

(19)



(11)

EP 2 821 603 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.01.2015 Bulletin 2015/02

(51) Int Cl.:
F01L 13/08 (2006.01)

(21) Application number: **14171225.7**

(22) Date of filing: **05.06.2014**

(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

(72) Inventors:
• **Nishiwaki, Ryoji**
Iwata-shi, Shizuoka 438-8501 (JP)
• **Sato, Isao**
Iwata-shi, Shizuoka 438-8501 (JP)

(30) Priority: **02.07.2013 JP 2013139095**

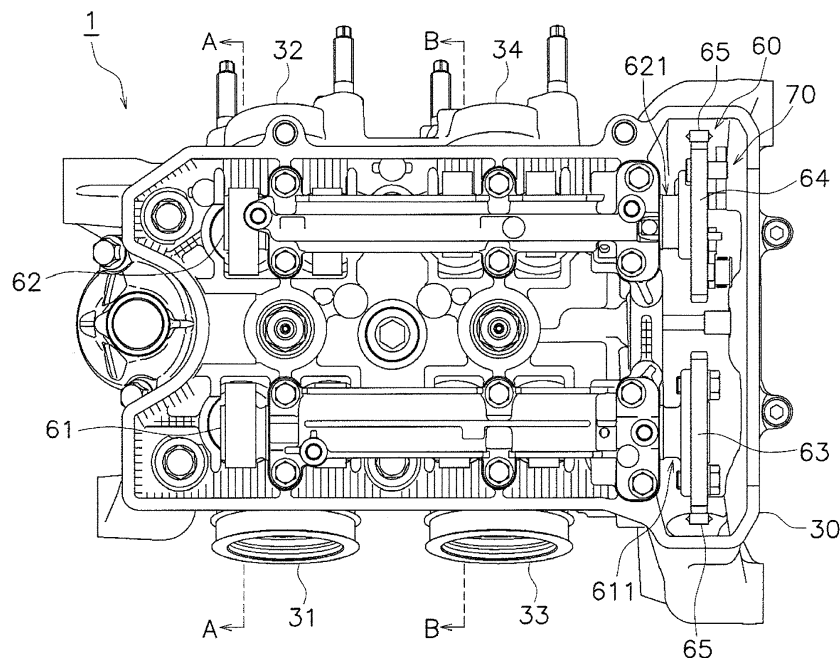
(74) Representative: **Grünecker, Kinkeldey,
Stockmair & Schwanhäusser**
Leopoldstrasse 4
80802 München (DE)

(71) Applicant: **Yamaha Hatsudoki Kabushiki Kaisha**
Iwata-shi, Shizuoka 438-8501 (JP)

(54) Engine and saddle type vehicle

(57) An engine has a cylinder, an exhaust valve, an exhaust camshaft, a compression release mechanism, and an oil supply system. The cylinder houses a piston. The exhaust valve is configured to release or block exhaust flow from the cylinder. The exhaust camshaft has a hollow structure and includes a valve for driving the exhaust valve. The compression release mechanism is

attached to the exhaust camshaft. The compression release mechanism is configured to release exhaust flow from the cylinder by driving the exhaust valve via the valve cam when the exhaust camshaft rotates below a prescribed speed. The oil supply system is configured to pump oil into the compression release mechanism by supplying oil to an internal space of the exhaust camshaft.

**FIG. 1****EP 2 821 603 A1**

Description

[0001] The technology disclosed herein relates to an engine provided with a compression release mechanism, and a saddle type vehicle.

Background Art

[0002] Traditional engines employ a compression release mechanism which opens an exhaust valve on engine start to release or block exhaust flow from a cylinder for the purpose of reducing the start load on the engine (see for example, Patent Document 1). The compression release mechanism is configured to run smoothly on a small amount of power by providing sufficient clearance between the constituent components of the mechanism.

Cited Documents

Patent Documents

[0003]

Patent Document 1: Japanese Unexamined Patent Application No. 2008-19845 Technical Problem

[0004] However, since there is clearance between the components in the compression release mechanism, the compression release mechanism will tend to generate noise while the engine is running.

[0005] With the above described situation in mind, the technology disclosed herein aims to provide an engine and saddle type vehicle capable of suppressing the noise from the compression release mechanism.

Solution to Technical Problem

[0006] An engine according to a first aspect of the technology disclosed herein is provided with a cylinder, an exhaust valve, an exhaust camshaft, a compression release mechanism, and an oil supply system. The cylinder houses a piston. The exhaust valve is configured to release or block exhaust flow from the cylinder. The exhaust camshaft has a hollow structure and includes a valve for driving the exhaust valve. The compression release mechanism is attached to the exhaust camshaft. The compression release mechanism is configured to release exhaust flow from the cylinder by driving the exhaust valve via the valve cam when the exhaust camshaft rotates below a prescribed speed. The oil supply system is configured to pump oil into the compression release mechanism by supplying oil to an internal space of the exhaust camshaft.

[0007] The engine according to the second aspect of the technology disclosed herein may include the features of the first aspect and further includes an exhaust valve lifter driven by the valve cam. The exhaust valve lifter is configured to open and close the exhaust valve. The com-

pression release mechanism includes a weight portion, a compression release shaft portion, and a compression release pin portion. The weight portion is configured to move due to centrifugal force when the exhaust camshaft rotates at a speed greater than the prescribed speed. the compression release shaft portion is arranged inside the internal space of the exhaust camshaft. The compression release shaft portion is configured to rotate in response to a movement of the weight portion. The compression release pin portion is arranged to protrude from a pinhole formed in a side surface of the exhaust camshaft to abut the exhaust valve lifter. The compression release pin portion is configured to withdraw from the exhaust valve lifter in response to a rotation of the compression release shaft portion.

[0008] The engine according to a third aspect of the technology disclosed herein may include the features of the second aspect wherein the exhaust camshaft includes a first end, a second end, a center portion, and a first oil inflow port formed in a side surface of the center portion. The oil supply system is configured to supply oil to the internal space from the first oil inflow port.

[0009] The engine according to the fourth aspect of the technology disclosed herein may include the features of the third aspect wherein the exhaust camshaft includes a second oil inflow port disposed opposite to the first oil inflow port with a shaft center of the exhaust camshaft located in-between as a reference. The oil supply system is configured to supply oil to the internal space from the second oil inflow port.

[0010] The engine according to the fifth aspect of the technology disclosed herein may include the features of the third or fourth aspects wherein the exhaust camshaft includes a sprocket secured to the first end. The weight portion is attached to the sprocket and is in contact with the sprocket.

[0011] The engine according to the sixth aspect of the technology disclosed herein may include the features of the fifth aspect wherein an opening formed in the first end of the exhaust camshaft is positioned inside a shaft bore of the sprocket when the sprocket is viewed from an axial direction of the exhaust camshaft. The shaft bore opens on a central axis of the sprocket.

[0012] The engine according to a seventh aspect of the technology disclosed herein may include the features of fifth or sixth aspect wherein the weight portion is located between the sprocket and an inner wall surface of the engine case. The inner wall surface faces the sprocket.

[0013] The engine according to an eighth aspect of the technology disclosed herein may include the features of any one of the third through seventh aspects wherein the exhaust camshaft includes a blocking plug which closes an opening formed in the second end of the exhaust camshaft.

[0014] The engine according to a ninth aspect of the technology disclosed herein may include the features of any of the third through eighth aspects wherein the oil

supply system includes a bearing portion which supports the exhaust camshaft. The bearing portion includes an internal oil passage and an oil supply port. The internal oil passage is formed in the bearing portion. The oil supply port faces the first oil inflow port.

[0015] The engine according to a tenth aspect of the technology disclosed herein may include the features if any of the second through ninth aspects wherein the compression release shaft portion includes a plurality of compression release shafts coupled in an axial direction of the exhaust camshaft. The compression release pin portion includes a plurality of compression release pins coupled respectively to the plurality of compression release shafts.

[0016] The engine according to an eleventh aspect of the technology disclosed herein may include the features of any of the fifth through tenth aspects wherein the weight portion includes a first support shaft, a first weighted body, a second support shaft, and a second weighted body. The first support shaft is parallel to a shaft center of the exhaust camshaft. The first weighted body is configured to rotate about the first support shaft. The first weighted body is formed as a fan shape. The second support shaft is parallel to the shaft center. The second support shaft is arranged symmetrically to the first support shaft about the shaft center. The second weighted body is configured to rotate about the second support shaft. The second weighted body is formed as a fan shape. The first weighted body and the second weighted body are arranged point-symmetrically about the shaft center.

[0017] The saddle type vehicle according to a twelfth aspect of the technology disclosed herein includes the engine according to the first aspect, and a vehicle frame that supports the engine.

Effects of the Technology disclosed herein

[0018] In the engine according to the first aspect of the technology disclosed herein the compression release mechanism can be supplied with oil using pressurized lubrication, to effectively suppress the generation of mechanical noise from the compression release mechanism. Consequently, even if there is little drive sound due to low engine speed, it is possible to subdue outstanding mechanical noise from the compression release mechanism. Further, for example when adopting non-pressurized lubrication methods such as splash lubrication, the centrifugal force will cause oil to scatter about the compression release mechanism and the compression release mechanism cannot be effectively lubricated; however the configuration using pressurized lubrication according to the first aspect, can lubricate the nooks and crannies of the compression release mechanism.

[0019] The engine according to the second aspect of the technology disclosed herein allows forcible return of the compression release pin responsive to an increase in the speed of the exhaust camshaft beyond a prescribed

speed. Therefore, the engine may properly and quickly return to a normal compression state after the engine has started.

[0020] The engine according to the third aspect of the technology disclosed herein allows oil to be supplied from the first oil inflow port formed in the center portion of the exhaust camshaft, and therefore the internal space of the engine may be efficiently filled with oil. The oil is supplied by being pumped from the first oil inflow port, and therefore even if the oil inflow port is formed at the center portion of the exhaust camshaft, the oil flows towards the first weight portion and the second weight portion.

[0021] The engine according to the fourth aspect of the technology disclosed herein allows oil to be continuously supplied from two opposing oil inflow ports, thereby allowing a more stable supply of oil compared to when the oil is discretely supplied from just the first oil inflow port.

[0022] Given that the weight abutting the sprocket will tend to generate mechanical noise in the engine according to a fifth aspect of the technology disclosed herein, the engine according to the fifth aspect effectively suppresses the amount of mechanical noise by using pressurized lubrication.

[0023] In the engine according to the sixth aspect of the technology disclosed herein, it is possible to make oil flow from an opening and to efficiently supply oil between the weight and the sprocket by making use of centrifugal force.

[0024] In the engine according to the seventh aspect of the technology disclosed herein, even when it is difficult to splash lubrication to supply oil to the weight sandwiched between the inner wall of the engine and a sprocket, the weight portion may be effectively lubricated using pressurized lubrication.

[0025] In the engine according to the eighth aspect of the technology disclosed herein, it is possible to prevent oil from flowing from the opening even when the saddle type vehicle is standing on its own with a side stand and the opening faces downward.

[0026] In the engine according to the ninth aspect of the technology disclosed herein, a general-use oil supply system pumps the oil used to lubricate the outer peripheral surface of the exhaust camshaft, and thus it is possible to prevent an increase in the number of parts used by using pressurized lubrication.

[0027] In the engine according to the tenth aspect of the technology disclosed herein, it is possible to synchronize the operation of a plurality of compression release pins in order to support multiple cylinders.

[0028] In the engine according to the eleventh aspect of the technology disclosed herein it is possible to have an exhaust camshaft with well-balanced rotation due to the first and second weight portioned bodies, and therefore the compression release mechanism may be driven smoothly compared to a case where only a single weighted body is used to drive the exhaust camshaft.

[0029] In the saddle type vehicle according to the twelfth aspect of the technology disclosed herein the

compression release mechanism can be supplied with oil using force-feed lubrication, to effectively suppress the generation of mechanical noise from the compression release mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

FIG. 1 is a top view of an engine;
 FIG. 2 is a top view of the engine;
 FIG. 3 is a partially transparent exploded side view of the engine;
 FIG. 4 is a cross-sectional view along A-A in FIG. 1;
 FIG. 5 is a cross-sectional view along B-B in FIG. 1;
 FIG. 6 is a cross-sectional view of the exhaust camshaft and the compression release mechanism;
 FIG. 7 is a three-sided view of a first compression release shaft;
 FIG. 8 is a side view of a first compression release pin;
 FIG. 9 is a three-sided view of a second compression release shaft;
 FIG. 10 is a side view of a second compression release pin;
 FIG. 11 is a side view of the compression release mechanism on startup of the engine 1;
 FIG. 12 is a side view of the compression release mechanism after the startup of the engine 1;
 FIG. 13 is a cross-sectional view along C-C in FIG. 6;
 FIG. 14 is a cross-sectional view along D-D in FIG. 6;
 FIG. 15 is a schematic view illustrating a configuration for an oil supply system;
 FIG. 16 is a main component exploded view of FIG. 3 illustrating a partial cross-sectional view of the oil supply system 80;
 FIG. 17 is a cross-sectional view along F-F in FIG. 16;
 FIG. 18 is a left side view of the saddle type vehicle.

Overall Configuration for the Engine 1

[0031] An overall configuration of an engine 1 according to an embodiment will be described with reference to the drawings. FIG. 1 and FIG. 2 are top views of the engine 1. In FIG. 1 the cylinder head cover 40 is omitted; in FIG. 2 the cylinder head cover 40, the valve train 50, and the valve gear 60 are omitted. FIG. 3 is a partially transparent partial side view of the engine 1. In FIG. 3 the cylinder block 20 is omitted. FIG. 4 is a cross-sectional view along A-A in FIG. 1. FIG. 5 is a cross-sectional view along B-B in FIG. 1. In FIG. 4 and FIG. 5 the spark plug is placed at the center of the drawing for ease of reference.

[0032] The engine 1 is mounted in a saddle type vehicle such as a motorcycle, an all-terrain vehicle, or a snowmobile. One example of a configuration of a saddle type vehicle in which the engine 1 may be mounted will be described later. The engine 1 is supported in the vehicle

frame. The engine 1 according to the present embodiment is a two-cylinder four-cycle engine that uses a four-valve DOHC format.

[0033] The engine 1 is provided with a crankcase 10, a cylinder block 20, a cylinder head 30, a cylinder head cover 40, valve train 50, a valve gear 60, a compression release mechanism 70, and an oil supply system 80.

[0034] The crankcase 10 houses a crankshaft 11. The cylinder block 20 is connected to the top of the crankcase 10. As illustrated in FIG. 4 and FIG. 5, the cylinder block 20 includes a first cylinder 21, and a second cylinder 22. The first cylinder 21 houses a first piston 23, and forms a first internal combustion chamber 21S. The second cylinder 22 houses a second piston 24 and forms the second internal combustion chamber 22S. The reciprocating motion of the first piston 23 and the second piston 24 rotate the crankshaft 11. Additionally, in FIG. 1 and FIG. 2 components below the cylinder head 30 (including the first piston 23 and the second piston 24) are schematically represented.

[0035] The cylinder head 30 is connected to the top of the cylinder block 20. The cylinder head 30 includes a first intake port 31, a first exhaust port 32, a second intake port 33, and a second exhaust port 34.

[0036] The first intake port 31 includes a pair of first intake inlets 31S that extends to the first internal combustion chamber 21S. The first exhaust port 32 includes a pair of first exhaust outlets 32S which extend to the first internal combustion chamber 21S. The second intake port 33 includes a pair of second intake inlets 33S which extends to the second internal combustion chamber 22S. The second exhaust port 34 includes a pair of second exhaust outlets 34S which extends to the second internal combustion chamber 22S.

[0037] The valve train 50, the valve gear 60, the compression release mechanism 70, and a head cap 86 making up one portion of the oil supply system 80 are supported on top of the cylinder head 30. A shaft support groove 30a (refer to FIG. 17) with a half-circle groove cross-section rotatably supports the exhaust camshaft 62 on the top surface of the cylinder head 30.

[0038] The cylinder head cover 40 is connected to the top of the cylinder head 30. The cylinder head cover 40 covers the valve train 50, the valve gear 60, the compression release mechanism 70, and the head cap 86.

[0039] As illustrated in FIG. 4 and FIG. 5, the valve train 50 includes a pair of intake valves 51, a pair of intake valve lifters 52, a pair of first exhaust valves 53, a pair of first exhaust valve lifters 54, a pair of second intake valves 55, a pair of second intake valve lifters 56, a pair of second exhaust valves 57, and a pair of second exhaust valve lifters 58.

[0040] The first intake valve 51 releases or blocks the flow of air from the first cylinder 21. The first intake valve lifters 52 open the first intake valves 51 each time the valve gear 60 presses thereon. The first exhaust valve 53 releases and blocks the flow of exhaust from the first cylinder 21. The first exhaust valve lifters 54 open the

first exhaust valves 53 each time the valve gear 60 presses thereon.

[0041] The second intake valve 55 releases and blocks the flow of air from the second cylinder 22. The second intake valve lifters 56 open the second intake valves 55 each time the valve gear 60 presses thereon. The second exhaust valves 57 release and block the flow of exhaust from the second cylinder 22. The second exhaust valve lifters 58 open the second exhaust valves 57 each time the valve gear 60 presses thereon.

[0042] The valve gear 60 includes an intake camshaft 61, an exhaust camshaft 62, a first sprocket 63, a second sprocket 64, and a timing chain 65.

[0043] The intake camshaft 61 is arranged above the pair of first intake valve lifters 52 and the first pair of second intake valve lifters 56. Four intake valve cams 61a are attached to the intake camshaft 61. The four intake valve cams 61a press the pair of first intake valve lifters 52, and the pair of second intake valve lifters 56. Hereby, the four intake valve cams 61a control the opening and closing of the pair of first intake valves 51 and the pair of second intake valves 55.

[0044] The exhaust camshaft 62 is arranged above the pair of first exhaust valve lifters 54 and the pair of second exhaust valve lifters 58. Four exhaust valve cams 62a are attached to the exhaust camshaft 62. The four exhaust valve cams 62a press the pair of first exhaust valve lifters 54, and the pair of second intake valve lifters 58. Hereby the four exhaust valve cams control the opening and closing of the pair of first exhaust valves 53, and the pair of second exhaust valves 57,

[0045] The exhaust camshaft 62 is hollow. The exhaust camshaft 62 has the compression release mechanism 17 attached thereto. A detailed configuration of the exhaust camshaft 62 will be described later.

[0046] The first sprocket 63 is attached to a first end 611 of the intake camshaft 61. The second sprocket 64 is attached to a first end 621 of the exhaust camshaft 62. The timing chain 65 is wound around the first sprocket 63, the second sprocket 64, and the crankshaft 11.

[0047] When the crankshaft 11 rotates the timing chain 65, the intake camshaft 61 connected to the first sprocket 63 rotates, and the exhaust camshaft 62 connected to the second sprocket 64 rotates. The pair of first intake valves 51 and the pair of second intake valves 55 open and close, and the pair of first exhaust valves 53, and the pair of second exhaust valves 57 open and close in response to the rotation of the sprockets.

[0048] The compression release mechanism 70 is attached to the exhaust camshaft 62. One portion of the compression release mechanism 70 is housed inside the exhaust camshaft 62. When the engine is started, the compression release mechanism 70 reduces the compression pressure inside the first internal combustion chamber 21S and the second internal combustion chamber 22S. A reduced compression pressure results in less cranking power being needed, and therefore a small and lightweight starter motor and battery may be used. The

compression release mechanism 70 restores the inside of the first internal combustion chamber 21S and the second internal combustion chamber 22S to a normal compression state after startup of the engine 1.

[0049] More specifically, if the exhaust camshaft 62 is below a prescribed speed, the compression release mechanism 70 drives the pair of first exhaust valves 53 by way of the two exhaust valve cams 62a during the compression stroke using the first piston 23, to release exhaust from the first cylinder 21. If the exhaust camshaft 62 is below a prescribed speed the compression release mechanism 70 drives the pair of second exhaust valves 57 by way of the remaining two exhaust valve cams 62a during the compression stroke using the second piston 24 to release exhaust from the second cylinder 22. The compression release mechanism 70 will stop releasing exhaust from the first and the second cylinders 21, 22 during the compression stroke when the speed of the exhaust camshaft 62 increases above a prescribed speed. A detailed configuration of the compression release mechanism 70 will be described later.

[0050] The head cap 86 making up the oil supply system 80 is arranged above the valve gear 60. The oil supply system 80 supplies oil to the internal space 62S (refer to FIG. 6) of the exhaust camshaft 62 from the engine start engine 1 start, to thereby pump oil into the compression release mechanism 70. In other words, the oil supply system 80 feeds oil to the compression release mechanism 70 by means of pressurized lubrication.

[0051] The oil supply system 80 supplies oil not only to the compression release mechanism 70, but also supplies oil to the outer surface of the intake camshaft 61, and the exhaust camshaft 62. The supply of oil to these outer surfaces maintains the smooth rotational driving of the intake camshaft 61 and the exhaust camshaft 62. The configuration of the compression release mechanism 70 and the oil supply system 80 will be described later.

[0052] Configuration of the Exhaust Camshaft 62 and the Compression Release Mechanism 70

The configuration of the exhaust camshaft 62 and the compression release mechanism 71 will now be described with reference to the drawings. FIG. 6 is a cross-sectional view (the cross-sectional view along E-E in FIG. 11) of the exhaust camshaft 62 and the compression release mechanism 70. FIG. 7 through FIG. 10 are separate views of components that make up the compression release mechanism 70. FIG. 11 is a side view of the compression release mechanism 70 while the engine 1 is starting. FIG. 6 and FIG. 11 illustrate the state where the exhaust camshaft 62 is rotating at less than a prescribed speed while the engine 1 is stopped or the engine 1 is starting.

[0053] In the description that follows, the direction in which the shaft center AX of the exhaust camshaft 62 extends is called the "axial direction", and the direction orthogonal to the shaft center AX is called the "radial direction". The configuration of the exhaust camshaft 62

and the compression release mechanism 70 will be described below, and the operations of the compression release mechanism 70 will be described later.

1. Configuration of the Exhaust Camshaft 62

[0054] The exhaust camshaft 62 includes a first end 621, a second end 622, a center portion 623, a through hole 624, and a blocking plug 625.

[0055] The second sprocket 64 is attached on the outer periphery of the tip of the first end 621. As illustrated in FIG. 6, the edge surface of the first end 621 is located slightly inside the outer surface of the second sprocket 64. The first end 621 includes a first journal side surface 621 S.

[0056] The second end 622 is provided opposite the first end 621 with the center portion 623 therebetween. The two exhaust valve cams 62a that drive the pair of first exhaust valves 53 are attached to the second end 622. The second end 622 includes a second journal side surface 622S which is formed between the two exhaust valve cams 62a.

[0057] The center portion 623 extends to the first end 621 and to the second end 622. The two exhaust valve cams 62a that drive the pair of second exhaust valves 57 are attached to the center portion 623. The center portion 623 includes a third journal side surface 623S which is formed between the two exhaust valve cams 62a. A first oil inflow port OH1 and a second oil inflow port OH2 are formed in the third journal side surface 623S. The first oil inflow port OH1 and the second oil inflow port OH2 are arranged at symmetry site each other about the shaft center AX. The oil supply system 80 (refer to FIG. 3) pumps oil into the first oil inflow port OH1 and the second oil inflow port OH2.

[0058] A pair of first pinholes PH1 is formed in the side surface of the center portion 623 to be adjacent to the exhaust valve cam 62a. The pair of first pinholes PH1 are arranged at symmetry site about the shaft center AX. In other words, the pair of first pinholes PH1 are formed on a straight line along the radial direction.

[0059] Similarly, a pair of second pinholes PH2 is formed adjacent to the exhaust valve cam 62a at the second end 622 near in the center portion 623. The pair of second pinholes PH2 are arranged at symmetry site about the shaft center AX. In other words, the pair of second pinholes PH2 are formed on a straight line along the radial direction.

[0060] The through hole 624 passes through the first end 621, the second end 622, and the center portion 623 in the axial direction. A first opening 621P for the through hole 624 is formed in the first end 621, and a second opening 622P for the through hole 624 is formed in the second end 622. When viewing the second sprocket 64 from the axial direction the first opening 621P is located on the inside of a shaft bore 64S in the second sprocket 64 (refer to FIG. 11). The through hole 624 forms in the internal space 62S that extends in the axial direction. A

portion of the compression release mechanism 70 is housed in the internal space 62S. Oil is pumped from the first oil inflow port OH1 and the second oil inflow port OH2 into the internal space 62S.

[0061] The blocking plug 625 is attached to the second end 622 to plug the second opening 622P. A metal or rubber cap may be used as the blocking plug 625. In the present embodiment, the shaft center AX substantially coincides with the vehicle width direction (that is the horizontal direction) of the saddle type vehicle. When the vehicle is stood up using a side stand, the second end 622 will be lower than the first end 621. The blocking plug 625 blocks the second opening 622P and therefore oil will not flow out of the second opening 622P even when the saddle type vehicle is stood up using a side stand.

2. Configuration of the Compression Release Mechanism 70

[0062] The compression release mechanism 70 includes a first compression release shaft 71, a first compression release pin 72, a second compression release shaft 73, a second compression release pin 74, a first weight portion 75, and a second weight portion 76. The first compression release shaft 71 and the second compression release shaft 73 constitutes a "compression release shaft portion" according to the present embodiment, and the first compression release pin 72, and the second compression release pin 74 constitute a "compression release pin portion" according to the present embodiment.

2-1. The First Compression Release Shaft 71 and the Second Compression Release Shaft 72

[0063] The first compression release shaft 71 is arranged along the axial direction in the internal space 62S as illustrated in FIG. 6. Further, the first compression release shaft 71 includes a base end 71a, a rod 71b, and a disk 71c as illustrated in FIG. 7(a).

[0064] The base end 71a is arranged in the first opening 621P of the exhaust camshaft 62. However, the outer diameter of the base end 71 a is smaller than the inner diameter of the through hole 624, and therefore there is a gap between the outer peripheral surface of the base end 71a and the inner peripheral surface of the exhaust camshaft 62. As illustrated in FIG. 7(b), the end surface of the base end 71a has an engagement groove 71d formed thereon. The engagement groove 71d is linearly formed along the radial direction.

[0065] The rod 71b is coupled to the base end 71a and extends in the axial direction. The rod 71b has a smaller diameter than the base end 71 a and the disk 71 c.

[0066] The disk 71c is coupled to the tip end of the rod 71 b. The outer diameter of the disk 71 c is substantially equal to the outer diameter of the base end 71a and therefore there is a gap between the outer peripheral surface of the disk 71c and the inner peripheral surface of the

exhaust camshaft 62. A projected catch 71e is formed on the end surface of the disk 71c. As illustrated in FIG. 7(c), the projected catch 71e is arranged at a location deviated from the shaft center AX. A coupling groove 71f is formed in the side surface of the disk 71c as illustrated in FIG. 7(c). The coupling groove 71f is formed to pass through the disk 71c in the axial direction. The coupling groove 71f is formed at a location away from the projected catch 71e along a circumferential direction with the shaft center AX as the center.

[0067] The first compression release pin 72 is rod-shaped. As illustrated in FIG. 6 the first compression release pin 72 is adjacent to the exhaust valve cam 62a. The first compression release pin 72 is inserted in the pair of first pinholes PH1 formed in the exhaust camshaft 62. The first compression release pin 72 protrudes to the outside from each of the pair of first pinholes PH1. As illustrated in FIG. 8, a recessed catch 72a is formed in the side surface of the first compression release pin 72. The recessed catch 72a engages with the projected catch 71e on the first compression release shaft 71. The tip end surface 72e of the first compression release pin 72 is subjected to curved surface machining.

2-2. The Second Compression Release Shaft 73 and the Second Compression Release Pin 74

[0068] As illustrated in FIG. 6 the second compression release shaft 73 is arranged in the internal space 62S along the axial direction. The second compression release shaft 73 includes a base end 73a, a rod 73b, and a disk 73c, as illustrated in FIG. 9(a).

[0069] The base end 73a is arranged to face the disk 71c of the first compression release shaft 71. The base end 73a and the disk 71c have the first compression release pin 72 arranged therebetween. The outer diameter of the base end 73a is smaller than the inner diameter of the through hole 624 and therefore there is a gap between the outer peripheral surface of the base end 73a and the inner peripheral surface of the exhaust camshaft 62. A coupling pin 73d is formed on the end surface of the base end 73a. The coupling pin 73d is arranged at a location eccentric to the shaft center AX as illustrated in FIG. 9(b). The coupling pin 73d extends from the end surface of the base end 73a toward the first compression released shaft 71. The coupling pin 73d passes next to the first compression release pin 72 to be inserted into the coupling groove 71f of the first compression release shaft 71.

[0070] The rod 73b is coupled to the base end 73a and extends in the axial direction. The rod 73b has a smaller diameter than the base end 73a and the disk 73c. The first oil inflow port OH1 and the second oil inflow port OH2 are located at the sides of the rod 73b.

[0071] The disk 73c is coupled to the tip end of the rod 73b. The outer diameter of the disk 73c is substantially equal to the outer diameter of the base end 73a and therefore there is a gap between the outer peripheral surface

of the disk 73c and the inner peripheral surface of the exhaust camshaft 62. As illustrated in FIG. 9(c), a projected catch 73e is formed on the end surface of the disk 73c.

[0072] The second compression release pin 74 is rod-shaped. As illustrated in FIG. 6, the second compression release pin 74 is adjacent to the exhaust valve cam 62a. The second compression release pin 72 is inserted into the pair of second pinholes PH2 formed in the exhaust camshaft 62. The second compression release pin 74 protrudes outside from each of the pair pinholes PH2. As illustrated in FIG. 10, a recessed catch 74a is formed in the side surface of the second compression release pin 74. The projected catch 73e in the second compression release shaft 73 engages with the recessed catch 74a. The tip end portion 74e of the second compression release pin 74 may be subject to curved surface machining.

2-3. The First weight portion 75 and the Second weight portion 76

[0073] The first weight portion 75 and the second weight portion 76 are located between the inner wall surface of the engine 1 and the second sprocket 64 (refer to FIG. 3). The first weight portion 75 and the second weight portion 76 are near the inner wall surface of the engine 1 and abut the second sprocket 64.

[0074] As illustrated in FIG. 11, the first weight portion 75 includes a first weighted body 75a, a first support shaft 75b, a first return spring 75c, a first slot 75d, and a first drive pin 75e.

[0075] The first weighted body 75a is arranged on the outer surface of the second sprocket 64. The first weighted body 75a is a stepped plate-like component formed in a fan shape or a bladed sickle shape. The first step 75a1 of the first weighted body 75a is rotatably supported on the first support shaft 75b while being capable of rotating with the first drive pin 75e inserted therethrough. The second step 75e of the first weighted body 75a is arranged to avoid the first support shaft 75b, and an anchor bolt 62a which secures the second sprocket 64 to the exhaust camshaft 62.

[0076] The first support shaft 75b is arranged at a location away from the shaft center AX. The first support shaft 75b has a first shaft 75P as the center which is parallel to the shaft center AX. The first support shaft 75b rotatably supports the first weighted body 75a with the first shaft 75P as the center.

[0077] The first return spring 75c couples the second sprocket 64 and the first weighted body 75a. The first return spring 75c biases the first weighted body 75a and keeps the first weighted body 75a in the initial position illustrated in FIG. 11. However, as is later described, the biasing force of the first return spring 75c is smaller than the centrifugal force applied to the first weighted body 75a after the engine 1 starts.

[0078] The first slot 75d is formed in the first weighted body 75a along a direction obliquely intersecting with the

radial direction. A stop 64b protruding from the outer surface of the second sprocket 64 is inserted into the first slot 75d. The range of rotation of the first weighted body 75a is defined by the stop 64b coming into contact with the inner surface of the first slot 75d.

[0079] The first drive pin 75e is inserted into the first weighted body 75a. The first drive pin 75e is arranged near the shaft center AX. The first drive pin 75e protrudes toward the first opening 621P of the exhaust camshaft 62. The tip end portion of the first drive pin 75e engages with the engagement groove 71d in the first compression release shaft 71.

[0080] As illustrated in FIG. 11, the second weight portion 76 includes a second weighted body 76a, a second support shaft 76b, a second return spring 76c, a second slot 76d, and a second drive pin 76e. The second weight portion 76 is configured in the same manner as the first weight portion 75. The second weight portion 76 is arranged at a location rotated 180° about the shaft center AX from the first weight portion 75. Therefore the second weighted body 76a is arranged point-symmetrically to the first weighted body 75a about the shaft center AX.

Operation of the Compression Release Mechanism 70

[0081] The operation of the compression release mechanism 70 will be described with reference to the drawings. FIG. 12 is a side view of the compression release mechanism 70 after the engine 1 has started. FIG. 13 is a cross-sectional view along C-C in FIG. 6. FIG. 14 is a cross-sectional view along D-D in FIG. 6. FIG. 13(a) and FIG. 14(a) illustrate when the engine 1 is stopped or is starting, namely, when the exhaust camshaft 62 is rotating below a prescribed speed. FIG. 13(b) and FIG. 14(b) illustrate when the engine 1 has started, namely when the exhaust camshaft 62 is rotating above a prescribed speed.

[0082] First, the first and second weight portioned bodies 75a, 76a are kept at an initial position by the biasing of the first and second return springs 75c, 76c while the exhaust camshaft 62 rotates below the prescribed speed (refer to FIG. 11).

[0083] At this time, as illustrated in FIG. 13(a), the first compression release pin 72 protrudes further out than the exhaust valve cam 62a, and the tip end portion 72E of the first compression pin 72 presses on the second exhaust valve lifter 58. Hereby, the second exhaust valve 57 is open during the compression stroke, releasing exhaust air from the second cylinder 22.

[0084] In the same manner, as illustrated in FIG. 14(a), the second compression release pin 74 protrudes further out than the exhaust valve cam 62a, and the tip end portion 74E of the second compression release pin 74 presses the first exhaust valve lifter 54. Hereby, the first exhaust valve 53 is open during the compression stroke releasing exhaust air from the first cylinder 21.

[0085] Next, when the speed of the exhaust camshaft 62 increases and grows larger than a prescribed speed,

the centrifugal force applied to the first and second weight portioned bodies 75a, 76a grows larger than the biasing force of the first and second return springs 75c, 76c. The centrifugal force thus causes the first and second weight portioned bodies 75a, 76a to move outward with the first and second support shafts 75b, 76b as the center until the stop 64b comes into contact with the inner surface of the first slot 75d.

[0086] When the first and second weight portioned bodies 75a, 76a move, the first and second drive pins 75e, 76e attached to the first and second weight portioned bodies 75a, 76a rotate about the shaft center AX. When the first and second drive pins 75e, 76e rotate, the first compression release shaft 71 which is engaged with the first and second drive pins 75e, 76e rotates about the shaft center AX. When the first compression release shaft 71 rotates, the second compression release shaft 73 which is coupled to the first compression release shaft 71 via the coupling pin 73d (refer to FIG. 9) rotates about the shaft center AX.

[0087] At this point, when the first compression release shaft 71 rotates, the first compression release pin 72 which is engaged with the projected catch 71e of the first compression release shaft 71 withdraws from the second exhaust valve lifter 58 as illustrated in FIG. 13(b). That is, the first compression release pin 72 retreats further inward than the exhaust valve cam 62a and the tip end portion 72E of the first compression release pin 72 ceases to be in contact with the second exhaust valve lifter 58. Hereby, the second exhaust valve 57 is closed during the compression stroke, and the second cylinder 22 returns to a normal compression state.

[0088] In the same manner when the second compression release shaft 73 rotates, the second compression release pin 74 which is engaged with the projected catch 73e of the second compression release shaft 73 withdraws from the first exhaust valve lifter 54. That is, the second compression release pin 74 retreats further inward than the exhaust valve cam 62a, and the tip end portion 74E of the second compression release pin 74 ceases to be in contact with the first exhaust valve lifter 54. Hereby, the first exhaust valve 53 is closed during the compression stroke and the first cylinder 21 returns to a normal compression state.

[0089] As above described, the compression release mechanism 70 reduces the compression pressure inside the first and second cylinders 21, 22 when the engine 1 cranks, and returns the inside of the first and second cylinders 21, 22 to a normal compression state as the engine 1 starts.

Configuration of the Oil Supply System 80

[0090] The oil supply system 80 will be described with reference to the drawings. FIG. 15 is a schematic diagram illustrating a configuration of the oil supply system 80. FIG. 16 is the main component exploded view in FIG. 3 illustrating a partial cross-sectional view of the oil supply

system 80. FIG. 17 is a cross-sectional view along F-F in FIG. 16. Finally FIG. 16 corresponds to the cross-sectional view along G-G in FIG. 17.

[0091] The oil supply system 80 includes an oil pump 81, an external oil passage 82, a gasket 83, and a bearing portion 84.

[0092] The oil pump 81 is housed inside the crankcase 10. The oil pump 81 takes up oil from an oil tank (not shown) and pumps the oil into the external oil passage 82.

[0093] The external oil passage 82 is formed inside the crankcase 10, the cylinder block 20, and the cylinder head 30. The external oil passage 82 extends to the oil pump 81 and an internal oil passage 90. The oil pumped from the oil pump 81 is supplied to the bearing portion 84 by way of the external oil passage 82. The external oil passage 82 is also connected to the intake camshaft 61.

[0094] The gasket 83 is provided partway along the external oil passage 82. The gasket 83 functions to restrict the oil flow along the external oil passage 82. By restricting the oil flow, the pressure of the oil supplied to the internal oil passage 90 can be kept constant even when the displacement of the oil pump 81 fluctuates.

[0095] The bearing portion 84 rotatably supports the journal of the exhaust camshaft 62. The bearing portion 84 includes the above described head cap 86, and journal bearings 85a, 85b, 85c.

[0096] As illustrated in FIG. 17, the head cap 86 includes in the cross-section orthogonal to the axial direction: a beam 87 with a bellflower cross-sectional outline, arches 88a, 88b, 88c connected at the lower portion of the beam 87 and having a gate-like cross-sectional outline, and internal oil passage 90 and first through third oil supply ports 84a - 84c. As illustrated in FIG. 16, the arches 88a, 88b, 88c are formed along the axial direction with gaps therebetween, at locations corresponding to the first journal side surface 621 S, the second journal side surface 622S, and the third journal side surface 623S respectively in that order. The arches 88a, 88b, 88c each have a recess 88s formed thereon, and each recess 88S is a half-circle in a cross-section orthogonal to the axial direction (refer to FIG. 17). The head cap 86 is connected to the top surface of the cylinder head 30.

[0097] The journal bearings 85a, 85b, 85c are each made up of the arches 88a, 88b, 88c, and the shaft support groove 30a on the top surface of the cylinder head 30. The journal bearings 85a, 85b, 85c include perfect circular holes 89 which are constituted by the respective recesses 88S in the arches 88a, 88b, 88c, and the shaft support groove 30a; the circular holes 89 rotatably support the exhaust camshaft 62 which is inserted therein.

[0098] The internal oil passage 90 is provided with a semicircular passage 91, a first introductory passage 92, a second introductory passage 93, a main passage 94, a secondary branch passage 95, and a central branch passage 96.

[0099] The semicircular passage 91 extends along the exhaust camshaft 62 near the second sprocket 64 into a

semicircular arc. The semicircular passage 91 communicates with the external oil passage 82.

[0100] The first introductory passage 92 extends from the upper portion of the semicircular passage 91 along the axial direction and extends away from the sprocket 64.

[0101] The second introductory passage 93 extends from the upper portion of the first introductory passage 92 toward the beam 87.

[0102] The main passage 94 communicates with the second introductory passage 93 and extends through the beam 87 in the axial direction. The main passage 94 extends from one end of the beam 87 to the other end of the beam 87 so as to be located above the arches 88a, 88b, 88c. The main passage 94 is provided with an embedded plug 97 on one end.

[0103] The secondary branch passage 95 extends radially from the main passage 94 and communicates with the second oil supply port 84 which is formed in the recess 88S in the arch 88b.

[0104] The central branch passage 96 extends radially from the main passage 94 and communicates with the third oil supply port 84c (oil supply port) formed in the recess 88S in the arch 88c. An oil pool 88x further recessed towards the main passage 94, and shaped into a circular arch when viewed in a cross-section orthogonal to the axial direction is formed in the recess 88S.

[0105] The first oil supply port 84 links the end portion of the first introductory passage 92 with the oil pool 88x in the arch 88a. The oil flowing out from the first oil supply port 84a to the journal bearing 85a lubricates the first journal side surface 621 S.

[0106] The second oil supply port 84b opens into the oil pool 88X in the recess 88S of the arch 88b, and faces the second journal side surface 622S on the exhaust camshaft 62. The oil flowing out from the second oil supply port 84b to the journal bearing 85b lubricates the second journal side surface 622S.

[0107] The third oil supply port 84c opens into the oil pool 88X in the recess 88S of the arch 88c, and faces the third journal side surface 623S on the exhaust camshaft 62. The oil flowing out from the third oil supply port 84c lubricates the third journal side surface 623S, while being pumped into the internal space 62S from the first and second oil inflow ports OH1, OH2 formed in the third journal side surface 623S. The third oil supply port 84c faces the second journal side surface 622S on the exhaust camshaft 62. The oil flowing from the third oil supply port 84c lubricates the second journal side surface 622S.

[0108] The oil pumped from the first and second oil inflow ports OH1, OH2 into the internal space 62S lubricates the first and second compression release shafts 71, 73 and the first and second compression release pins 72, 74 while gradually filling the internal space 62S. Thereafter when the internal space 62S is filled with oil, the second opening 622P is blocked with the blocking plug 625, and therefore the oil pumped in is pushed out from the first opening 621P. The oil pushed out from the

first opening 621P spreads out through the gaps between the second sprocket 64, and the first and second weight portioned bodies 75a, 76a due to centrifugal force. Accordingly, between the second sprocket 64, and the first and second weight portioned bodies 75a, 76a is lubricated.

Overall configuration of the saddle type vehicle 100

[0109] An overall configuration of a saddle type vehicle 100 in which the above-described engine 1 is mounted will be described with reference to the drawings. FIG. 18 is a side view of the saddle type vehicle 100.

[0110] The saddle type vehicle 100 is a motorcycle. As illustrated in FIG. 18, the saddle type vehicle 100 is provided with a frame 110, a front fork 120, a front wheel 130, a swingarm 140, a rear wheel 150, and the engine 1.

[0111] The frame 110 includes a head pipe 111, a front frame 112, and a pair of down tubes 113, 113. The head pipe 111 is arranged at the vehicle center in the width direction of the vehicle. The head pipe 111 extends vertically. The front frame 112 extends rearward and downward from the head pipe 111. The front frame 112 is arranged to surround the engine 1 from above and behind. The lower end portion of the front frame 112 is coupled to the engine 1. The pair of down tubes 113, 113 is connected to the head pipe 111 below the front frame 112. The respective down tubes 113, 113 extends rearward and downward from the head pipe 111 and extend away from each other. The rear end portion of each of the down tubes 113, 113 is coupled to the front portion of the engine 1.

[0112] The head pipe 111 rotatably supports the front fork 120. The front wheel 130 is rotatably supported at the lower end portion of the front fork 120.

[0113] The swingarm 140 is pivotally supported at the lower end portion of the front frame 112. The rear wheel 150 is rotatably supported at the rear end portion of the swingarm 140.

[0114] The engine 1 is supported by the lower end portion of the front frame 112, and by the respective rear end portion of the down tubes 113, 113.

Operations and Effects

[0115] (1) The engine 1 according to the present embodiment is provided with a compression release mechanism 70 and an oil supply system 80. The compression release mechanism 70 is attached to an exhaust camshaft 62 attached thereto. When the exhaust camshaft 62 is rotating below a prescribed speed, the compression release mechanism 70 drives a pair of first exhaust valves 53, and a pair of second exhaust valves 57 via four exhaust valve cams 62a to release exhaust from the first and second cylinders 21, 22. The oil supply system 80 supplies oil to the internal space 62S of the exhaust camshaft 62 and pumps oil into the compression release mechanism 70.

[0116] In this manner the compression release mechanism 70 may be supplied with oil using pressurized lubrication, and thereby reducing the amount of mechanical noise generated by the compression release mechanism 70. Accordingly, it is possible to prevent the mechanical noise from the compression release mechanism 70 from standing out even when the engine 1 is rotating at a low speed and there is little drive sound.

[0117] Additionally, if a non-pressurized lubrication method is employed where splashes of oil are scattered in the compression release mechanism 70, the oil splashes bounce off and therefore the compression release mechanism 70 cannot be effectively lubricated. Whereas, in the engine according to the present embodiment the nooks and crannies of the compression release mechanism 70 can be effectively lubricated using pressurized lubrication.

[0118] (2) The compression release mechanism 70 includes the first and second weight portions 75, 76, the first and second compression release shafts 71, 73 arranged in the internal space 62S, and the first second compression release pins 72, 74. The first and second weight portions 75, 76 move in accordance with the centrifugal force that occurs when the exhaust camshaft 62 rotates at a speed greater than a prescribed speed. The first and second compression release shafts 71, 73 rotate in response to the movement of the first and second weight portions 75, 76. The first and second compression release pins 72, 74 withdraw from the pair of first exhaust valve lifters 54, and the pair of second exhaust valve lifters 58 in response to the rotation of the first and second compression release shafts 71, 73.

[0119] In this manner, the first and second compression release pins 72, 74 can be forcibly withdrawn in response to the exhaust camshaft 62 rotating greater than a prescribed speed. Therefore, after the engine 1 is started, the cylinders in the engine 1 may be properly and quickly returned to a normal compression state.

[0120] (3) The exhaust camshaft 62 includes the first oil inflow port OH1 formed in the side surface 623 S in the center portion 623. The oil supply system 80 supplies oil to the internal space 62S via the first oil inflow port OH1.

[0121] In this manner, given that oil is supplied from the first oil inflow port OH1 formed in the center portion 62S of the exhaust camshaft 62, the internal space 62S can be efficiently filled with oil. Once the internal space is filled, the oil is pumped from the first oil inflow port OH1, and therefore the oil will flow toward the first and second weight portions 75, 76 even though the first oil inflow port OH1 is formed in the center portion 623.

[0122] Additionally, it is the journal bearing 85c that supports the central portion 623 of the exhaust camshaft 62 which functions to supply oil (referred to below as having a low noise oil supply function) to the first oil inflow port OH 1, and the second will support OH 2, not the journal bearings 85a, 85b which support the first end 621, and the second end 622 of the exhaust camshaft 62.

Usually the bearing for the center portion 623 (journal bearing 85c) has a relatively small operation load compared to the bearings at the shaft end portions (the first end 621, and the second end 622). In other words, it is not the journal bearings 85a, 85b requiring the relatively larger amount of lubrication, but the journal bearing 85c that permits a relatively low amount of lubrication which has the low noise oil supply function, and therefore it is possible to ensure the lubricating performance for all the journal bearings 85a, 85b, and 85c, while pumping oil to the compression release mechanism 70.

[0123] The journal bearing 85 has a low noise oil supply function, and therefore facilitates adjustment of the oil pressure on the bearing 84, so that oil may be quickly supplied to the compression release mechanism 70 during the start of the engine. For example, if the first oil inflow port OH1 were formed in the first journal side surface 621S of the first end 621, and only the journal bearing 85a were given the low-noise oil supply function, it would be difficult to adjust the oil pressure to the journal bearings 85b, 85c. Furthermore if the first oil inflow port OH1 were formed in the second journal side surface 622S on the second end 622, and only the journal bearing 85b were given the low noise oil supply function, oil would flow out from the first oil inflow port OH1 which would be positioned downward when the side stand is used while the engine is stopped, thereby drastically reducing the amount of oil in the internal space 62S. Therefore, when the engine starts, because a sufficient amount of oil is supplied to the compression release mechanism 70 after the internal space 62S is filled with oil, it takes time for oil to be supplied to the first weight portion 75, and the second weight portion 76 in particular. According to the configuration of the present embodiment, the journal bearing 85c has the low noise oil supply function, which therefore facilitates adjusting the oil pressure of the bearing portion 84, and allows the compression release mechanism 70 to be quickly supplied with oil when the engine starts.

[0124] (4) The exhaust camshaft 62 includes a second oil inflow port OH2 facing the first oil inflow port OH1 about the access center AX.

[0125] In this manner, oil may be continuously supplied from the two opposing oil inflow ports OH1, OH2 allowing for stable supply of oil compared to the case where oil is discreetly supplied from only the first oil inflow port OH1.

[0126] (5) The first and second weight portions 75, 76 are in contact with the second sprocket 64.

[0127] Given that the first and second weight portions 75, 76 abutting the second sprocket 64 will tend to generate mechanical noise, pressurized lubrication is particularly effective for suppressing the mechanical noise.

[0128] (6) The first opening 621P in the exhaust camshaft 62 is positioned inside the shaft bore 64S of the second sprocket 64, when the second sprocket 64 is viewed from the axial direction.

[0129] Therefore, oil will flow from the first opening 621P, and the centrifugal force will allow oil to be effi-

ciently supplied to the areas between the first and second weight portions 75, 76, and the second sprocket 64.

[0130] (7) The first and second weight portions 75, 76 are positioned between the inner wall surface of the engine 1, and the second sprocket 64.

[0131] In this manner, the first and second weight portions 75, 76 may be effectively lubricated using pressurized lubrication even when it is difficult to supply oil to the first and second weight portions 75, 76 which are sandwiched between the inner wall surface of the engine 1 and the second sprocket 64.

[0132] (8) The exhaust camshaft 62 includes a blocking plug 625 that closes the second opening 622P formed in the second end 622 of the exhaust camshaft.

[0133] Therefore it is possible to prevent oil from flowing out from the second opening 622P even if the second opening 622P faces downward when the saddle type vehicle is made to stand by itself using a side stand.

[0134] Furthermore, closing the second opening 622P causes the oil pumped into the internal space 62S of the exhaust camshaft 62 to flow from the first opening 621P. In other words, a large amount of oil flows toward the second sprocket 64 which is arranged near the first opening 621P. Therefore it is possible to apply a sufficient amount of oil to the first and second weight portions 75, 76, and the second sprocket 64 which tend to generate mechanical noise.

[0135] (9) The oil supply system 80 includes a bearing portion 84 that supports the exhaust camshaft 62. The bearing portion 84 includes an internal oil passage 90 formed on the inside, and a second oil supply port 84b facing the first oil inflow port OH1.

[0136] In this manner, given that a commonly used oil supply system 80 may be used to pump oil to lubricate the outer surface of the exhaust camshaft 62, it is possible to control an increase in the number of parts used by adopting the pressurized lubrication method.

[0137] (10) The compression release shaft portion according to the present embodiment includes first and second compression release shafts 71, 73, and the compression release pin portion according to the present embodiment includes first and second compression release pins 72, 74.

[0138] Therefore it is possible to synchronize the operations of the first and second compression release pins 72, 74 in the two-cylinder engine 1.

[0139] (11) The first weight portion 75 includes a first weighted body 75a, and a first support shaft 75b. The second weight portion 76 includes the second weighted body 76a, and the second support shaft 76b. The second weighted body 76a is arranged point-symmetrically to the first weighted body 75a about the shaft center AX.

[0140] In this manner, it is possible to rotate the exhaust camshaft 62 in a well-balanced manner using the first and second weight portioned bodies 75a, 76a, and therefore the compression release mechanism 70 may be driven smoothly compared to a case where only a single weighted body is used to drive the exhaust cam-

shaft 62.

[0141] Other Embodiments While the present invention has been described by way of the above-mentioned embodiment, the statements and drawings which are one portion of this disclosure should not be taken as limitations on the invention. Various substitute embodiments, working examples, and practical features should be clear to persons skilled in the art from this description.

[0142] In the above mentioned embodiment, the engine 1 is two-cylinder, four-cycle engine having four valves in a DOHC configuration, however, the number of valve and number of cylinders may be freely configured.

[0143] In the above mentioned embodiment, the compression release mechanism 70 includes the first and second weight portions 75, 76, however, the compression release mechanism 70 may include just the first weight portion 75.

[0144] In the above mentioned embodiment, the first and second oil inflow ports OH1, OH2 are formed in the center portion 623 of the exhaust camshaft 62, however, the first and second oil inflow ports OH1, OH2 may be formed in the first end 621, or the second end 622.

[0145] In the above mentioned embodiment, the exhaust camshaft 62 includes the first and second oil inflow ports OH1, OH2, however, the exhaust camshaft 62 may include just the first oil inflow port OH1.

[0146] In the above mentioned embodiment the exhaust camshaft 62 includes a blocking plug that closes the second opening 622P, however the second opening 622P may remain unclosed. More specifically, if the second end 622 is not lowered when the saddle type vehicle is stood up on its own using a side stand, there is no need to include the blocking plug in the exhaust camshaft 62.

[0147] In the above mentioned embodiment, details of the shape of the components making up the compression release mechanism 70 was described with reference to FIG. 7 through FIG. 10; however, the shape of the components making up compression release mechanism 70 may be freely changed. For example, various modifications may be made to the method of coupling the first compression release shaft 71 and the first compression release pin 72, the method of coupling the first compression release shaft 71 and the second compression release shaft 73, and the method of engaging the first and second drive pins 75e, 76e with the engagement groove 71d.

[0148] In the above mentioned embodiment, a detailed configuration of the oil supply system 80 was described with reference to FIG. 15 through FIG. 17, however the constituent elements of the oil supply system 80 may be freely changed. Various modifications may be made to the cross-sectional shape and direction of extension of the passages in particular.

[0149] In this way it is obvious that the present invention may include various embodiments and so forth that are not described here. Accordingly, the technical scope of the present invention is defined by the characterizing

features of the invention as set forth in the scope of the claims which are properly supported by the above description.

5 Industrial Applicability

[0150] According to the present invention the noise from the compression release mechanism can be suppressed and therefore the present invention is applicable in the field of engines and saddle type vehicles.

Reference Numerals

[0151]

1	Engine
20	Cylinder block
20 21	First cylinder
23	First piston
22	Second cylinder
25 24	Second piston
30	Cylinder head
30 50	Valve train
53	First exhaust valve
54	First exhaust valve lifter
35 57	Second exhaust valve
58	Second exhaust valve lifter
40 60	Valve gear
62	Exhaust cam shaft
62a	Exhaust valve cam
45 62S	Internal space
623	Center portion
50 623S	Third journal surface
OH1	First oil inflow port
OH2	Second oil inflow port
55 PH1	First pinhole
PH2	Second pinhole

624	Through hole		ing:
621P	First port		an exhaust valve lifter (54, 58) driven by the valve cam (62a), the exhaust valve lifter (54, 58)
622P	Second port	5	configured to open and close the exhaust valve (53, 57); wherein
64	Second sprocket		the compression release mechanism (70) includes a weight portion (75, 76), a compression release shaft portion (71, 73), and a compression release pin portion (72, 74),
70	Compression release mechanism	10	the weight portion (75, 76) configured to move due to centrifugal force when the exhaust camshaft (62) rotates at a speed greater than the prescribed speed;
71	First compression release shaft		the compression release shaft portion (71, 73) arranged inside the internal space of the exhaust camshaft (62), the compression release shaft portion (71, 73) configured to rotate in response to a movement of the weight portion (75, 76); and
72	First compression release pin		the compression release pin portion (72, 74) arranged to protrude from a pinhole (PHI) formed in a side surface of the exhaust camshaft (62) to abut the exhaust valve lifter (54, 58),
73	Second compression release shaft	15	the compression release pin portion (72, 74) configured to withdraw from the exhaust valve lifter (54, 58) in response to a rotation of the compression release shaft portion (71, 73).
74	Second compression release pin		
75	First weight portion	20	
76	Second weight portion		
80	Oil supply system		
84	Bearing portion	25	
90	Internal oil passage		
84a	First oil supply port	30	3. The engine (1) according to claim 2, wherein the exhaust camshaft (62) includes a first end (621), a second end (622), a center portion (623), and a first oil inflow port (OH1) formed in a side surface of the center portion (623); and
84b	Second oil supply port		the oil supply system (80) is configured to supply oil to the internal space from the first oil inflow port (OH1).
84c	Third oil supply port	35	

Claims

1. An engine (1) comprising:
 - a cylinder (21, 22) housing a piston (23, 24);
 - an exhaust valve (53, 57) configured to release or block exhaust flow from the cylinder (21, 22);
 - an exhaust camshaft (62) having a hollow structure, the exhaust camshaft (62) including a valve cam (62a) for driving the exhaust valve (53, 57);
 - a compression release mechanism (70) attached to the exhaust camshaft (62), the compression release mechanism (70) configured to release exhaust flow from the cylinder (21, 22) by driving the exhaust valve (53, 57) via the valve cam (62a) when the exhaust camshaft (62) rotates below a prescribed speed; and an oil supply system (80) configured to pump oil into the compression release mechanism (70) by supplying oil to an internal space of the exhaust camshaft (62).
2. The engine (1) according to claim 1 further comprising:
 - an exhaust valve lifter (54, 58) driven by the valve cam (62a), the exhaust valve lifter (54, 58) configured to open and close the exhaust valve (53, 57); wherein
 - the compression release mechanism (70) includes a weight portion (75, 76), a compression release shaft portion (71, 73), and a compression release pin portion (72, 74),
 - the weight portion (75, 76) configured to move due to centrifugal force when the exhaust camshaft (62) rotates at a speed greater than the prescribed speed;
 - the compression release shaft portion (71, 73) arranged inside the internal space of the exhaust camshaft (62), the compression release shaft portion (71, 73) configured to rotate in response to a movement of the weight portion (75, 76); and
 - the compression release pin portion (72, 74) arranged to protrude from a pinhole (PHI) formed in a side surface of the exhaust camshaft (62) to abut the exhaust valve lifter (54, 58),
 - the compression release pin portion (72, 74) configured to withdraw from the exhaust valve lifter (54, 58) in response to a rotation of the compression release shaft portion (71, 73).
3. The engine (1) according to claim 2, wherein the exhaust camshaft (62) includes a first end (621), a second end (622), a center portion (623), and a first oil inflow port (OH1) formed in a side surface of the center portion (623); and the oil supply system (80) is configured to supply oil to the internal space from the first oil inflow port (OH1).
4. The engine (1) according to claim 3, wherein the exhaust camshaft (62) includes a second oil inflow port (OH2) disposed opposite to the first oil inflow port (OH1) with a shaft center of the exhaust camshaft (62) located in-between as a reference; and the oil supply system (80) is configured to supply oil to the internal space from the second oil inflow port (OH2).
5. The engine (1) according to claim 3 or claim 4, wherein the exhaust camshaft (62) includes a sprocket (64) secured to the first end (621); and the weight portion (75, 76) is attached to the sprocket (64) and is in contact with the sprocket (64).
6. The engine (1) according to claim 5, wherein an opening formed in the first end (621) of the exhaust camshaft (62) is positioned inside a shaft bore (64S) of the sprocket (64) when the sprocket (64) is

viewed from an axial direction of the exhaust camshaft (62), the shaft bore (64S) opening on a central axis of the sprocket (64).

7. The engine (1) according to claim 5 or 6, wherein the weight portion (75, 76) is located between the sprocket (64) and an inner wall surface of the engine case, the inner wall surface facing the sprocket (64). 5
8. The engine (1) according to any one of claims 3 to 7, wherein the exhaust camshaft (62) includes a blocking plug (625) which closes an opening (622P) formed in the second end (622) of the exhaust camshaft (62). 10
15
9. The engine (1) according to any one of claims 3 to 8, wherein the oil supply system (80) includes a bearing portion (84) which supports the exhaust camshaft (62); and the bearing portion (84) includes an internal oil passage (90) and an oil supply port (84a), the internal oil passage (90) formed in the bearing portion (84), the oil supply port (84a) facing the first oil inflow port (OH1). 20
25
10. The engine (1) according to any one of claims 2 to 9, wherein the compression release shaft portion (71, 73) includes a plurality of compression release shafts (71, 73) coupled in an axial direction of the exhaust camshaft (62); and the compression release pin portion (72, 74) includes a plurality of compression release pins (72, 74) coupled respectively to the plurality of compression release shafts (71, 73). 30
35
11. The engine (1) according to any one of claims 5 to 10, wherein the weight portion (75, 76) includes a first support shaft (75b), a first weighted body (75a), a second support shaft (76b), and a second weighted body (76a), the first support shaft (75b) parallel to a shaft center of the exhaust camshaft (62); the first weighted body (75a) configured to rotate about the first support shaft (75b), the first weighted body (75a) formed as a fan shape; the second support shaft (76b) parallel to the shaft center, the second support shaft (76b) arranged symmetrically to the first support shaft (75b) about the shaft center; the second weighted body (76a) configured to rotate about the second support shaft (76b), the second weighted body (76a) formed as a fan shape; and the first weighted body (75a) and the second weighted body (76a) arranged point-symmetrically about the shaft center. 40
45
50
55

12. A saddle type vehicle comprising: an engine (1) according to claims 1; and a vehicle frame supporting the engine (1).

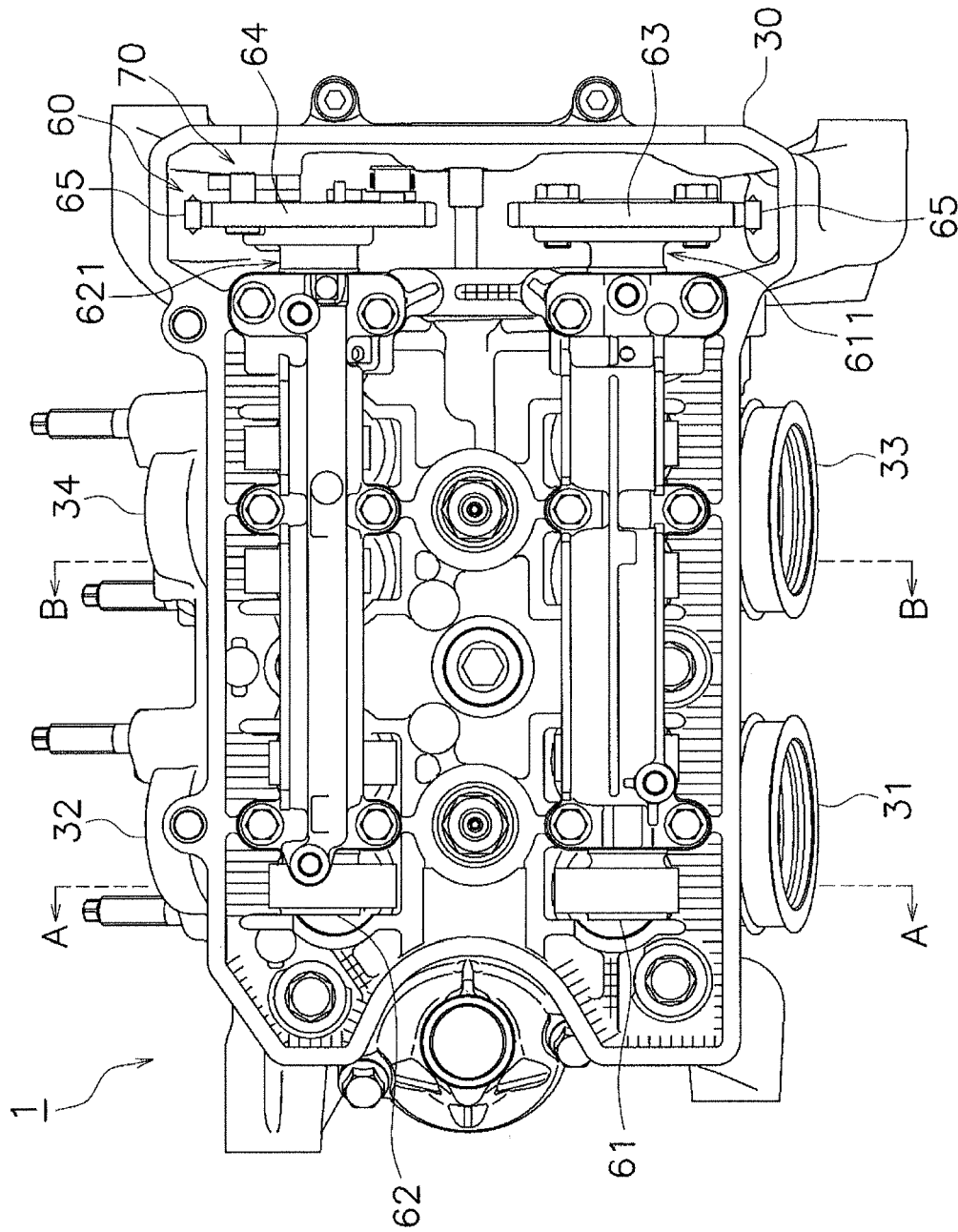


FIG. 1

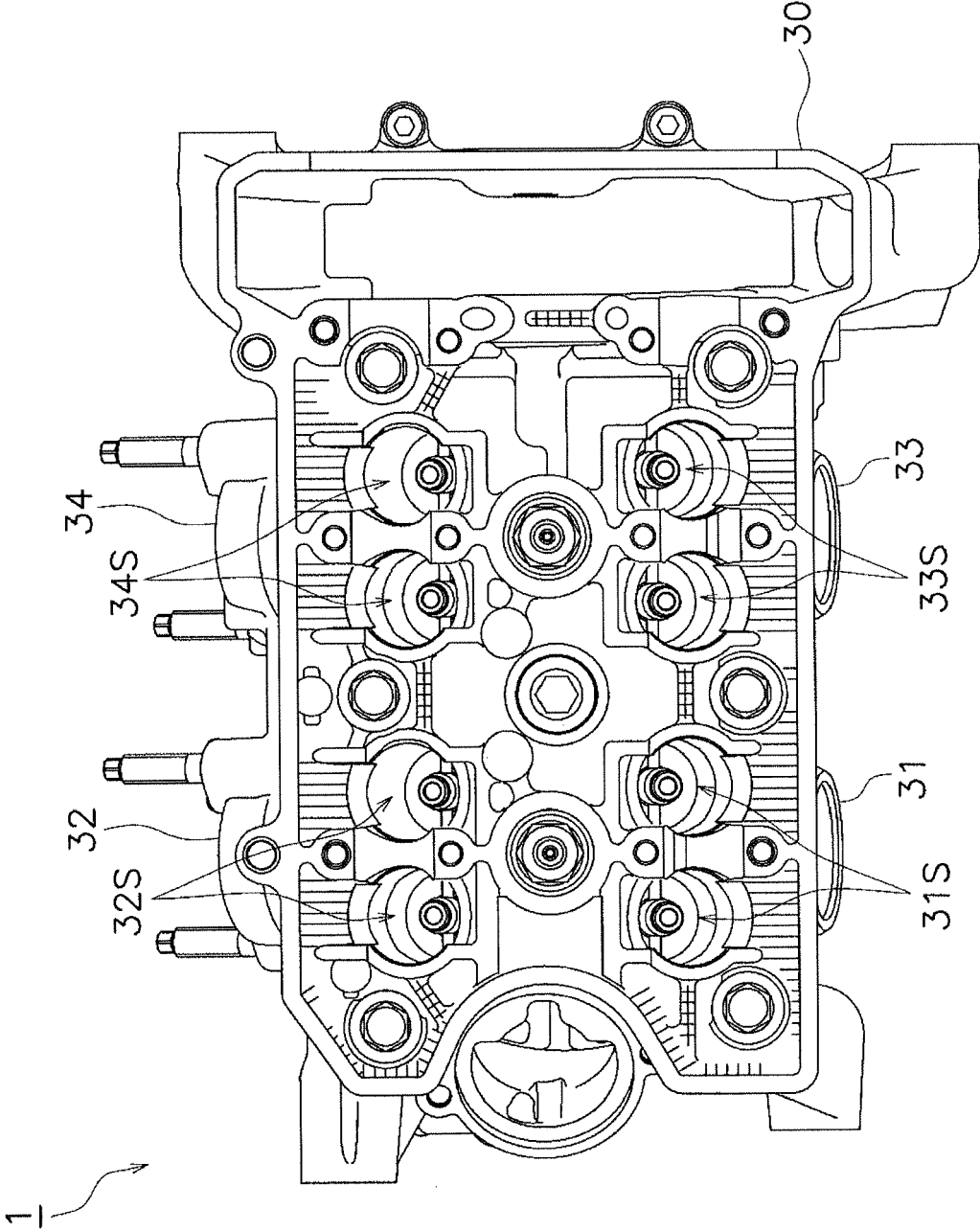


FIG. 2

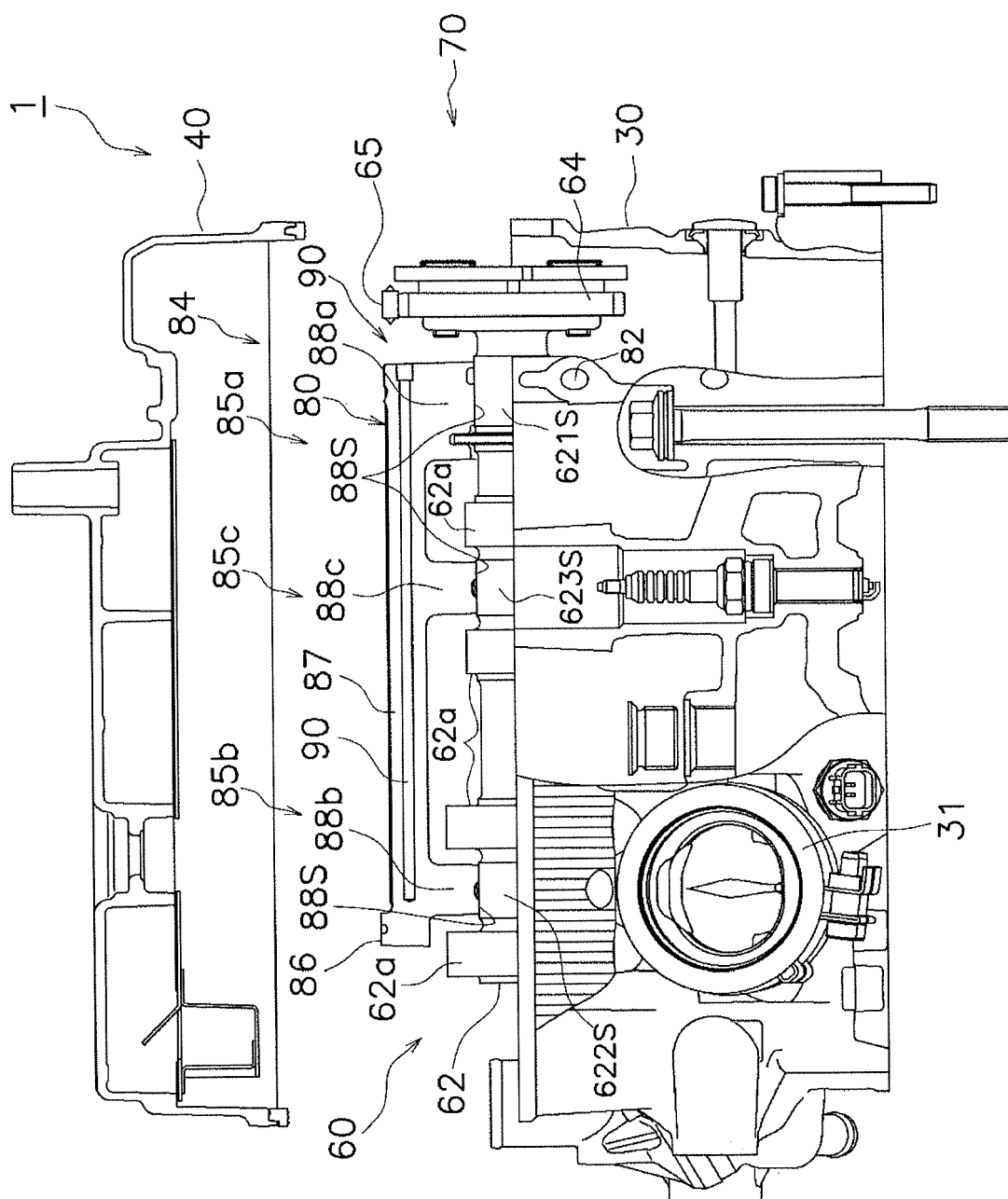


FIG. 3

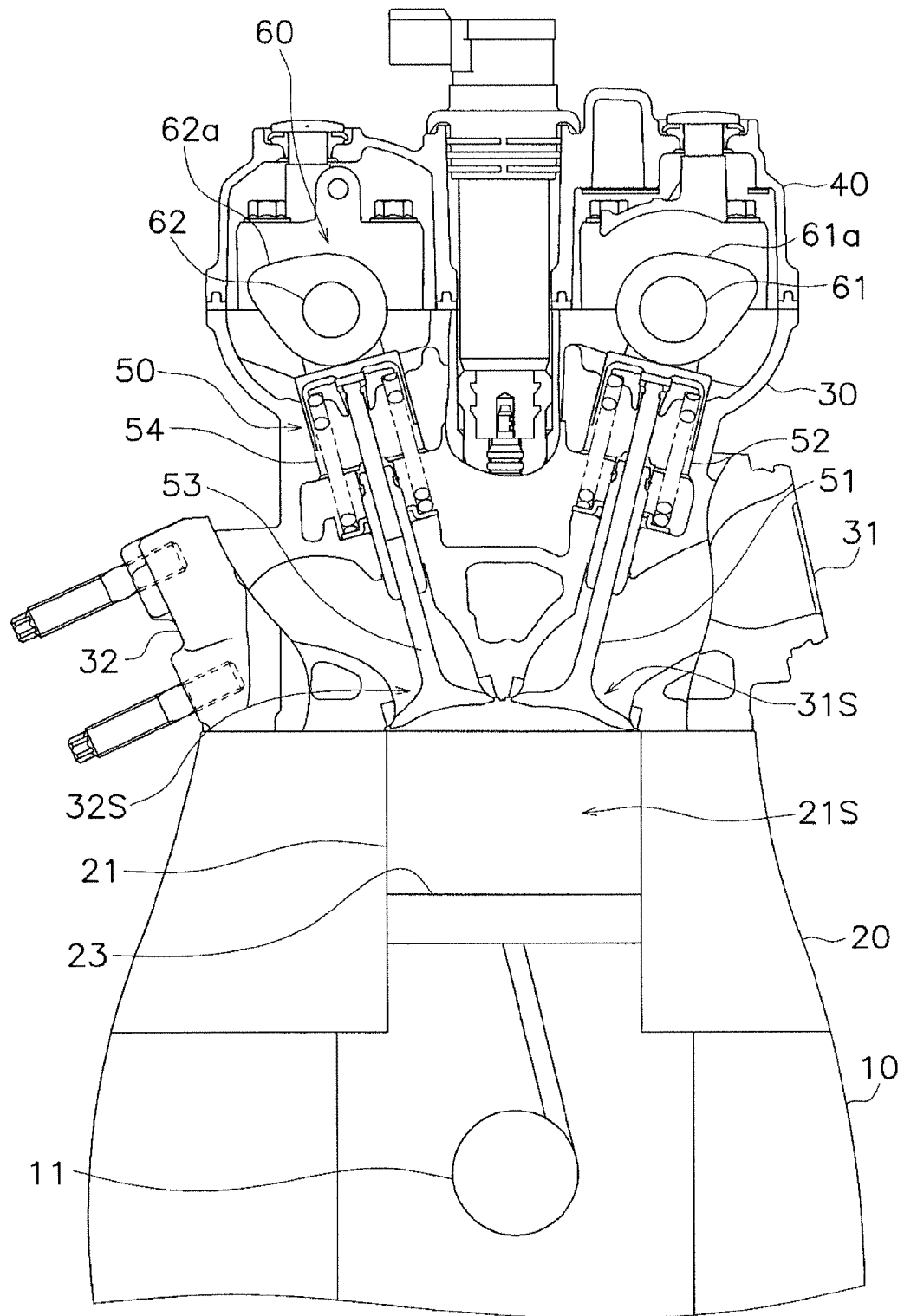


FIG. 4

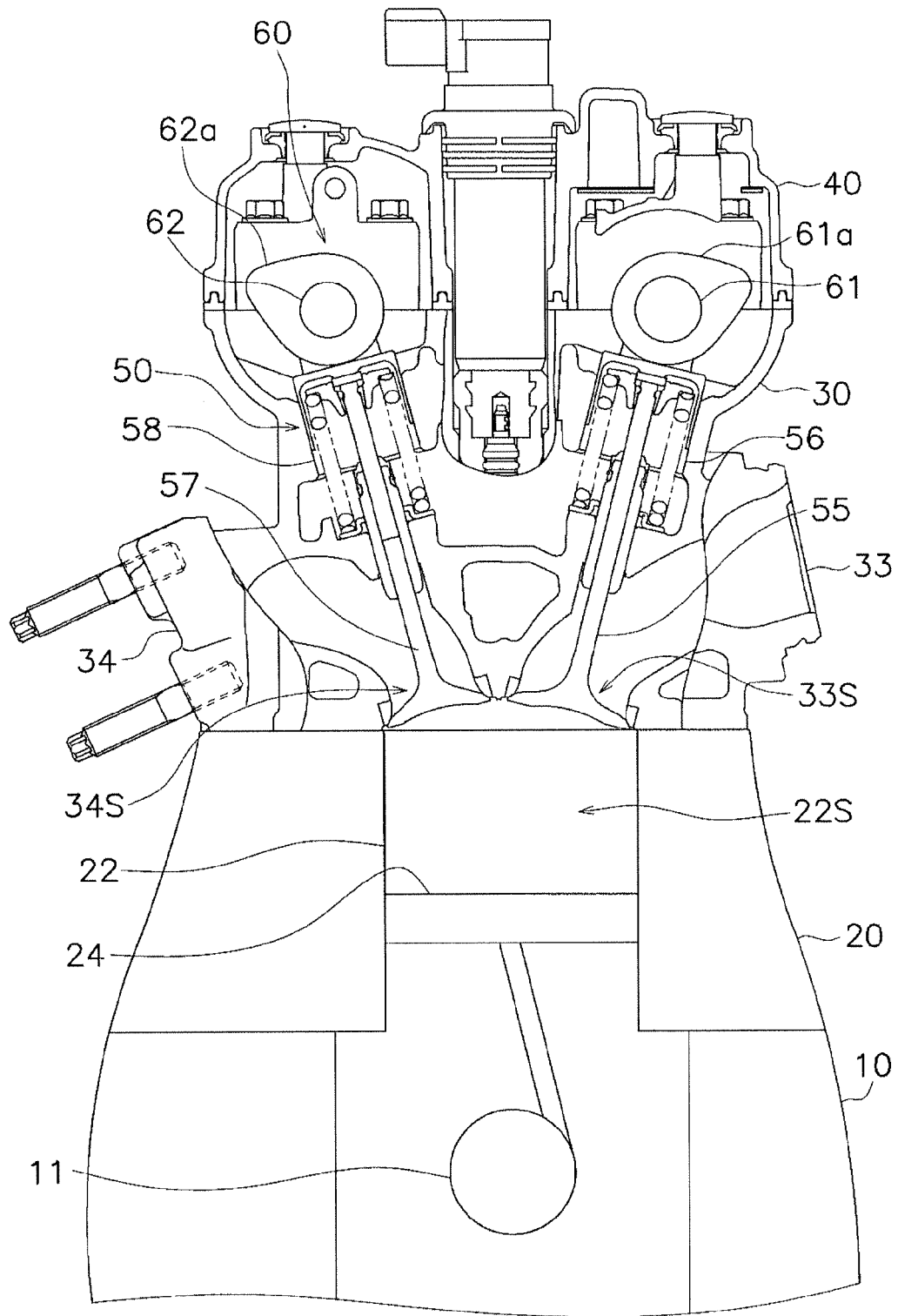


FIG. 5

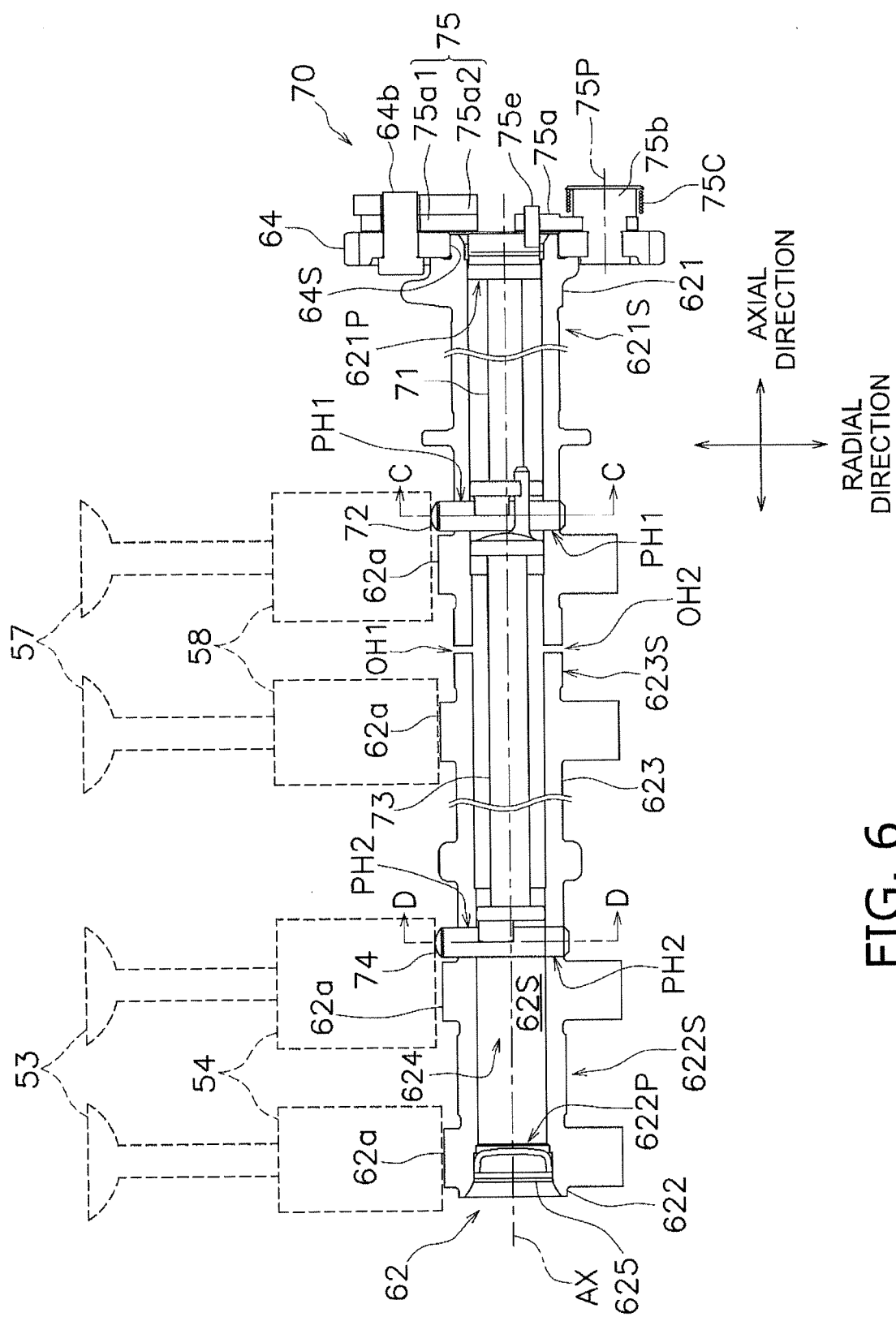


FIG. 6

FIG. 7A

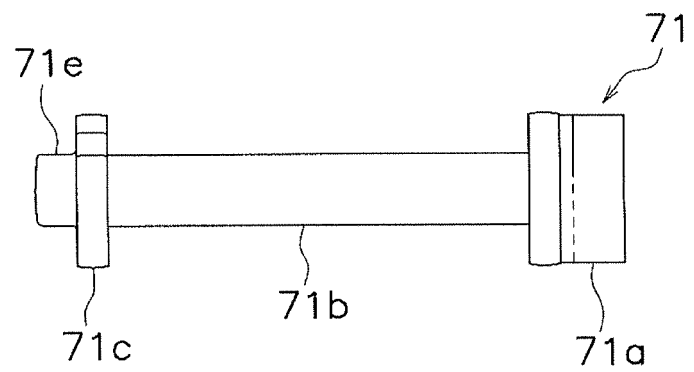


FIG. 7B

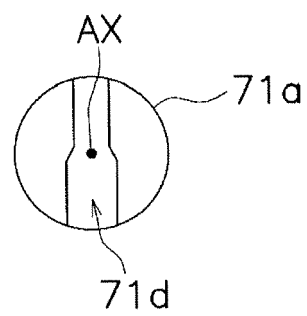


FIG. 7C

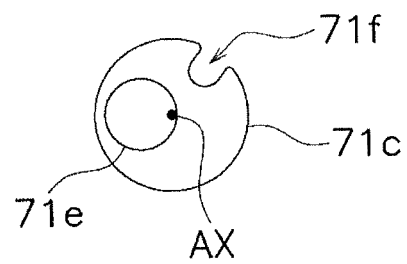


FIG. 8

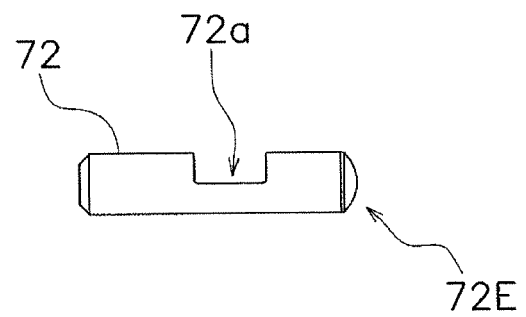


FIG. 9A

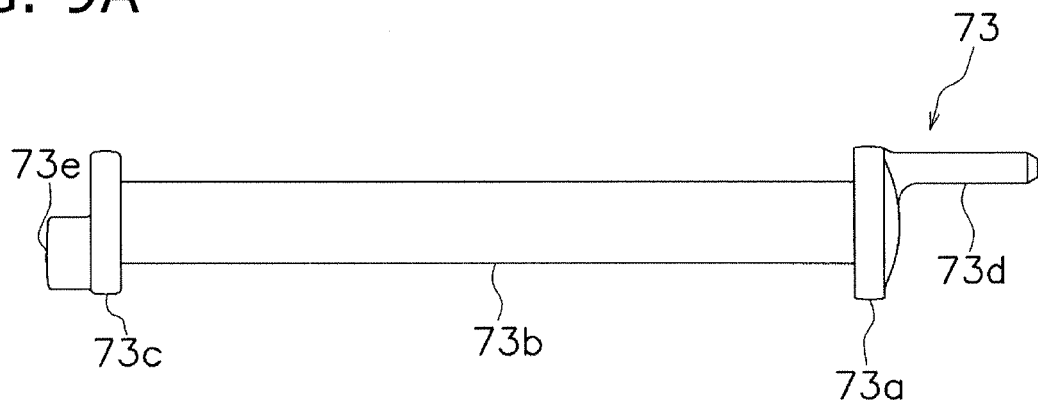


FIG. 9B

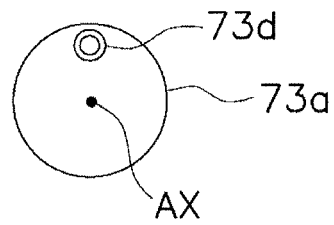


FIG. 9C

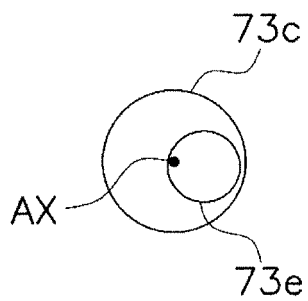
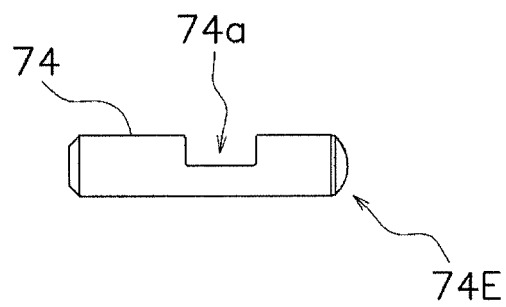


FIG. 10



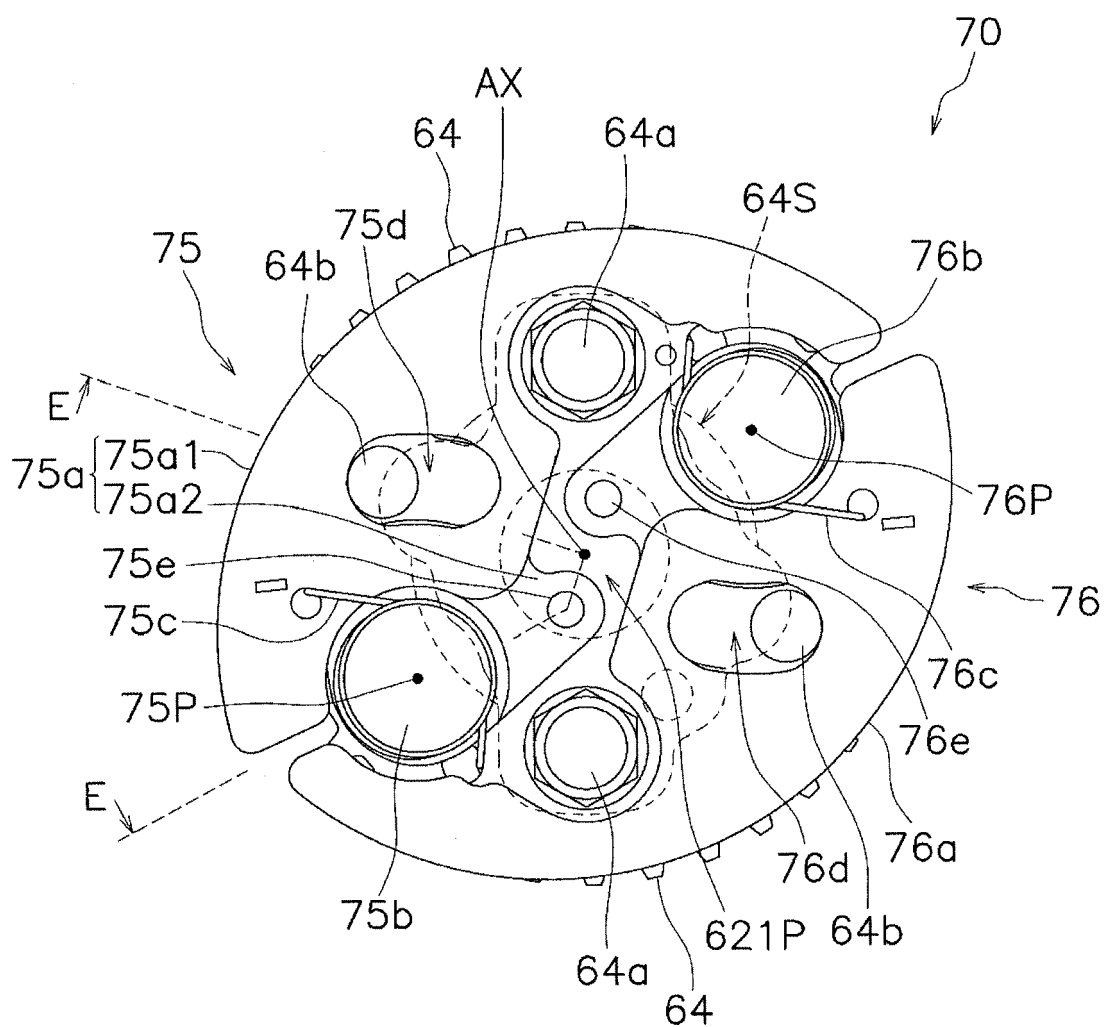


FIG. 11

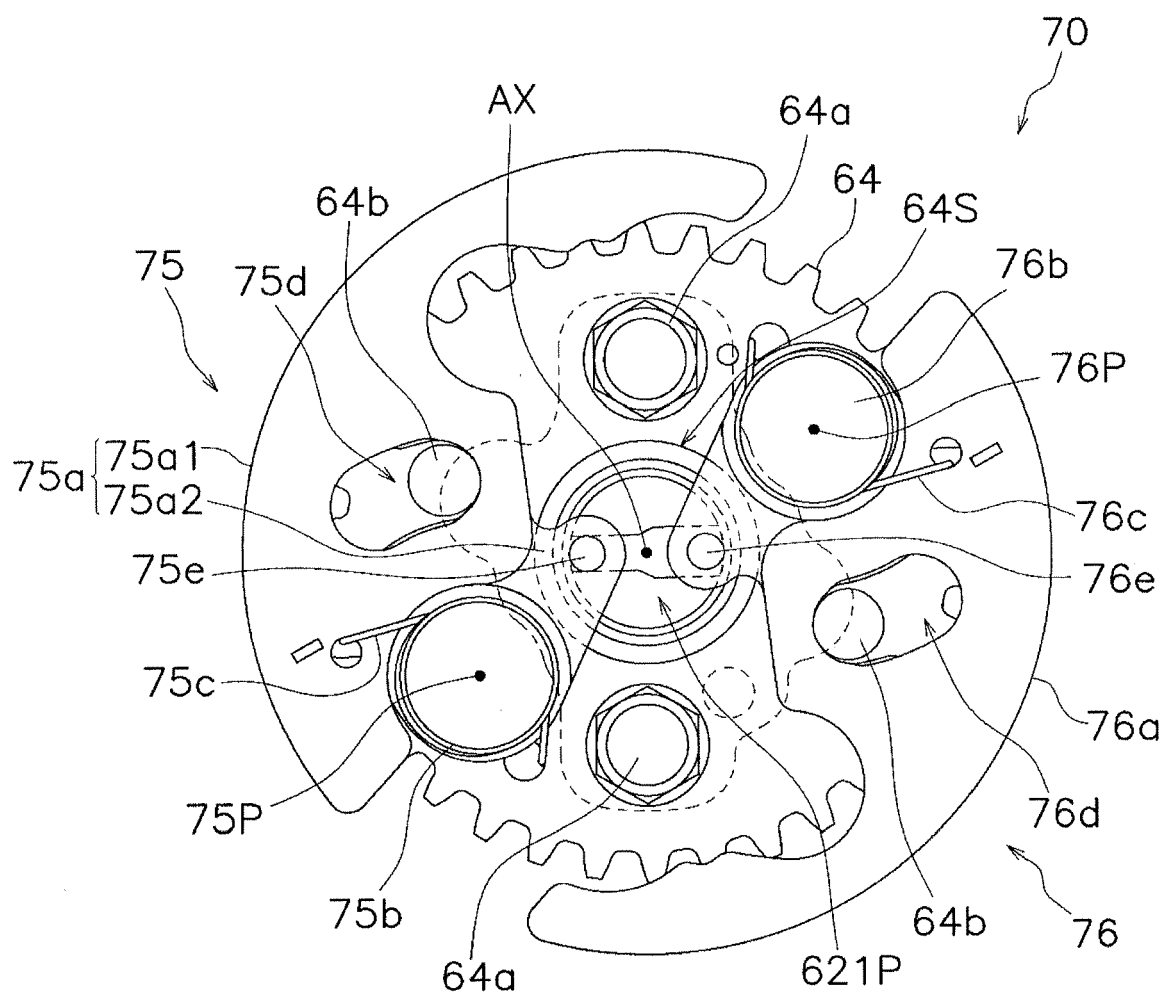


FIG. 12

FIG. 13A

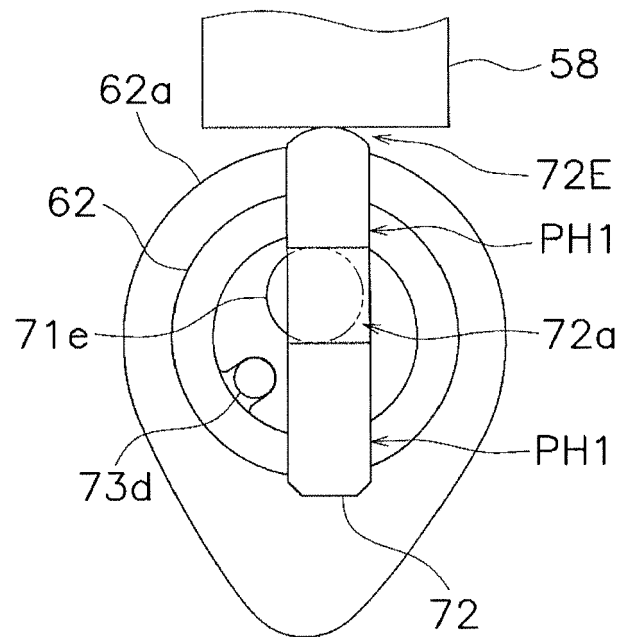


FIG. 13B

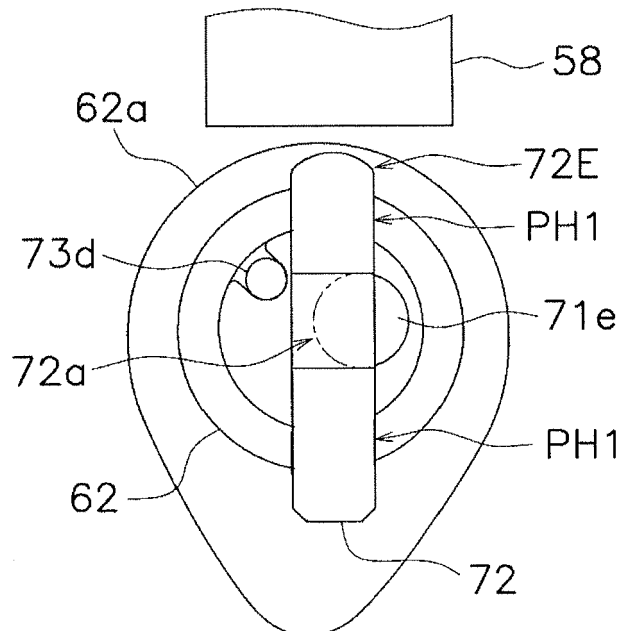


FIG. 14A

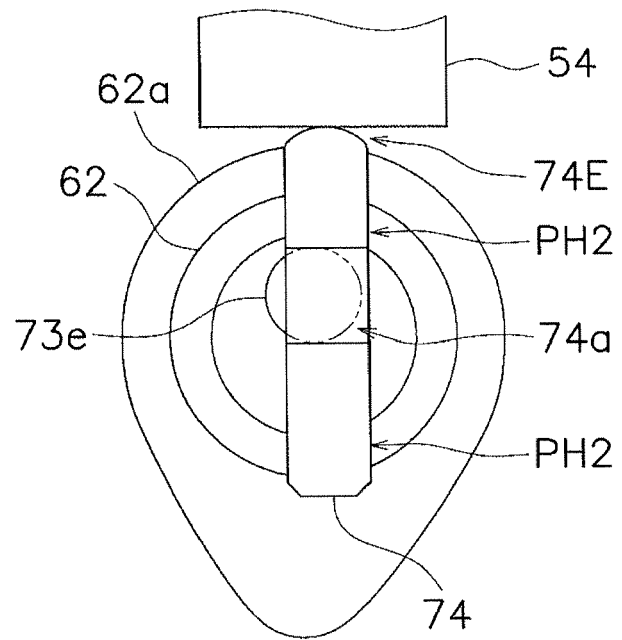
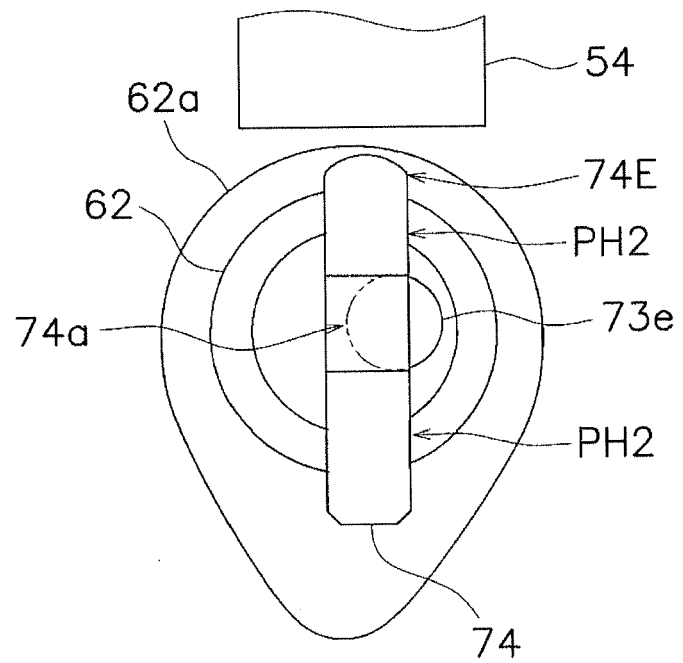


FIG. 14B



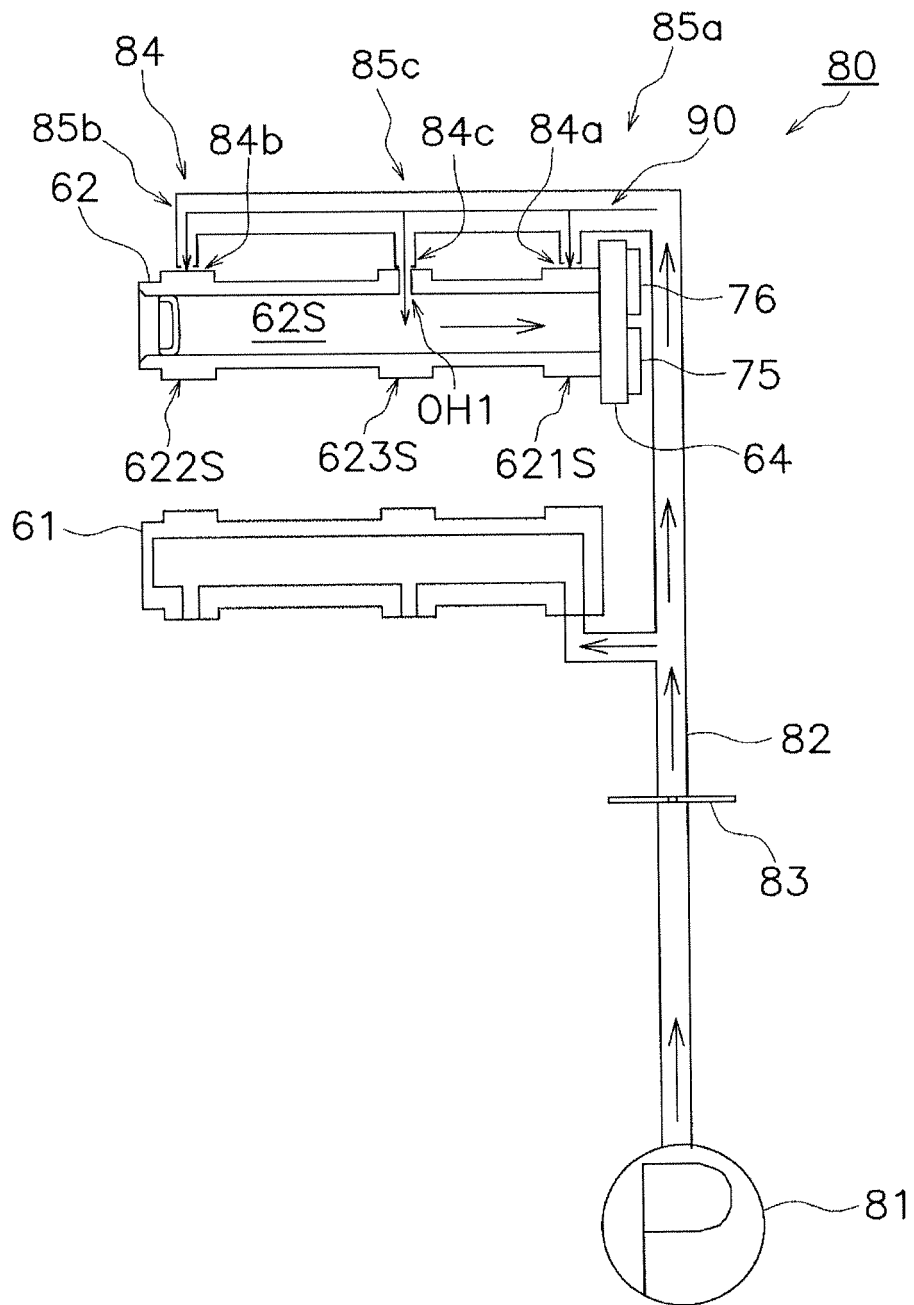


FIG. 15

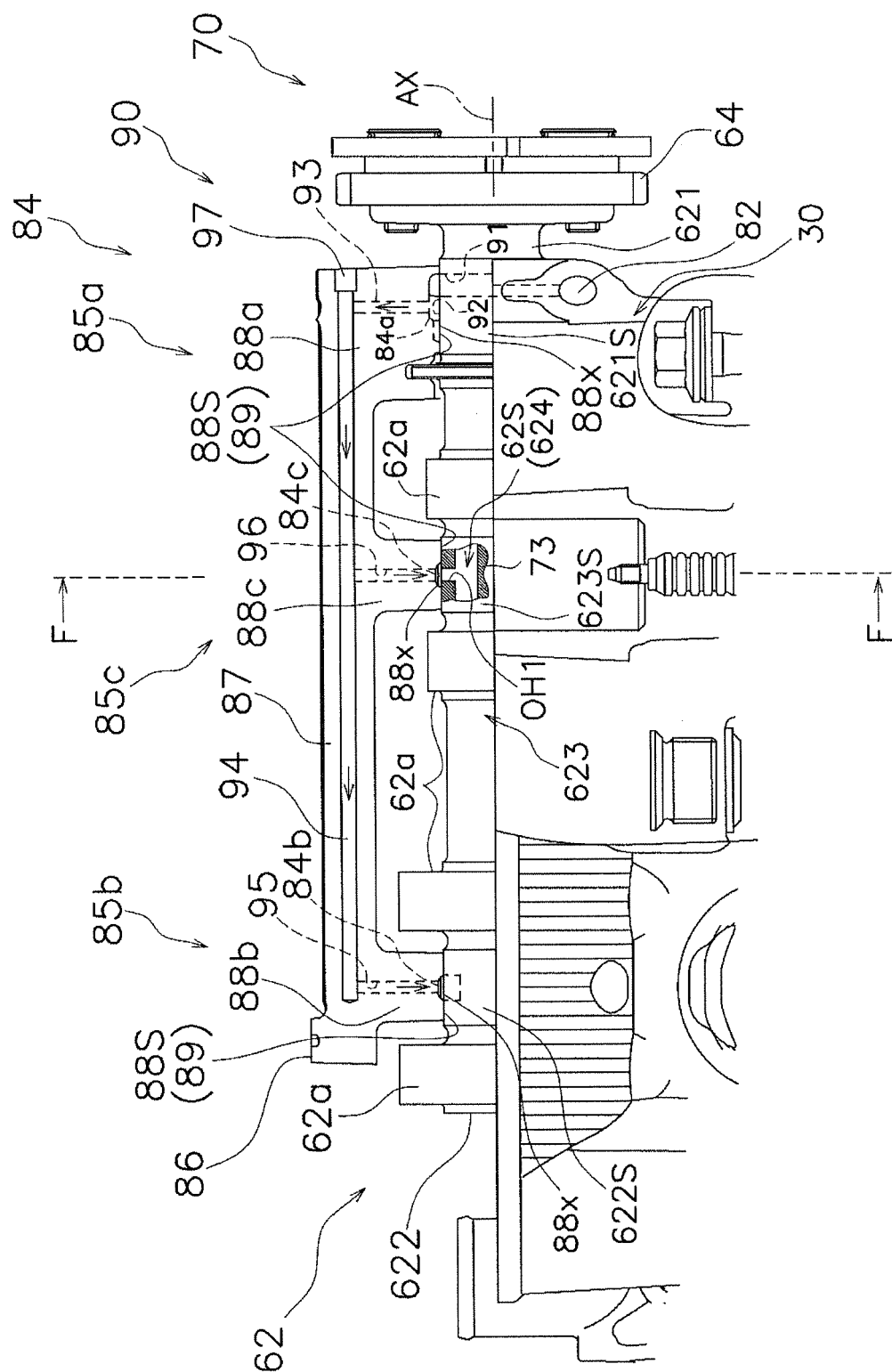


FIG. 16

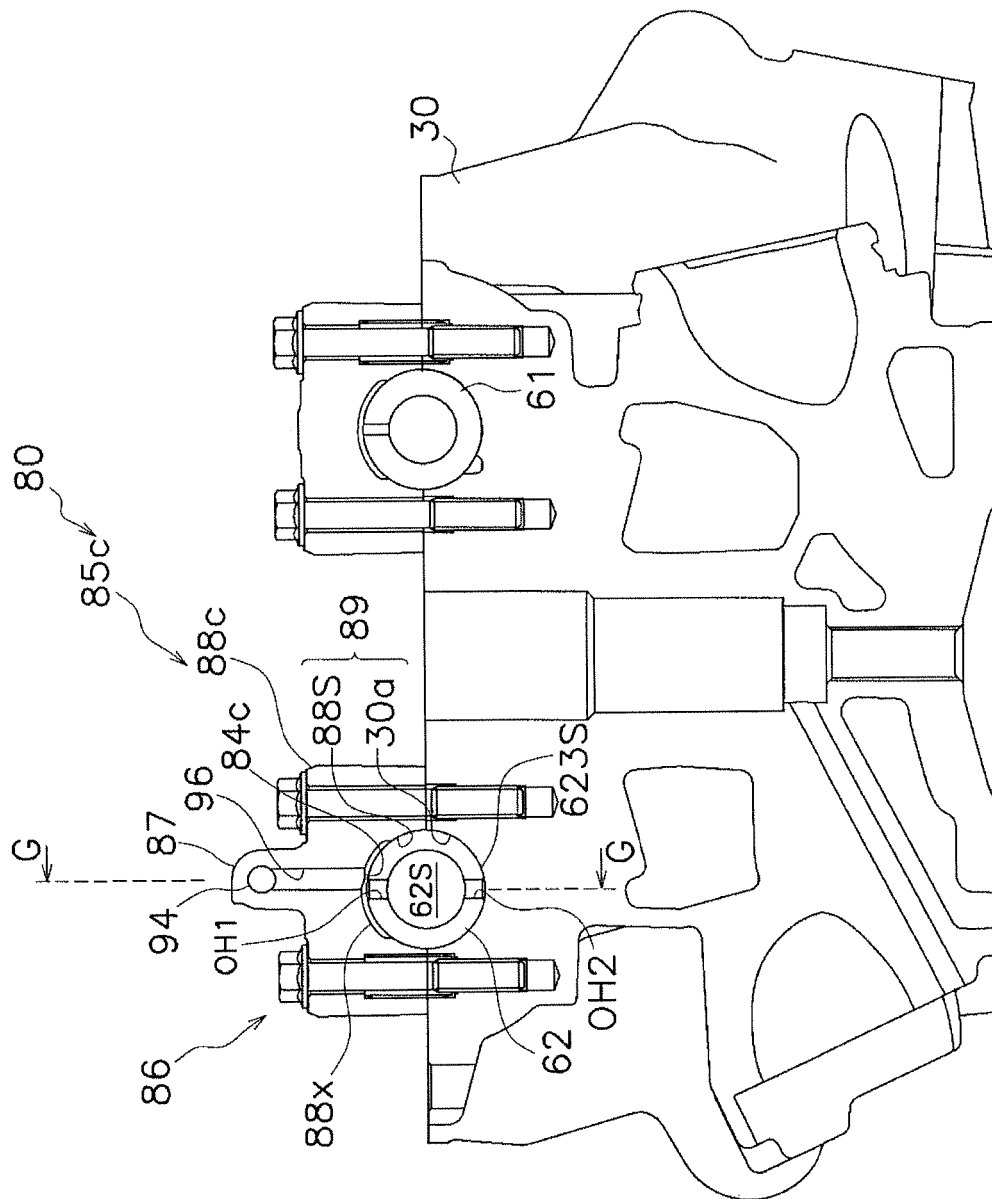


FIG. 17

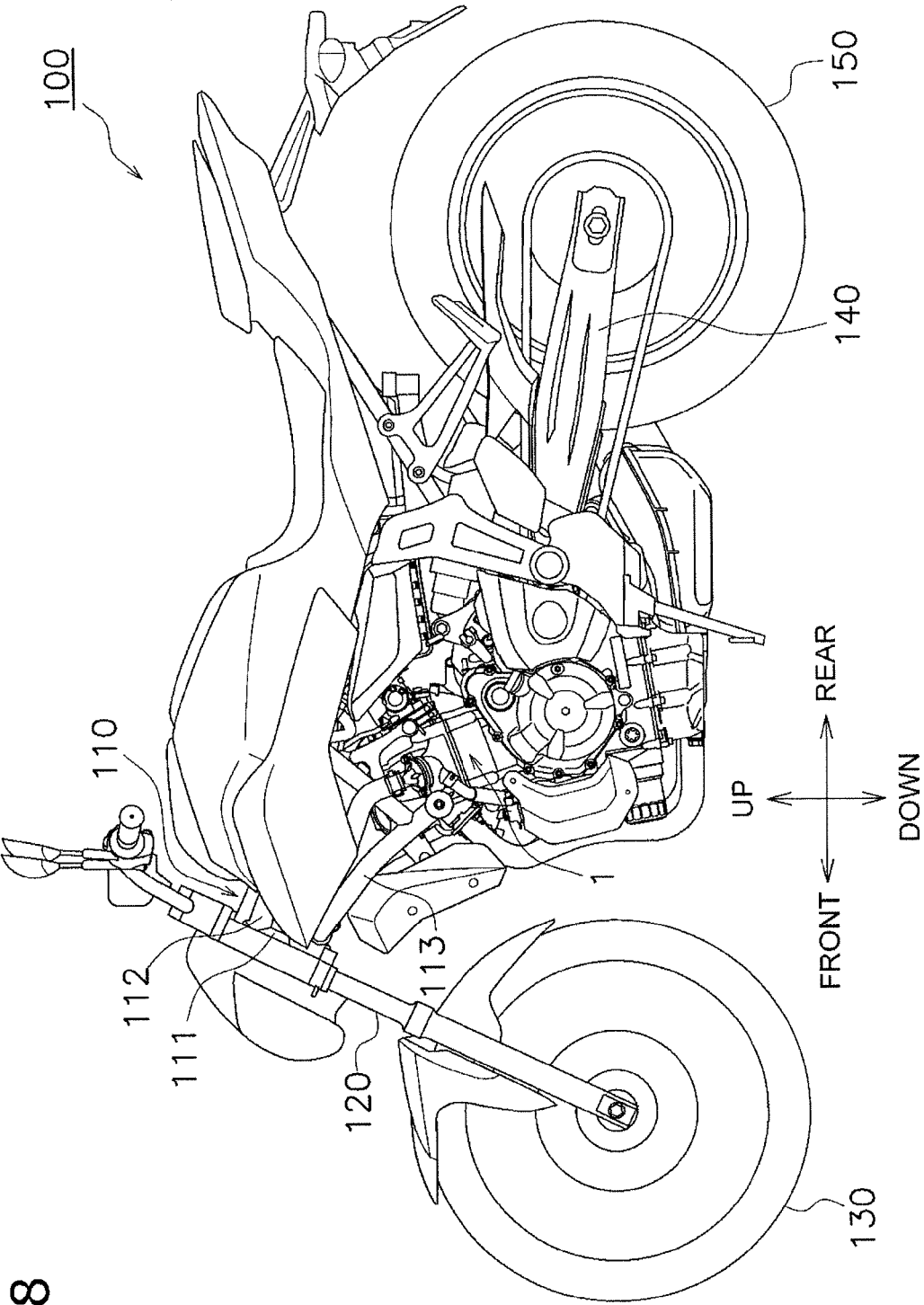


FIG. 18



EUROPEAN SEARCH REPORT

Application Number
EP 14 17 1225

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2005/279307 A1 (ITOH JUN [JP] ET AL) 22 December 2005 (2005-12-22) * the whole document *	1,2	INV. F01L13/08
X	US 2006/225686 A1 (ASANO YUUCHI [JP] ET AL) 12 October 2006 (2006-10-12) * the whole document *	1,2	
X	EP 1 336 726 A2 (HONDA MOTOR CO LTD [JP]) 20 August 2003 (2003-08-20) * the whole document *	1,2	
X	US 6 250 271 B1 (IKUMA TOMONORI [JP] ET AL) 26 June 2001 (2001-06-26) * the whole document *	1,2	
X	US 5 816 208 A (KIMURA SAKAYUKI [JP]) 6 October 1998 (1998-10-06) * the whole document *	1,2	
			TECHNICAL FIELDS SEARCHED (IPC)
			F01L
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 2 October 2014	Examiner Klinger, Thierry
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			

2
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 14 17 1225

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.

02-10-2014

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005279307 A1	22-12-2005	JP 2006002741 A	05-01-2006
		US 2005279307 A1	22-12-2005
US 2006225686 A1	12-10-2006	JP 2006291778 A	26-10-2006
		US 2006225686 A1	12-10-2006
EP 1336726 A2	20-08-2003	AU 2003200227 A1	16-10-2003
		CA 2418335 A1	06-08-2003
		CN 1436923 A	20-08-2003
		DE 60301021 D1	25-08-2005
		DE 60301021 T2	13-04-2006
		EP 1336726 A2	20-08-2003
		US 2003145820 A1	07-08-2003
US 6250271 B1	26-06-2001	CA 2298986 A1	09-09-2000
		JP 4208329 B2	14-01-2009
		JP 2000257411 A	19-09-2000
		US 6250271 B1	26-06-2001
US 5816208 A	06-10-1998	JP H0949408 A	18-02-1997
		US 5816208 A	06-10-1998
		US 6073599 A	13-06-2000

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 2008019845 A [0003]