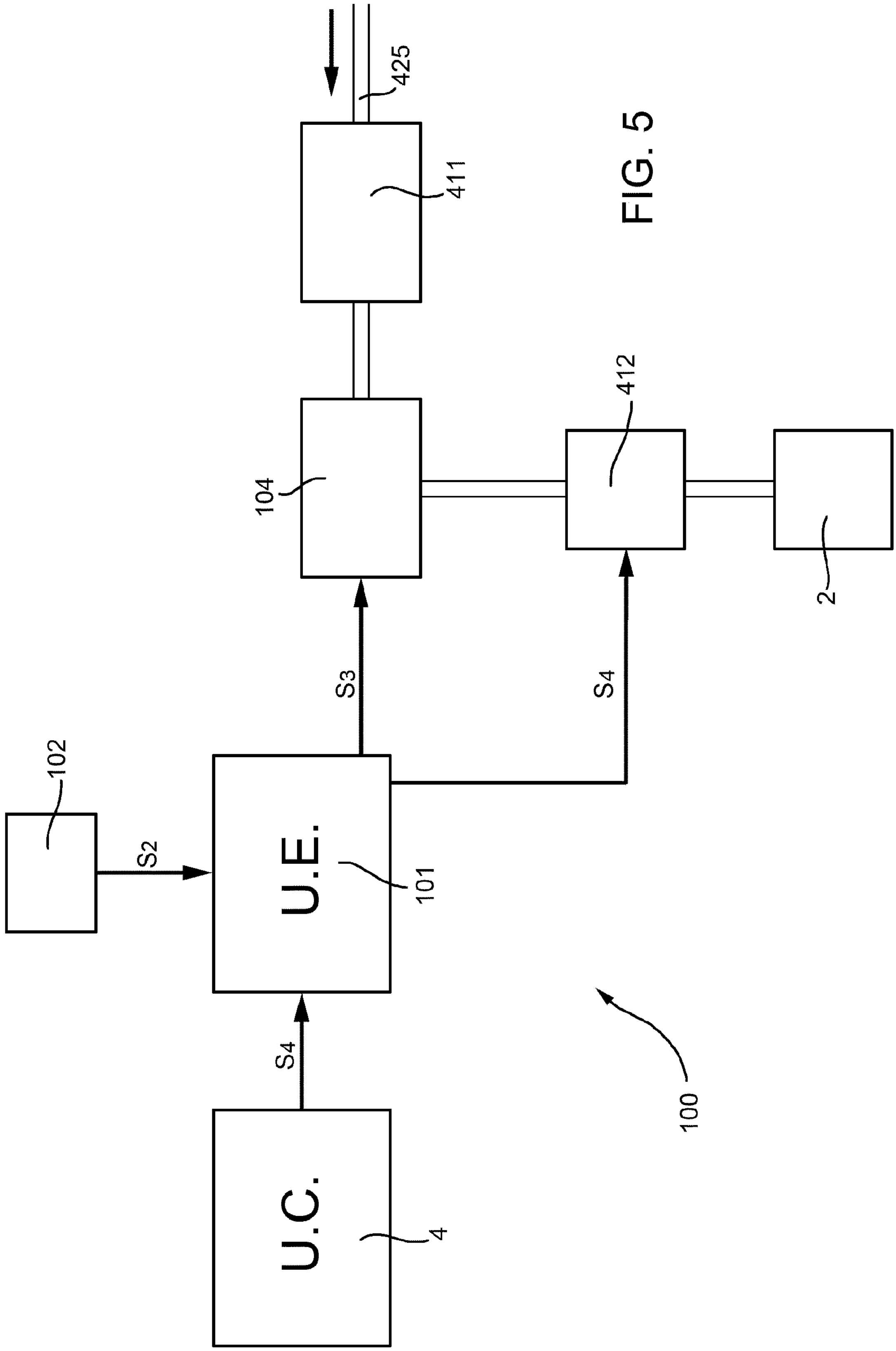

FIG. 5

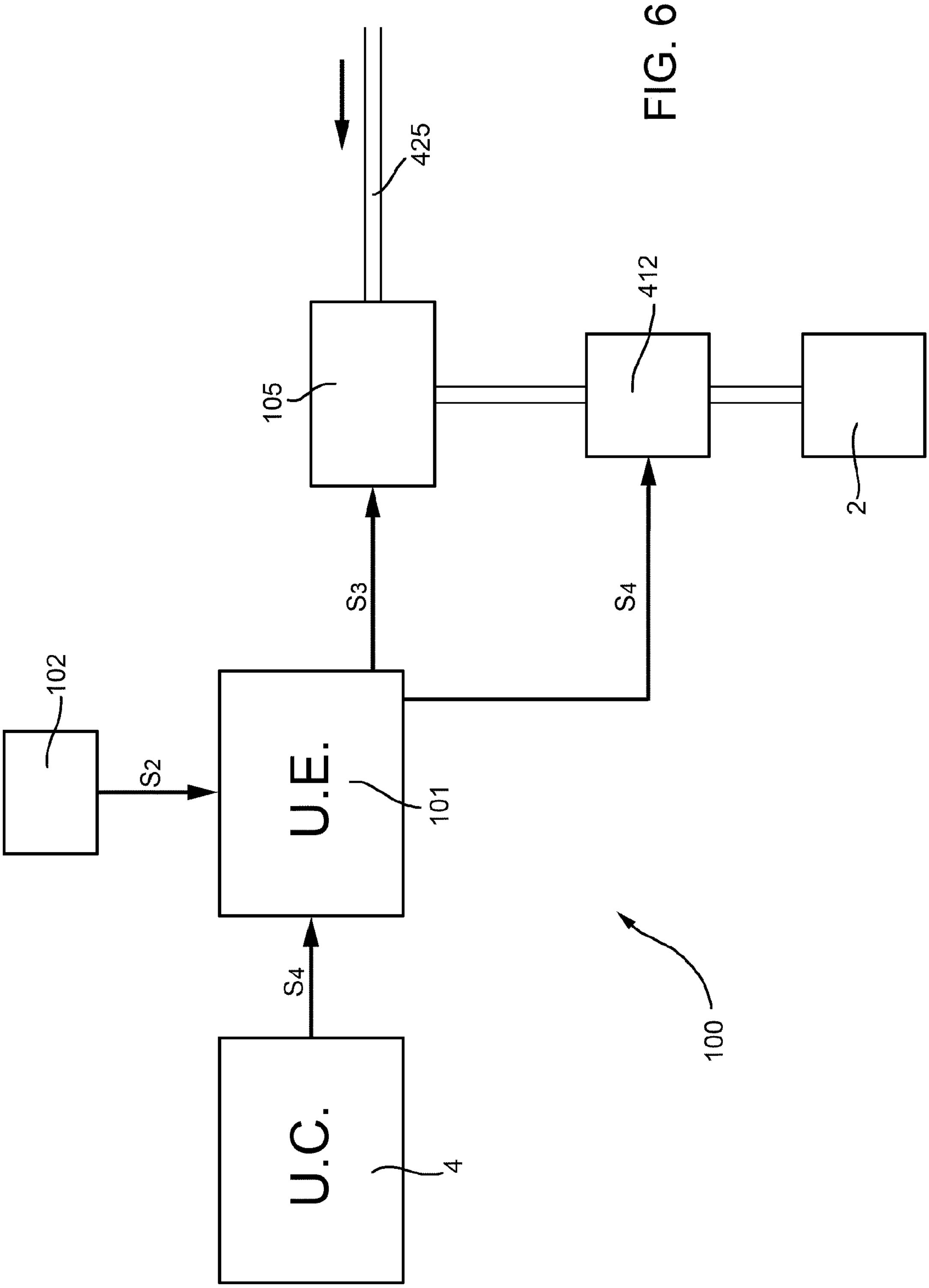

FIG. 6

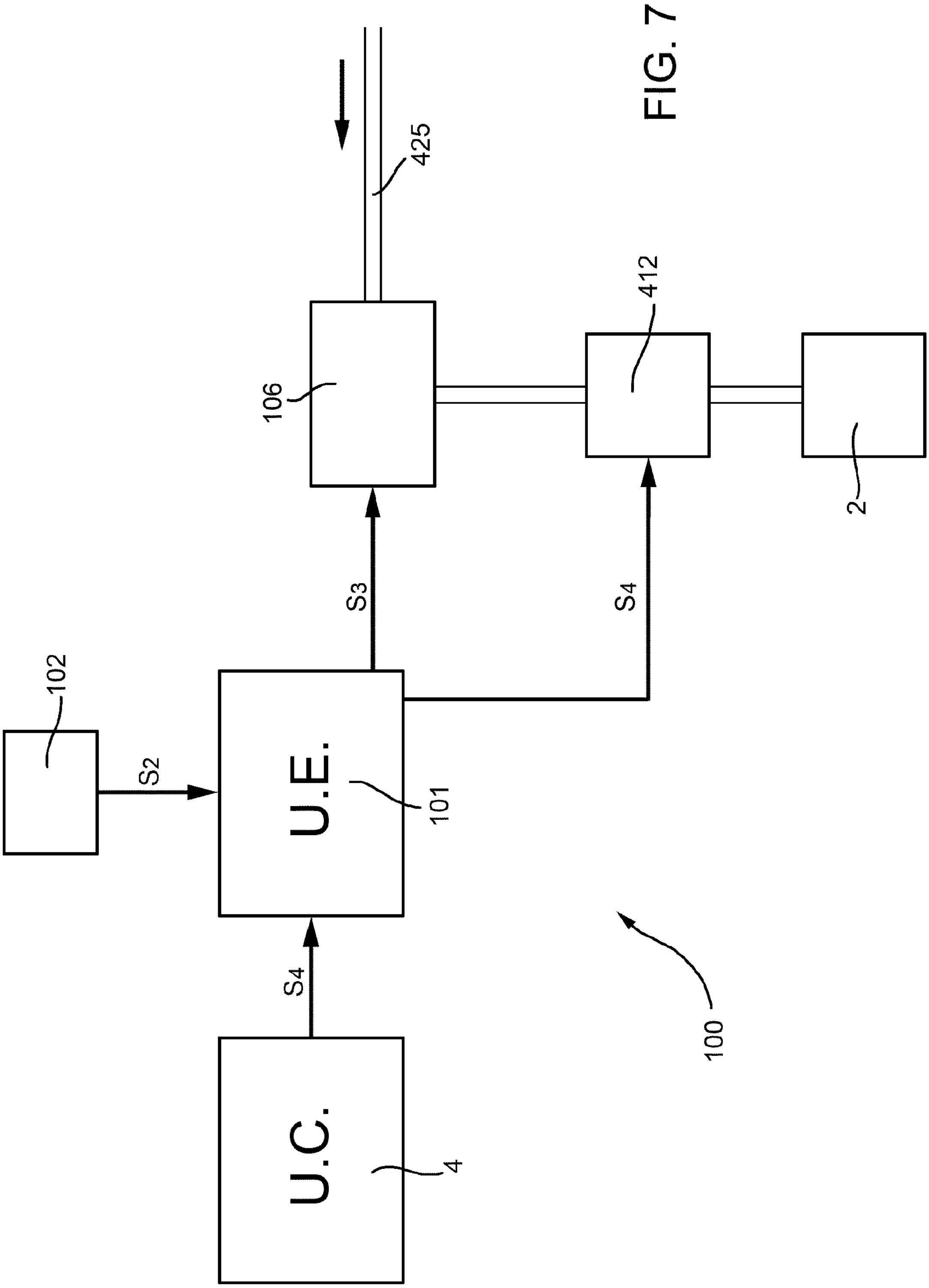

FIG. 7

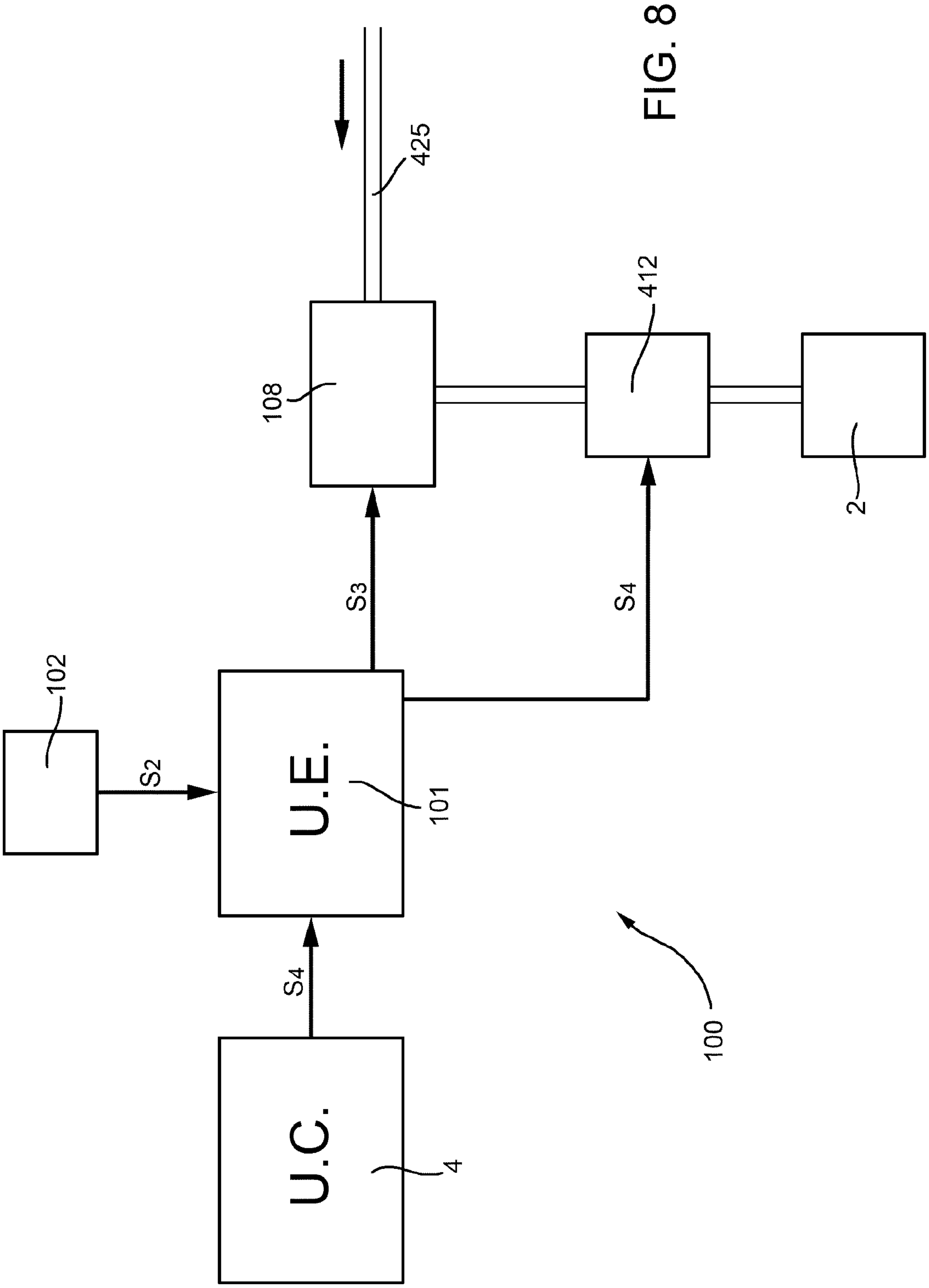

FIG. 8

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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