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

(11) **EP 2 631 541 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.08.2013 Bulletin 2013/35

(51) Int Cl.:
F23N 5/08 *(2006.01)* ***F23N 5/18*** *(2006.01)*
F23N 5/20 *(2006.01)* ***F23N 1/02*** *(2006.01)*
F23N 3/00 *(2006.01)*

(21) Application number: **12157091.5**

(22) Date of filing: **27.02.2012**

(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

(71) Applicant: **Honeywell Technologies Sarl**
1180 Rolle (CH)

(72) Inventor: **Langius, Gerwin**
7772 ZB Hardenberg, OV (NL)

(74) Representative: **Sturm, Christoph**
Quermann Sturm Weilnau
Patentanwälte
Unter den Eichen 7
65195 Wiesbaden (DE)

(54) **Method for operating a gas burner**

(57) Method for operating a gas burner (10), wherein during burner-on phases a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber (11) of the gas burner (10) for combusting the defined gas/air mixture within the burner chamber (11). The defined gas/air mixture is provided by a mixing device (23) mixing an air flow provided by an air duct (15) with a gas flow provided by a gas duct (16). The defined mixing ratio of gas and air of the defined gas/air mixture is calibrated to different gas qualities on basis of a signal provided by a sensor (13) positioned downstream of the mixing device (23). Before the calibration of the defined gas/air mixture is started the gas/air mixture is changed and a dead time between the change of the gas/air mixture and a corresponding signal change of a sensor (13, 24) positioned downstream of the mixing device (23) is determined. The dead time is compared with a reference value, whereby the defined gas/air mixture is calibrated to different gas qualities only if the determined dead time is equal or smaller than the reference value.

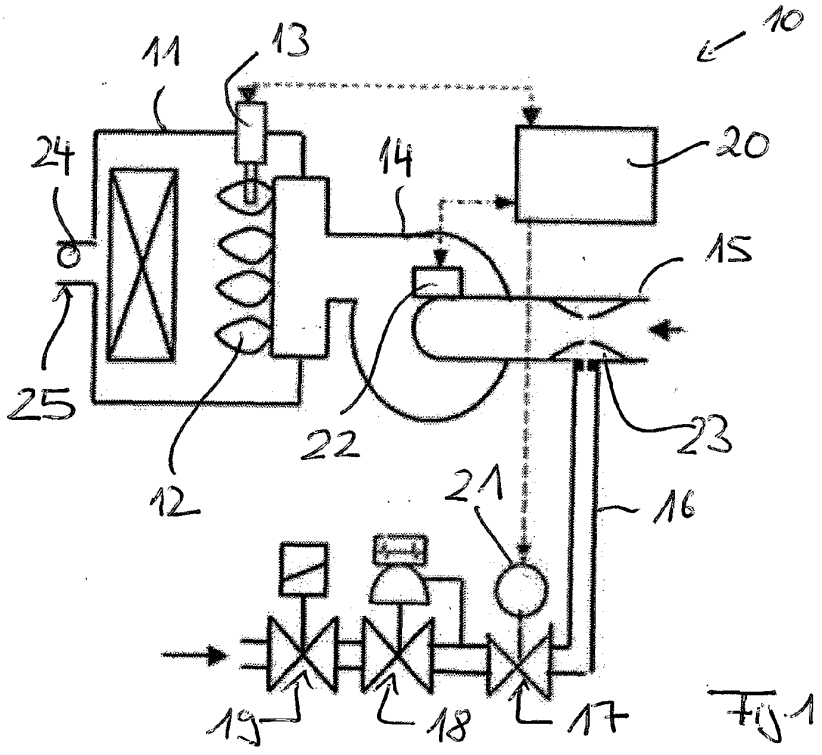


Fig. 1

EP 2 631 541 A1

Description

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

[0002] EP 0 833 106 B1 discloses a method for operating a gas burner. According to this prior art document, during burner-on phases of the gas burner a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber of the gas burner. The defined gas/air mixture is provided by mixing an air flow provided by an air duct with a gas flow provided by a gas duct. The quantity of the air flow is adjusted by a fan. The defined mixing ratio of the gas/air mixture is controlled by a controller.

[0003] It is further known from EP 0 833 106 B1 that the defined gas/air mixture has to be calibarted to the quality of the gas in order to ensure an optimum and complete combustion of the gas. The quality of the gas is defined by the so-called "Wobbe-Index". EP 0 833 106 B1 disclosed a method to calibrate the defined gas/air mixture to different gas qualities depending on a signal provided by an ionization sensor.

[0004] EP 0 962 703 B1 discloses that the calibration of the defined gas/air mixture to different gas qualities on basis of a signal provided by an ionization sensor shall only be performed in a range close to full-load operation of the gas burner, whereby the range close to full full-load operation lies between 60% and 100% of full full-load operation of the gas burner.

[0005] EP 1 309 821 B1 discloses that the calibration of the defined gas/air mixture to different gas qualities on basis of a signal provided by an ionization sensor shall be only performed at selected times, namely immediately after installation of the sensor and/or immediately after restart of the gas burner and/or immediately after a reset.

[0006] DE 10 2010 026 389 A1 discloses a method to control a so-called "λ-value" of the defined gas/air mixture on basis of a dead time between a change of the gas/air mixture and a signal change of sensor positioned downstream of a mixing device used to mix the air flow with the gas flow. DE 10 2010 026 389 A1 relates to a method to control the air flow and/or the gas flow depending on said dead time.

[0007] Against this background, novel methods for operating a gas burner are provided.

[0008] A method for operating a gas burner according to a first aspect of the present application is defined in the claim 1. Before the calibration of the defined gas/air mixture is started, the gas/air mixture is changed and a dead time between the change of the gas/air mixture and a corresponding signal change of a sensor positioned downstream of the mixing device is determined. The dead time is compared with a reference value, whereby the defined gas/air mixture is calibrated to different gas qualities only if the determined dead time is equal or smaller than the reference value.

[0009] The method according to the first aspect of the present application is directed to the calibration of the defined gas/air mixture to different gas qualities. The calibration is only performed if the dead time is equal or smaller than the reference value. The dead time is an indication of the burner load. The dead time and thereby the indication of the burner load can be determined using sensors being present in the gas burner application. No additional sensors are required. The method is easy, reliable and cost effective.

[0010] According to a preferred embodiment of the invention, only the decision if the calibration of the defined gas/air mixture is performed or if the calibration of the gas/air mixture is not performed depends on the determined dead time. The calibration of the gas/air mixture as such is independent from the determined dead time.

[0011] Another method for operating a gas burner is defined in the claim 7. The gas/air mixture is changed and a dead time between the change gas/air mixture and a corresponding signal change of sensor positioned downstream of the mixing device is determined. The dead time is compared with a reference value depending on the speed of a fan adjusting the quantity of the air flow, whereby a blocked flue is determined when the dead time is equal or larger than the reference value.

[0012] The method according to the second aspect of the present application is directed to the diction of a blocked flue. No additional sensors are required. The method is easy, reliable and cost effective.

[0013] Preferably, both methods are used in combination with each other.

[0014] The present application further relates to a controller of a gas burner having means for performing the method according to the first aspect of the present application and/or means for performing the method according to the second aspect of the present application.

[0015] 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 a gas burner; and
Figure 2 shows diagram used in connection with one aspect of the present invention.

[0016] Figure 1 shows a schematic view of a gas burner 10. The gas burner comprises a 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 10. The combustion of the gas/air mixture results into flames 12 monitored by e.g. an ionization sensor 13.

[0017] The defined gas/air mixture is provided to the burner chamber 11 of the gas burner 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 though a gas duct 16. A gas valve 17 for adjusting the gas flow through the gas duct 16 and safety valves 18, 19 are assigned to the gas duct 16.

[0018] 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 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. Such a mixing device can be designed as a so-called Venturi nozzle.

[0019] 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.

[0020] The defined mixing ratio of the defined gas/air mixture is controlled by a controller 20. The controller 20 generates a control variable for the gas valve 17, namely for an actuator 21 of the gas valve 17. The gas valve position of the gas valve 17 is adjusted by the actuator 21 of the same on basis of this control variable in order to provide the defined mixing ratio of gas and air in the defined gas/air mixture.

[0021] As mentioned above, the defined mixing ratio of the defined gas/air mixture is controlled by a controller 20. The control of the defined mixing ratio of the gas/air mixture is preferably based on a signal provided by the ionization sensor 13. The controller 20 compares an actual value of the signal provided by the ionization sensor 13 with a corresponding nominal value, whereby a control deviation between said actual value and said nominal value is used by the controller to determine a control variable for the actuator 21 of the gas valve 17 in such a way that the actual value follows the nominal value. In this way the defined mixing ratio of the defined gas/air mixture is kept constant. This control of the gas flow by the control variable for the actuator 21 of the gas valve 17 is also often called modulation of gas flow.

[0022] As also mentioned above, the quantity of the air flow and thereby the quantity of the gas/air mixture flow is adjusted by the fan 14, whereby the controller 20 provides a control variable for the actuator 22 of the fan 14 for adjusting the quantity of air flow and thereby the quantity of gas/air mixture flow. By changing the speed of the fan 14 the load of the gas burner 10 can be adjusted. Over the entire load range of the gas burner 10 the defined mixing ratio of the defined gas/air mixture is kept constant. This control of the fan speed of the fan 14 is also often called modulation of air flow or modulation of the burner load.

[0023] Exhaust gas resulting form the combustion of the defined gas/air mixture within the burner chamber 11 during burner-on phases of the gas burner 10 is leaving the burner chamber 11 through an exhaust flue 25 of the burner chamber 11 of the gas burner 10. An exhaust gas temperature sensor 24 may be assigned to the exhaust flue 25.

[0024] As described above, the controller 20 comprises means for controlling the defined mixing ratio of the defined gas/air mixture by modulating the gas flow and means for controlling the burner load by modulating the speed of the fan 14. Further on, the controller 20 comprises means for calibrating the defined mixing ratio of the defined gas/air mixture to different gas qualities on basis of a signal provided by a sensor positioned downstream of the mixing device 23.

[0025] The calibration of the defined mixing ratio of gas and air of the defined gas/air mixture to different gas qualities as such is known to the person skilled, e.g. from EP 0 833 106 B1. The calibration as such is preferably performed on basis a signal provided by the ionization sensor 13 positioned downstream the mixing device 23.

[0026] According to the first aspect of the present application, before the calibration of the defined gas/air mixture as such is started by the controller 20, the controller 20 changes the gas/air mixture and determines a dead time between the change of the gas/air mixture and a corresponding signal change of sensor positioned downstream of the mixing device 23.

[0027] The sensor which is used to determine the above dead time and the sensor which is used for performing the calibration of the defined gas/air mixture to different gas qualities as such can be the same. In this case, e.g. the ionization sensor 13 is used to determine the dead time and is further used to perform the calibration as such.

[0028] Alternatively, the sensor which is used to determine the above dead time and the sensor which is used for performing the calibration of the defined gas/air mixture to different gas qualities as such can be different sensors. In this case, e.g. the exhaust gas temperature sensor 24 is used to determine the dead time and the ionization sensor 13 is used to perform the calibration as such.

[0029] Other sensors can be used to determine the above dead time, e.g. CO sensor or O_2 sensor detecting the CO or O_2 content in the exhaust gas.

[0030] The controller 20 compares the above dead with a reference value stored in the controller 20.

[0031] The defined mixing ratio of the defined gas/air mixture is calibrated to different gas qualities only if the determined dead time is equal or smaller than the reference value. The defined mixing ratio of the defined gas/air mixture is not calibrated to different gas qualities if the determined dead time is greater than the reference value.

[0032] Accordingly, only the decision if the calibration of the defined gas/air mixture to different gas qualities is performed or if this calibration of the gas/air mixture is not performed depends on the above dead time. The calibration of the defined gas/air mixture to different gas qualities as such is independent from the determined dead time. Further on, the control of the defined mixing ratio of the defined gas/air mixture by modulating the gas flow and the control of the burner load by modulating the speed of the fan 14 are both independent from the determined dead time.

[0033] According to the second aspect of the present application, which is preferably used in combination with the first aspect of the present application, the dead time is compared with a reference value depending on the

speed of the fan 14. A blocked exhaust flue 25 is determined when the dead time is equal or larger than the reference value.

[0034] The reference value which is used in the first aspect of the present application does not depend on the speed of the fan 14. The reference value which is used in the second aspect of the present application depends on the speed of the fan 14. Figure 2 shows a curve in which the relationship of reference value for the dead time Δt and the speed n of the fan 14 are shown. The controller 20 knows the actual speed n of the fan 14 and can determine from this fan speed n the reference value for the dead time Δt. If the dead time is equal or larger than this reference value, the controller 20 detects a blocked exhaust flue 25.

[0035] Preferably, the dead time is compared with a first reference value and a second reference value both depending on the speed of the fan 14. A warning signal is generated when the dead time is equal or larger than the first reference value. The burner 10 is turned off when the dead time is equal or larger than the second reference value. The second reference value is larger than the first reference value.

[0036] List of reference signs

10	gas burner
11	burner chamber
12	flame
13	ionization sensor
14	fan
15	air duct
16	gas duct
17	regulating valve
18	safety valve
19	safety valve
20	controller
21	actuator
22	actuator
23	mixing device
24	exhaust gas temperature sensor
25	exhaust flue

Claims

1. Method for operating a gas burner (10), wherein during burner-on phases a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber (11) of the gas burner (10) for combusting the defined gas/air mixture within the burner chamber (11), wherein the defined gas/air mixture is provided by a mixing device (23) mixing an air flow provided by an air duct (15) with a gas flow provided by a gas duct (16), and wherein the defined mixing ratio of gas and air of the defined gas/air mixture is calibrated to different gas qualities on basis of a signal provided by a sensor (13) positioned downstream of the mixing device (23), **characterized in that** before the calibration of the defined gas/air mixture is started the gas/air mixture is changed and a dead time between the change of the gas/air mixture and a signal change of a sensor (13, 24) positioned downstream of the mixing device (23) is determined, and that the dead time is compared with a reference value, whereby the defined gas/air mixture is calibrated to different gas qualities only if the determined dead time is equal or smaller than the reference value.

2. Method as claimed in claim 1, **characterized in that** the defined gas/air mixture is not calibrated to different gas qualities if the determined dead time is greater than the reference value.

3. Method as claimed in claim 1 or 2, **characterized in that** only the decision if the calibration of the defined gas/air mixture is performed or if the calibration of the gas/air mixture is not performed depends on the determined dead time, whereby the calibration of the defined gas/air mixture as such is independent from the determined dead time.

4. Method as claimed in one of claims 1 to 3, **characterized in that** the sensor (13) which used for performing the calibration of the defined gas/air mixture to different gas qualities and the sensor (13) which used to determine the dead time are the same.

5. Method as claimed in one of claims 1 to 3, **characterized in that** the sensor (13) which used for performing the calibration of the defined gas/air mixture to different gas qualities and the sensor (24) which used to determine the dead time are different.

6. Method as claimed in one of claims 1 to 5, **characterized by** features as claimed in one of claims 7 to 9.

7. Method for operating a gas burner (10), wherein during burner-on phases a defined gas/air mixture having a defined mixing ratio of gas and air is provided to a burner chamber (11) of the gas burner (10) for

combusting the defined gas/air mixture within the burner chamber (11), wherein the defined gas/air mixture is provided by a mixing device (23) mixing an air flow provided by an air duct (15) with a gas flow provided by a gas duct (16), **characterized in that** the gas/air mixture is changed and a dead time between the change of the gas/air mixture and a signal change of a sensor (13, 24) positioned downstream of the mixing device (23) is determined, and that the dead time is compared with a reference value depending on the speed of a fan (14) adjusting the quantity of the air flow, whereby a blocked exhaust flue (25) is determined when the dead time is equal or larger than the reference value.

8. Method as claimed in claim 7, **characterized in that** the dead time is compared with a first reference value depending on the speed of the fan (14), whereby a warning signal is generated when the dead time is equal or larger than the first reference value.

9. Method as claimed in claim 7 or 8, **characterized in that** the dead time is compared with a second reference value depending on the speed of the fan (10'4), whereby the burner is turned off when the dead time is equal or larger than the second reference value.

10. Controller (20) of a gas burner, comprising means for controlling a defined gas/air mixture, and further comprising means for calibrating the defined gas/air mixture to different gas qualities, **characterized by** means for performing the method as claimed in one of claims 1 to 5 and/or by means for performing the method as claimed in one of claims 7 to 9.

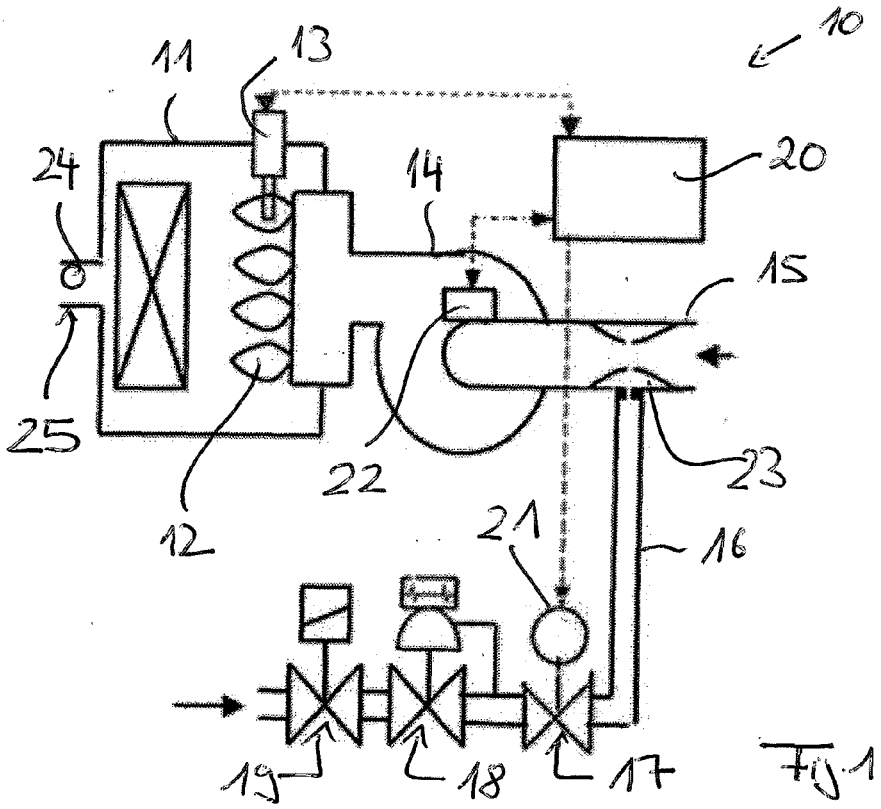


Fig.1

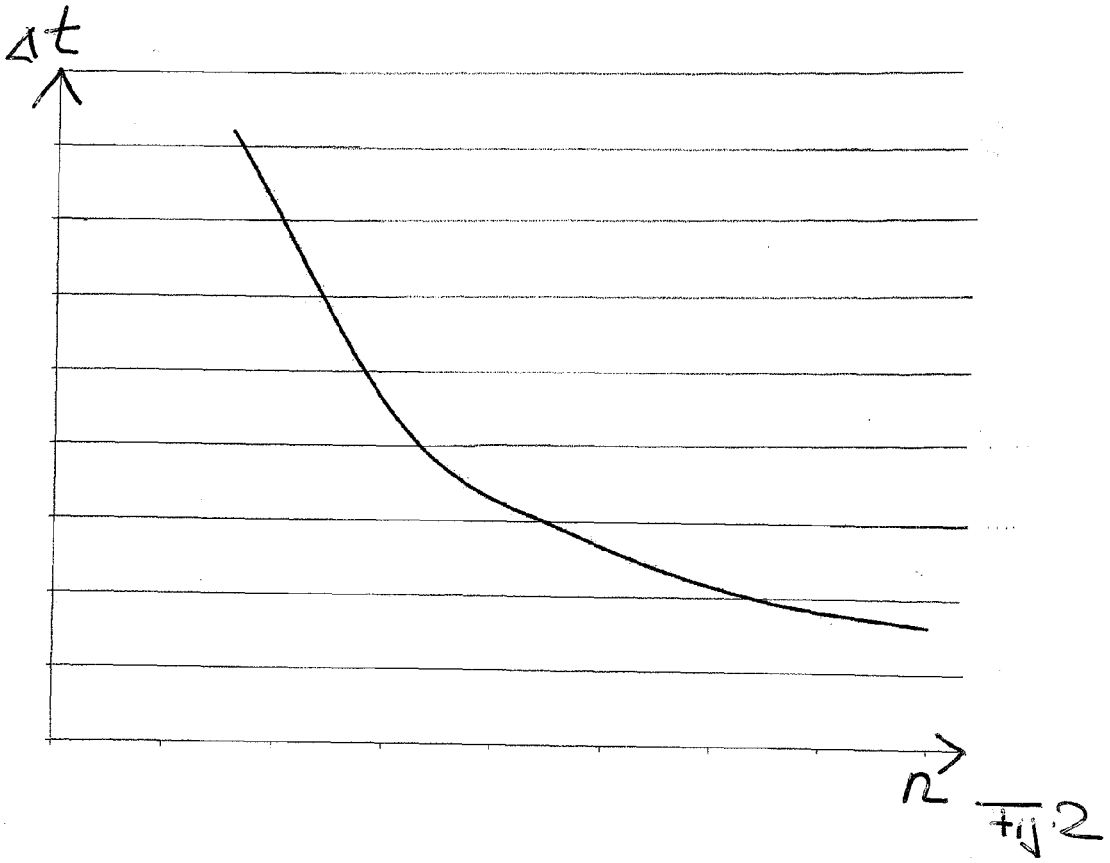


Fig.2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 15 7091

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	DE 10 2010 026389 A1 (BOSCH GMBH ROBERT [DE]) 12 January 2012 (2012-01-12)	1-7,10	INV.
Y	* the whole document *	8,9	F23N5/08
	-----		F23N5/18
			F23N5/20
Y	DE 199 36 696 A1 (RUHRGAS AG [DE]) 8 February 2001 (2001-02-08)	2-6	F23N1/02
			F23N3/00
A	* the whole document *	1,7-10	

Y	DE 39 37 290 A1 (VAILLANT JOH GMBH & CO [DE]) 17 May 1990 (1990-05-17)	2-6	
A	* the whole document *	1,7-10	

Y	US 2005/092851 A1 (TROOST HENRY E [US] ET AL) 5 May 2005 (2005-05-05) * paragraph [0005] - paragraph [0007]; figure 1 *	8,9	

Y	DE 44 33 425 A1 (STIEBEL ELTRON GMBH & CO KG [DE]) 21 March 1996 (1996-03-21)	2-6	
A	* the whole document *	1,7-10	
	-----		TECHNICAL FIELDS SEARCHED (IPC)
A	EP 2 354 657 A2 (HONEYWELL TECHNOLOGIES SARL [CH]) 10 August 2011 (2011-08-10) * the whole document *	1-10	F23N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 August 2012	Munteh, Louis

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 15 7091

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-08-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102010026389 A1	12-01-2012	DE 102010026389 A1	12-01-2012
		WO 2012004211 A2	12-01-2012
DE 19936696 A1	08-02-2001	NONE	
DE 3937290 A1	17-05-1990	DE 3937290 A1	17-05-1990
		FR 2638819 A1	11-05-1990
		GB 2226163 A	20-06-1990
		IT 1236688 B	26-03-1993
		NL 8902775 A	01-06-1990
US 2005092851 A1	05-05-2005	US 2005092851 A1	05-05-2005
		WO 2005045320 A2	19-05-2005
DE 4433425 A1	21-03-1996	NONE	
EP 2354657 A2	10-08-2011	DE 102010004826 A1	21-07-2011
		EP 2354657 A2	10-08-2011

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- EP 0833106 B1 **[0002] [0003] [0025]**
- EP 0962703 B1 **[0004]**
- EP 1309821 B1 **[0005]**
- DE 102010026389 A1 **[0006]**