

REVISED VERSION

(19) World Intellectual Property Organization  
International Bureau



(10) International Publication Number  
WO 2012/142359 A9

(43) International Publication Date  
18 October 2012 (18.10.2012)

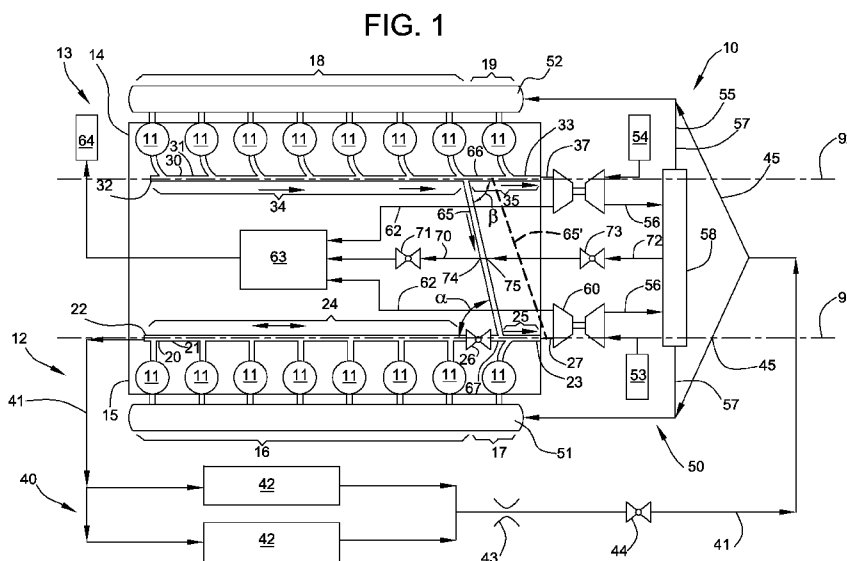
- (51) International Patent Classification:  
F02M 25/07 (2006.01) F02B 37/007 (2006.01)  
F02B 37/20 (2006.01) F01N 13/10 (2010.01)
- (21) International Application Number:  
PCT/US2012/033441
- (22) International Filing Date:  
13 April 2012 (13.04.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
13/086,798 14 April 2011 (14.04.2011) US
- (71) Applicant (for all designated States except US): CATERPILLAR INC. [US/US]; 100 N.E. Adams Street, Peoria, IL 61629-9510 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): LUFT, Aaron [US/US]; 1292 West County Road 650 South, Frankfort, IN 46041-7536 (US). STANCIU, Lucian [RO/US]; P.O. Box 18, Dayton, IN 47947 (US). TIRU, Catalin [RO/US]; 114 Kettle Circle, Lafayette, IN 47905 (US). BYRD, Jeremy [US/US]; 3317 Hamilton Street, West Lafayette, IN 47906 (US).
- (74) Agents: REED, Joseph, E. et al.; 100 N.E. Adams Street, Peoria, IL 61629-9510 (US).

- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

- Published:  
— with international search report (Art. 21(3))
- (88) Date of publication of the international search report:  
17 January 2013

[Continued on next page]

(54) Title: INTERNAL COMBUSTION ENGINE WITH IMPROVED EXHAUST MANIFOLD



(57) Abstract: An internal combustion engine includes a plurality of combustion cylinders, at least one turbocharger, an air supply line, an exhaust gas line and an exhaust gas recirculation system. An exhaust manifold of the exhaust gas line may have both non-direction specific and modular pulse exhaust manifold elements. If the internal combustion engine has dual cylinder banks, an exhaust gas balance tube may extend between exhaust gas lines of the cylinder banks and be fluidly connected to an exhaust manifold between the ends thereof.

WO 2012/142359 A9

**Date of publication of the revised international search  
report:**

**(15) Information about Correction:**  
see Notice of 7 March 2013

7 March 2013

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/US2012/033441

A. CLASSIFICATION OF SUBJECT MATTER  
INV. F02M25/07 F02B37/20 F02B37/007 F01N13/10  
ADD.  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
F02M F02B F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 378 308 B1 (PFLUEGER FRANK [DE]) 30 April 2002 (2002-04-30) column 3, line 45 - column 5, line 4; figures 1-3	1-4
A	----- US 2006/059908 A1 (SCHORN NORBERT A [DE] ET AL SCHORN NORBERT ANDREAS [DE] ET AL) 23 March 2006 (2006-03-23) the whole document	1-4
A	----- EP 1 734 237 A1 (TOYOTA JIDOSHOKKI KK [JP]; TOYOTA MOTOR CO LTD [JP]) 20 December 2006 (2006-12-20) paragraph [0065] - paragraph [0080]; figures 5,7,8	1-4
	----- -/--	

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search <b>6 September 2012</b>	Date of mailing of the international search report <b>03/01/2013</b>
--	---

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Martinez Cebollada</b>
--	---

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2012/033441

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3.  Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1.  As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2.  As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3.  As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-4

### Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4

Exhaust manifold having an exhaust balance tube

---

2. claims: 5-10

EGR system

---

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2012/033441

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2009/090098 A1 (SUGIYAMA TOSHIHISA [JP]) 9 April 2009 (2009-04-09) paragraph [0030] - paragraph [0042]; figure 1  -----	1-4

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2012/033441
---

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6378308	B1	30-04-2002	EP 1071870 A1 31-01-2001
			JP 2002512337 A 23-04-2002
			US 6378308 B1 30-04-2002
			US 2002112478 A1 22-08-2002
			WO 9954607 A1 28-10-1999
-----			
US 2006059908	A1	23-03-2006	EP 1640597 A1 29-03-2006
			US 2006059908 A1 23-03-2006
-----			
EP 1734237	A1	20-12-2006	EP 1734237 A1 20-12-2006
			JP 4057549 B2 05-03-2008
			JP 2005291090 A 20-10-2005
			US 2007193564 A1 23-08-2007
			WO 2005098220 A1 20-10-2005
-----			
US 2009090098	A1	09-04-2009	CN 101466927 A 24-06-2009
			EP 2032814 A1 11-03-2009
			JP 2007332844 A 27-12-2007
			US 2009090098 A1 09-04-2009
			WO 2007145372 A1 21-12-2007
-----			