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

(11) EP 2 333 258 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
15.06.2011 Bulletin 2011/24

(21) Application number: **10014354.4**

(22) Date of filing: **06.11.2010**

(51) Int Cl.:
F01M 1/04 *(2006.01)* ***F01M 1/06*** *(2006.01)*
F01M 11/00 *(2006.01)*

(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

(30) Priority: **26.11.2009 JP 2009268516**

(71) Applicant: **Yamabiko Corporation**
Ohme-shi
Tokyo
198-8760 (JP)

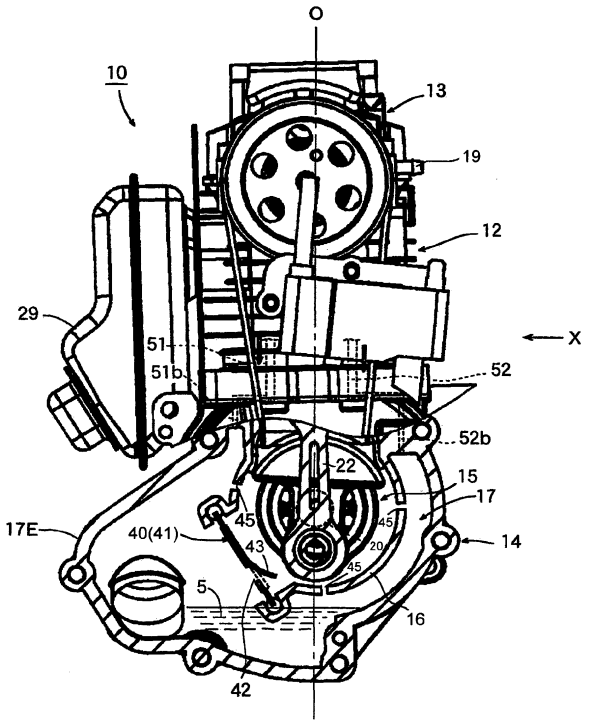
(72) Inventors:
- **Saitou, Shinichi**
  Hamura-shi,
  Tokyo 205-0001 (JP)
- **Ohtsubo, Tomohiro**
  Hamura-shi,
  Tokyo 205-0001 (JP)

(74) Representative: **Grosse, Rainer et al**
Gleiss Grosse Schrell & Partner
Patentanwälte Rechtsanwälte
Leitzstrasse 45
70469 Stuttgart (DE)

(54) Four-stroke internal combustion engine lubrication device

(57) There is provided a four-stroke internal combustion engine lubrication device that is capable of appropriately lubricating various parts regardless of engine attitude, of improving the capability for collecting excess oil within a valve chamber or the like and the capability for supplying oil to the various parts, and of reliably preventing oil leakage from a breather port provided in the valve chamber. It comprises: a reed valve (40) that allows oil flow from an oil chamber (17) into a crankcase (15) but prevents oil flow from the crankcase (15) to the oil chamber (17); an oil supply passage (35) for supplying oil from the crankcase (15) to a valve chamber (18); and a plurality of independent oil collection passages (51, 52) with differing inlet/outlet positions and for collecting in the oil chamber (17) the excess oil in the valve chamber (18). The dimensions of the various parts are so designed as to constantly maintain the oil chamber (17) under negative pressure during operation. The excess oil within the crankcase (15) is returned to the oil chamber (17) utlilizing the negative pressure of the oil chamber (17).

FIG. 1



When piston is rising: Reed valve 40 is open
When piston is descending: Reed valve 40 is closed

EP 2 333 258 A1

Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a lubrication device for a four-stroke internal combustion engine that is suitable for use as a power source of a portable work machine such as a brush cutter, a chain saw, etc., and more specifically to a four-stroke internal combustion engine lubrication device that is so arranged as to be capable of appropriately lubricating various parts regardless of the attitude of the work machine (engine), of improving the capability for collecting excess oil within a valve chamber, etc., and the capability for supplying oil to the various parts, and of reliably preventing oil leakage from a breather port (blow-by gas discharge port) provided in the valve chamber.

Background Art

[0002] As can be seen in JP Patent Publication (Kokai) No. 2002-188423 A (Patent Document 1), etc., as four-stroke internal combustion engines that are suitable for use as power sources of portable work machines such as brush cutters, chain saws, etc., there are known those of the overhead cam type comprising: a cylinder portion into which a piston is inserted; a valve chamber formed above the cylinder portion; a crankcase formed below the cylinder portion; and an oil chamber (oil reservoir) formed at the outer circumference of the crankcase. With the above, utilizing the up/down motion of the piston (i.e., the positive/negative pressure generated thereby), the oil within the oil chamber is caused to flow into the crankcase in mist form. The oil mist within the crankcase is supplied to the valve chamber via an L-shaped passage portion formed within a crankshaft, a gas-liquid separation chamber provided at the outer circumference thereof, and an oil supply passage formed in the cylinder portion.

[0003] Further, as can be seen in JP Patent Publication (Kokai) No. 11-36839 A (1999) (Patent Document 2), etc., there are known those in which a one-way valve is provided between a crankcase and an oil chamber, the positive pressure of the crankcase is utilized to supply oil to various parts, and an oil circulation path in a given direction from the crankcase to the oil chamber via a valve chamber is formed.

SUMMARY OF THE INVENTION

[0004] However, conventional four-stroke internal combustion engine lubrication devices such as those discussed above do not sufficiently address changes in the attitude of the engine, and are deficient in terms of their capability for collecting excess oil within the valve chamber, etc., and their capability for supplying oil to various parts. Thus, there are such problems as leakage of excess oil from within the valve chamber to the outside through the breather port (blow-by gas discharge device), etc.

[0005] The present invention is made in view of the problems above, and an object thereof is to provide a four-stroke internal combustion engine lubrication device that is capable of appropriately lubricating various parts regardless of the attitude of the engine, of improving the capability for collecting excess oil within a valve chamber, etc., and the capability for supplying oil to the various parts, and of reliably preventing oil leakage from a breather port (blow-by gas discharge port) provided in the valve chamber.

[0006] With a view to achieving the objective above, a four-stroke internal combustion engine lubrication device according to the present invention basically comprises: a cylinder portion into which a piston is inserted; a valve chamber formed above the cylinder portion; a crankcase formed below the cylinder portion; and an oil chamber formed at the outer circumference of the crankcase, wherein, utilizing the up/down motion of the piston, oil within the oil chamber is caused to flow into the crankcase in mist form. The four-stroke internal combustion engine lubrication device further comprises: a one-way valve configured to allow oil flow from the oil chamber into the crankcase, while preventing oil flow from the crankcase into the oil chamber; an oil supply passage for supplying oil to the valve chamber from the crankcase; and a plurality of independent oil collection passages with differing inlet/outlet positions and for collecting in the oil chamber the excess oil in the valve chamber, wherein the dimensions of each part are so designed as to constantly maintain the oil chamber under negative pressure during operation, and the excess oil within the crankcase is returned to the oil chamber utilizing the negative pressure of the oil chamber.

[0007] In a preferred embodiment, a reed valve is used for the one-way valve.

[0008] In another preferred embodiment, the oil chamber is disposed adjacent to the crankcase in such a manner as to surround the crankcase with a baffle in-between, and a predetermined number of fine holes are formed in the baffle in order to return the excess oil within the crankcase to the oil chamber utilizing the negative pressure of the oil chamber.

[0009] In another preferred embodiment, in order to improve the capability for sucking oil into the oil chamber and prevent backflow, the effective passage sectional area of the narrowest portion of each of the oil collection passages is set to or below a predetermined value.

[0010] In another preferred embodiment, the oil mist within the crankcase is supplied to the valve chamber via an L-shaped passage portion formed within the crankshaft, a gas-liquid separation chamber provided at the outer circumference thereof, and the oil supply passages.

[0011] In yet another preferred embodiment, the shape of the oil chamber that surrounds the crankcase is such

that there is provided an expansive bulging portion that protrudes further outward, as compared to the other sides, on a side below the crankshaft and where the valve opening in the reed valve is located relative to the engine centerline.

[0012] With a four-stroke internal combustion engine lubrication device according to the present invention, since a one-way valve, such as a reed valve, etc., is disposed between the crankcase and the oil chamber in a predetermined arrangement, it becomes possible to separate the pressure fluctuation that occurs within the crankcase into positive pressure and negative pressure. Consequently, it is possible to use the positive pressure for pumping oil (supplying to various parts), and to use the negative pressure for sucking (collecting) oil into the oil chamber and for constantly maintaining the oil chamber under negative pressure.

[0013] Further, when a reed valve is used for the one-way valve, the reed valve opens as the piston rises and the crankcase becomes negatively pressured (i.e., lower in pressure than the oil chamber). As oil consequently flows into the crankcase from the oil chamber, air and oil end up rapidly passing through a small gap (ordinarily of approximately 1 mm) that is formed between the valve member and valve seat of the reed valve. Consequently, the turning of oil into mist is further facilitated, and oil flows into the crankcase (i.e., the reed valve functions as a means for facilitating oil mist generation).

[0014] The read valve closes as the piston descends and the crankcase becomes positively pressured (i.e., higher in pressure than the oil chamber), and the oil mist within the crankcase is thus supplied to various parts. In this case, some of the oil mist within the crankcase is supplied to the valve chamber via the L-shaped passage portion formed within the crankshaft, the gas-liquid separation chamber provided at the outer circumference thereof, and the oil supply passages. At this point, since the oil chamber is maintained under negative pressure, the excess oil within the valve chamber is sucked into and collected in the negatively pressured oil chamber via the plurality of independent oil collection passages with differeing inlet/outlet positions. Further, the excess oil within the crankcase is also returned to the oil chamber via, for example, fine holes formed in the baffle.

[0015] Thus, by having the oil chamber be negatively pressured, it is possible to confer flow directionality to each of the oil passages, and oil collection becomes possible regardless of engine attitude (upright, inclined, inverted, etc.). It is noted that since both the gas and liquid portions within the oil chamber become negatively pressured, positional freedom for the outlets (end portions) of the oil collection passages (i.e., passage layout freedom) is extremely high, thereby enabling omnidirectional operation.

[0016] Thus, according to a lubrication device of the present invention, various parts can be appropriately lubricated regardless of engine attitude, the capability for collecting the excess oil within the valve chamber and the capability for supplying oil to the various parts can be improved, and oil leakage from the breather port (blow-by gas discharge port) provided in the valve chamber can be prevented reliably.

[0017] In addition, by virtue of the thus improved oil collection capability, oil can be fed to the various parts in sufficiently large amounts (i.e., oil circulation flow rate is increased). Consequently, lubrication is improved, and, at the same time, cooling of the various engine parts is improved.

[0018] Further, if the plurality of oil collection passages are integrated (merged) midway, gas would be more readily sucked in than liquid, thereby making oil collection difficult. However, by independently providing a plurality of oil collection passages with differing inlet/outlet positions, as is done in the present invention, oil collection becomes possible without compromising the suction capability of each oil collection passage.

[0019] In addition, since a predetermined number of fine holes (insensitive to positive pressure but sensitive to negative pressure) are formed in the baffle, which separates the oil chamber and the crankcase, as oil returning means for returning the excess oil within the crankcase to the oil chamber utilizing the negative pressure of the oil chamber, it is possible to achieve overall simplification, cost reduction, etc., as compared to cases in which other oil returning means, such as a valve device, etc., are employed.

[0020] In addition, since the oil chamber that surrounds the crankcase is so shaped as to comprise an expansive bulging portion in the direction in which the one-way valve is provided so that the one-way valve would always be maintained at a position above oil level regardless of engine attitude, oil is prevented from flowing into the crankcase while still in liquid form, and it is possible to realiably supply to the crankcase oil that has been turned into mist.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a partially cutaway front view of an overhead cam type four-stroke internal combustion engine to which an embodiment of a lubrication device according to the present invention is applied.

Fig. 2 is a partially cutaway side view as viewed in the direction of arrow X in Fig. 1.

Fig. 3 is a schematic view corresponding to Fig. 1 and for illustrating an oil supply path and an oil collection path.

Fig. 4 is a schematic view corresponding to Fig. 2 and for illustrating an oil supply path and an oil collection path.

Description of Symbols

[0022]

10	Overhead cam type four-stroke internal combustion engine
11	Piston
15	Crankcase
16	Baffle
17	Oil chamber
18	Valve chamber
20	Crankshaft
35	Oil supply passage
40	Reed valve (one-way valve)
45	Fine hole (return hole)
51, 52	Oil collection passage

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0023] Embodiments of the present invention are described below with reference to the drawings.

[0024] Fig. 1 is a partially cutaway front view of an overhead cam type four-stroke intenal combustion engine to which an embodiment of a lubrication device according to the present invention is applied. Fig. 2 is a partially cutaway side view as viewed in the direction of arrow X in Fig. 1.

[0025] In Figs. 3 and 4, which are schematic views of Figs. 1 and 2, respectively, the outlined white arrows indicate the oil supply path, whereas the arrows with hatching indicate the oil collection path.

[0026] The engine 10 in Fig. 1 is an overhead cam type four-stroke internal combustion engine with a displacement of approximately 30 cc that is suitable for use as a power source for a portable work machine such as a brush cutter, a chain saw, etc. The engine 10 comprises: a cylinder portion 12 into which a piston 11 is inserted; an upper chamber defining portion 13 provided above the cylinder portion 12; and a lower chamber defining portion 14 of a two-part structure provided below the cylinder portion 12. A valve chamber 18 in which a camshaft 25 for driving an intake/exhaust valve to open/close is disposed is formed in the upper chamber defining portion 13. A crankcase 15, in which a crankshaft 20 that is linked to the piston 11 via a con rod 22 is disposed, and an oil chamber 17 (a reservoir for oil 5), which is disposed adjacent to the crankcase 15 in such a manner as to surround the crankcase 15 with a baffle 16 in-between, are formed in the lower chamber defining portion 14.

[0027] The lower-left portion, as viewed from the front, of the baffle 16 that separates the crankcase 15 and the oil chamber 17 is open, and a reed valve 40 is attached in such a manner as to block this opening.

[0028] In correspondence with the lower-left portion, as viewed from the front, at which the reed valve 40 is attached, the oil chamber is so arranged as to be greater in volume at the position in the same direction as compared to other directions. This is to maintain the reed valve 40 above oil level regardless of attitude and state, and to prevent oil from flowing into the crankcase in a liquid state. In this respect, so long as the relative positions of expanded portion of the oil chamber and the reed valve are maintained, the expanded portion and the reed valve may be provided in any given direction.

[0029] It is noted that by providing them in, as viewed from the front, the lower-left portion as is done in the present embodiment, dead-space can be used effectively, and the volume of the oil chamber can be secured without increasing the longitudinal direction of the engine. Further, only oil that has been turned into mist would flow into the crankcase regardless of attitude, which is desirable.

[0030] The reed valve 40 comprises: a valve seat 41 comprising a metal plate member in which a valve opening 42 of a predetermined diameter is formed; and an elastically flexible tongue-shaped valve member 43 of which one end is fixed to the surface of this valve seat 41 on the side of the crankcase 15, and of which the other end covers and blocks the valve opening 42. Thus, this reed valve 40 so functions as to allow oil flow from the oil chamber 17 into the crankcase 15, while preventing oil flow from the crankcase 15 into the oil chamber 17.

[0031] In addition, three fine holes 45 are provided (at three locations) in the baffle 16 in order to return the excess oil within the crankcase 15 to the oil chamber 17 utilizing the negative pressure of the oil chamber 17. In the present case, the fine holes 45 are each given a circular sectional shape with a diameter of approximately 1 mm so that they would be insensitive to positive pressure but sensitive to negative pressure.

[0032] In addition, a breather port (blow-by gas discharge port) 19 is provided in the center portion of the valve chamber 18.

[0033] An oil supply passage 35 for supplying oil from the crankcase 15 to the valve chamber 18, and two independent oil collection passages 51 and 52 for collecting in the oil chamber 17 the excess oil within the valve chamber 18 are formed in the wall portions of the cylinder portion 12, the lower chamber defining portion 14 and the upper chamber defining portion 13.

[0034] Here, the positive pressure of the crankcase 15 is used for supplying oil to the valve chamber 18, and the oil mist within the crankcase 15 is supplied to the valve chamber 18 via an L-shaped passage portion 31 formed in the crankshaft 20, a gas-liquid separation chamber 32 provided at the outer circumference thereof, and the oil-supply passage 35 (if necessary, see Patent Document 1 mentioned above for details). It is noted that the passage diameter (sectional diameter) of the passage 35 is

set to approximately 3 mm or above in order to increase supply amount (circulation amount).

[0035] Of the two independent oil collection passages 51 and 52, one (the first oil collection passage 51) has its inlet (upper end portion) 51 a open into an excess oil reservoir 18a (mainly for when the engine is upright) provided on the left side of the floor portion side of the valve chamber 18 as viewed from the side, and the other (the second oil collection passage 52) has its inlet (upper end portion) 52a open into an excess oil reservoir 18b (mainly for when the engine is inverted) provided on the right side of the ceiling portion side of the valve chamber 18 as viewed from the side. In addition, outlets (lower end portions) 51b and 52b of the first and second oil collection passages 51 and 52, respectively, open into the upper portion of the oil chamber 17.

[0036] Further, for purposes of improving the capability for sucking oil into the oil chamber 17 and of preventing backflow, portions of the oil collection passages 51 and 52 on the side of the outlets 51b and 52b (downstream portions), respectively, are made narrower than the upstream portions. Specifically, the passage diameter (sectional diameter) of the respective upstream portions of the oil collection passages 51 and 52 are set to approximately 2.5 mm, with which adequate suction capability can be attained, and the respective portions thereof on the side of the outlets 51b and 52b (the downstream portions) have their passage diameter set to approximately 1 mm in order to prevent backflow (from the oil chamber 17 to the valve chamber 18). It is noted that instead of narrowing the passages 51 and 52, an orifice may be provided in the middle of each passage. In addition, although the sectional shapes of the passages 35, 51 and 52 have been defined as being circular in the present case, generally similar working effects may be attained with other shapes, too, so long as the effective passage sectional areas are the same.

[0037] With a four-stroke internal combustion engine lubrication device of the present embodiment having the configuration above, since the reed valve 40 is disposed between the crankcase 15 and the oil chamber 17 in a predetermined arrangement, it becomes possible to separate the pressure fluctuation that occurs within the crankcase 15 into positive pressure and negative pressure. Consequently, it is possible to use the positive pressure for pumping oil (supplying to various parts), and to use the negative pressure for sucking (collecting) oil into the oil chamber and for constantly maintaining the oil chamber under negative pressure.

[0038] The reed valve 40 opens as the piston 11 rises and the crankcase 15 becomes negatively pressured (i.e., lower in pressure than the oil chamber). As oil consequently flows into the crankcase 15 from the oil chamber 17, air and oil end up rapidly passing through a small gap (ordinarily of approximately 1 mm) that is formed between the valve member 43 and valve seat 41 of the reed valve 40. Consequently, the oil becomes mist-like and flows into the crankcase (i.e., the reed valve 40 functions as an oil mist generation means). It is noted that a vibrating body may be provided in the oil chamber as the oil mist generation means that causes the oil within the oil chamber to flow into the crankcase in mist form.

[0039] Further, in this case, due to the negative pressure of the crankcase, the oil within the gas-liquid separation chamber 32 flows into the crankcase 15 via an oil collection passage 38.

[0040] On the other hand, as the piston descends and the crankcase 15 thus becomes positively pressured (i.e., higher in pressure than the oil chamber), the reed valve 40 closes and the oil mist within the crankcase 15 is supplied to various parts. In this case, some of the oil mist within the crankcase 15 is supplied to the valve chamber 18 via the L-shaped passage portion 31 formed within the crankshaft 20, the gas-liquid separation chamber 32 provided at the outer circumference thereof, and the oil supply passage 35. Since the oil chamber 17 is maintained under negative pressure at this point, the excess oil in the valve chamber 18 is sucked into and collected in the negatively pressured oil chamber 17 via the two independent oil collection passages 51 and 52 with differing inlet/outlet positions., while the excess oil in the crankcase 15 is also returned to the oil chamber 17 via the three fine holes 45, 45, 45 formed in the baffle 16.

[0041] Thus, by having the oil chamber 17 be negatively pressured, it is possible to confer flow directionality to each of the oil passages, and oil collection becomes possible regardless of the attitude of the engine 10 (e.g., upright, inclined, inverted, etc.). It is noted that since both the gas and liquid portions within the oil chamber 17 are negatively pressured, the positional freedom of the respective outlets (downstream end portions) 51b and 52b of the oil collection passages 51 and 52 (i.e., the freedom of passage layout) is extremely high, thereby enabling omnidirectional operation.

[0042] Thus, according to a lubrication device of the present embodiment, various parts can be appropriately lubricated regardless of engine attitude, the capability for collecting the excess oil within the valve chamber 18 and the capability for supplying oil to the various parts can be improved, and oil leakage from the breather port (blow-by gas discharge port) 19 provided in the valve chamber 18 can be prevented reliability.

[0043] In addition, by virtue of the thus improved oil collection capability, oil can be adequately fed to the various parts (i.e., oil circulation flow rate is increased), as a result of which it is possible to improve lubrication, while at the same time improving cooling for the various parts of the engine.

[0044] Further, if the two oil collection passages 51 and 52 are integrated (merged) midway, gas is sometimes sucked in more readily than liquid when one of them sucks gas in, thereby making oil collection difficult. However, by independently providing the two oil collection passages 51 and 52 with differing inlet/outlet positions as in the present embodiment, oil collection becomes possible without compromising the suction capa-

bility of each of the oil collection passages 51 and 52.

[0045] In addition, since the three fine holes 45 (insensitive to positive pressure but sensitive to negative pressure) are formed in the baffle 16, which separates the oil chamber 17 and the crankcase 15, as oil returning means for returning the excess oil within the crankcase 15 to the oil chamber 17 utilizing the negative pressure of the oil chamber 17, it is possible to achieve overall simplification, cost reduction, etc., as compared to cases in which other oil returning means, such as valve devices, etc., are employed.

Claims

1. A four-stroke internal combustion engine lubrication device comprising:

   a cylinder portion into which a piston is inserted;
   a valve chamber formed above the cylinder portion;
   a crankcase formed below the cylinder portion; and
   an oil chamber formed at the outer circumference of the crankcase, wherein
   oil within the oil chamber is caused to flow into the crankcase in mist form utilizing an up/down motion of the piston, and
   the four-stroke internal combustion engine lubrication device further comprises:

      a one-way valve configured to allow oil flow from the oil chamber into the crankcase, but prevent oil flow from the crankcase to the oil chamber;
      an oil supply passage configured to supply oil from the crankcase to the valve chamber; and
      a plurality of independent oil collection passages with differing inlet/outlet positions, the oil collection passages configured to collect in the oil chamber excess oil in the valve chamber, wherein
      dimensions of each part are so designed that the oil chamber would be constantly maintained under negative pressure during operation, and
      excess oil within the crankcase is returned to the oil chamber utilizing the negative pressure of the oil chamber.

2. The four-stroke internal combustion engine lubrication device according to claim 1 wherein the one-way valve is a reed valve.

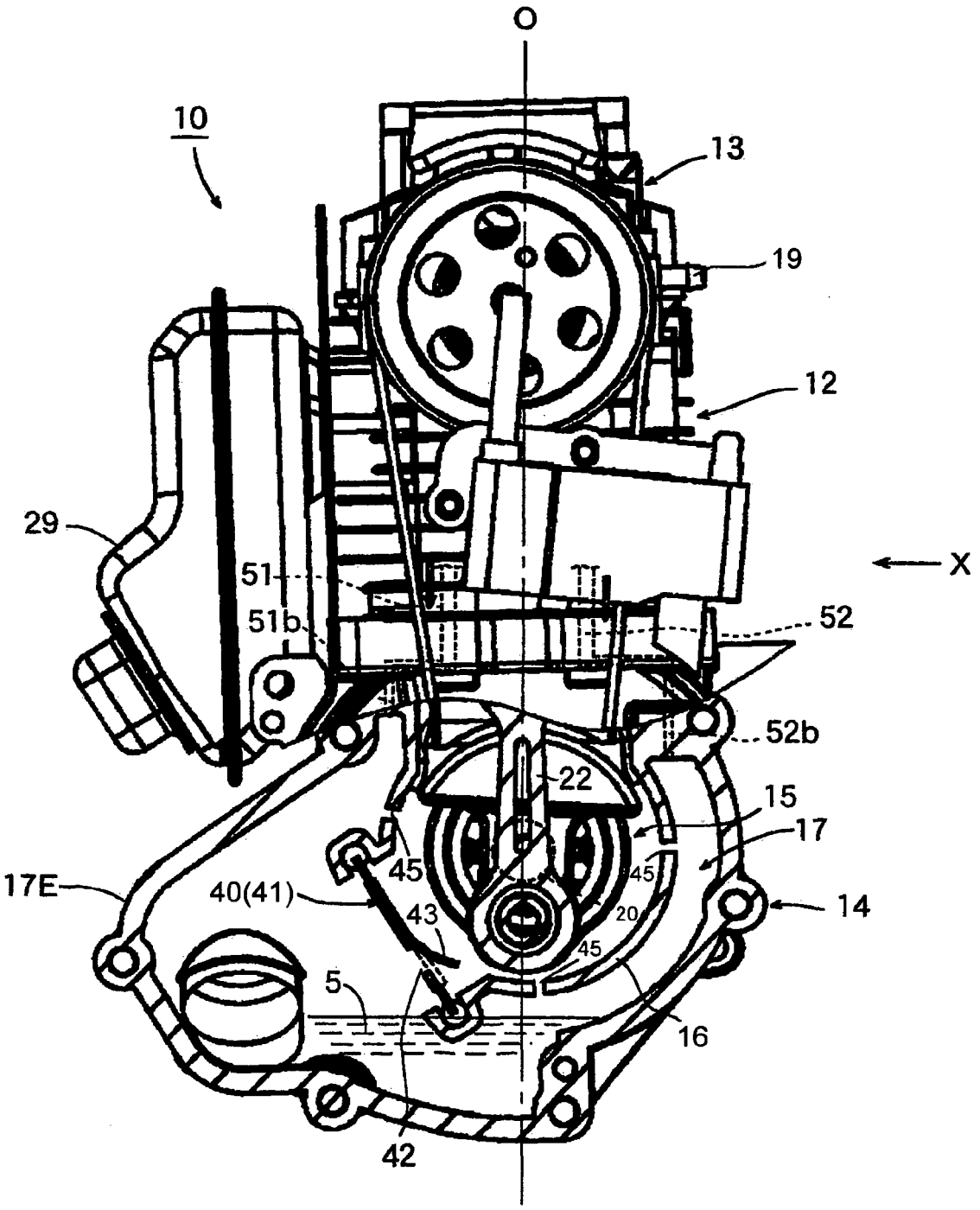
3. The four-stroke internal combustion engine lubrication device according to claim 1 or 2, wherein the oil chamber is disposed adjacent to the crankcase in such a manner as to surround the crankcase with a baffle in-between, and
   a predetermined number of fine holes are formed in the baffle in order to return the excess oil within the crankcase to the oil chamber utilizing the negative pressure of the oil chamber.

4. The four-stroke internal combustion engine lubrication device according to claim 1 wherein, in order to improve capability for sucking oil into the oil chamber and to prevent backflow, an effective passage sectional area of the narrowest portion of each of the oil collection passages is set to or below a predetermined value.

5. The four-stroke internal combustion engine lubrication device according to claim 1 wherein an oil mist within the crankcase is suppliled to the valve chamber via an L-shaped passage portion formed within a crankshaft, a gas-liquid separation chamber provided at the outer circumference thereof, and the oil supply passage.

6. The four-stroke internal combustion engine lubrication device according to claim 2 wherein
   a valve opening in the reed valve is disposed at a position that is set apart from the engine centerline by a predetermined distance in a predetermined direction below the crankshaft, and
   in conjunction therewith, the shape of the oil chamber that surrounds the crankcase is so configured as to comprise, so that the valve opening in the reed valve would assume a position above the level of the oil within the oil chamber regardless of engine attitude, an expansive bulging portion configured to protrude further outward, as compared to other sides, on a side below the crankshaft and where the valve opening in the reed valve is located relative to the engine centerline.

FIG. 1



When piston is rising: Reed valve 40 is open
When piston is descending: Reed valve 40 is closed

FIG. 2

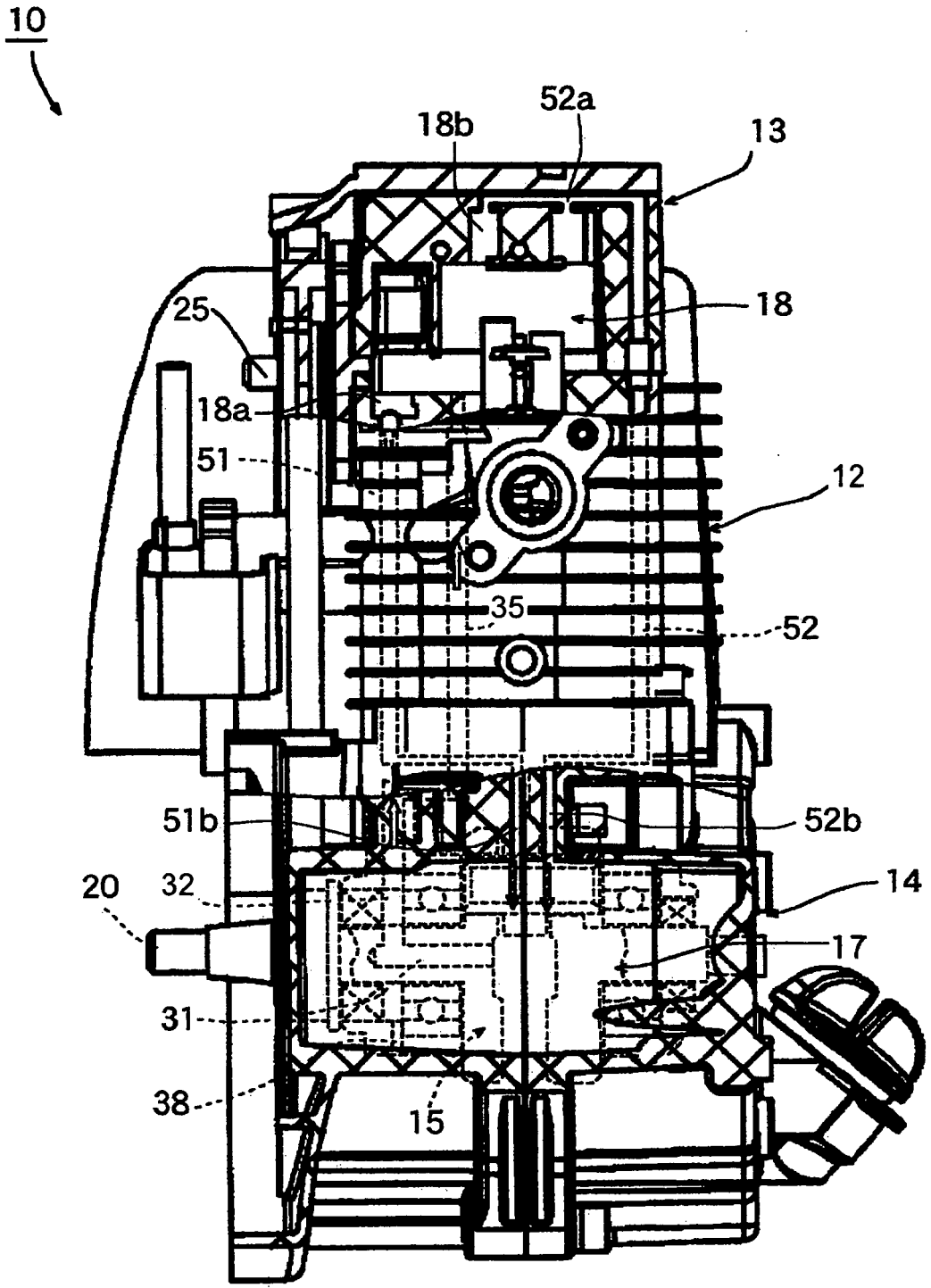
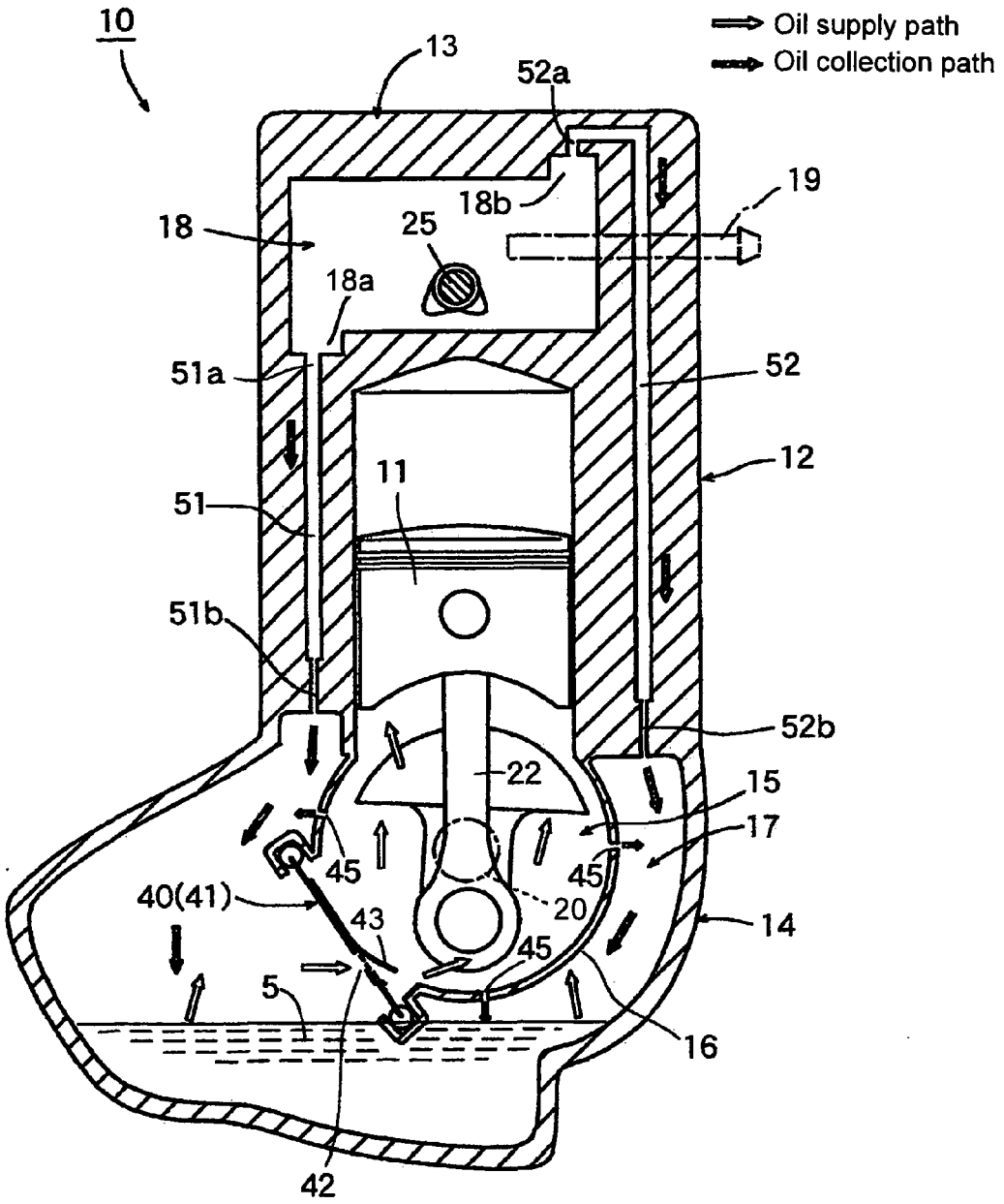
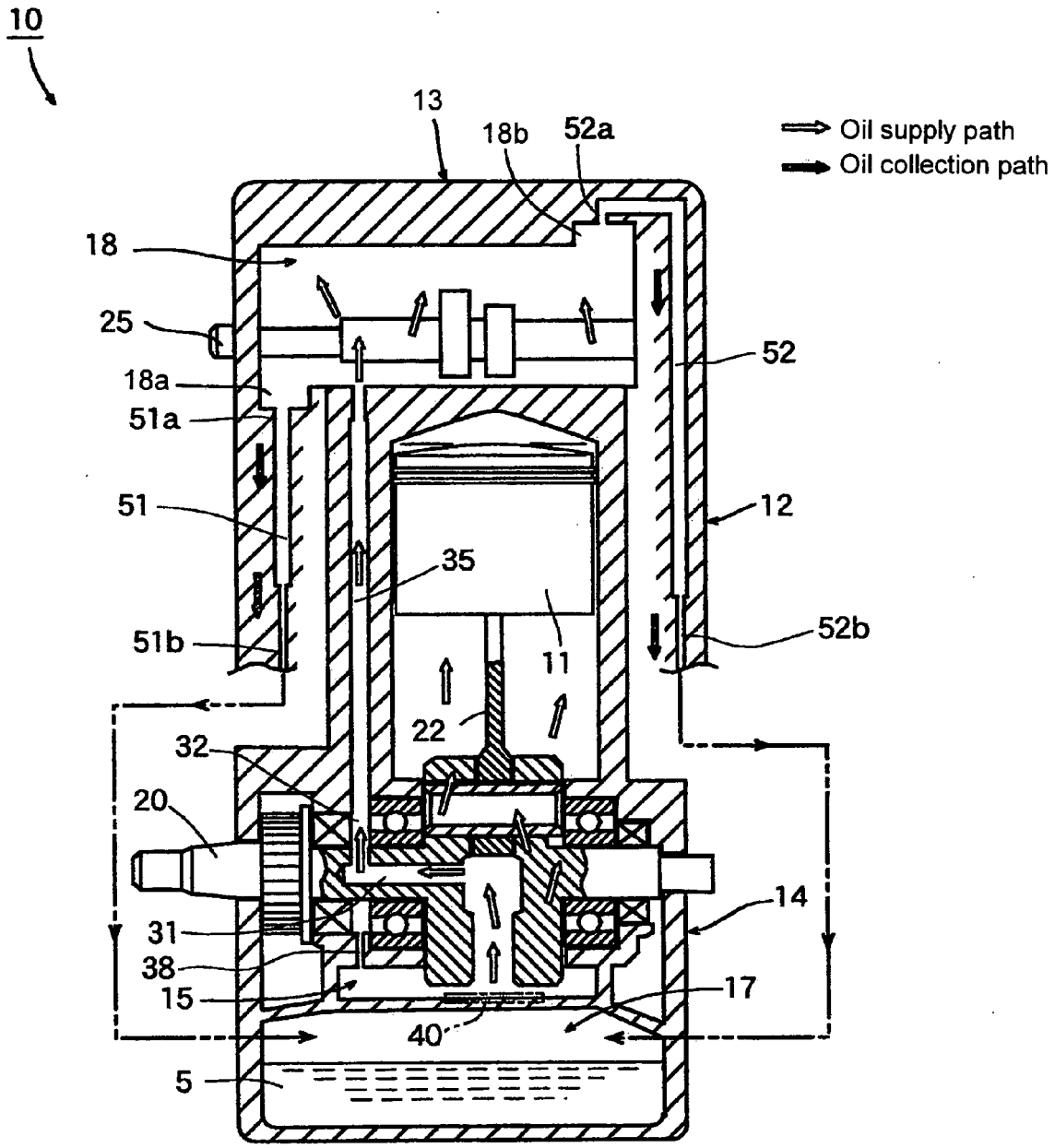


FIG. 3



When piston is rising: Reed valve 40 is open
When piston is descending: Reed valve 40 is closed

FIG. 4


10
13
18b
52a
Oil supply path
Oil collection path
18
25
18a
51a
51
51b
52
12
35
11
52b
22
32
20
31
38
15
14
17
40
5

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 10 01 4354

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2009/272360 A1 (LI SHAO-YU [TW] ET AL) 5 November 2009 (2009-11-05) * the whole document *	1-6	INV. F01M1/04 F01M1/06 F01M11/00
A	EP 2 103 786 A2 (SANYANG INDUSTRY CO LTD [TW]) 23 September 2009 (2009-09-23) * paragraphs [0014] - [0026]; figures *	1-6	
A	US 2009/283067 A1 (KURIHARA KATSUMI [JP] ET AL) 19 November 2009 (2009-11-19) * paragraphs [0023] - [0054]; figures 1,2 *	1-6	
A	FR 1 085 991 A (VOISIN) 8 February 1955 (1955-02-08) * the whole document *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC) F01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	17 March 2011	Vedoato, Luca

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 10 01 4354

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.

17-03-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2009272360 A1	05-11-2009	NONE	
EP 2103786 A2	23-09-2009	US 2009235894 A1	24-09-2009
US 2009283067 A1	19-11-2009	NONE	
FR 1085991 A	08-02-1955	NONE	

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

- JP 2002188423 A **[0002]**
- JP 11036839 A **[0003]**