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Commande de soupapes

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Description

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to an engine valve operation mechanism comprising a timing transmission that is linked to a crankshaft and a cam system that has a cam linked to the driven side of the timing transmission and transmits the rotational force of the cam as opening and closing forces to intake and exhaust valves, the engine valve operation mechanism being provided in a valve operation chamber that is defined between a cylinder head and a head cover that is joined in an oil tight manner to the upper end of the cylinder head.

DESCRIPTION OF THE PRIOR ART

[0002] Such an engine valve operation mechanism is already known as disclosed in, for example, Japanese Patent Application Laid-open No. 8-177416.

[0003] With regard to such a conventional engine valve operation mechanism, an outer end of a support shaft that supports a cam is supported in a support hole provided in the outside wall of a cylinder head. In this case, in order to prevent oil leakage from the support hole, a sealing member that is in close contact with the inner periphery of the support hole is mounted around the outer periphery of the support shaft, and a stopper member such as a split pin for preventing the support shaft from becoming detached from the support hole is attached to the cylinder head. With such an arrangement, it is difficult to achieve a reduction in the number of components and the cost.

SUMMARY OF THE INVENTION

[0004] The present invention has been carried out in view of the above-mentioned circumstances, and it is an object of the present invention to provide an engine valve operation mechanism that can be made compact while allowing the support shaft to be attached and detached prior to attaching the head cover.

[0005] EP-A-0839992 discloses an engine valve operation mechanism in accordance with the preamble of claim 1. There, the axial end of the cam support shaft is not covered by the head cover.

[0006] In accordance with a first characteristic of the present invention in order to achieve the above-mentioned object, there is proposed an engine valve operation mechanism comprising a timing transmission that is linked to a crankshaft and a cam system that has a cam linked to the driven side of the timing transmission and transmits the rotational force of the cam as opening and closing forces to intake and exhaust valves, the engine valve operation mechanism being provided in a valve operation chamber that is defined between a cylinder head and a head cover that is joined in an oil tight manner to the upper end of the cylinder head, wherein opposite ends of a support shaft that supports the cam in a rotatable manner are supported in a first support hole of a first support wall formed in the cylinder head and a second support hole of a second support wall placed inwardly from the first support wall relative to the cylinder head, the first support hole is made as a through hole to allow the support shaft to be inserted into the first support hole and the second support hole from outside the cylinder head, and the inner face of the head cover prevents the support shaft from becoming detached from the first support hole.

[0007] In accordance with the present invention, in addition to the above-mentioned first characteristic, there is proposed an engine valve operation mechanism wherein the first and second support walls are formed so that the first and second support holes are positioned above the plane in which the cylinder head and the head cover are joined, and the head cover is formed so that the head cover inner face is in contact with or in the vicinity of the outside face of the first support wall.

[0008] Since the support shaft that supports the cam by being inserted into the first support hole and the second support hole in that order is prevented from falling out by the inner face of the head cover that is joined to the cylinder head, it is unnecessary to provide a special stopper member for the support shaft. Moreover, since lubrication of the support shaft is carried out within the head cover and leakage of lubricating oil to the outside is prevented by the oil-tight joint between the head cover and the cylinder head, there is no need to attach a special sealing member to the support shaft. It is therefore possible to reduce the number of components to achieve a reduction in the cost.

[0009] In accordance with the invention, the head cover can be made compact while allowing the support shaft to be attached and detached prior to attaching the head cover.

[0010] Preferably, there is proposed an engine valve operation mechanism wherein the second support hole is a bottomed hole, and both the bottom of the second support hole and the inner face of the head cover restrict the axial movement of the support shaft.

[0011] Therefore, the axial movement of the support shaft can be restricted without employing a special positioning member so that the number of components can be further reduced.

[0012] The first and second support walls above correspond to a support wall 27 and a partition 85 in an embodiment of the present invention, which will be described below, the first and second support holes correspond to a through hole 28a and a bottomed hole 28b, and the valve operation chamber corresponds to first and second valve operation chambers 21a and 21b.

[0013] The above-mentioned objects, other objects, characteristics and advantages of the present invention will become apparent from an explanation of a preferable

embodiment which will be described in detail below by reference to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIG. 1 is an oblique view showing one embodiment of the handheld type four-cycle engine of the present invention in practical use.
FIG. 2 is a longitudinal side view of the above-mentioned four-cycle engine.
FIG. 3 is a cross-sectional view at line 3-3 in FIG. 2.
FIG. 4 is a cross-sectional view at line 4-4 in FIG. 2.
FIG. 5 is a magnified view of an essential part of FIG. 2.
FIG. 6 is an exploded view of an essential part of FIG. 5.
FIG. 7 is a cross-sectional view at line 7-7 in FIG. 4.
FIG. 8 is a cross-sectional view at line 8-8 in FIG. 4.
FIG. 9 is a cross-sectional view at line 9-9 in FIG. 8.
FIG. 10 is a view from line 10-10 in FIG. 5 (bottom view of a head cover).
FIG. 11 is a cross-sectional view at line 11-11 in FIG. 5.
FIG. 12 is a diagram showing a lubrication route of the above-mentioned engine.
Fig. 13 is a view corresponding to Fig. 4 in which the above-mentioned engine is in an upside down state.
Fig. 14 is a view corresponding to Fig. 4 in which the above-mentioned engine is in a laid-sideways state.

DESCRIPTION OF PREFERRED EMBODIMENT

[0015] An embodiment of the present invention is explained below by reference to the appended drawings.

[0016] As shown in FIG. 1, a handheld type four-cycle engine E is attached as a source of power to the drive section of, for example, a powered trimmer T. Since the powered trimmer T is used in a manner in which a cutter C is positioned so as to face in various directions according to the operational conditions, the engine E is also tilted to a large extent or turned upside-down as a result and the operational position is changeable.

[0017] Firstly, the external structure of the handheld type four-cycle engine E is explained by reference to FIGS. 2 and 3.

[0018] Attached to the front and back of an engine main body 1 of the above-mentioned handheld type four-cycle engine E are a carburetor 2 and an exhaust muffler 3 respectively, and an air cleaner 4 is attached to the inlet of the carburetor 2. A fuel tank 5 made of a synthetic resin is mounted on the lower face of the engine main body 1. Opposite ends of a crankshaft 13 project outside the engine main body 1 and an oil tank 40 adjoining one side of the engine main body 1, and a recoil type starter 42 that can be operatively connected to a driven member 84 that is fixed to one end of the crankshaft 13 is mounted on the outside face of the oil tank 40.

[0019] Fixed to the other end of the crankshaft 13 is a cooling fan 43 that also serves as a flywheel. A plurality of fitting bosses 46 (one thereof is shown in FIG. 2) are formed on the outside face of the cooling fan 43, and a centrifugal shoe 47 is axially supported on each of the fitting bosses 46 in a swingable manner. These centrifugal shoes 47, together with a clutch drum 48 fixed to a drive shaft 50 which will be described below, form a centrifugal clutch 49 and when the rotational rate of the crankshaft 13 exceeds a predetermined value the centrifugal shoes 47 are pressed onto the inner periphery of the clutch drum 48 due to the centrifugal force of the shoes 47, thereby transmitting the output torque of the crankshaft 13 to the drive shaft 50. The cooling fan 43 has a larger diameter than that of the centrifugal clutch 49.

[0020] An engine cover 51 covering the engine main body 1 and its attachments except the fuel tank 5 is fixed at appropriate positions to the engine main body 1, and a cooling air inlet 19 is provided between the engine cover 51 and the fuel tank 5. Rotation of the cooling fan 43 therefore takes in outside air through the cooling air inlet 19 and supplies it for cooling each part of the engine E.

[0021] Fixed to the engine cover 51 is a frustoconical bearing holder 58 that is arranged coaxially with the crankshaft 13, and the bearing holder 58 supports, via a bearing 59, the drive shaft 50 that rotates the cutter C.

[0022] Since the oil tank 40 and the starter 42 are arranged on one side of the engine main body 1 and the cooling fan 43 and the centrifugal clutch 49 are arranged on the other side thereof, the weight balance of the engine E in the right and left directions is improved and the center of gravity of the engine E can be made closer to the central part of the engine main body 1, thereby enhancing the handling performance of the engine E.

[0023] Furthermore, since the cooling fan 43 which has a larger diameter than that of the centrifugal shoe 47 is fixed to the crankshaft 13 between the engine main body 1 and the centrifugal shoe 47, it is possible to minimize any increase in the dimensions of the engine E due to the cooling fan 43.

[0024] The structures of the engine main body 1 and the oil tank 40 are now explained below by reference to FIGS. 2 to 6 and 10 and 11.

[0025] In FIGS. 2 to 5 the engine main body 1 includes a crankcase 6 having a crank chamber 6a, a cylinder block 7 having one cylinder bore 7a, and a cylinder head 8 having a combustion chamber 8a and intake and exhaust ports 9 and 10 that open into the combustion chamber 8a, and a large number of cooling fins 38 are formed on the outer peripheries of the cylinder block 7 and the cylinder head 8.

[0026] The crankshaft 13 housed in the crank chamber 6a is supported in the left and right side walls of the crankcase 6 via ball bearings 14 and 14'. In this case, the left-hand ball bearing 14 is equipped with a seal, and an oil seal 17 is provided so as to adjoin the outside of the right-hand ball bearing 14'. A piston 15 fitted in the cyl-

inder bore 7a is connected to the crankshaft 13 via a connecting rod 16 in a conventional and general manner.

[0027] The oil tank 40 is provided so as to be integrally formed with the left-hand wall of the crankcase 6 and is arranged so that the end of the crankshaft 13 on the sealed ball bearing 14 side runs through the oil tank 40. An oil seal 39 through which the crankshaft 13 runs is fitted in the outside wall of the oil tank 40.

[0028] A. belt guide tube 86 having a flattened cross-section is provided integrally with the roof of the oil tank 40, the belt guide tube 86 running vertically through the roof of the oil tank 40 and having open upper and lower ends. The lower end of the belt guide tube 86 extends toward the vicinity of the crankshaft 13 within the oil tank 40, and the upper end is provided integrally with the cylinder head 8 so as to share a dividing wall 85 with the cylinder head 8. A continuous ring-shaped sealing bead 87 is formed around the periphery of the upper end of the belt guide tube 86 and the cylinder head 8, and the dividing wall 85 projects above the sealing bead 87.

[0029] As shown in FIGS. 6, 10 and 11, a ring-shaped sealing channel 88a corresponding to the above-mentioned sealing bead 87 is formed in the lower end face of a head cover 36, and a linear sealing channel 88b providing communication between opposite sides of the ring-shaped channel 88a is formed in the inner face of the cover 36. A ring-shaped packing 89a is fitted in the ring-shaped sealing channel 88a, and a linear packing 89b formed integrally with the ring-shaped packing 89a is fitted in the linear sealing channel 88b. The head cover 36 is joined to the cylinder head 8 by means of a bolt 37 so that the sealing bead 87 and the dividing wall 85 are pressed into contact with the ring-shaped packing 89a and the linear packing 89b respectively.

[0030] The belt guide tube 86 and one half of the head cover 36 define a first valve operation chamber 21a, the cylinder head 8 and the other half of the head cover 36 define a second valve operation chamber 21b, and the two valve operation chambers 21a and 21b are divided by the above-mentioned dividing wall 85.

[0031] Referring again to FIGS. 2 to 5, the engine main body 1 and the oil tank 40 are divided into an upper block Ba and a lower block Bb on a plane that includes the axis of the crankshaft 13 and is perpendicular to the axis of the cylinder bore 7a. That is to say, the upper block Ba integrally includes the upper half of the crankcase 6, the cylinder block 7, the cylinder head 8, the upper half of the oil tank 40 and the belt guide tube 86. The lower block Bb integrally includes the lower half of the crankcase 6 and the lower half of the oil tank 40. These upper and lower blocks Ba and Bb are cast individually, and joined to each other by means of a plurality of bolts 12 (see FIG. 4) after each part has been machined.

[0032] Provided in the cylinder head 8 so as to be parallel to the axis of the cylinder bore 7a are an intake valve 18i and an exhaust valve 18e for opening and closing the intake port 9 and the exhaust port 10 respectively, and a spark plug 20 is screwed into the cylinder head 8 so that the electrodes thereof are close to the central area of the combustion chamber 8a.

[0033] A valve operation mechanism 22 for opening and closing the above-mentioned intake valve 18i and exhaust valve 18e is explained below by reference to FIGS. 3 to 7.

[0034] The valve operation mechanism 22 includes a timing transmission 22a, which runs from the interior of the oil tank 40 to the first valve operation chamber 21a, and a cam system 22b, which runs from the first valve operation chamber 21a to the second valve operation chamber 21b.

[0035] The timing transmission 22a includes a drive pulley 23 fixed to the crankshaft 13 within the oil tank 40, a driven pulley 24 rotatably supported in the upper part of the belt guide tube 86, and a timing belt 25 wrapped around these drive and driven pulleys 23 and 24. The end face of the driven pulley 24 on the dividing wall 85 side is joined integrally to a cam 26 forming part of the cam system 22b. The drive and driven pulleys 23 and 24 are toothed, and the drive pulley 23 drives the driven pulley 24 via the belt 25 with a reduction ratio of 1/2.

[0036] A support wall 27 is formed integrally with the outside wall of the belt guide tube 86, the support wall 27 rising inside the ring-shaped sealing bead 87 and being in contact with or in the vicinity of the inner face of the head cover 36. A through hole 28a and a bottomed hole 28b are provided in the support wall 27 and the dividing Wall 85 respectively, the through hole 28a and the bottomed hole 28b being arranged coaxially above the sealing bead 87. Opposite ends of a support shaft 29 are rotatably supported by the through hole 28a and the bottomed hole 28b, and the above-mentioned driven pulley 24 and the cam 26 are rotatably supported on the middle part of the support shaft 29. The support shaft 29 is inserted from the through hole 28a into a shaft hole 35 of the driven pulley 24 and the cam 26 and the bottomed hole 28b before the head cover 36 is attached. By joining the head cover 36 to the cylinder head 8 and the belt guide tube 86 subsequent to the insertion, the inner face of the head cover 36 sits opposite the outer end of the support shaft 29 thereby functioning as a stopper for preventing the shaft 29 from falling out of the through hole 28a, and the bottom of the bottomed hole 28b restricts inward movement of the shaft 29. The support shaft 29 is thus restricted in its inward and outward movement in the axial direction.

[0037] It is therefore unnecessary to provide a special stopper member for the support shaft 29, the support shaft 29 can be lubricated inside the head cover 36, and oil leakage can be prevented by an oil-tight joint between the head cover 36 and the cylinder head 8. It is therefore unnecessary to fit a special sealing member to the support shaft 29, thereby reducing the number of components and the cost. Furthermore, the support wall 27 rising inside the sealing bead 87 has the through hole 28a at a higher position than that of the sealing bead 87, the head cover 36 is formed so that the inner face of the head

cover 36 is in contact with or in the vicinity of the outside face of the support wall 27, and the head cover 36 can thus be made more compact while allowing the support shaft 29 to be attachable and detachable prior to the head cover 36 being attached.

[0038] Formed integrally with the dividing wall 85 on the second valve operation chamber 21b side are a pair of bearing bosses 30i and 30e projecting parallel to the support shaft 29. The cam system 22b includes the above-mentioned cam 26, an intake rocker shaft 31i and an exhaust rocker shaft 31e rotatably supported in the above-mentioned bearing bosses 30i and 30e respectively, an intake cam follower 32i and an exhaust cam follower 32e fixed to one end of the rocker shafts 31i and 31e respectively within the first valve operation chamber 21a, the extremity of each of the intake cam follower 32i and the exhaust cam follower 32e being in sliding contact with the lower face of the cam 26, an intake rocker arm 33i and an exhaust rocker arm 33e fixed to the other end of the intake and exhaust rocker shafts 31i and 31e respectively within the second valve operation chamber 21b, the extremity of each of the intake rocker arm 33i and the exhaust rocker arm 33e being in contact with the upper end of the intake valve 18i and exhaust valve 18e respectively, and an intake spring 34i and an exhaust spring 34e mounted on the intake valve 18i and the exhaust valve 18e respectively and forcing them in the closed direction.

[0039] When the crankshaft 13 rotates, the drive pulley 23 rotating together with the crankshaft 13 rotates the driven pulley 24 and the cam 26 via the belt 25, the cam 26 then rocks the intake and exhaust cam followers 32i and 32e with appropriate timing, the rocking movements are transmitted to the intake and exhaust rocker arms 33i and 33e via the corresponding rocker shafts 31i and 31e, and the intake and exhaust rocker arms 33i and 33e so rocked can open and close the intake and exhaust valves 18i and 18e with appropriate timing while co-operatively working with the intake and exhaust springs 34i and 34e.

[0040] In the timing transmission 22a, since the driven pulley 24 and the cam 26 are rotatably supported by the support shaft 29 and the support shaft 29 is also rotatably supported in opposite side walls of the first valve operation chamber 21a, the support shaft 29 rotates due to frictional drag during rotation of the driven pulley 24 and the cam 26, the difference in rotational rate between the support shaft 29 and the driven pulley 24 and the cam 26 decreases and abrasion of the rotating and sliding areas can be suppressed, thus contributing to an improvement in the durability.

[0041] The lubrication system of the above-mentioned engine E is now explained by reference to FIGS. 3 to 12.

[0042] As shown in FIGS. 4 and 5, the oil tank 40 stores a predetermined amount of lubricating oil O poured in through an oil inlet 40a. Within the oil tank 40, a pair of oil slingers 56a and 56b arranged on either side of the drive pulley 23 in the axial direction are press-fitted, etc. onto the crankshaft 13. These oil slingers 56a and 56b extend in directions radially opposite to each other and the extremities thereof are bent so as to move away from each other in the axial direction so that when the oil slingers 56a and 56b are rotated by the crankshaft 13 at least one of the oil slingers 56a and 56b stirs and scatters the oil O stored within the oil tank 40, thereby generating an oil mist regardless of the operational position of the engine E. In this case, the oil mist becomes attached to the part of the timing transmission 22a that extends within the oil tank 40 from the first valve operation chamber 21a, or the oil mist enters the first valve operation chamber 21a, and the timing transmission 22a can thus be lubricated directly, which provides one lubrication system.

[0043] Another lubrication system includes, as shown in FIGS. 3 to 5 and 12, a through hole 55 provided in the crankshaft 13 so as to provide communication between the interior of the oil tank 40 and the crank chamber 6a, an oil feed pipe 60 disposed outside the engine main body 1 so as to connect the lower part of the crank chamber 6a to the lower part of the second valve operation chamber 21b, an oil recovery chamber 74 provided in the cylinder head 8 in order to draw up oil liquefied and resided in the second valve operation chamber 21b, an oil return passage 78 formed between the cylinder head 8 and the oil tank 40 so as to provide communication between the oil recovery chamber 74 and the oil tank 40 via the first valve operation chamber 21a, and a one-way valve 61 provided in the lower part of the crank chamber 6a and allowing the flow of oil mist only in the direction from the crank chamber 6a to the oil feed pipe 60.

[0044] An open end 55a of the above-mentioned through hole 55 within the oil tank 40 is positioned in the central part or the vicinity thereof within the oil tank 40 so that the open end 55a is always above the liquid level of the oil O within the oil tank 40 regardless of the operational position of the engine E. The drive pulley 23 and one of the oil slingers 56a are fixed to the crankshaft 13 with the open end 55a therebetween so that it is not blocked.

[0045] The above-mentioned one-way valve 61 (see FIG. 3) is formed from a reed valve in the illustrated embodiment; it closes when the pressure of the crank chamber 6a becomes negative and opens when the pressure becomes positive accompanying the reciprocating motion of the piston 15.

[0046] The lower end of the oil feed pipe 60 is connected by fitting it onto a lower connection pipe 62a projectingly provided on the outside face of the crankcase 6 (see FIG. 3) and the upper end of the oil feel pipe 60 is connected by fitting it onto an upper connection pipe 62b projectingly provided on the outside face of the cylinder head 8 (see FIGS. 4 and 8). The interior of the upper connection pipe 62b communicates on the one hand with the lower part of the second valve operation chamber 21b via a communicating passage 63 (see FIGS. 8 and 9) formed in the cylinder head 8 and having large dimensions, and on the other hand with the oil return passage

78 via an orifice-like bypass 64 (see FIG. 8).

[0047] As shown in FIGS. 5, 10 and 11, a partition plate 65 defining a breather chamber 69 in the upper part within the head cover 36 is fitted to the roof of the head cover 36 by means of a plurality of stays 66 and clips 67 fastened to the stays 66, the stays 66 being projectingly provided on the roof. The breather chamber 69 communicates on the one hand with the second valve operation chamber 21b via a communicating pipe 68 and a gap g between the inner face of the head cover 36 and the partition plate 65, the communicating pipe 68, which has large dimensions, being formed integrally with the partition plate 65 and projecting toward the second valve operation chamber 21b, and on the other hand with the interior of the above-mentioned air cleaner 4 via a breather pipe 70. In the breather chamber 69 a mixture of oil and blowby gas is separated into gas and liquid, and a labyrinth wall 72 for promoting the gas-liquid separation is projectingly provided on the inner face of the roof of the head cover 36.

[0048] The upper surface of the partition plate 65 is welded to a box-shaped partition body 79, having one open face and being T-shaped in plan view, so as to define the above-mentioned oil recovery chamber 74 therebetween, the oil recovery chamber 74 therefore also being T-shaped.

[0049] Integral with the partition plate 65 are projectingly provided two draw-up pipes 75, which respectively communicate with opposite ends of the lateral bar of the T-shaped oil recovery chamber 74. The extremity of each of the draw-up pipes 75 extends toward the vicinity of the base of the second valve operation chamber 21b, and an opening in the extremity of each of the draw-up pipes 75 forms an orifice 75a.

[0050] Integral with the upper wall of the partition body 79 are projectingly provided three draw-up pipes 76, which communicate with three positions corresponding to the extremities of the lateral and vertical bars of the T-shape of the oil recovery chamber 74. Each of the extremities of these draw-up pipes 76 extends toward the vicinity of the roof of the breather chamber 69, and an opening in the extremity of each of the draw-up pipes 76 forms an orifice 76a.

[0051] Furthermore, in the upper wall of the partition body 79 is provided an orifice 80, providing communication between an indentation 79a in the upper face of the partition body 79 and the oil recovery chamber 74.

[0052] Moreover, integral with the partition plate 65 is projectingly provided one pipe 81 communicating with a region corresponding to the extremity of the vertical bar of the T-shape of the oil recovery chamber 74. The extremity of the pipe 81 is fitted into an inlet 78a of the above-mentioned oil return passage 78 via a grommet 82, the inlet 78a opening onto the base of the second valve operation chamber 21b. The oil recovery chamber 74 is thereby connected to the oil return passage 78. The above-mentioned pipe 81 is placed close to an inner side face of the second valve operation chamber 21b, and an orifice 81a for drawing up oil is provided in the region close to the above-mentioned inner side face, the orifice 81a providing communication between the second valve operation chamber 21b and the interior of the pipe 81.

[0053] Since the breather chamber 69 communicates with the interior of the air cleaner 4 via the breather pipe 70, the pressure of the breather chamber 69 is maintained at substantially atmospheric pressure even during operation of the engine E, and the pressure of the second valve operation chamber 21b communicating with the breather chamber 69 via the communicating pipe 68, which has a low flow resistance, is substantially the same as that of the breather chamber 69.

[0054] Since the crank chamber 6a discharges only the positive pressure component of the pressure pulsations caused by the ascending and descending motion of the piston 15 into the oil feed pipe 60 through the one-way valve 61 during operation of the engine E, the pressure of the crank chamber 6a is negative on average, and since the second valve operation chamber 21b receiving the above-mentioned positive pressure communicates with the breather chamber 69 via the communicating pipe 68 having a small flow resistance, the pressure of the second valve operation chamber 21b is substantially the same as that of the breather chamber 69. Since the negative pressure of the crank chamber 6a is transmitted to the oil tank 40 via the through hole 55 of the crankshaft 13 and further to the oil recovery chamber 74 via the oil return passage 78, the pressure of the oil recovery chamber 74 is lower than those of the second valve operation chamber 21b and the breather chamber 69, and the pressures of the oil tank 40 and the first valve operation chamber 21a are lower than that of the oil recovery chamber 74.

[0055] As shown in FIG. 12, if the pressure of the crank-chamber 6a is denoted by Pc, the pressure of the oil tank 40 is denoted by Po, the pressure of the first valve operation chamber 21a is denoted by Pva, the pressure of the second valve operation chamber 21b is denoted by Pvb, the pressure of the oil recovery chamber 74 is denoted by Ps, and the pressure of the breather chamber 69 is denoted by Pb, the following relationship is therefore satisfied.

$$Pvb = Pb > Ps > Po = Pva > Pc$$

[0056] As a result, the pressure of the second valve operation chamber 21b and the breather chamber 69 is transferred to the oil recovery chamber 74 via the draw-up pipes 75 and 76 and the orifice 80, further to the oil tank 40 via the oil return passage 78 and then to the crank chamber 6a.

[0057] During operation of the engine E, oil mist is generated by the oil slingers 56a and 56b stirring and scattering the lubricating oil O within the oil tank 40, the oil slingers 56a and 56b being rotated by the crankshaft 13.

As hereinbefore described, the oil droplets so generated is splashed over the part of the timing transmission 22a exposed within the oil tank 40 from the belt guide tube 86, that is to say, the drive pulley 23 and part of the timing belt 25, or the oil droplets enter the first valve operation chamber 21a, and the timing transmission 22a is thus lubricated directly. When the oil is splashed over even a part of the timing transmission 22a, the oil is transferred not only to the entire timing transmission 22a but also to the cam 26, accompanying the operation of the timing transmission 22a, thereby effectively lubricating these components.

[0058] The oil mist generated in the oil tank 40 is drawn into the crank chamber 6a via the through hole 55 of the crankshaft 13 along the direction of the above-mentioned pressure flow, thereby lubricating the area around the crankshaft 13 and the piston 15. When the pressure of the crank chamber 6a becomes positive due to the piston 15 descending, the one-way valve 61 opens and the above-mentioned oil mist together with the blowby gas generated in the crank chamber 6a ascend through the oil feed pipe 60 and the communicating passage 63 and are supplied to the second valve operation chamber 21b, thereby lubricating each part of the cam system 22b within the chamber 21b, that is to say, the intake and exhaust rocker arms 33i and 33e ,etc.

[0059] In this case, a portion of the oil mist passing through the above-mentioned communicating passage 63 is shunted to the oil return passage 78 via the orifice-like bypass 64. It is therefore possible to control the amount of oil mist supplied to the second valve operation chamber 21b by setting the flow resistance of the bypass 64 appropriately.

[0060] The oil mist and the blowby gas within the second valve operation chamber 21b are separated into gas and liquid by expansion and collision with the labyrinth wall 72 while being transferred to the breather chamber 69 through the communicating pipe 68 and the gap g around the partition plate 65, and the blowby gas is taken into the engine E via the breather pipe 70 and the air cleaner 4 in that order during the intake stroke of the engine E.

[0061] When the engine E is in an upright state, since the oil liquefied in the breather chamber 69 resides in the indentation 79a in the upper face of the partition body 79 or flows down the communicating pipe 68 or through the gap g and is resided on the base of the second valve operation chamber 21b, in that case the oil is drawn up by means of the orifice 80 or the draw-up pipe 75 provided in those places into the oil recovery chamber 74. When the engine E is in an upside down state, since the above-mentioned liquefied oil resides on the roof of the head cover 36, in that case the oil is drawn up by means of the draw-up pipe 76 provided there into the oil recovery chamber 74.

[0062] The oil thus drawn up into the oil recovery chamber 74 retums from the pipe 81 into the oil tank 40 via the oil return passage 78. In this case, when the oil return passage 78 communicates with the oil tank 40 via the first valve operation chamber 21a as in the illustrated embodiment, the oil discharged from the oil return passage 78 is splashed over the timing transmission 22a, thereby advantageously lubricating it.

[0063] Since the roof of the head cover 36 and the partition plate 65 attached to the inner wall of the head cover 36 define the above-mentioned breather chamber 69 therebetween and the upper face of the above-mentioned partition plate 65 and the partition body 79 welded to the partition plate 65 define the above-mentioned oil recovery chamber 74 therebetween, the oil recovery chamber 74 and the breather chamber 69 can be provided in the head cover 36 without splitting the roof of the head cover 36. Moreover, since the breather chamber 69 and the oil recovery chamber 74 are present within the head cover 36, even if some oil leaks from either of the chambers 69 and 74, the oil simply returns to the second valve operation chamber 21b without causing any problems, and it is unnecessary to inspect the peripheries of the two chambers 69 and 74 for oil tightness and the production cost can thus be reduced.

[0064] Since the partition body 79 can be welded to the partition plate 65 before attaching the partition plate 65 to the head cover 36, the oil recovery chamber 74 can easily be formed using the partition plate 65.

[0065] Furthermore, since the oil draw-up pipes 75 and 76 are formed integrally with the partition plate 65 and the partition body 79 respectively, the oil draw-up pipes 75 and 76 can easily be formed.

[0066] When the engine E is in an upside down state as shown in FIG. 13, the oil O stored in the oil tank 40 moves toward the roof of the tank 40, that is to say, the first valve operation chamber 21a side. Since the open end of the first valve operation chamber 21a within the oil tank 40 is set so as to be at a higher level than the liquid level of the stored oil O by means of the belt guide tube 86, the stored oil O is prevented from entering the first valve operation chamber 21a, thereby preventing excess oil from being supplied to the timing transmission 22a, and it is also possible to maintain a predetermined amount of oil within the oil tank 40, thus allowing the oil slingers 56a and 56b to continuously generate an oil mist.

[0067] When the engine E is laid sideways during its operation as shown in FIG. 14, the stored oil O moves toward the side face of the oil tank 40, and, in this case also, since the open end of the first valve operation chamber 21a within the oil tank 40 is set so as to be at a higher level than the liquid level of the stored oil O by means of the belt guide tube 86, the stored oil O is prevented from entering the first valve operation chamber 21a and it is possible to prevent excess oil from being supplied to the timing transmission 22a and also to maintain a predetermined amount of oil within the oil tank 40, thus allowing the oil slingers 56a and 56b to continuously generate an oil mist

[0068] The lubrication system for the valve operation mechanism 22 can thus be divided into a system for lu-

bricating part of the cam system 22b and the timing transmission 22a within the first valve operation chamber 21a and the oil tank 40 with the oil scattered within the oil tank 40, and a system for lubricating the remainder of the cam system 22b within the second valve operation chamber 21b with the oil mist transferred to the second valve operation chamber 21b. The load put on each of the lubrication systems can thus be reduced and the entire valve operation mechanism 22 can be lubricated thoroughly. Moreover, each part of the engine E can be lubricated reliably by the use of oil droplets and oil mist regardless of the operational position of the engine E.

[0069] Since the oil mist generated within the oil tank 40 is returned by utilizing the pressure pulsations within the crank chamber 6a and the one-way transfer function of the one-way valve 61, it is unnecessary to employ a special oil pump for circulating the oil mist and the structure can be simplified.

[0070] Furthermore, not only the oil tank 40 but also the oil feed pipe 60 providing communication between the crank chamber 6a and the second valve operation chamber 21b are disposed outside the engine main body 1, which does not prevent making the engine main body 1 thinner and more compact, greatly contributing to reduction in the weight of the engine E. In particular, since the externally placed oil feed pipe 60 is little influenced by the heat of the engine main body 1 and easily releases its heat, cooling of the oil mist passing through the oil feed pipe 60 can be promoted.

[0071] Furthermore, since the oil tank 40 is placed on one side of the exterior of the engine main body 1, the total height of the engine E can be greatly reduced, and since part of the timing transmission 22a is housed in the oil tank 40, any increase in the width of the engine E can be minimized, thus making the engine E more compact.

[0072] The number of oil draw-up pipes 75 and 76 and orifices 80 and 81a for drawing up oil and the positions in which they are placed can be chosen freely. Furthermore, the partition body 79 can be welded to the lower face of the partition plate 65, thereby forming the oil recovery chamber 74 below the partition plate 65. In this case, the oil draw-up pipe 75 is formed integrally with the partition body 79 and the oil draw-up pipe 76 is formed integrally with the partition plate 65.

[0073] Moreover, instead of the one way valve 61, a rotary valve can be provided, the rotary valve being operable in association with the crankshaft 13 and operating so as to open the oil feed pipe 60 when the piston 15 descends and block the oil feed pipe 60 when the piston 15 ascends.

[0074] In an engine valve operation mechanism, opposite ends of a support shaft that supports a cam in a rotatable manner are supported in a first support hole of a first support wall formed in a cylinder head and a second support hole of a second support wall placed inwardly from the first support wall relative to the cylinder head, thereby aiiowing the support shaft to be inserted into the first support hole and the second support hole from outside the cylinder head, and an inner face of a head cover prevents the support shaft from becoming detached from the first support hole. The axial movement of the cam support shaft can thereby be restricted without employing a special stopper member, and the leakage of lubricating oil for the support shaft can be prevented without using a special sealing member.

Claims

1. An engine valve operation mechanism comprising a timing transmission (22a) that is linked to a crankshaft (13) and a cam system (22b) that has a cam (26) linked to the driven side of the timing transmission (22a) and transmits the rotational force of the cam (26) as opening and closing forces to intake and exhaust valves (18i, c), the engine valve operation mechanism being provided in a valve operation chamber (21a, b) that is defined between a cylinder head (8) and a head cover (36) that is joined in an oil tight manner to the upper end of the cylinder head (8),
wherein opposite ends of a support shaft (29) that supports the cam (26) in a rotatable manner are supported in a first support hole (28a) of a first support wall (27) formed in the cylinder head (8) and a second support hole (28b) of a second support wall (85) placed inwardly from the first support wall (27) relative to the cylinder head (8), the first support hole (28a) is made as a through hole (28a) to allow the support shaft (29) to be inserted into the first support hole (28a) and the second support hole (28b) from outside the cylinder head (8), and the inner face of the head cover (36) prevents the support shaft (29) from becoming detached from the first support hole (28a),
characterized in that the first and second support walls (27, 85) are formed so that the first and second support holes (28a, b) are positioned above the plane in which the cylinder head (8) and the head cover (36) are joined, and the head cover (36) is formed so that the head cover inner face is in contact with or in the vicinity of the outside face of the first support wall (27).

2. The engine valve operation mechanism according to claim 1, wherein the second support hole (28b) is a bottomed hole, and both the bottom of the second support hole (28b) and the inner face of the head cover (36) restrict the axial movement of the support shaft (29).

Patentansprüche

1. Motorventilantriebsmechanismus, umfassend: ein Steuergetriebe (22a), das mit einer Kurbelwelle (13)

gekoppelt ist, sowie ein Nockensystem (22b), das einen Nocken (26) aufweist, der mit der Abtriebseite des Steuergetriebes (22a) gekoppelt ist und die Drehkraft des Nockens (26) als Öffnungs- und Schließkräfte auf Einlass- und Auslassventile (18i, c) überträgt, wobei der Motorventilantriebsmechanismus in einer Ventilantriebskammer (21a,b) vorgesehen ist, die zwischen einem Zylinderkopf (8) und dem Kopfdeckel (36) definiert ist, der mit dem Oberende des Zylinderkopfs (8a) öldicht verbunden ist,
worin entgegengesetzte Enden einer Tragwelle (29), die den Nocken (26) drehbar trägt, in einem ersten Lagerloch (28a) einer ersten Tragwand (27), die in dem Zylinderkopf (8) ausgebildet ist, und einem zweiten Lagerloch (28b) einer zweiten Tragwand (85), die relativ zum Zylinderkopf (8) innerhalb von der ersten Tragwand (27) angeordnet ist, gelagert ist, wobei das erste Lagerloch (28a) als Durchgangsloch (28a) ausgebildet ist, um zu erlauben, dass die Tragwelle (29) von der Außenseite des Zylinderkopfs (8) in das erste Lagerloch (28a) und das zweite Lagerloch (28b) eingesetzt wird, und die Innenseite des Kopfdeckels (36) verhindert, dass die Tragwelle (29) aus dem ersten Lagerloch (28a) abgenommen wird,
dadurch gekennzeichnet, dass die ersten und zweiten Tragwände (27, 85) so ausgebildet sind, dass die ersten und zweiten Lagerlöcher (28a, b) oberhalb der Ebene angeordnet sind, in der der Zylinderkopf (8) und der Kopfdeckel (36) verbunden sind, und der Kopfdeckel (36) so ausgebildet ist, dass die Kopfdeckelinnenseite in Kontakt mit der Außenseite der ersten Tragwand (27) steht oder dieser benachbart ist.

2. Motorventilantriebsmechanismus nach Anspruch 1, worin das zweite Lagerloch (28b) ein Sackloch ist, und sowohl der Boden des zweiten Lagerlochs (28b) als auch die Innenseite des Kopfdeckels (36) die axiale Bewegung der Tragwelle (29) begrenzen.

Revendications

1. Mécanisme de fonctionnement de soupape moteur comprenant une transmission de distribution (22a) qui est reliée à un vilebrequin (13) et un système à cames (22b) qui comporte une came (26) reliée au côté entraîné de la transmission de distribution (22a) et qui transmet la force de rotation de la came (26) en tant que forces d'ouverture et de fermeture aux soupapes d'admission et d'échappement (18i, c), le mécanisme de fonctionnement de soupape moteur étant fourni dans une chambre de fonctionnement de soupape (21a, b) qui est définie entre une culasse (8) et un couvercle de culasse (36) qui est raccordé à l'extrémité supérieure de la culasse (8) de manière à être étanche à l'huile,
dans lequel les extrémités opposées d'un arbre-support (29) qui supporte la came de manière rotative sont supportées par un premier trou de support (28a) d'une première paroi de support (27) formée dans la culasse (8) et un deuxième trou de support (28b) d'une deuxième paroi de support (85) placée vers l'intérieur à partir de la première paroi de support (27) par rapport à la culasse (8), le premier trou de support (28a) est conçu sous forme de trou traversant (28a) pour permettre à l'arbre-support (29) d'être inséré dans le premier trou de support (28a) et le deuxième trou de support (28b) à partir de l'extérieur de la culasse (8), et la face interne du couvercle de culasse (36) empêche l'arbre-support (29) de se détacher du premier trou de support (28a),
caractérisé en ce que les première et deuxième parois de support (27, 85) sont formées de sorte que les premier et deuxième trous de support (28a, b) sont placés au-dessus du plan dans lequel la culasse (8) et le couvercle de culasse (36) sont raccordés, et le couvercle de culasse (36) est formé de sorte que la face interne du couvercle de culasse est en contact avec ou à proximité de la face externe de la première paroi de support (27).

2. Mécanisme de fonctionnement de soupape moteur selon la revendication 1, dans lequel le deuxième trou de support (28b) est un trou borgne et le fond du deuxième trou de support (28b) ainsi que la face interne du couvercle de culasse (36) limitent le mouvement axial de l'arbre-support (29).

FIG.1



FIG.2

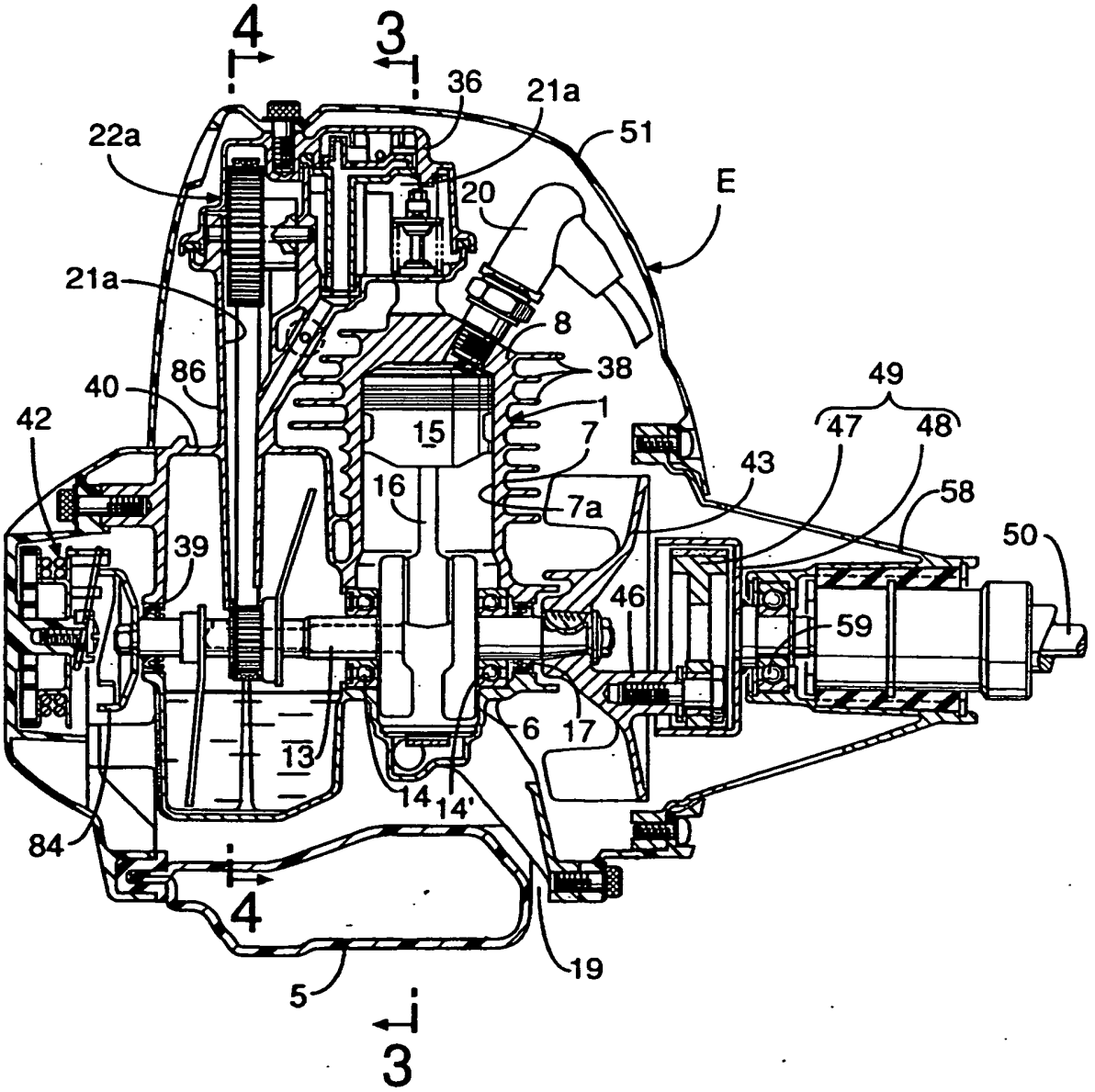

4
3
36
21a
22a
51
E
20
21a
8
38
49
40
86
1
42
15
7
47
48
43
16
7a
58
50
39
46
59
6
17
13
14
14'
84
4
19
5
3

FIG.3

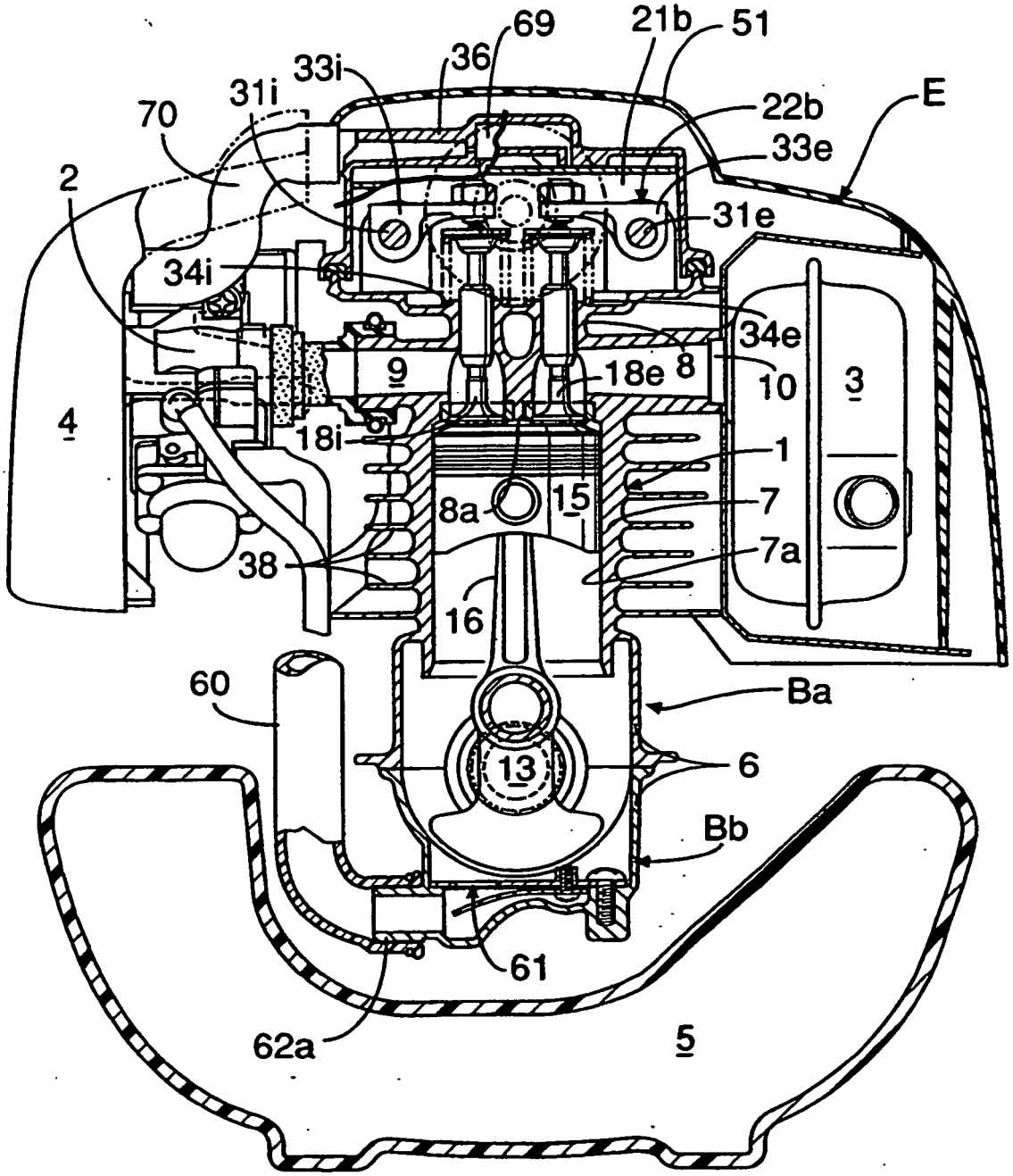

69
21b
51
33i
36
31i
22b
E
70
33e
2
31e
34i
34e
9
18e
8
10
3
4
18i
1
8a
15
7
7a
38
16
60
Ba
13
6
Bb
61
62a
5

FIG.4

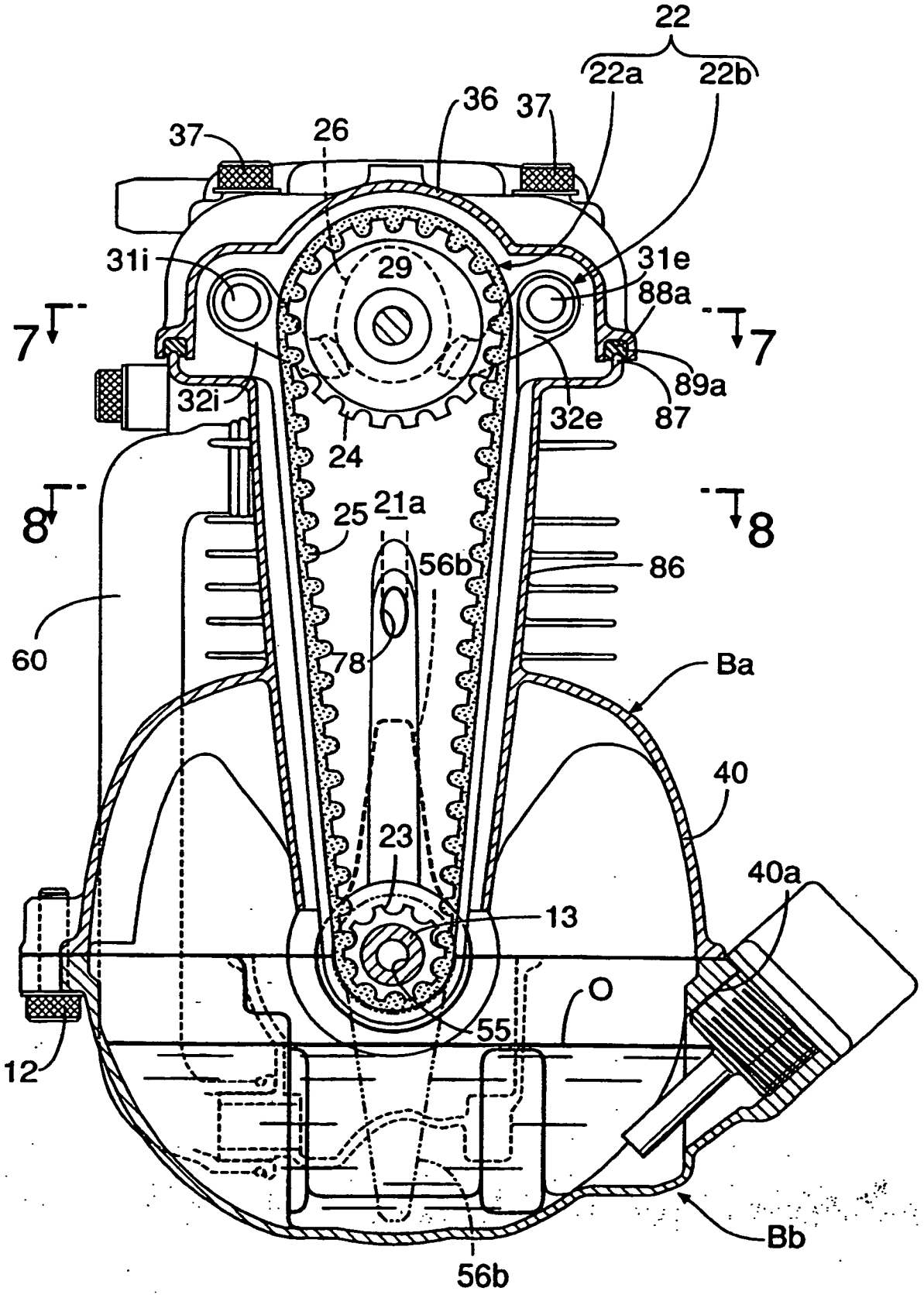

22
22a
22b
36
37
37
26
31i
29
31e
88a
7
7
89a
32i
32e
87
24
8
8
25
21a
56b
86
60
78
Ba
40
23
40a
13
O
55
12
Bb
56b

FIG.5

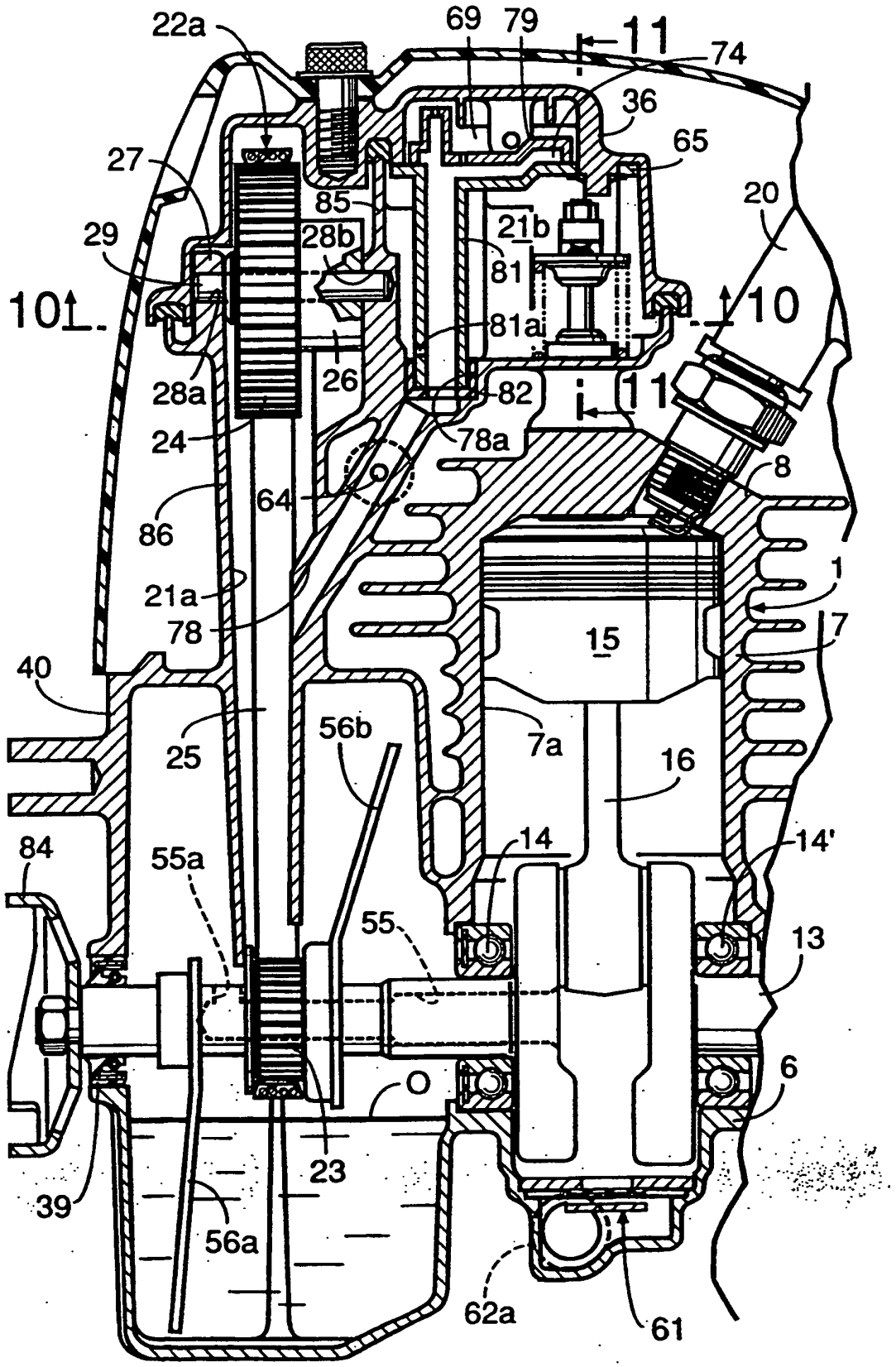

22a
69
79
11
74
36
65
27
85
20
29
28b
21b
81
10
10
81a
28a
26
82
11
24
78a
8
64
86
1
21a
78
15
7
40
25
56b
7a
16
84
55a
14
14'
55
13
6
O
23
39
56a
62a
61

FIG.6

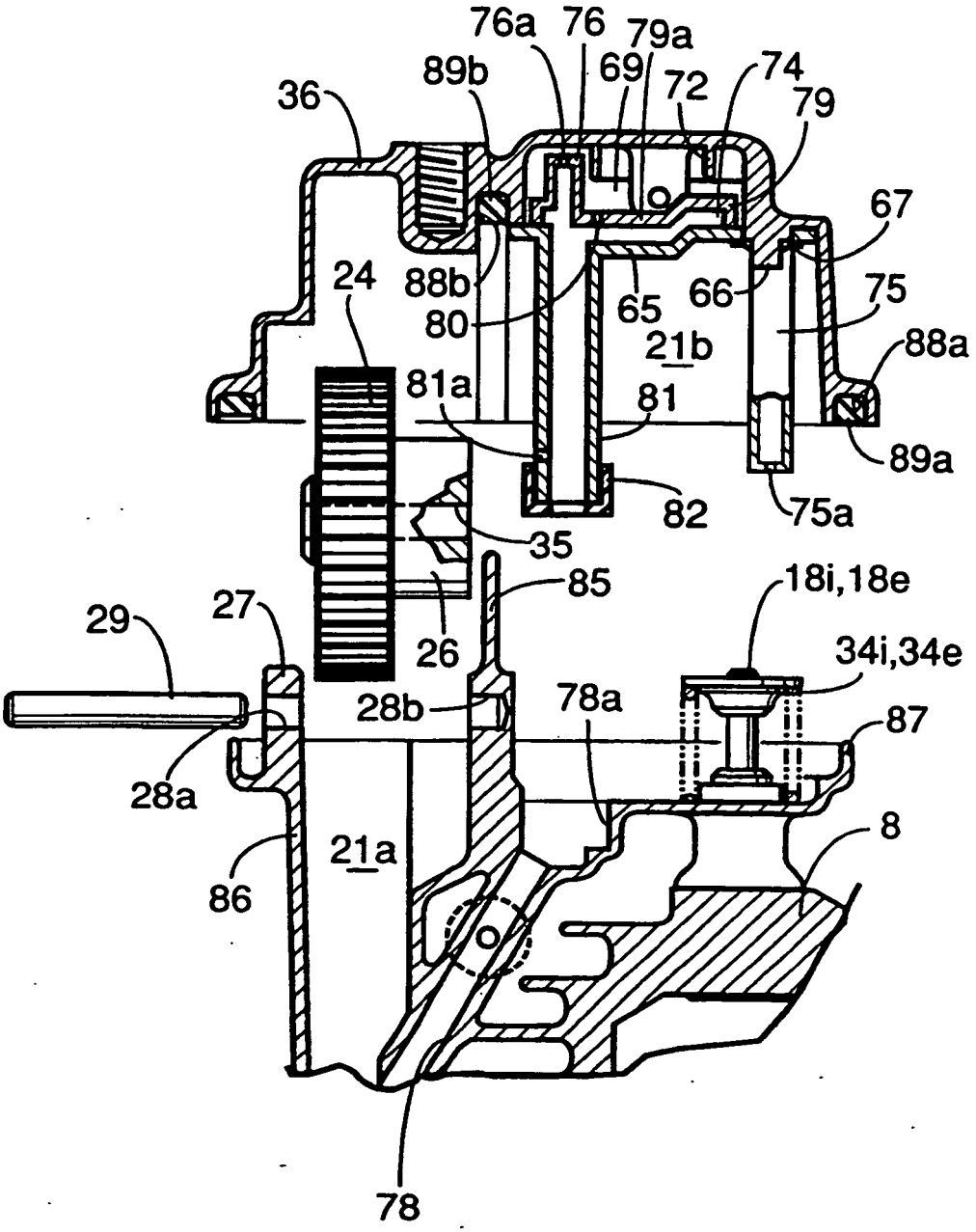

76a
76
79a
89b
69
72
74
36
79
67
24
88b
66
75
80
65
21b
88a
81a
81
89a
82
75a
35
85
18i,18e
29
27
26
34i,34e
28b
78a
87
28a
8
21a
86
78

FIG.7

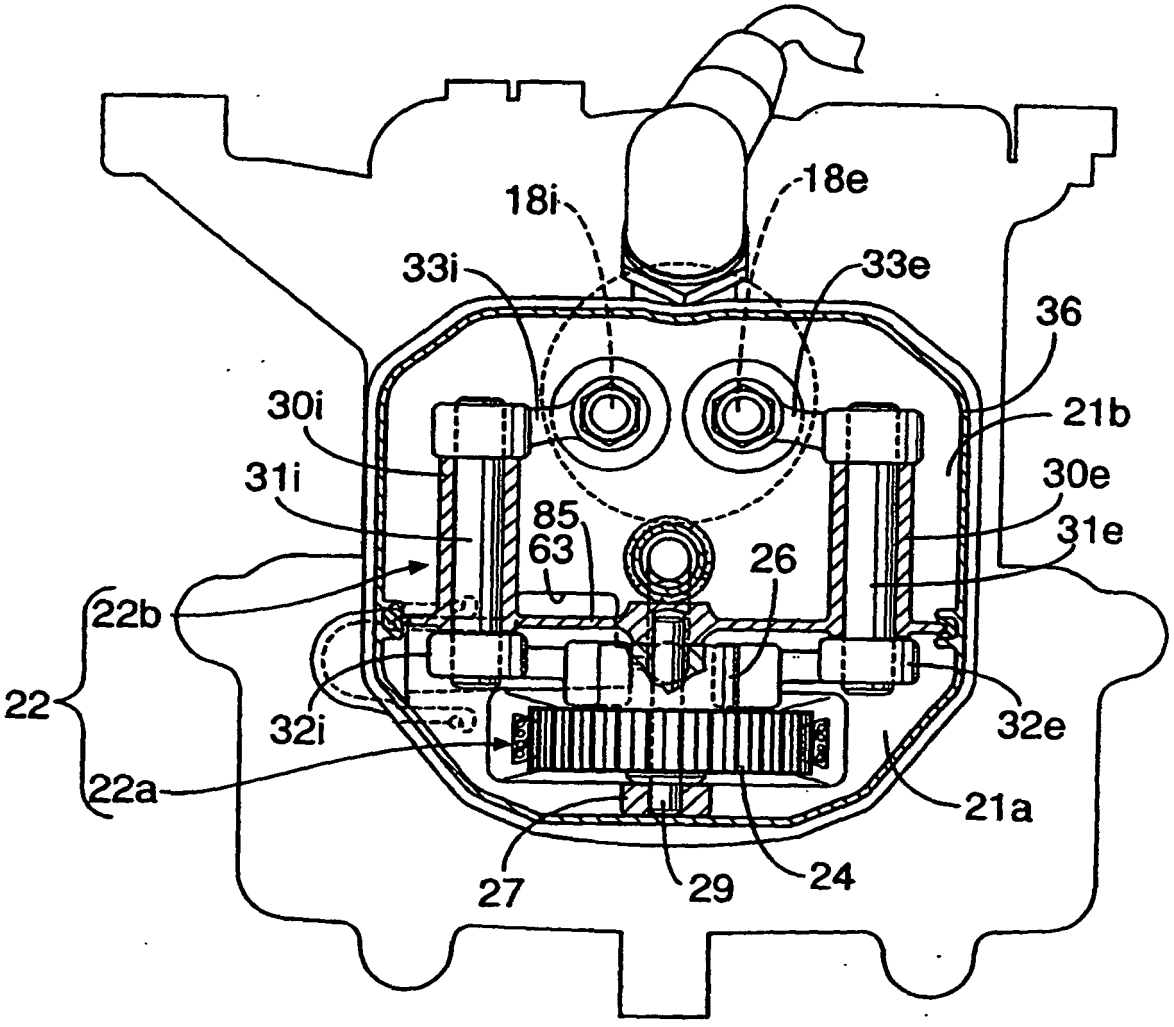

18i
18e
33i
33e
36
30i
21b
31i
30e
85
63
26
31e
22b
22
32i
32e
22a
21a
27
29
24

FIG.8

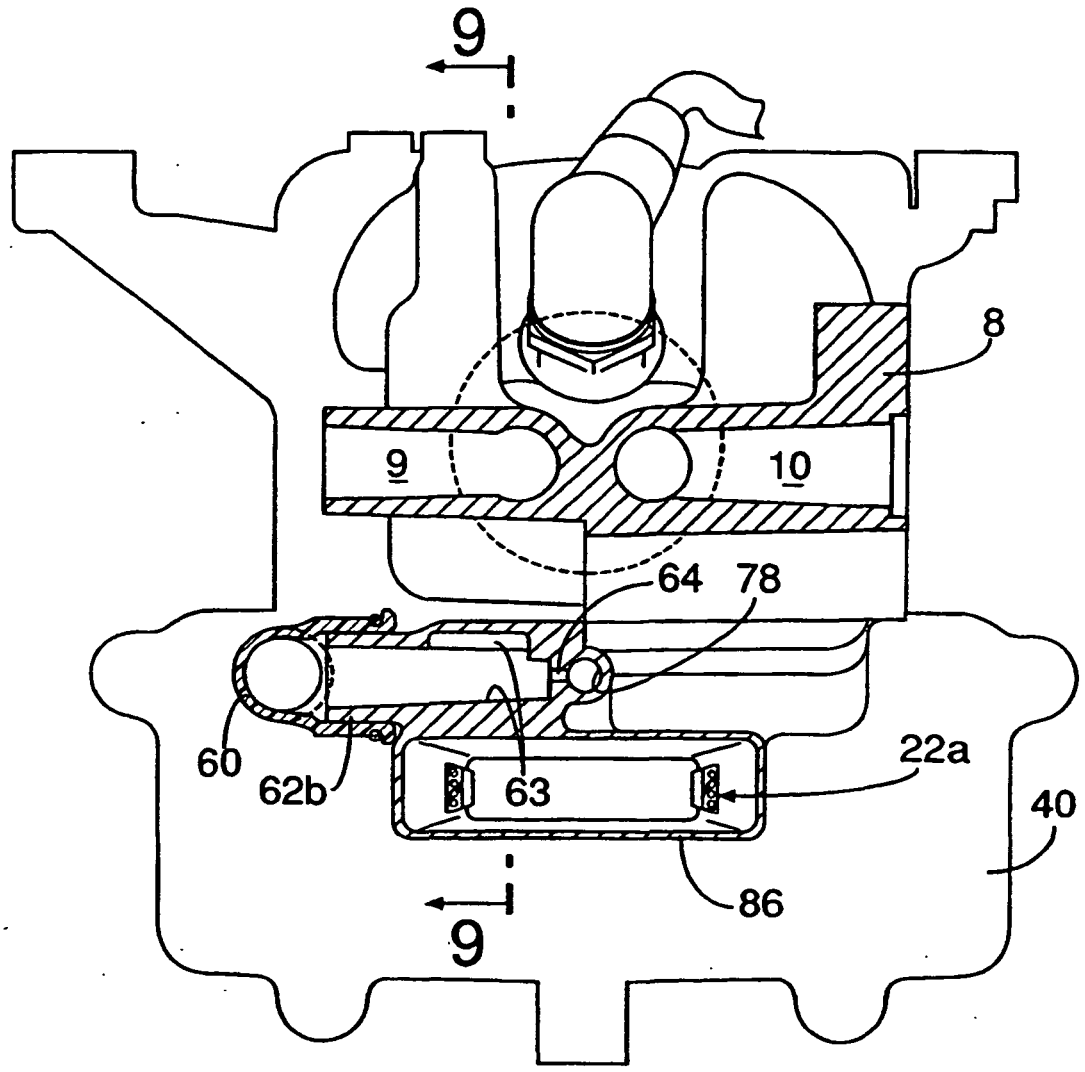


FIG.9

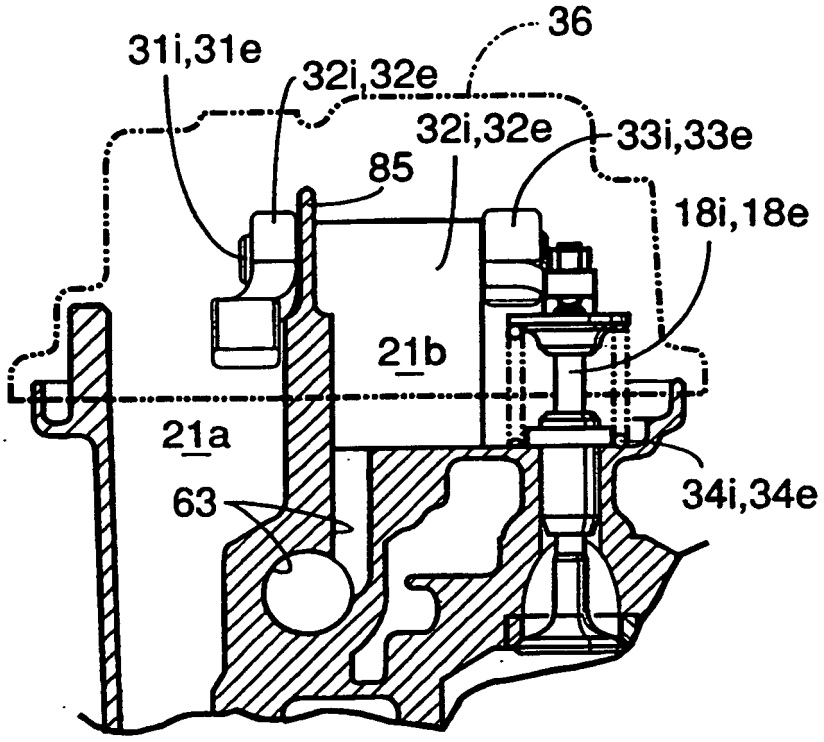


FIG.10

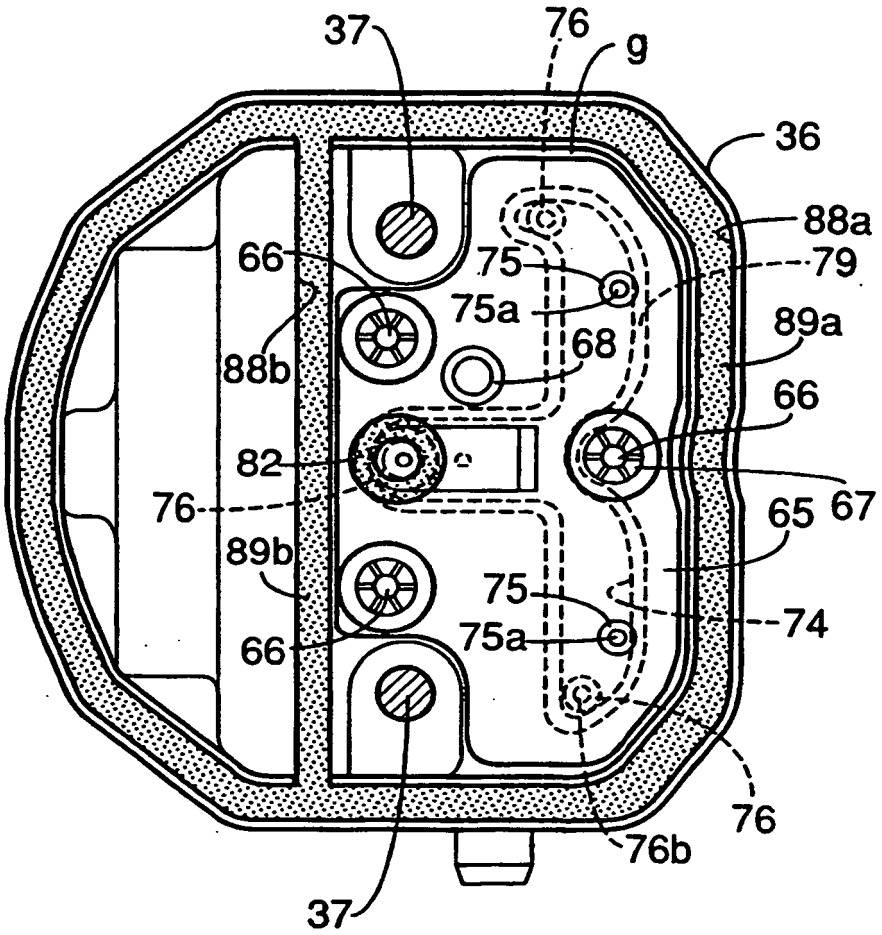

37
76
g
36
88a
66
75
79
75a
89a
68
88b
66
82
67
76
65
89b
75
74
75a
66
76
76b
37

FIG.11

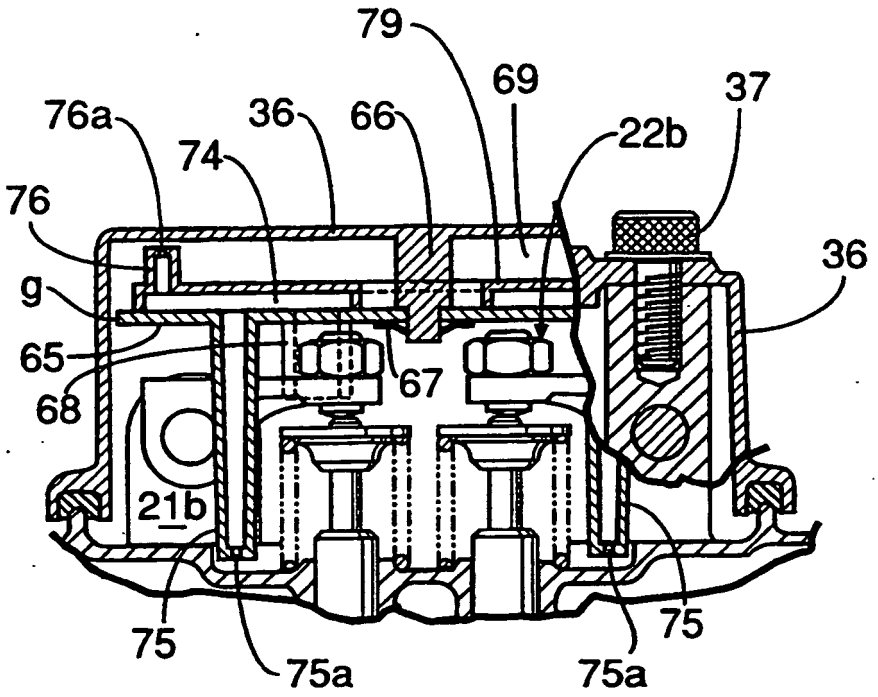


FIG.12

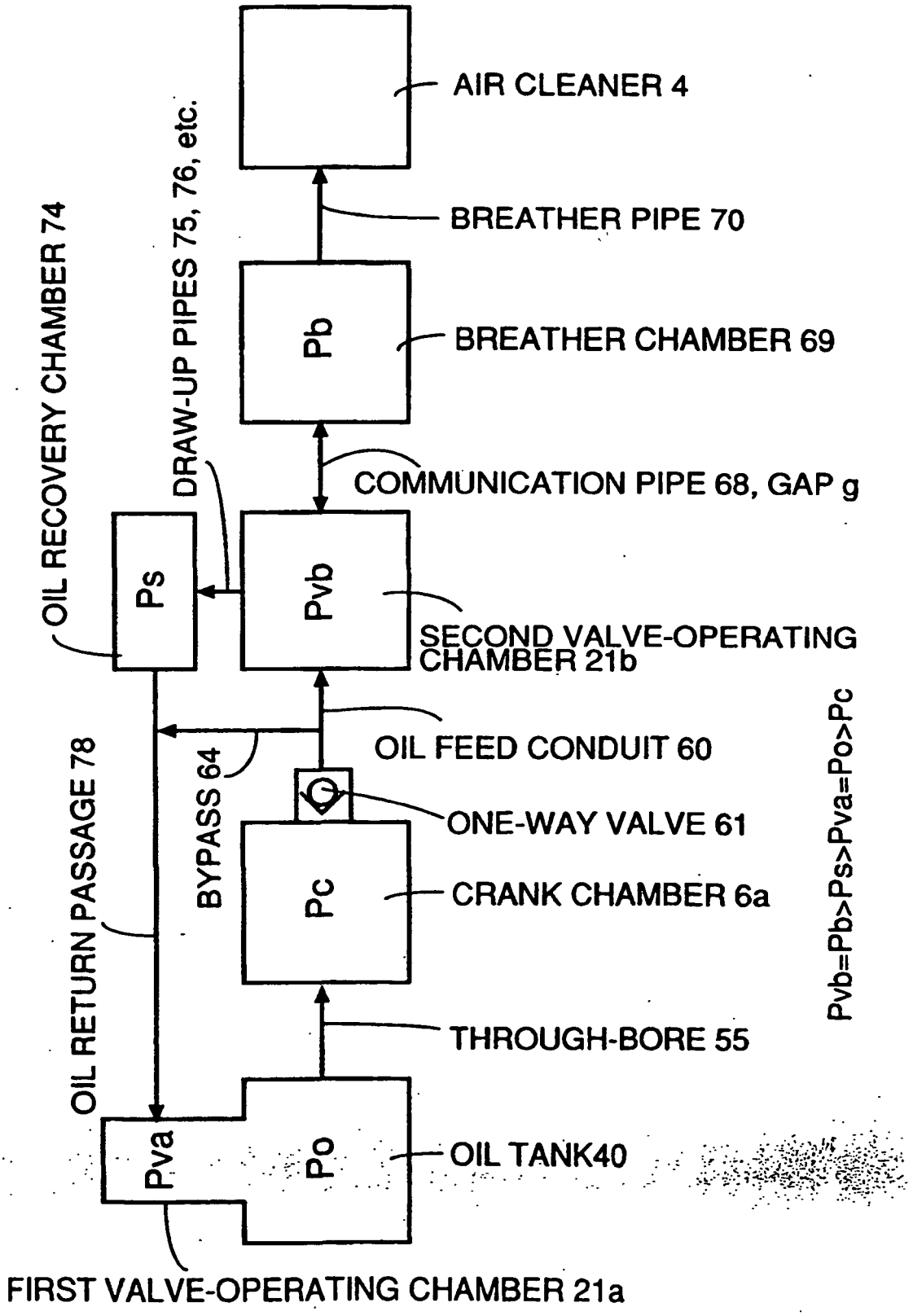

AIR CLEANER 4
BREATHER PIPE 70
Pb
BREATHER CHAMBER 69
COMMUNICATION PIPE 68, GAP g
DRAW-UP PIPES 75, 76, etc.
OIL RECOVERY CHAMBER 74
Ps
Pvb
SECOND VALVE-OPERATING CHAMBER 21b
OIL FEED CONDUIT 60
BYPASS 64
ONE-WAY VALVE 61
OIL RETURN PASSAGE 78
Pc
CRANK CHAMBER 6a
THROUGH-BORE 55
Pva
Po
OIL TANK40
FIRST VALVE-OPERATING CHAMBER 21a
Pvb=Pb>Ps>Pva=Po>Pc

FIG.13

UPSIDE-DOWN STATE

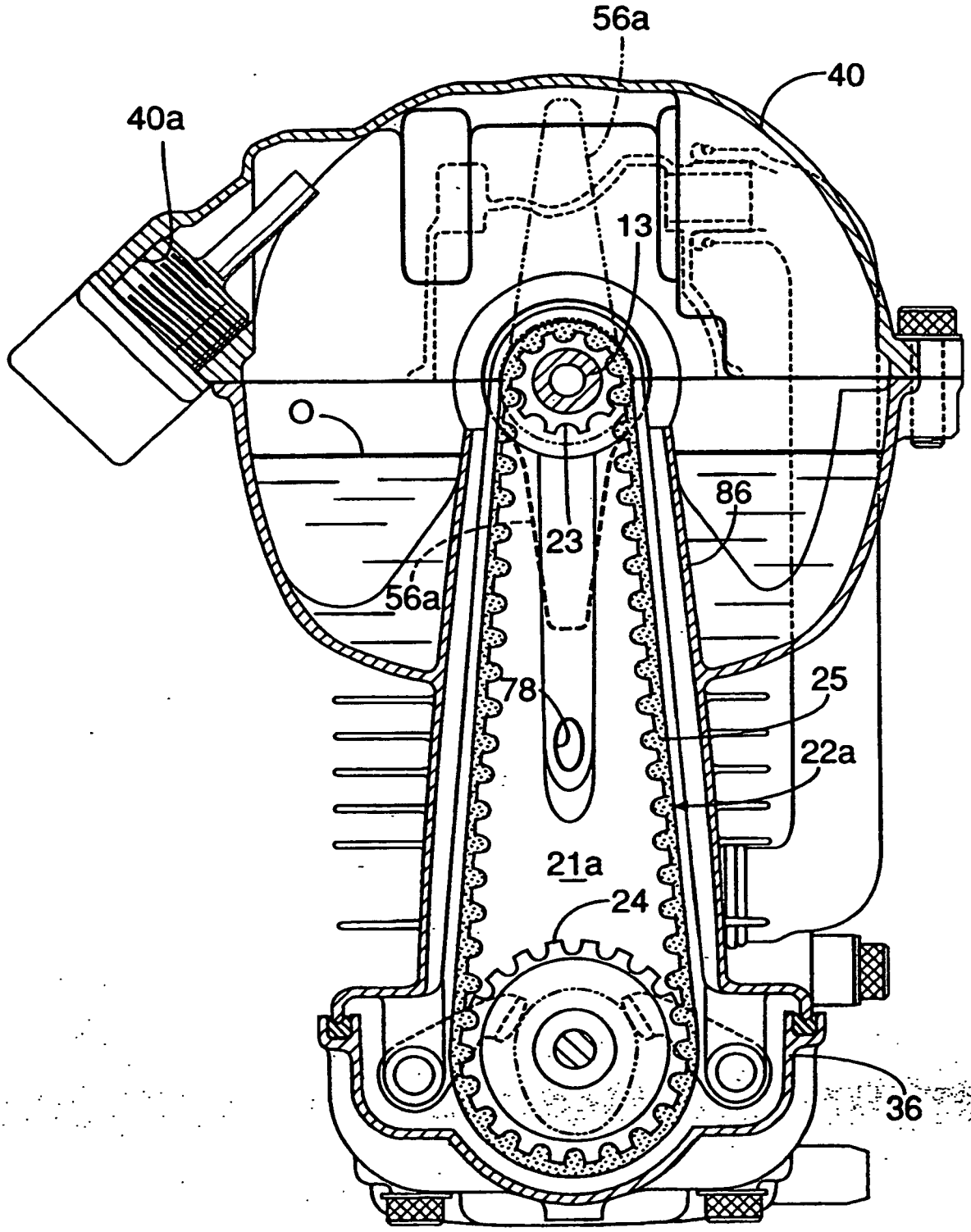


FIG.14

LAID-SIDEWAYS TATE

