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(54) **METHOD AND CONTROLLER FOR OPERATING A GAS BURNER APPLIANCE**

(57) Method for operating a gas burner appliance (10) by providing during burner-on-phases of the gas burner appliance (10) a flow of a gas/air mixture having a defined mixing ratio of gas and air to a burner chamber (11) of the gas burner appliance (10) for combusting the defined gas/air mixture within the burner chamber (11). Said gas/air mixture is provided by a mixing device (23) of the gas burner appliance (10) mixing an air flow with a gas flow. The air flow and thereby the flow of the gas/air mixture is provided by a fan (14) of the gas burner appliance (10) in such a way that the fan speed of the fan (14) depends on a desired burner-load of the gas burner appliance (10). The fan speed range of the fan (14) defines a modulation range of the gas burner appliance (10) in such a way that a maximum fan speed of the fan (14) defines the maximum burner-load of the gas burner appliance (10). Said defined mixing ratio of gas and air of the gas/air mixture is controlled over the modulation range of the gas burner appliance (10) using a gas regulating valve (18) in order to keep the defined mixing ratio of gas and air constant over the modulation range of the gas burner appliance (10). The altitude of the location at which the gas burner appliance (10) is operated is determining automatically. The maximum fan speed of the fan (14) and thereby the maximum burner-load of the gas burner appliance (10) is adjusted automatically on basis of the determined altitude. (Figure 1)

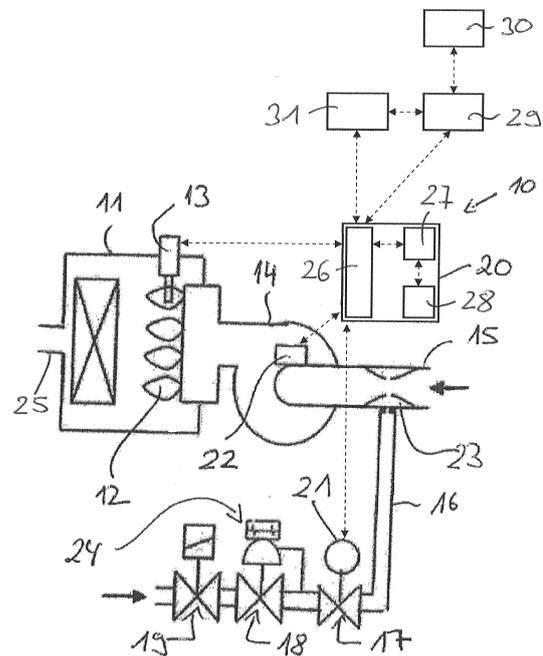


Fig. 1

Description

[0001] The present patent application relates to a method and to a controller for operating a gas burner appliance.

[0002] EP 2 667 097 A1 discloses a method for operating a gas burner appliance. During burner-on-phases of the gas burner appliance, a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber of the gas burner appliance for combusting the defined gas/air mixture. The defined gas/air mixture is provided by a mixing device mixing an air flow provided by an air duct with a gas flow provided by a gas duct. The mixing device may be provided by a Venturi nozzle. The air flow flowing through the air duct is provided by fan in such a way that the fan speed of the fan depends on a desired burner-load of the gas burner appliance, wherein a fan speed range of the fan defines a so-called modulation range of the gas burner appliance.

[0003] According to EP 2 667 097 A1, the defined mixing ratio of gas and air of the defined gas/air mixture is kept constant over the entire modulation range of the gas burner appliance by a pneumatic controller of a gas regulation valve being positioned with the gas duct. The pneumatic controller uses a pressure difference between the gas pressure of the gas flow in the gas duct and a reference pressure, wherein either the air pressure of the air flow in the air duct or the ambient pressure is used as reference pressure, and wherein the pressure difference between the gas pressure of the gas flow in the gas duct and the reference pressure is determined and controlled pneumatically. The combustion quality may be monitored on basis of a signal provided by a combustion quality sensor like a flame ionization sensor.

[0004] According to EP 2 667 097 A1, during burner-on-phases of the gas burner appliance, the mixing ratio of the gas/air mixture may be calibrated to different gas qualities on basis of the signal provided by the flame ionization sensor. The flame ionization sensor is used to calibrate the gas/air mixture to different gas qualities. The control of the mixing ratio of the gas/air mixture over the modulation range of the gas burner is independent from the flame ionization current.

[0005] It should be noted that calibration of such a pneumatic gas/air control is optional. There are also pneumatic controllers in place not making use of a calibration of the gas/air mixture to different gas qualities.

[0006] As mentioned above, EP 2 667 097 A1 discloses a method for operating a gas burner appliance in which the defined mixing ratio of the gas/air mixture is kept constant over the entire modulation range of the gas burner. This is done by the pneumatic controller of the gas regulation valve establishing a pneumatic control to keep the mixing ratio of gas and air within the gas/air mixture constant.

[0007] It is also possible to control the mixing ratio of gas and air within the gas/air mixture electrically or electronically. DE 198 24 521 A1 discloses a method to con-

trol the mixing ratio of gas and air within the gas/air mixture on basis of a signal provided by an electrical or electronic pressure sensor or flow meter. An actual value corresponding to a pressure ratio between a gas pressure in a gas duct and an air pressure in an air duct or corresponding to a pressure ratio between the gas pressure in the gas duct and the air pressure at the reference point is provided by the electrical or electronic sensor, wherein this actual value is compared with a nominal value. A control variable for a gas valve assigned to the gas duct is generated on basis of the control deviation between the actual value and nominal value, wherein the gas valve is adjusted on basis of this control variable to control the defined mixing ratio of gas and air in the gas/air mixture. A mentioned above, the amount of the air flow and thereby the amount of the flow of the gas/air mixture having the defined mixing ratio of gas and air provided to the burner chamber depends on the desired burner load. The desired burner-load corresponds to a desired heat demand. The desired burner-load defines the fan speed at which the fan is operated.

[0008] The fan speed range of the fan of the gas burner appliance defines the modulation range of the gas burner appliance. A maximum fan speed of the fan defines the maximum burner-load of the gas burner appliance. If a desired heat demand requires maximum burner load, then the fan is operated at maximum fan speed. If a desired heat demand requires burner-load being 50% of the maximum burner load, then the fan is operated at 50% of the maximum fan speed. If a desired heat demand requires burner-load being 20% of the maximum burner load, then the fan is operated at 20% of the maximum fan speed.

[0009] The maximum fan speed of the fan of a gas burner appliance is factory pre-set in a controller of the gas burner appliance. When such a gas burner appliance becomes installed in the field at a certain location or premises like a residential home, the maximum fan speed may be adjusted manually by the installer to the geodetic or geographic altitude of the premises to adjust the maximum fan speed to altitude dependent oxygen content of the air and to keep thereby the capacity of the gas burner appliance constant. If this is forgotten by the installer, the gas burner appliance may not reach the maximum capacity which leads to complaints from end users.

[0010] Against this background a novel method and controller for operating a gas burner are provided.

[0011] The method for operating a gas burner according to the invention is defined in the claim 1.

[0012] The method comprises the step of determining automatically the altitude of the location at which the gas burner appliance is operated.

[0013] The method further comprises the step of adjusting or adapting automatically the maximum fan speed of the fan and thereby the maximum burner-load of the gas burner appliance on basis of the determined altitude.

[0014] According to the present application, the maximum fan speed of the fan of a gas burner appliance

which is factory pre-set in the controller of the gas burner appliance becomes automatically adjusted or adapted to the altitude of the location at which the gas burner appliance is operated.

[0015] It is no longer necessary to adjust or adapted the maximum fan speed manually by the installer. The gas burner appliance can reach maximum capacity during operation.

[0016] Preferably, the altitude of the location at which the gas burner appliance is operated is automatically determined by the controller of gas burner appliance over the internet. The controller of the gas burner appliance may directly or indirectly communicate with an inter router to retrieve the altitude of the location over the internet. This allows an easy and secure automatic adjustment or adaptation of the maximum fan speed of the fan to the altitude of the location at which the gas burner appliance is operated.

[0017] Preferably, the maximum fan speed of the fan is automatically adjusted or adapted on basis of the determined altitude in such a way that the maximum fan speed increases with increasing altitude. The gas burner appliance can always reach the maximum capacity during operation regardless of the altitude of the location at which the gas burner appliance is operated.

[0018] Preferably, the maximum fan speed of the fan is factory pre-set in the controller of the gas burner appliance for an altitude of normal zero. The controller of the gas burner appliance determines automatically the altitude of the location of the premises at which the gas burner appliance is operated. The controller of the gas burner appliance automatically adjusts or adapts the maximum fan speed of the fan and thereby the maximum burner-load on basis of the determined altitude, namely in such a way that for a determined altitude being greater than normal zero the factory pre-set maximum fan speed is increased. This is most preferred for a secure adaption of operation of the gas burner appliance to a altitude being different from normal zero.

[0019] The present application further provides a controller of a gas burner appliance for operating a gas burner appliance. The controller of a gas burner appliance is configured to determine on basis of a heat demand a desired burner-load to provide the heat demand, wherein the desired burner-load is a load with a modulation range of the gas burner appliance. The controller of a gas burner appliance is further configured to determine on basis of the desired burner-load a fan speed of a fan of the gas burner appliance which is needed to provide the burner load, wherein a fan speed range of the fan defines the modulation range of the gas burner appliance in such a way that a maximum fan speed of the fan defines the maximum burner-load of the gas burner appliance. The controller of a gas burner appliance is further configured to determine automatically the altitude of the location at which the gas burner appliance is operated and to adjusted or adapt automatically on basis of the determined altitude the maximum fan speed of the fan and thereby

the maximum burner-load of the gas burner appliance.

[0020] Preferred developments of the invention are provided by the dependent claims and the description which follows. Exemplary embodiments are explained in more detail on the basis of the drawing, in which:

Figure 1 shows a schematic view of an exemplary gas burner appliance.

[0021] Figure 1 shows a schematic view of an exemplary gas burner appliance 10. The same comprises a gas burner chamber 11 in which combustion of a defined gas/air mixture having a defined mixing ratio of gas and air takes place during burner-on phases of the gas burner appliance 10.

[0022] The combustion of the gas/air mixture results into flames 12 and may be monitored by a combustion quality sensor, e.g. by a flame rod 13.

[0023] The defined gas/air mixture is provided to the burner chamber 11 of the gas burner appliance 10 by mixing an air flow with a gas flow. A fan 14 sucks in air flowing through an air duct 15 and gas flowing through a gas duct 16. A gas regulating valve 18 for adjusting the gas flow through the gas duct 16 and preferably a gas safety valve 19 are assigned to the gas duct 16. The defined gas/air mixture having the defined mixing ratio of gas and air is provided to the burner chamber 11 of the gas burner appliance 10. The defined gas/air mixture is provided by mixing the air flow provided by an air duct 15 with a gas flow provided by a gas duct 16. The air flow and the gas flow become preferably mixed by a mixing device 23.

[0024] The quantity of the air flow and thereby the quantity of the gas/air mixture flow is adjusted by the fan 14, namely by the speed of the fan 14. The fan speed can be adjusted by an actuator 22 of the fan 14 on basis of a desired burner-load. The fan speed of the fan 14 is controlled by a controller 20 of the gas burner appliance generating a control variable for the actuator 22 of the fan 14.

[0025] The defined mixing ratio of the defined gas/air mixture is controlled by the gas regulating valve 18. The shown exemplary gas burner appliance 10 the gas regulating valve 18 is controlled by a pneumatic controller 24.

[0026] The pneumatic controller 24 of the gas regulating valve 18 controls the opening/closing position of the gas valve 18. The position of the gas regulating valve 18 is adjusted by the pneumatic controller 24 on basis of a pressure difference between the gas pressure of the gas flow in the gas duct 16 and a reference pressure. The gas regulating valve 18 is controlled by the pneumatic controller 24 in such a way that at the outlet pressure of the gas valve 18 is equal to the reference pressure. In Figure 1, the ambient pressure serves as reference pressure. However, it is also possible to use the air pressure of the air flow in the air duct 15 as reference pressure.

[0027] The pressure difference between the gas pressure and the reference pressure is determined pneumat-

ically by pneumatic sensor of the pneumatic controller 24. The mixing ratio of the defined gas/air mixture is controlled by the pneumatic controller 24 in such a way that over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of the defined gas/air mixture is kept constant.

[0028] Alternatively, the constant mixing ratio of gas and air within the gas/air mixture may be controlled electrically or electronically on basis of a signal provided by an electrical or electronic pressure sensor or flow meter (not shown). In this case the electrical or electronic sensor may provide to the controller 20 an actual value corresponding to a pressure ratio between a gas pressure in a gas duct and an air pressure in an air duct or corresponding to a pressure ratio between the gas pressure in the gas duct and the air pressure at the reference point, wherein the controller 20 may compare said actual value with a nominal value. In this case, the controller may generate a control variable for the gas regulation valve 18 on basis of the control deviation between the actual value and the nominal value, wherein the gas regulation valve may be operated on basis of this control variable to keep over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of gas and air in the gas/air mixture constant.

[0029] A modulation of "1" means that the fan 14 is operated at maximum fan speed (100% of maximum fan speed) and thereby at a full-load of the gas burner appliance 10. A modulation of "2" means that the fan 14 is operated at 50% of the maximum fan speed and a modulation of "5" means that the fan 14 is operated at 20% of the maximum fan speed. By changing the fan speed of the fan 14, the burner-load of the gas burner appliance 10 can be adjusted. Over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of gas and air within the defined gas/air mixture is kept constant.

[0030] As described above, the mixing ratio of the defined gas/air mixture is controlled during burner-on phases so that over the entire modulation range of the gas burner appliance 10 the defined mixing ratio of the gas/air mixture is kept constant. During burner-on phases the defined mixing ratio of gas and air of the defined gas/air mixture may be calibrated. The calibration may be performed by adjusting a position of a throttle 17 within the gas duct 16. The throttle 17 may be an integral element of the gas regulation valve 18. The throttle position of the throttle 17 can be adjusted by an actuator 21 assigned to the throttle 17. The controller 20 may control the actuator 21 and thereby the throttle position of the throttle 17 during calibration. Calibration is optional and not mandatory for the present invention.

[0031] The gas burner appliance 10 is installed at a certain location or premises like a residential home. The maximum fan speed of the fan 14 of a gas burner appliance 10 is factory pre-set in the controller 20 of the gas burner appliance.

[0032] According to the present application, the geo-

detic or geographic altitude of the location at which the gas burner appliance 10 is operated is determined automatically. Further on, the maximum fan speed of the fan 14 and thereby the maximum burner-load of the gas burner appliance 10 is automatically adjusted or adapted on basis of the determined geodetic or geographic altitude. Preferably, the geodetic or geographic altitude of the location at which the gas burner appliance 10 is operated is automatically determined by the controller 20 of gas burner appliance 10 over the internet 30.

[0033] The geodetic or geographic altitude of the location at which the gas burner appliance 10 is operated may be determined automatically by the controller 20 of gas burner appliance 10 in such a way that the controller 20 communicates directly with an internet router 29 installed at the same location or premises as the gas burner appliance 10.

[0034] Alternatively, said geodetic or geographic altitude may be determined automatically by the controller 20 in such a way that the controller 20 communicates indirectly through another device like a room thermostat 31 with the internet router 29 installed at the same location or premises as the gas burner appliance 10.

[0035] The internet router 29 can retrieve the geodetic or geographic altitude of the location at which the same is installed in known manner from the internet 30.

[0036] The internet router 29 connects to the internet 30 through a so-called dial-in node of a telecommunication network. From said dial-in node the geodetic or geographic altitude may be retrieved.

[0037] It is also possible that the controller 20 of gas burner appliance 10 may have an own internet connectivity like a mobile phone. In this case the controller 20 as such may communicate with the internet 30 without needing an internet router 29. In this case the controller 20 can also retrieve the geodetic or geographic altitude of the location at which the same is installed in known manner from the internet 30 using a dial-in node of a mobile network.

[0038] It is also possible that the controller 20 may have GPS connectivity like a mobile phone. In this case the controller 20 as such may retrieve the geodetic or geographic altitude of the location at which the same is installed in known manner from the internet 30 using GPS data.

[0039] The maximum fan speed of the fan 14 is automatically adjusted on basis of the determined geodetic or geographic altitude in such a way that the maximum fan speed increases with increasing altitude. The maximum fan speed of the fan 14 may be adjusted by discrete steps depending from the determined geodetic or geographic altitude. Alternatively, the maximum fan speed of the fan 14 may be adjusted by a steady function depending from the determined geodetic or geographic altitude.

[0040] Preferably, the maximum fan speed of the fan 14 of the gas burner appliance 10 is factory pre-set in the controller 20 for an geodetic or geographic altitude

of normal zero. Said factory pre-set maximum fan speed of the fan 14 is stored in a data memory 28 of the controller 20.

[0041] The controller 20 determines automatically the geodetic or geographic altitude of the location or premises at which the gas burner appliance 10 is operated. The controller 20 comprises a data interface 26, especially with direct or indirect communication with the internet router 29.

[0042] The controller 20 automatically adjusts the maximum fan speed of the fan 14 and thereby the maximum burner-load for the gas burner appliance 10 on basis of the determined geodetic or geographic altitude, namely in such a way that for a determined geodetic or geographic altitude being greater than normal zero the factory pre-set maximum fan speed is increased. This increase of the maximum fan speed of the fan 14 can be done by discrete steps or by a steady function depending from the determined geodetic or geographic altitude.

[0043] The method according to the present invention may be automatically executed by the controller 20 of the gas burner appliance 10 after installation of the gas burner appliance 10 and/or after a reset of the gas burner appliance 10 and/or after a service interval of the gas burner appliance 10.

List of reference signs

[0044]

10	gas burner appliance	
11	gas burner chamber	
12	flame	
13	flame rod	
14	fan	35
15	air duct	
16	gas duct	
17	throttle	
18	gas valve / regulating valve	
19	gas valve / safety valve	40
20	controller	
21	actuator	
22	actuator	
23	mixing device	
24	pneumatic controller	45
25	exhaust gas chimney	
26	data interface	
27	data processor	
28	data memory	
29	internet router	50
30	internet	
31	room thermostat	

Claims

1. Method for operating a gas burner appliance (10), by

providing during burner-on-phases of the gas burner appliance (10) a flow of a gas/air mixture having a defined mixing ratio of gas and air to a burner chamber (11) of the gas burner appliance (10) for combusting the defined gas/air mixture within the burner chamber (11),

wherein said gas/air mixture is provided by a mixing device (23) of the gas burner appliance (10) mixing an air flow with a gas flow,

wherein the air flow or the flow of the gas/air mixture is provided by a fan (14) of the gas burner appliance (10) in such a way that the fan speed of the fan (14) depends on a desired burner-load of the gas burner appliance (10),

wherein the fan speed range of the fan (14) defines a modulation range of the gas burner appliance (10) in such a way that a maximum fan speed of the fan (14) defines the maximum burner-load of the gas burner appliance (10);

wherein said defined mixing ratio of gas and air of the gas/air mixture is controlled over the modulation range of the gas burner appliance (10) using a gas regulating valve (18) in order to keep the defined mixing ratio of gas and air constant over the modulation range of the gas burner appliance (10),

characterized by

determining automatically the altitude of the location at which the gas burner appliance (10) is operated,

adjusting automatically the maximum fan speed of the fan (14) and thereby the maximum burner-load of the gas burner appliance (10) on basis of the determined altitude.

2. Method as claimed in claim 1, **characterized in that** the altitude of the location at which the gas burner appliance (10) is operated is automatically determined by a controller (20) of gas burner appliance (10) over the internet (30).

3. Method as claimed in claim 2, **characterized in that** the altitude of the location is automatically determined by the controller (20) in such a way that the controller (20) communicates with an internet router (29) installed at the same location as the gas burner appliance (10).

4. Method as claimed in claim 2, **characterized in that** the altitude of the location is operated is automatically determined by the controller (20) in such a way that the controller (20) communicates through another device like a room thermostat (31) with an in-

ternet router (29) installed at the same location as the gas burner appliance (10).

5. Method as claimed in one of claims 1 to 4, **characterized in that** the maximum fan speed of the fan (14) is automatically adjusted on basis of the determined altitude in such a way that the maximum fan speed of the fan (14) increases with increasing altitude.

6. Method as claimed in one of claims 1 to 5, **characterized in that**

the maximum fan speed of the fan (14) is factory pre-set in a controller (20) of gas burner appliance (10) for an altitude of normal zero, the controller (20) determines automatically the altitude of the location of the location at which the gas burner appliance is operated, the controller (20) automatically adjust the maximum fan speed of the fan (14) and thereby the maximum burner-load on basis of the determined altitude, namely in such a way that for a determined altitude being greater than normal zero the factory pre-set maximum fan speed is increased.

7. Method as claimed in one of claims 1-6, **characterized in that** the maximum fan speed of the fan (14) is adjusted by discrete steps depending from the determined altitude.

8. Method as claimed in one of claims 1-6, **characterized in that** the maximum fan speed of the fan (14) is adjusted by a steady function depending from the determined altitude.

9. Controller (20) of a gas burner appliance (10) for operating the gas burner appliance (10), the controller (20) being configured to

determine on basis of a heat demand a desired burner-load to provide the heat demand, wherein the desired burner-load is a load with a modulation range of the gas burner appliance (10),

determine on basis of the desired burner-load a fan speed of a fan (14) of the gas burner appliance (10) which is needed to provide the burner load,

wherein a fan speed range of the fan (14) defines the modulation range of the gas burner appliance (10) in such a way that a maximum fan speed of the fan (14) defines the maximum burner-load of the gas burner appliance (10),

characterized in that the controller (20) is further configured to determine the altitude of the location at which

the gas burner appliance (10) is operated, adjusted on basis of the determined altitude the maximum fan speed of the fan (14) and thereby the maximum burner-load of the gas burner appliance (10).

10. Controller of claim 9, **characterized in that** the same is configured to determine the altitude of the location at which the gas burner appliance (10) is operated over the internet (30).

11. Controller of claim 9 or 10, **characterized in that** the same has

a data memory (28) in which a factory pre-set maximum fan speed of the fan (14) for an altitude of normal zero is stored, a data interface (26) for communicating directly or indirectly with an internet router (29) in order to determine the altitude of the location at which the gas burner appliance (10) is operated, a data processor (27) for adjusting the maximum fan speed of the fan (14) on basis of the determined altitude, namely in such a way that for a determined altitude being greater than normal zero the factory pre-set maximum fan speed is increased.

12. Controller of one of claims 9 to 11, **characterized in that** the same configured to execute the method of one of claims 1 to 8.

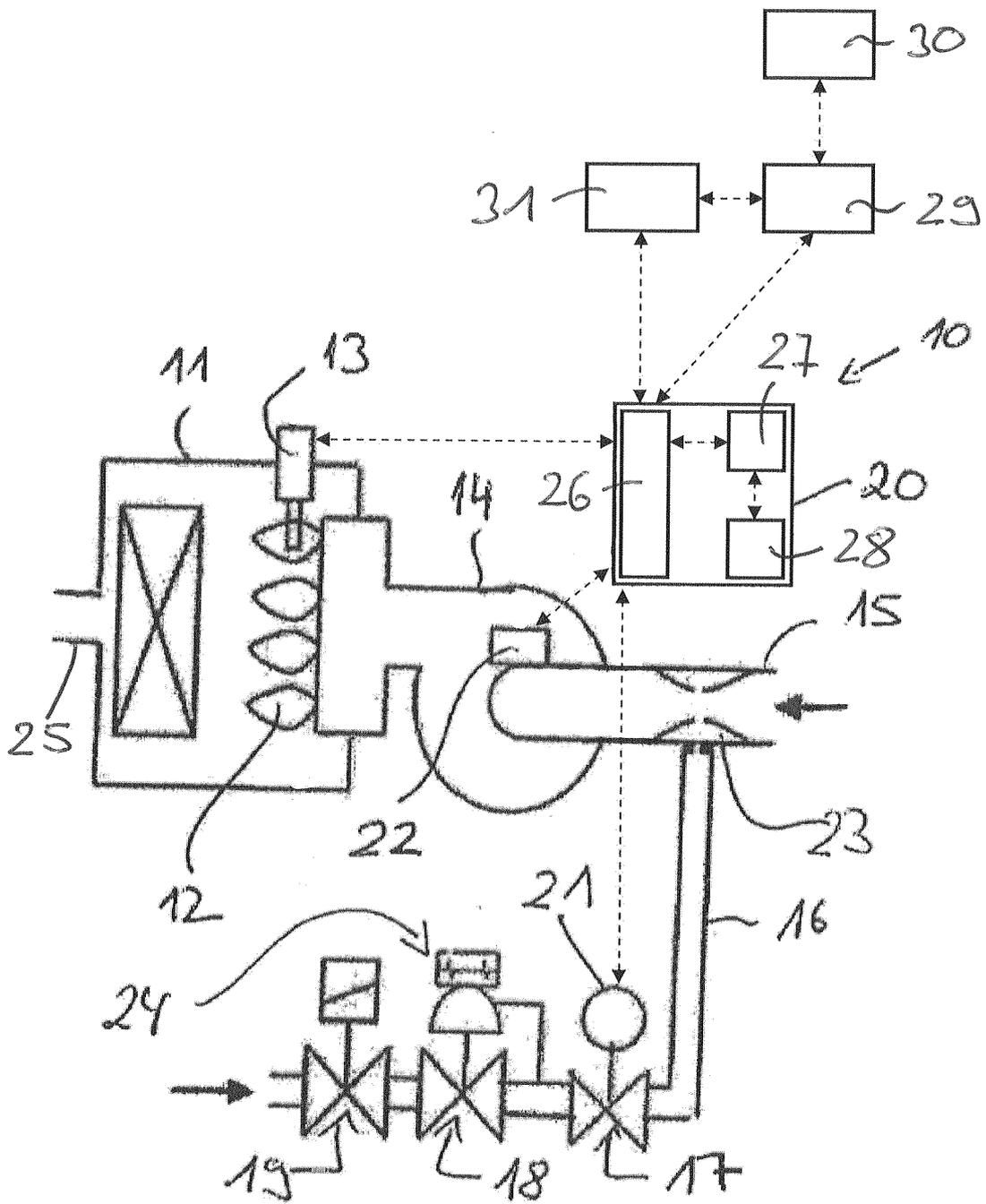


Fig. 1



EUROPEAN SEARCH REPORT

Application Number
EP 19 15 8042

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The present search report has been drawn up for all claims			
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 15 8042

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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