



- (51) International Patent Classification:
F02B 77/10 (2006.01) *F02B 77/13* (2006.01)
- (21) International Application Number:
PCT/FI2012/050026
- (22) International Filing Date:
13 January 2012 (13.01.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
20115353 13 April 2011 (13.04.2011) FI
- (71) Applicant (for all designated States except US): **WÄRTSILÄ FINLAND OY** [FI/FI]; Tarhaajantie 2, FI-65380 Vaasa (FI).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **AURA, Matias** [FI/FI]; Porintie 154, FI-65480 Vikby (FI). **COLLANDER, Oskar** [FI/FI]; Störviksvägen 33, FI-65230 Vaasa (FI). **NURMI, Hannu** [FI/FI]; Niittytie 16, FI-65380 Vaasa (FI). **EL-ASHMAWY, Ali** [FI/FI]; Reginanpolku 4 As 11, FI-65380 Vaasa (FI).
- (74) Agent: **BERGGREN OY AB**; P.O. Box 16, FI-00101 Helsinki (FI).

(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))

(54) Title: EXPLOSION RELIEF VALVE

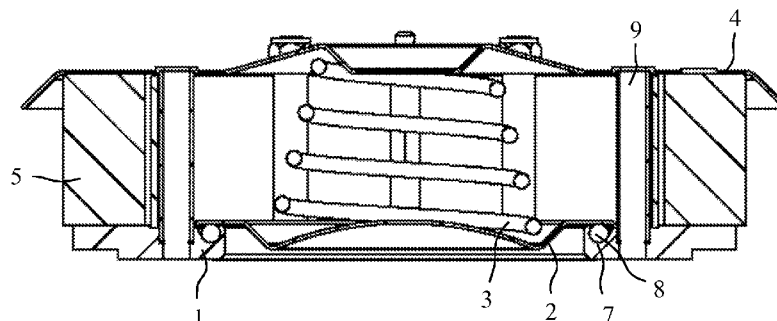


FIG. 1

(57) Abstract: The explosion relief valve for a crankcase of an internal combustion engine comprises a valve seat (1), a closure plate (2) co-operating with the valve seat (1), a flame arrester (5) for preventing flames from escaping the crankcase, a cover plate (4) for guiding explosion gases, and a closing spring (3) for pressing the closure plate (2) against the valve seat (1). The cover plate (4) has a sandwich structure comprising at least two support layers (4a, 4c) and at least one dampening layer (4b) that is made of a dampening material and arranged between the support layers (4a, 4c).

Explosion relief valve

Technical field of the invention

The present invention relates to an explosion relief valve according to the preamble of claim 1.

5

Background of the invention

A crankcase explosion in an internal combustion engine is an unwanted event that can have severe consequences. When the lubricating oil inside the crankcase comes into contact with a hot spot, which may have been caused for instance by insufficient lubrication between moving parts, the oil evaporates. When the oil vapor circulates to a cooler place inside the crankcase, it condenses forming oil mist that consists of very small droplets. If the concentration of the oil mist reaches a certain limit, it might be ignited by the hot spot and an explosion will occur. To avoid damaging of the engine and improve safety of the people operating the engine, the crankcases of large internal combustion engines are provided with explosion relief valves. According to the requirements of the International Association of Classification Societies (IACS) concerning machinery installations, internal combustion engines having a cylinder bore of 200 mm and above or a crankcase volume of 0.6 m³ and above have to be provided with crankcase explosion relief valves. The required number of the explosion relief valves depends on the cylinder bore, crankcase volume, free area of the relief valves and the number of crank throws. A purpose of the explosion relief valves is to relieve pressure from the engine crankcase in a controlled way. An explosion relief valves comprises a spring loaded valve member that is opened by a pressure increase inside the crankcase, and a flame arrester for preventing the flames from escaping from the crankcase. The valve member must close tightly after an explosion to prevent air flow into the crankcase and thus a secondary explosion.

Patent document GB 1334165 A discloses an explosion relief valve comprising a spring loaded closure plate and a circular flame arrester. The flame arrester is arranged around a valve seat against which the closure plate lies. The flame arrester protrudes outwards from the valve seat and the outer end of the flame arrester is covered by a cover plate

that is made of a metal sheet. The compression spring keeping the valve closed is supported against the cover plate. A problem with this kind of metallic cover plates is that engine vibrations may induce vibrations in the cover plates making them a significant source of noise.

5

Summary of the invention

The object of the present invention is to provide an improved explosion relief valve for a crankcase of an internal combustion engine. The characterizing features of the explosion relief valve according to the present invention are given in the characterizing part of claim 1.

10

According to the present invention, the explosion relief valve comprises a valve seat, a closure plate co-operating with the valve seat, a flame arrester for preventing flames from escaping the crankcase, a cover plate for guiding explosion gases, and a closing spring for pressing the closure plate against the valve seat. The cover plate has a sandwich structure comprising at least two support layers and at least one dampening layer that is made of a dampening material and arranged between the support layers.

15

When a cover plate with a sandwich structure that comprises a dampening layer is used, the vibration of the cover plate and thus the induced noise can be effectively reduced.

20

According to an embodiment of the present invention, the dampening layer is made of a polymer. According to other embodiments of the invention, the dampening layer is made of epoxy or silicone and the support layers are made of a metal or a metal alloy, such as aluminum or steel. The thickness of the cover plate is suitably 1–4 mm.

25

Brief description of the drawings

Fig. 1 shows a cross-sectional view of an explosion relief valve.

Fig. 2 shows the structure of the cover plate of the explosion relief valve of Fig. 1 according to an embodiment of the invention.

30

Detailed description of the invention

Embodiments of the invention are now described in more detail with reference to the accompanying drawings.

5 The explosion relief valve according to the present invention can be used as a security device in connection with a crankcase of a large internal combustion engine, such as an engine used in a ship or at a power plant. The valve releases overpressure from the crankcase in case of an explosion and prevents air flow into the crankcase. An engine can be provided with one or more explosion relief valves. The explosion relief valves
10 can be fastened for instance to crankcase doors that cover openings of the crankcase. The explosion relief valve of figure 1 comprises a circular valve seat 1 that can be arranged outside the crankcase around an aperture in a crankcase door or in a crankcase wall. The valve seat 1 comprises a groove 7 for accommodating a sealing. An O-ring seal 8 is arranged in the groove 7.

15 A flame arrester 5 is arranged around the valve seat 1 protruding outwards from the plane of the valve seat 1. The flame arrester 5 is made of thin lamellas. The lamellas allow gas flow through the flame arrester 5 but prevent flames from escaping from the space that is protected by the explosion relief valve. Also different flame arrester arrangements are possible. For instance, a flame arrester could be arranged on the other
20 side of the valve seat 1 to cover the opening in the valve seat 1. The flame arrester could thus be at least partly inside the crankcase. In the embodiment of figure 1, a plurality of bolts 9 is arranged around the valve seat 1. The bolts 9 extend outwards from the plane of the valve seat 1 and support a cover plate 4 that is arranged on top of the flame arrester 5. The edge of the cover plate 4 is bent approximately 45 degrees towards the
25 valve seat 1 for guiding possible explosion gas flow. In order to more effectively direct the explosion gases to a certain direction, the cover plate 4 can be attached or integrated to a cylindrical collar encircling the valve seat 1 and having an opening in one direction. This kind of arrangement is suitable especially for valves where the flame arrester 9 is
30 arranged on the crankcase side of the valve seat 1.

The valve comprises a closure plate 2 that co-operates with the valve seat 1 and prevents fluid flow into the crankcase of the engine. The valve is kept closed by a helical

closing spring 3 that is arranged between the cover plate 4 and the closure plate 2 and presses the closure plate 2 against the valve seat 1. The closure plate 2 is guided by the bolts 9 supporting the cover plate. If the pressure in the crankcase increases, the closing spring 3 allows opening of the explosion relief valve and gas flow out of the crankcase.

5

To reduce noise that is caused by the cover plate 4 due to engine vibrations, the cover plate 4 has a sandwich structure. The cover plate 4 comprises a dampening layer 4b that is arranged between a pair of support layers 4a, 4c. The support layers 4a, 4c are made of a metal or an alloy, such as steel. The support layers 4a, 4c do not necessarily need to be made of the same material. The dampening layer 4b is made of a material that dampens vibrations. Suitable materials for the dampening layer 4b are many polymers, such as epoxy or silicone. The thickness of the cover plate 4 is selected so that it can fulfill the requirements for its mechanical strength, and at the same have low resonant frequencies. The thickness of the cover plate 4 is suitably 1–4 mm.

15

The cover plate 4 can comprise more than two support layers 4a, 4c and more than one dampening layer 4b. For instance, the cover plate 4 could comprise five or more layers so that the support layers and dampening layers are arranged alternately in the construction. It is also possible that more than one dampening layers are arranged between a pair of support layers. If the cover plate 4 comprises more than three layers, the outermost layers do not necessarily need to be support layers, but at least one of the outer layers can also be made of a dampening material. If the valve comprises a collar for guiding the explosion gases, also the collar can have a sandwich structure with support and dampening layers.

25

It will be appreciated by a person skilled in the art that the invention is not limited to the embodiments described above, but may vary within the scope of the appended claims.

Claims

1. An explosion relief valve for a crankcase of an internal combustion engine, the valve comprising a valve seat (1), a closure plate (2) co-operating with the valve seat (1), a flame arrester (5) for preventing flames from escaping the crankcase, a cover plate (4) for guiding explosion gases, and a closing spring (3) for pressing the closure plate (2) against the valve seat (1), **characterized** in that the cover plate (4) has a sandwich structure comprising at least two support layers (4a, 4c) and at least one dampening layer (4b) that is made of a dampening material and arranged between the support layers (4a, 4c).
- 10 2. An explosion relief valve according to claim 1, **characterized** in that the dampening layer (4b) is made of a polymer.
- 15 3. An explosion relief valve according to claim 2, **characterized** in that the dampening layer (4b) is made of epoxy.
4. An explosion relief valve according to claim 2, **characterized** in that the dampening layer (4b) is made of silicone.
- 20 5. An explosion relief valve according to any of the preceding claims, **characterized** in that the support layers (4a, 4c) are made of a metal or a metal alloy.
6. An explosion relief valve according to claim 5, **characterized** in that the support layers (4a, 4c) are made of steel.
- 25 7. An explosion relief valve according to any of the preceding claims, **characterized** in that the thickness of the cover plate 4 is 1–4 mm.

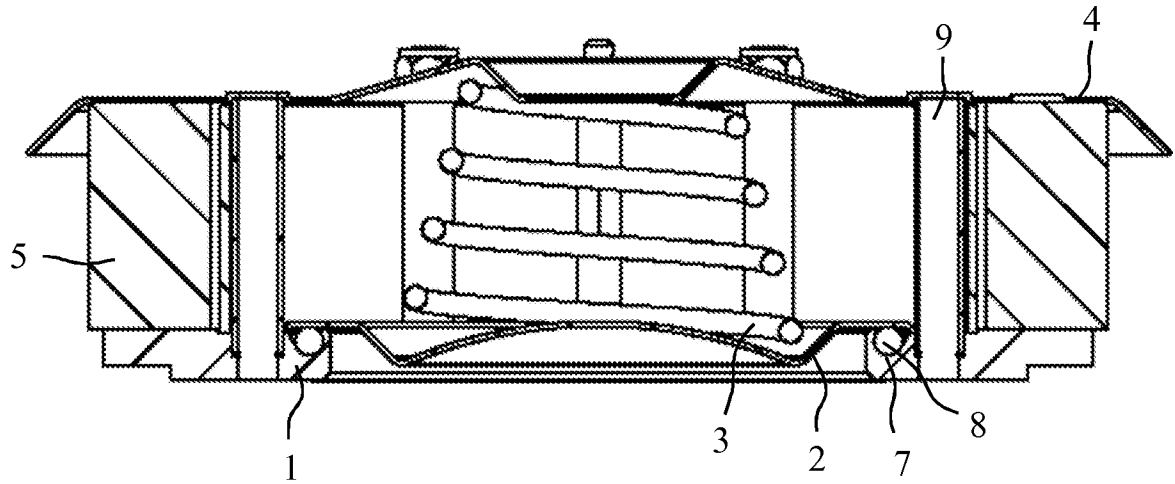


FIG. 1

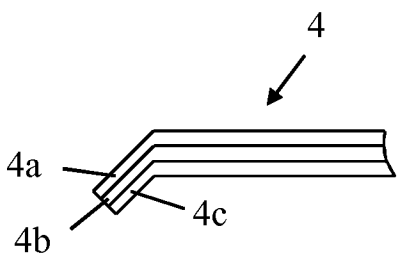


FIG. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/FI2012/050026

A. CLASSIFICATION OF SUBJECT MATTER
INV. F02B77/10 F02B77/13
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)
F02B

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 practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 3 016 913 A (RICHARD BARGMANN) 16 January 1962 (1962-01-16) abstract figures	1-7
Y	DD 87 441 A (HOERBIGER VENTILWERKE AG) 20 January 1972 (1972-01-20) figures	1-7
Y	US 6 453 892 B1 (PLUNKETT TOM [US] ET AL) 24 September 2002 (2002-09-24) abstract figures	1-7
Y	US 4 522 165 A (OGAWA NAOKI [JP]) 11 June 1985 (1985-06-11) abstract figures	1,7



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

"E" earlier document but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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.

"&" document member of the same patent family

Date of the actual completion of the international search

26 April 2012

Date of mailing of the international search report

04/05/2012

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

Matray, J

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3016913	A	16-01-1962	NONE
DD 87441	A	20-01-1972	NONE
US 6453892	B1	24-09-2002	CA 2407020 A1 11-04-2003 MX PA02009962 A 13-09-2004 US 6453892 B1 24-09-2002
US 4522165	A	11-06-1985	DE 3020818 A1 04-12-1980 FR 2457981 A1 26-12-1980 GB 2052388 A 28-01-1981 US 4522165 A 11-06-1985