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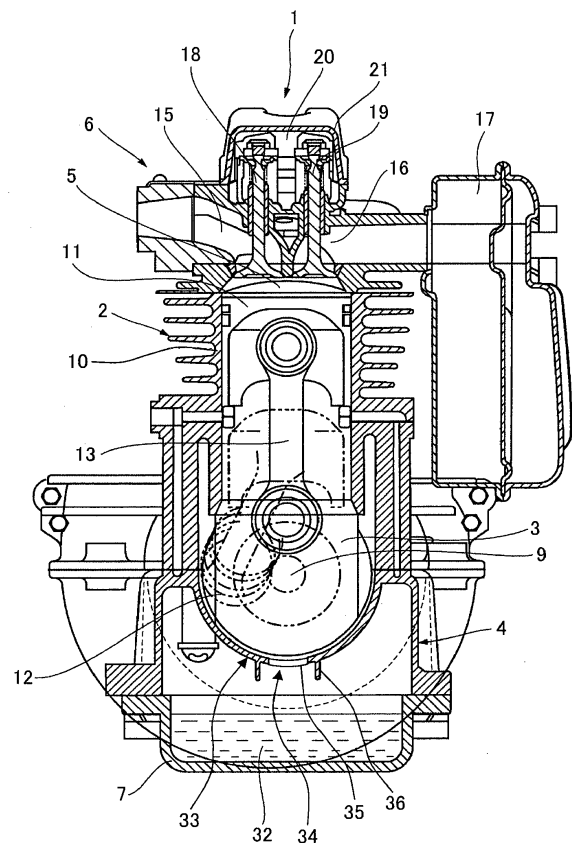
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(54) **LUBRICATING DEVICE FOR ENGINE**

(57) A lubricating device for an engine is provided. A first opening part (35) penetrates a first partition wall (33) separating a crank chamber (3) and an oil sump chamber (32). A second opening part (45) penetrates a second partition wall (42) separating the crank chamber (3) and a valve drive chamber (30). In a lubricating device (50) for an engine (1), when the pressure in the crank chamber (3) is positive, gas in the crank chamber (3) is injected into the oil sump chamber (32) through the first opening part (35) and impacts oil, thus generating mist oil in the oil sump chamber (32), and mist oil in the crank chamber (3) passes through the second opening part (45) and is supplied to the valve drive chamber (30), whereas when the pressure in the crank chamber (3) is negative, mist oil in the oil sump chamber (32) passes through the first opening part (35) and is supplied to the crank chamber (3).

**FIG. 3**



## Description

### BACKGROUND OF THE INVENTION

#### 1. FIELD OF THE INVENTION

**[0001]** The present invention relates to a lubricating device for an engine (internal combustion engine) that can be installed in a portable work machine or the like.

#### 2. DESCRIPTION OF RELATED ART

**[0002]** An engine installed in a portable work machine, such as a brush/weed cutter, may include a crank chamber, the pressure in which varies as a piston moves up and down, and an oil sump chamber which is disposed beneath the crank chamber and that stores a lubricating oil. Such an engine is disclosed in Japanese Patent Application Laid-open Publication No. 2004-293448. According to the Japanese Patent Application Laid-open Publication No. 2004-293448, a crank chamber and an oil sump chamber are in communication through an opening part, and the mist oil generated in the oil sump chamber is supplied to the crank chamber through the opening part.

**[0003]** However, according to the Japanese Patent Application Laid-open Publication No. 2004-293448, the opening area of the opening part, which provides the communication between the crank chamber and the oil sump chamber, is relatively large. Hence, a gas in the crank chamber is supplied extensively in the oil sump chamber through the opening part when the pressure in the crank chamber is a positive pressure, so that a force (pressure) of the gas impacting the surface of the oil is relatively low. Therefore, according to the Japanese Patent Application Laid-open Publication No. 2004-293448, it has been difficult to generate sufficient mist oil in the oil sump chamber.

**[0004]** In view of such circumstances, an object of the present invention is to efficiently generate mist oil in an oil sump chamber.

#### SUMMARY OF THE INVENTION

**[0005]** According to one aspect of the present invention, there is provided a lubricating device for an engine, including: a crank chamber, a pressure in which varies as a piston moves up and down; an oil sump chamber which is disposed beneath the crank chamber and that stores a lubricating oil; and a valve drive chamber which is disposed on a side of the crank chamber and that accommodates drive components of each valve mechanism for intake and exhaust. The lubricating device for an engine further includes: a first partition wall that separates the crank chamber and the oil sump chamber; a second partition wall that separates the crank chamber and the valve drive chamber; a first opening part that penetrates the first partition wall and provides communi-

cation between the crank chamber and the oil sump chamber; and a second opening part that penetrates the second partition wall and provides communication between the crank chamber and the valve drive chamber.

In the lubricating device for an engine, when the pressure in the crank chamber is a positive pressure, a gas in the crank chamber is injected into the oil sump chamber through the first opening part and impacts the oil in the oil sump chamber thereby to generate a mist oil in the oil sump chamber, and a mist oil in the crank chamber passes through the second opening part and is supplied to the valve drive chamber. In the lubricating device for an engine, when the pressure in the crank chamber is a negative pressure, the mist oil in the oil sump chamber passes through the first opening part and is supplied to the crank chamber.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]**

FIG. 1 is a perspective view of an engine according to an embodiment of the present invention;

FIG. 2 is a plan view of the engine according to the embodiment;

FIG. 3 is a sectional view taken at line I-I in FIG. 2;

FIG. 4 is a partial perspective view of a crank case of the engine according to the embodiment when the crank case is observed from the oil sump chamber side;

FIG. 5 is a view illustrating a bearing that rotatably supports a crank shaft of the engine according to the embodiment; and

FIG. 6 is a schematic explanatory diagram of a lubricating device of the engine according to the embodiment.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0007]** The following will describe an embodiment of the present invention with reference to the accompanying drawings.

**[0008]** FIG. 1 and FIG. 2 are a perspective view and a plan view, respectively, of an engine according to an embodiment of the present invention. FIG. 3 is a sectional view taken at line I-I in FIG. 2. FIG. 3 illustrates the engine when a piston is positioned near a top dead center. Furthermore, as used in the present embodiment, "upper side" approximately coincides with a vertical upper side in a state in which the engine is used over a longest period of time (erect state).

**[0009]** An engine 1 is an overhead valve (OHV) 4-stroke, air-cooled engine. The engine 1 has a cylinder block 2, a crank case 4, and a cylinder head 6. The crank case 4 is disposed on one end (the lower end) in the longitudinal direction of the cylinder block 2 and constitutes a crank chamber 3. The cylinder head 6 is disposed on the other end (the upper end) in the longitudinal di-

rection of the cylinder block 2 and constitutes, together with the cylinder block 2, a combustion chamber 5.

**[0010]** In the present embodiment, the cylinder block 2, the crank case 4, and the cylinder head 6, which are all provided separately, are connected by bolts. An oil case 7 for storing a lubricating oil is connected to the lower end of the crank case 4.

**[0011]** The crank case 4 is provided at the lower end of the cylinder block 2. The cylinder block 2 and the crank case 4 rotatably support a crank shaft 9. More specifically, both ends of the crank shaft 9 are disposed so that the ends project out of the crank chamber 3 formed inside the crank case 4. In the present embodiment, both ends of the crank shaft 9 projecting out of the crank chamber 3 are held between the cylinder block 2 and the crank case 4, and are rotatably supported thereby. Furthermore, in the present embodiment, one end of the crank shaft 9 (namely, the end adjacent to a valve drive chamber 30, which will be described below) is rotatably supported by the cylinder block 2 and the crank case 4 via a bearing 40, which will be described below. This will be described below in more detail with reference to FIG. 5.

**[0012]** A cylinder 10 having a columnar space is provided in the cylinder block 2. A piston 11 is inserted in the cylinder 10 such that the piston 11 can reciprocate in the vertical direction. The piston 11 is connected to the crank shaft 9 of the crank chamber 3 via a crank web 12 and a connecting rod 13. Thus, the reciprocating motion of the piston 11 is converted into the rotational motion of the crank shaft 9. Furthermore, the reciprocation of the piston 11 also changes the pressure (air pressure) in the crank chamber 3.

**[0013]** The cylinder head 6 is provided with an intake port 15 and an exhaust port 16. The intake port 15 is in communication with a carburetor (not illustrated). The exhaust port 16 is in communication with a muffler 17. Furthermore, the cylinder head 6 is provided with an intake valve 18, which opens and closes the intake port 15, and an exhaust valve 19, which opens and closes the exhaust port 16.

**[0014]** Furthermore, the cylinder head 6 includes a valve system chamber 20, which accommodates the intake valve 18 and the exhaust valve 19. The valve system chamber 20 is formed of the cylinder head 6 and a valve system chamber cover 21.

**[0015]** The intake valve 18 and the exhaust valve 19 are provided with a valve mechanism 25 (refer to FIG. 6) for driving the intake valve 18 and the exhaust valve 19. The valve mechanism 25 includes a valve drive gear 26, a cam gear 27, a cam 28, a pair of cam followers (not illustrated), a pair of pushrods (not illustrated), and valve springs (not illustrated). The valve drive gear 26 is fixed to the crank shaft 9. The cam gear 27 is driven by the valve drive gear 26. The cam 28 is provided on one end of the cam gear 27. The pair of cam followers is swung by the cam 28 and rotatably supported by the cylinder block 2. The pair of pushrods is supported by a rocker shaft (not illustrated) provided on the head of the cylinder

block 2, one ends thereof being in contact with the valve heads of the intake valve 18 and the exhaust valve 19. The valve springs urge the intake valve 18 and the exhaust valve 19 in a valve closing direction.

**[0016]** Among the sections constituting the valve mechanism 25, the valve drive gear 26, the cam gear 27, and the cam 28 are accommodated in the valve drive chamber 30. The valve drive chamber 30 is disposed on a side of the crank chamber 3. The valve drive chamber 30 is composed of the cylinder block 2, the crank case 4, and a valve drive chamber cover (not illustrated). Among the sections constituting the valve mechanism 25, the pushrods and the valve springs are accommodated in the valve system chamber 20. The valve system chamber 20 is disposed above the combustion chamber 5.

**[0017]** The valve mechanism 25 corresponds to "each valve mechanism for intake and exhaust" in the present invention. Furthermore, the valve drive gear 26, the cam gear 27, and the cam 28 correspond to "the drive components of each valve mechanism for intake and exhaust" in the present invention.

**[0018]** The oil case 7 is formed of a casing surrounding all sides and the bottom. By attaching the oil case 7 to the crank case 4, an oil sump chamber 32 is formed by the cases 4 and 7. A lubricating oil is stored in the oil sump chamber 32. A semi-cylindrical part of the crank case 4 rotatably accommodates the crank shaft 9, and the semi-cylindrical part provides a first partition wall 33, which separates the crank chamber 3 and the oil sump chamber 32.

**[0019]** FIG. 4 is a partial perspective view of the crank case 4 of the engine 1 according to the present embodiment when the crank case 4 is observed from the oil sump chamber 32 side.

**[0020]** As illustrated in FIG. 3 and FIG. 4, the crank chamber 3 and the oil sump chamber 32 are separated by the first partition wall 33. The first partition wall 33 has a semi-cylindrical shape. More specifically, the first partition wall 33 functions to rotatably accommodate the crank web 12, which is accommodated in the crank chamber 3, on the crank chamber 3 side, thus providing a curved surface part bulging toward the oil sump chamber 32. A central portion 34 of the curved surface part bulges most toward the oil sump chamber 32.

**[0021]** A first opening part 35, which provides communication between the crank chamber 3 and the oil sump chamber 32 is penetratingly formed in the central portion 34 of the semi-cylindrical first partition wall 33. The first opening part 35 is positioned within a projection plane of the piston 11 in the first partition wall 33. In other words, the first opening part 35 is penetratingly formed in an area hidden by the piston 11 when the first partition wall 33 is observed from the combustion chamber 5 side.

**[0022]** The first opening part 35 is preferably positioned right below the central portion of the piston 11. In other words, the central axis of the first opening part 35 and the central axis of the piston 11 are preferably positioned

on the same axial line.

**[0023]** The opening area of the first opening part 35 is preferably within a range of from 3% up to 40% of the cross-sectional area of the piston 11, and more preferably within a range of from 5% up to 35% of the cross-sectional area of the piston 11. The cross-sectional area of the piston 11 refers to the cross-sectional area of the piston 11 in a plane that is orthogonal to the direction of the reciprocation of the piston 11 (i.e., the central axis of the piston 11).

**[0024]** Although the shape of the cross-section of the first opening part 35 is rectangular in the present embodiment, the shape of the cross-section of the first opening part 35 is not limited thereto, and may be, for example, circular.

**[0025]** Furthermore, the first opening part 35 in the present embodiment is composed of the single through hole; however, the first opening part 35 may alternatively be composed of two or more through holes. If the first opening part 35 is composed of two or more through holes, then the total sum of the opening areas of the two or more through holes, i.e. the total opening area, is preferably within a range of from 3% up to 40% of the cross-sectional area of the piston 11, and more preferably within a range of from 5% up to 35% of the cross-sectional area of the piston 11.

**[0026]** A tubular section 36 is provided, surrounding the first opening part 35, at the lower surface of the semi-cylindrical first partition wall 33. The tubular section 36 projects downward from the lower surface of the first partition wall 33. In the present embodiment, the tubular section 36 has a rectangular cross-sectional shape. Alternatively, however, the cross-section of the tubular section 36 is not limited to the rectangular shape, and may be, for example, a circular shape.

**[0027]** FIG. 5 illustrates the bearing 40 that rotatably supports the crank shaft 9 of the engine 1 according to the present embodiment. The crank chamber 3 and the valve drive chamber 30 are separated by a second partition wall 42. The second partition wall 42 is composed of the cylinder block 2 and the crank case 4.

**[0028]** In the second partition wall 42, an upper opening part 43 having a semicircular cross-section is formed in the lower end of the cylinder block 2. In the second partition wall 42, a lower opening part 44 having a semicircular cross-section is formed in the upper end of the crank case 4.

**[0029]** A second opening part 45 is composed of the semicircular upper opening part 43 and the semicircular lower opening part 44 and has a circular cross-sectional shape. The second opening part 45 penetrates the second partition wall 42, providing communication between the crank chamber 3 and the valve drive chamber 30.

**[0030]** The bearing 40 is inserted in the second opening part 45 of the second partition wall 42. In other words, the bearing 40 is provided in the second opening part 45 of the second partition wall 42. The bearing 40 is an open ball bearing, which has a gap between the inner ring and

the outer ring thereof and has gaps among a plurality of balls thereof. Thus, the bearing 40 allows the passage of a mist oil, which is a mist-like oil.

**[0031]** The bearing 40 has one end of the crank shaft 9 (the end on the valve drive chamber 30 side) inserted in the inner ring thereof to rotatably support the crank shaft 9. Hence, the one end of the crank shaft 9 (the end on the valve drive chamber 30 side) is rotatably supported by the cylinder block 2 and the crank case 4 via the bearing 40. A valve drive gear 26 is fixed to a portion of the one end of the crank shaft 9 that is positioned in the valve drive chamber 30. FIG. 5 does not illustrate the cam gear 27 driven by the valve drive gear 26.

**[0032]** Referring now to FIG. 6, a description will be given of a lubricating device 50 of the engine 1 according to the present embodiment. FIG. 6 is a schematic explanatory diagram of the lubricating device 50 of the engine 1 according to the present embodiment. The lubricating device 50 of the engine 1 utilizes the changes in the pressure in the crank chamber 3 caused by the reciprocation of the piston 11 to circulate the oil stored in the oil sump chamber 32, thereby lubricating each section of the engine 1.

**[0033]** A circulation path 61 for circulating the oil is provided between the oil sump chamber 32 and the valve system chamber 20. The circulation path 61 includes the first opening part 35, the second opening part 45, the valve drive chamber 30, the valve system chamber 20, an oil feed passage 62, and the crank chamber 3.

**[0034]** If the piston 11 moves toward the top dead center, causing the pressure in the crank chamber 3 to become a negative pressure, then the mist oil in the oil sump chamber 32 passes through the first opening part 35 and is supplied to the crank chamber 3. Thereafter, if the piston 11 moves toward a bottom dead center, causing the pressure in the crank chamber 3 to become a positive pressure, then the mist oil in the crank chamber 3 passes through the second opening part 45 and is supplied to the valve drive chamber 30 and the valve system chamber 20.

**[0035]** The bearing 40 is provided in the second opening part 45 (refer to FIG. 5). With this arrangement, mist oil droplets having relatively large diameters among the mist oil droplets in the crank chamber 3 are blocked by the bearing 40, thus restricting their passage to the valve drive chamber 30 from the crank chamber 3. Meanwhile, among the mist oil droplets in the crank chamber 3, mist oil droplets having relatively small diameters pass through the gap between the inner ring and the outer ring of the bearing 40 and through the gaps among the plurality of balls of the bearing 40, and are supplied to the valve drive chamber 30. Thus, the valve drive gear 26, the cam gear 27, the cam 28, the pushrods, and the valve springs constituting the valve mechanism 25 are lubricated by the mist oil flowing through the circulation path 61.

**[0036]** A suction passage 64 through which the oil in the valve system chamber 20 is drawn in is provided in-

side the valve system chamber 20. The oil feed passage 62 is provided between the suction passage 64 and the crank chamber 3. The oil feed passage 62 has the open end on one side thereof connected to the suction passage 64 and the open end on the other side thereof connected to the crank chamber 3. The open end on the other side of the oil feed passage 62 is positioned such that the open end is fully opened when the piston 11 reaches the top dead center.

**[0037]** When the pressure in the crank chamber 3 becomes a negative pressure due to the movement of the piston 11 to the top dead center, the mist oil in the valve system chamber 20 is drawn in through the opening of the oil feed passage 62 and fed into the crank chamber 3 through the suction passage 64 and the oil feed passage 62. The oil fed into the crank chamber 3 is returned into the oil sump chamber 32 through the first opening part 35.

**[0038]** A discharge passage 65 for discharging the blow-by gas in the oil circulation path to the combustion chamber 5 is provided inside the valve system chamber 20. One end 66 of the discharge passage 65 is provided in the valve system chamber 20, while the other end thereof is connected to an air cleaner 67. The air cleaner 67 is provided on the upstream side of the above-mentioned carburetor and functions to remove dust and the like in the air.

**[0039]** The blow-by gas containing oil, which has been sent to the air cleaner 67, is subjected to the gas-liquid separation to be separated to the blow-by gas and oil by an oil separator 68 provided in the air cleaner 67. The separated oil passes through a reflux passage 70, which provides communication between the air cleaner 67 and the crank chamber 3, to be sent to the crank chamber 3. The open end of the reflux passage 70 on the crank chamber 3 side is positioned such that the open end is fully opened when the piston 11 reaches the top dead center. Hence, when the pressure in the crank chamber 3 becomes a negative pressure due to the movement of the piston 11 to the top dead center, the oil separated by the oil separator 68 is drawn through the reflux passage 70 and fed into the crank chamber 3. Meanwhile, the blow-by gas separated by the oil separator 68 is burnt in the combustion chamber 5 and then discharged to the outside through the muffler 17.

**[0040]** When the pressure in the crank chamber 3 becomes a positive pressure due to the movement of the piston 11 to the bottom dead center, a high-pressure gas in the crank chamber 3 is injected into the oil sump chamber 32 through the first opening part 35. In other words, the gas in the crank chamber 3 that is pushed out as the piston 11 moves to the bottom dead center is injected into the oil sump chamber 32 through the first opening part 35. The injected gas impacts the oil in the oil sump chamber 32. The high-pressure gas from the crank chamber 3 blown onto the oil surface in the oil sump chamber 32 in the manner described above expedites the misting of the oil in the oil sump chamber 32, thus

efficiently generating a mist oil in the oil sump chamber 32.

**[0041]** If the opening area of the first opening part 35 is unduly large, then it becomes difficult to cause the gas in the crank chamber 3 to vigorously impact the surface of the oil in the oil sump chamber 32 through the first opening part 35. This may lead to unsuccessful generation of a mist oil. Meanwhile, if the opening area of the first opening part 35 is unduly small, then the crank chamber 3 functions like a pump, and the output of the engine 1 may be reduced. Thus, the upper limit value of the opening area of the first opening part 35 can be set, considering the efficiency of the generation of the mist oil in the oil sump chamber 32. Furthermore, the lower limit value of the opening area of the first opening part 35 can be set, considering the output required of the engine 1. Taking these into account, the opening area of the first opening part 35 is preferably within a range of from 3% up to 40% of the cross-sectional area of the piston 11, and more preferably within a range of from 5% up to 35% of the cross-sectional area of the piston 11.

**[0042]** According to the present embodiment, the lubricating device 50 of the engine 1 includes: the crank chamber 3, the pressure inside which varies as the piston 11 moves up and down; the oil sump chamber 32 which is disposed below the crank chamber 3 and that stores a lubricating oil; the valve drive chamber 30 which is disposed on the side of the crank chamber 3 and that accommodates the drive components of each valve mechanism for the intake and the exhaust; the first partition wall 33 that separates the crank chamber 3 and the oil sump chamber 32; the second partition wall 42 that separates the crank chamber 3 and the valve drive chamber 30; the first opening part 35 that penetrates the first partition wall 33 and provides communication between the crank chamber 3 and the oil sump chamber 32; and the second opening part 45 that penetrates the second partition wall 42 and provides communication between the crank chamber 3 and the valve drive chamber 30. In the lubricating device 50 of the engine 1, when the pressure in the crank chamber 3 is a positive pressure, the gas in the crank chamber 3 is injected through the first opening part 35 into the oil sump chamber 32 and impacts the oil in the oil sump chamber 32 thereby to generate the mist oil in the oil sump chamber 32, and the mist oil in the crank chamber 3 passes through the second opening part 45 and is supplied to the valve drive chamber 30. In the lubricating device 50 of the engine 1, when the pressure in the crank chamber 3 is a negative pressure, the mist oil in the oil sump chamber 32 passes through the first opening part 35 and is supplied to the crank chamber 3. Thus, the high-pressure gas from the crank chamber 3 is blown onto the oil surface in the oil sump chamber 32 so as to disturb the oil surface. This makes it possible to expedite the misting of the oil in the oil sump chamber 32, thus efficiently generating a mist oil in the oil sump chamber 32.

**[0043]** Furthermore, according to the present embod-

iment, the first opening part 35 is positioned in the projection plane of the piston 11 in the first partition wall 33. Therefore, the high-pressure gas generated in the crank chamber 3 by the reciprocation of the piston 11 can be vigorously blown, through the first opening part 35, onto the oil surface in the oil sump chamber 32 to disturb the oil surface, thus permitting more efficient generation of the mist oil in the oil sump chamber 32.

**[0044]** Furthermore, according to the present embodiment, the opening area of the first opening part 35 is within a range of from 3% up to 40% of the cross-sectional area of the piston 11. This allows the mist oil to be efficiently generated in the oil sump chamber 32 and also allows the output required of the engine 1 to be ensured.

**[0045]** Furthermore, according to the present embodiment, the first partition wall 33 has the tubular section 36, which projects downward from the lower surface of the first partition wall 33 and which surrounds the first opening part 35. This makes it possible to restrain the oil in the oil sump chamber 32 from excessively flowing into the crank chamber 3 through the first opening part 35 during, for example, an inverted operation of the engine 1.

**[0046]** Furthermore, according to the present embodiment, the bearing 40 rotatably supporting the crank shaft 9 is provided in the second opening part 45. The bearing 40 is an open ball bearing, which permits the passage of the mist oil. Hence, mist oil droplets having relatively small diameters among the mist oil droplets in the crank chamber 3 pass through the gap between the inner ring and the outer ring of the bearing 40 and through the gaps among the plurality of balls of the bearing 40, and are supplied to the valve drive chamber 30, thus making it possible to restrain oversupply of the oil to the valve drive chamber 30 and the valve system chamber 20.

**[0047]** In the present embodiment, the dimensions, the opening area, the shape and the like of the first opening part 35 may be set based on the volume of the stroke of the vertical movement of the piston 11 in the cylinder 10 (cylinder capacity) of the engine 1.

**[0048]** Furthermore, in the present embodiment, the flow velocity of the gas injected through the first opening part 35 into the oil sump chamber 32 and blown onto the surface of the oil in the oil sump chamber 32 (i.e. the blowoff velocity of the gas at the first opening part 35) is preferably within a range of from 1,000 cm/s up to 10,000 cm/s, and more preferably within a range of from 1,500 cm/s up to 8,000 cm/s. Setting the blowoff velocity of the gas at the first opening part 35 to the ranges mentioned above permits efficient generation of the mist oil in the oil sump chamber 32.

**[0049]** Furthermore, the engine 1 in the present embodiment can be installed, as a drive source, in a portable work machine, such as a brush/weed cutter, a hole digging machine, or a concrete cutter. Furthermore, the engine 1 can be installed, as a drive source, in a backpack work machine, such as a backpack blower, a sprayer, a duster, or a backpack brush/weed cutter.

**[0050]** In the lubricating device for an engine according

to the present invention, the mist oil is generated in the oil sump chamber by a gas in the crank chamber being injected into the oil sump chamber through the first opening part and impacting the oil in the oil sump chamber when the pressure in the crank chamber is a positive pressure. This makes it possible to expedite the generation of the mist oil (misting) in the oil sump chamber by blowing the high-pressure gas from the crank chamber onto the surface of the oil in the oil sump chamber, so that the mist oil can be efficiently generated in the oil sump chamber.

**[0051]** Although the embodiment of the present invention has been described, the present invention is not limited to the foregoing embodiment, and it is obvious that more modifications, changes and the like can be made on the basis of the technical idea of the present invention.

## Claims

1. A lubricating device (50) for an engine (1), comprising: a crank chamber (3), a pressure in which varies as a piston (11) moves up and down; an oil sump chamber (32) which is disposed below the crank chamber (3) and that stores a lubricating oil; and a valve drive chamber (30) which is disposed on a side of the crank chamber (3) and that accommodates drive components (26, 27 and 28) of each valve mechanism (25) for intake and exhaust, **characterized in that** the lubricating device (50) further comprises:

a first partition wall (33) that separates the crank chamber (3) and the oil sump chamber (32);

a second partition wall (42) that separates the crank chamber (3) and the valve drive chamber (30);

a first opening part (35) that penetrates the first partition wall (33) and provides communication between the crank chamber (3) and the oil sump chamber (32); and

a second opening part (45) that penetrates the second partition wall (42) and provides communication between the crank chamber (3) and the valve drive chamber (30),

wherein, in the case in which a pressure in the crank chamber (3) is a positive pressure, a gas in the crank chamber (3) is injected into the oil sump chamber (32) through the first opening part (35) and impacts an oil in the oil sump chamber (32) thereby to generate a mist oil in the oil sump chamber (32), and a mist oil in the crank chamber (3) passes through the second opening part (45) and is supplied to the valve drive chamber (30), and

in the case in which the pressure in the crank chamber (3) is a negative pressure, the mist oil in the oil sump chamber (32) passes through the

first opening part (35) and is supplied to the crank chamber (3).

2. The lubricating device (50) for the engine (1) according to claim 1,  
wherein the first opening part (35) is positioned in a projection plane of the piston (11) in the first partition wall (33). 5
3. The lubricating device (50) for the engine (1) according to claim 1 or 2,  
wherein an opening area of the first opening part (35) is within a range of from 3% up to 40% of a cross-sectional area of the piston (11). 10  
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4. The lubricating device (50) for the engine (1) according to any one of claims 1 to 3,  
wherein a flow velocity of the gas injected through the first opening part (35) into the oil sump chamber (32) and blown onto an oil surface in the oil sump chamber (32) is within a range of from 1,000 cm/s up to 10,000 cm/s. 20
5. The lubricating device (50) for the engine (1) according to any one of claims 1 to 4,  
wherein the first partition wall (33) has a tubular section (36) that projects downward from a lower surface of the first partition wall (33) such that the tubular section (36) surrounds the first opening part (35). 25  
30
6. The lubricating device (50) for the engine (1) according to any one of claims 1 to 5,  
wherein a bearing (40) that rotatably supports a crank shaft (9) is provided in the second opening part (45), and 35  
the bearing (40) is an open ball bearing that allows passage of the mist oil. 40  
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FIG. 1

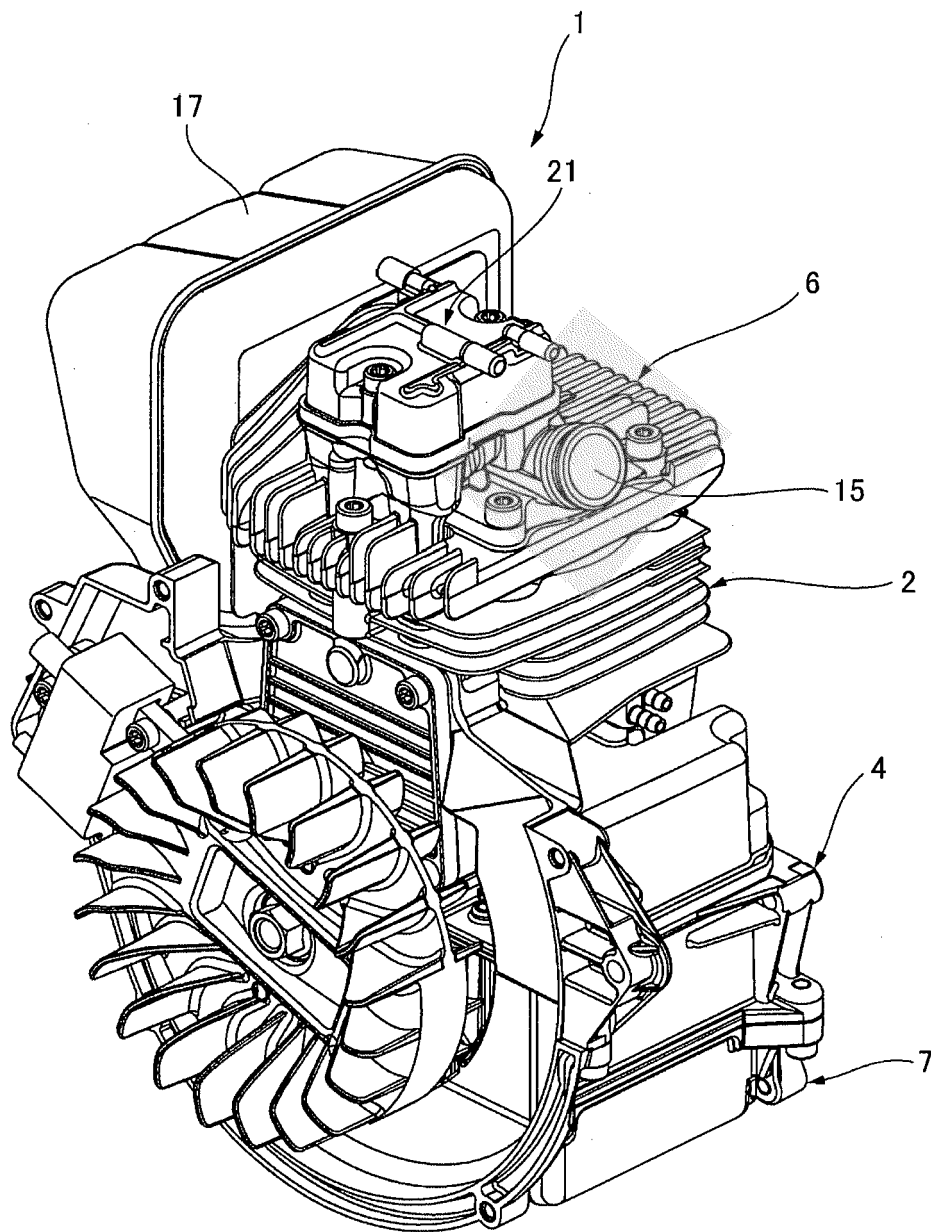




FIG. 2

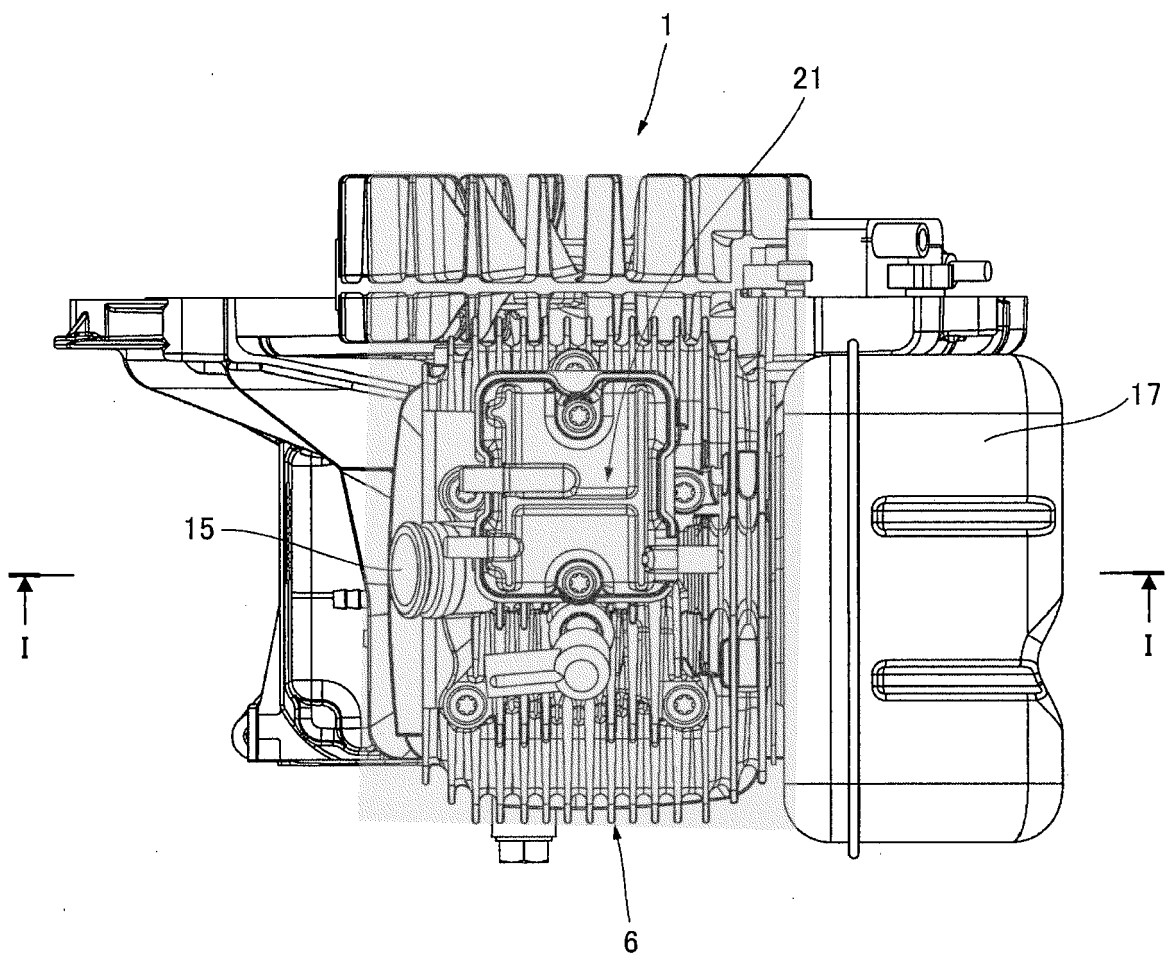


FIG. 3

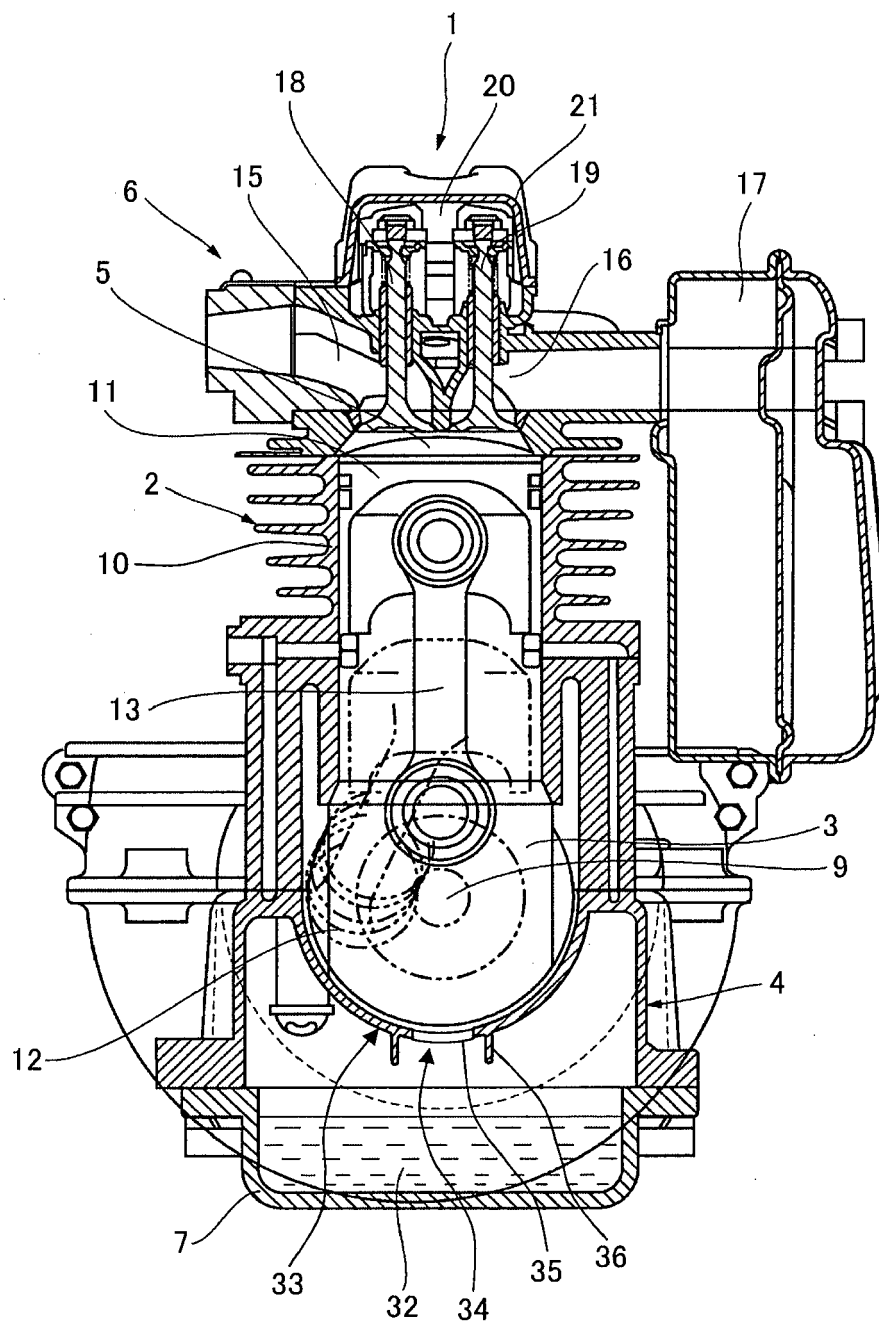


FIG. 4

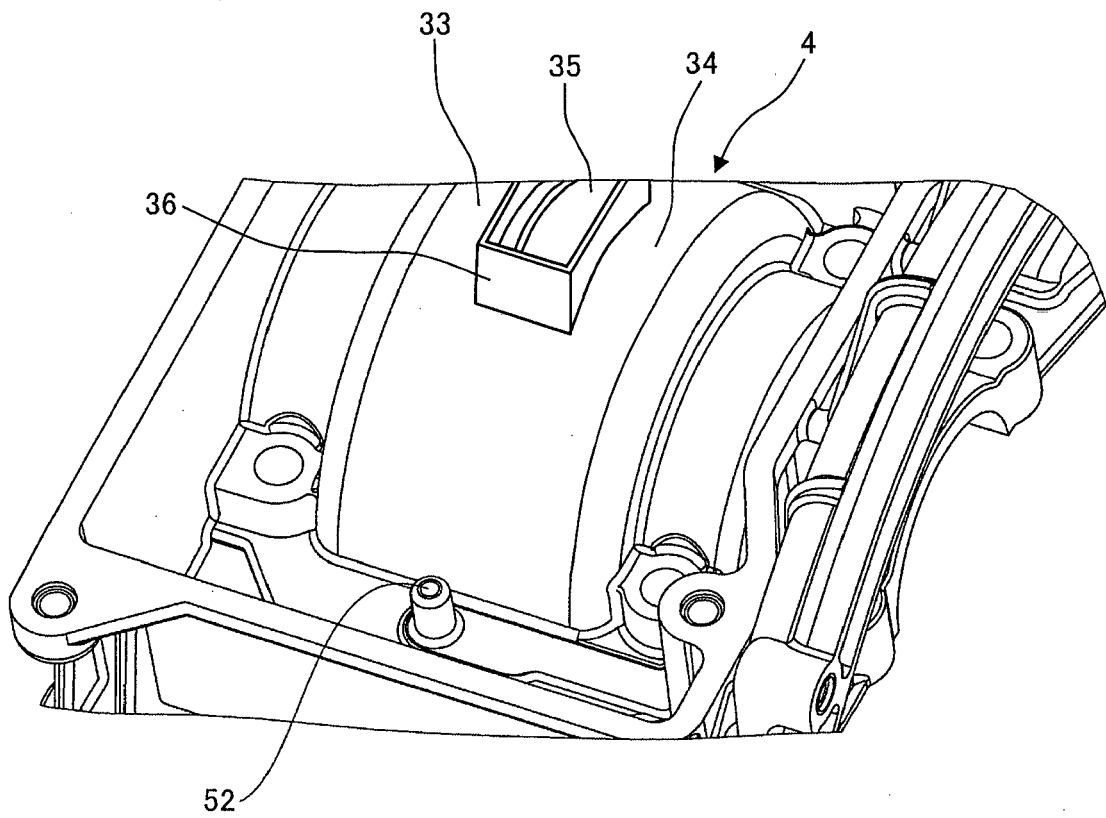


FIG. 5

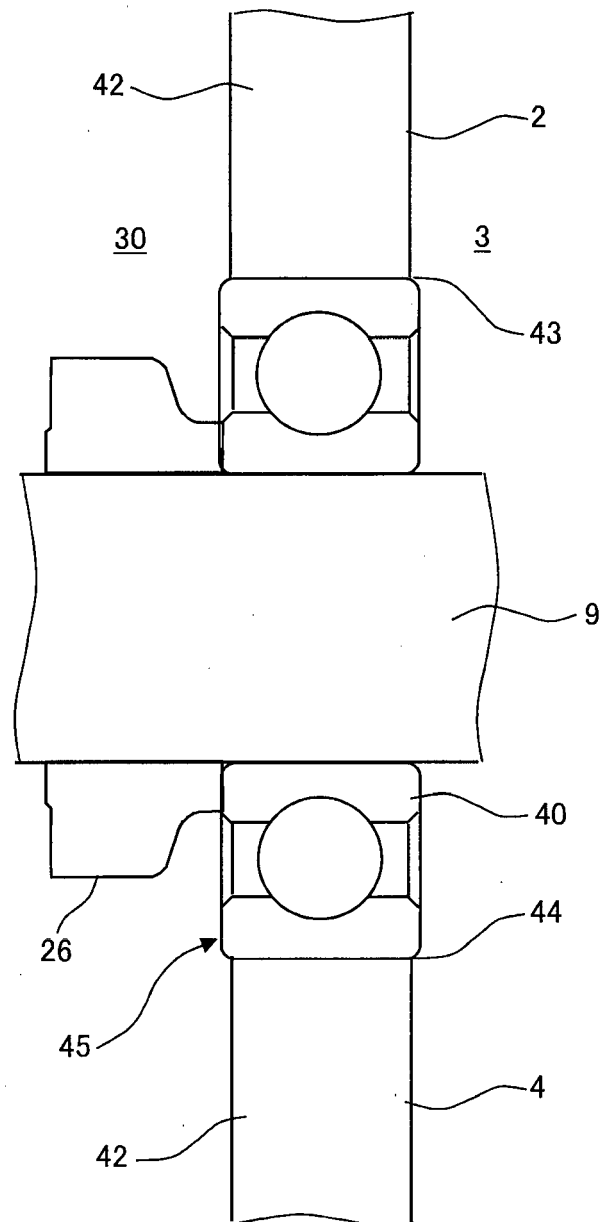
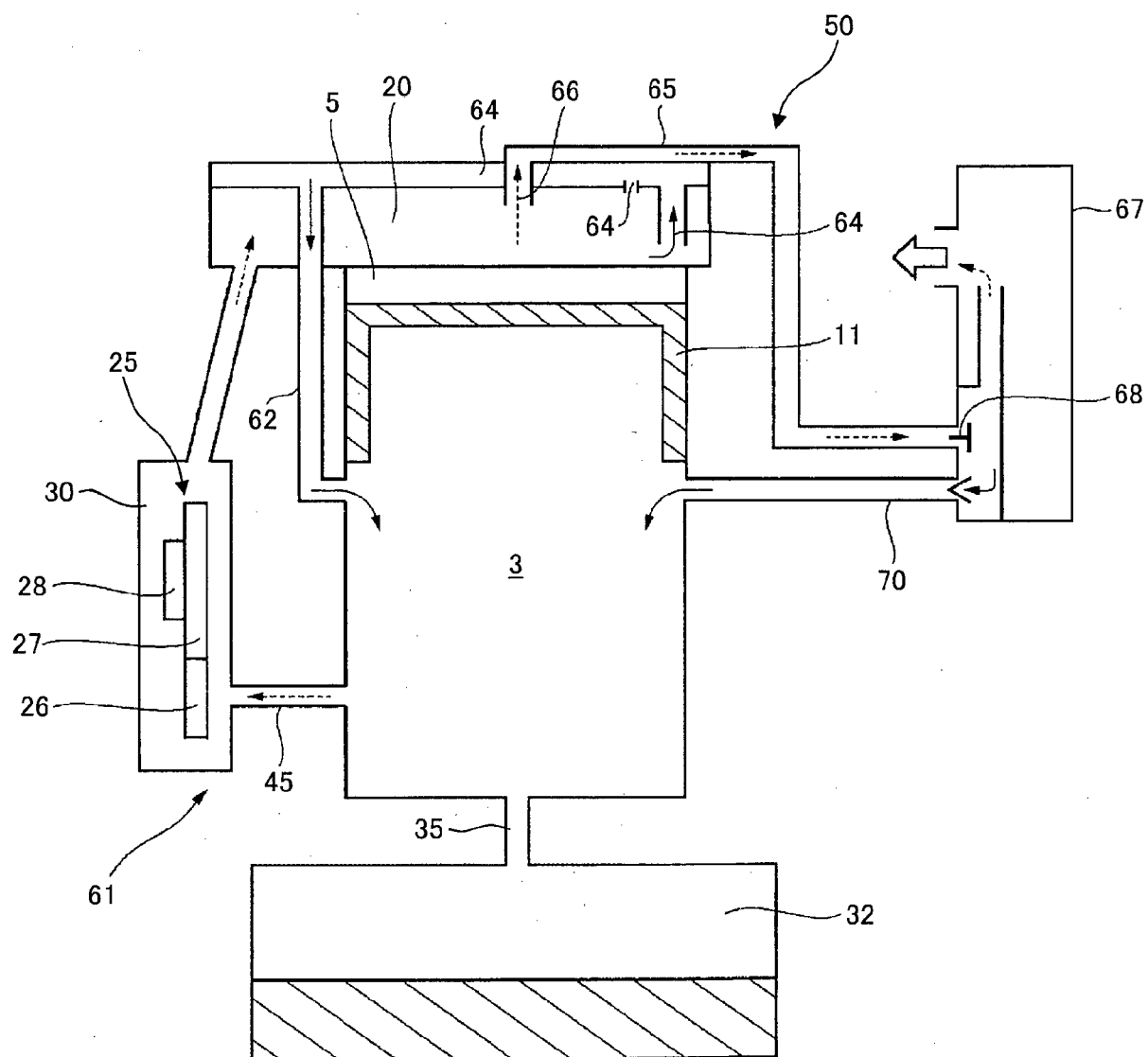


FIG. 6





## EUROPEAN SEARCH REPORT

Application Number  
EP 16 00 0348

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