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(54) **Engine**

(57) A first rocker arm (36) is supported by a rocker shaft (33) and is provided to be able to operate a valve (24-27). A second rocker arm (37) is supported by the rocker shaft (33) and is arranged to line up with the first rocker arm (36) in the axial direction of a cam shaft (14). A switching pin member (35) is able to be moved in the axial direction of the cam shaft (14), and links the first rocker arm (36) and the second rocker arm (37) at a first position and swings together with the first rocker arm (36) and the second rocker arm (37). The switching pin member (35) is positioned on an end section side of the valve with regard to the rocker shaft when viewed from the axial direction of the cam shaft.

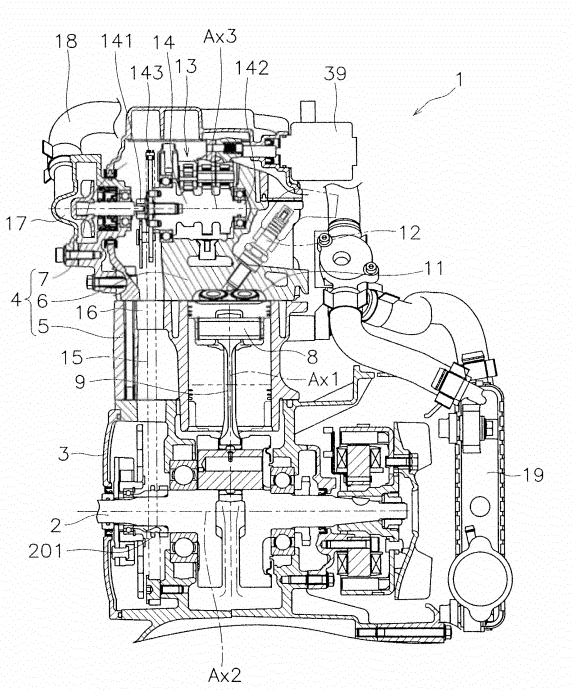


FIG. 1

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## Description

### Technical Field

**[0001]** The present invention relates to an engine.

### Background Art

**[0002]** A SOHC (Single OverHead Camshaft) engine is known which is provided with a variable valve gear where switching between linking or not linking of a plurality of rocker arms is possible by a pin member which links the rocker arms being directly pressurized by an actuator. For example, in an engine described in Japan Patent Laid-open Patent Publication JP-A-2012-77741, a drive shaft of an actuator is arranged at an engaging surface of a cylinder head and a cylinder head cover. The actuator is attached to the cylinder head and the cylinder head cover. In addition, a rod which is driven by the actuator and pressurizes the pin member is arranged so as to pass through the cylinder head and is supported by the cylinder head.

### SUMMARY OF INVENTION

### Technical Problem

**[0003]** The engine described above is a so-called SOHC engine. Essentially, it is possible to arrange a valve gear in a SOHC engine in a compact manner. However, in the engine described above, a variable valve gear is realized with a simple configuration by adopting a configuration where a pin member is directly pressurized by an actuator, but the size of the SOHC engine is increased since the variable valve gear is realized.

**[0004]** An object of the present invention is to provide a compact SOHC engine which is mounted with a variable valve gear.

### Solution to Problem

**[0005]** The object of the present invention is solved by an engine according to claim 1.

**[0006]** An engine according to an aspect of the present invention is a single cylinder engine and is provided with a cylinder section, a valve, a cam shaft, a rocker shaft, a first rocker arm, a second rocker arm, a switching pin member, and an actuator. The cylinder section includes a combustion chamber. The valve is supported by the cylinder section and opens and closes an exhaust port or an intake port in the combustion chamber. The cam shaft includes an intake cam and an exhaust cam and is supported by the cylinder section. The rocker shaft is supported by the cylinder section and is parallel to the cam shaft.

**[0007]** The first rocker arm is supported by the rocker shaft and is provided to be able to be operated in the direction in which the valve is pressed down. One end section of the first rocker arm is able to come into contact with the cam shaft. The other end of the first rocker arm is able to come into contact with the valve. The second rocker arm is supported by the rocker shaft and is arranged to line up with the first rocker arm in the axial direction of the cam shaft. One end section of the second rocker arm is able to come into contact with the cam shaft. The switching pin member is able to be moved in the axial direction of the cam shaft and is provided to be able to be moved between a first position and a second position. The switching pin member links the first rocker arm and the second rocker arm at the first position and swings together with the first rocker arm and the second rocker arm. The switching pin member does not link the first rocker arm and the second rocker arm at the second position.

**[0008]** The actuator switches the position of the switching pin member between the first position and the second position by pressurizing the switching pin member in the axial direction of the cam shaft. The switching pin member is positioned on the end section side of the valve with regard to the rocker shaft when viewed from the axial direction of the cam shaft.

**[0009]** In the engine according to the present aspect, when the first rocker arm pressurizes the valve, the switching pin member also moves in the same direction as the valve pressurising direction. As a result, it is possible to suppress an increase in the size of the cylinder section even when the switching pin member is added in order to realise a variable valve gear. Due to this, it is possible to reduce the size of the SOHC engine which is provided with a variable valve gear.

**[0010]** Preferably, the actuator includes a rod which pressurizes the switching pin member and a body section which drives the rod. The distance between the rocker shaft and the switching pin member is preferably shorter than the distance between the rocker shaft and the end section of the valve. In this case, since the distance between the rocker shaft and the switching pin member is short, the movement distance of the switching pin member when swinging is short. As a result, it is possible to reduce the diameter of the rod. When the diameter of the rod is reduced, it is possible to reduce the size of the body section since the drive force for moving the rod is smaller, and it is possible to reduce the size of the engine.

**[0011]** Preferably, the first rocker arm includes a first roller which comes into contact with an intake cam or an exhaust cam. The first roller is positioned on the cam shaft side with regard to the rocker shaft when viewed from the axial direction of the cam shaft. In this case, the first roller and the switching pin member are arranged to be opposite to each other with regard to the rocker shaft. As a result, it is possible to arrange the switching pin member at a position which is close to the rocker shaft even when the first roller is adopted. Due to this, it is possible to reduce the diameter of the rod. When the diameter of the rod is reduced, it is possible to reduce the size of the body section since the drive force for mov-

ing the rod is smaller, and it is possible to reduce the size of the engine. Due to this, it is possible to reduce the size of a variable valve gear and it is possible to reduce the size of the SOHC engine which is provided with a variable valve gear.

**[0012]** Preferably, the second rocker arm includes a second roller which comes into contact with the intake cam or the exhaust cam. The second roller is positioned on the cam shaft side with regard to the rocker shaft when viewed from the axial direction of the cam shaft. In this case, the second roller and the switching pin member are arranged to be opposite to each other with regard to the rocker shaft. As a result, it is possible to arrange the switching pin member at a position which is close to the rocker shaft even while avoiding interference with the second roller. Due to this, it is possible to reduce the diameter of the rod. When the diameter of the rod is shortened, it is possible to reduce the size of the body section since the drive force for moving the rod is smaller, and it is possible to reduce the size of the engine.

**[0013]** Preferably, a fastening bolt, which is arranged on the valve side with regard to the axis of the cam shaft, is further provided. The axis of the switching pin member is preferably positioned on the rocker shaft side with regard to the center of a head section of the fastening bolt. In this case, it is possible to shorten the rocker arms since the switching pin member is close to the rocker shaft. Due to this, it is possible to reduce the size of a variable valve gear and it is possible to reduce the size of the SOHC engine which is provided with a variable valve gear.

**[0014]** Preferably, the engine is further provided with a spark plug which is supported by the cylinder section. The spark plug is attached to a side section of the cylinder section in the axial direction of the cam shaft. The actuator is preferably attached to the side section of the cylinder section and preferably does not overlap with an extended line of the axis of the spark plug.

**[0015]** In this case, it is possible to arrange the actuator to be close to the spark plug. Due to this, it is possible to reduce the size of a variable valve gear and it is possible to reduce the size of the SOHC engine which is provided with a variable valve gear.

## Advantageous Effects of Invention

**[0016]** According to the present invention, it is possible to provide a compact SOHC engine which is provided with a variable valve gear.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0017]**

Fig. 1 is a cross sectional diagram of a portion of an engine.

Fig. 2 is a diagram where a cylinder head and a head cover are viewed from a direction which is perpendicular to a cylinder axis and a cam axis.

Fig. 3 is a cross sectional diagram where a cylinder head and a head cover are viewed from a direction which is perpendicular to a cylinder axis and a cam axis.

Fig. 4 is a perspective diagram of an inner section of a cylinder head.

Fig. 5 is a perspective diagram of an inner section of a cylinder head.

Fig. 6 is a diagram where an inner section of a cylinder head is viewed from a cylinder axial direction.

Fig. 7 is a cross sectional diagram where an inner section of a cylinder head is viewed from a cam axial direction.

Fig. 8 is a cross sectional diagram of the vicinity of a second support wall and a pressing member.

Fig. 9 is a cross sectional diagram where an inner section of a cylinder head is viewed from a cam axial direction.

Fig. 10 is a diagram where a cylinder head and a head cover are viewed from a cylinder axial direction.

Fig. 11 is a cross sectional diagram where a portion of an engine is viewed from a direction which is perpendicular to a cam axis and a cylinder axis.

Fig. 12 is a cross sectional diagram where a portion of an engine is viewed from a direction which is perpendicular to a cam axis and a cylinder axis.

## DETAILED DESCRIPTION OF THE EMBODIMENTS

**[0018]** Below, an engine 1 according to an embodiment will be described with reference to the diagrams. The engine 1 according to the present embodiment is a water cooled single cylinder engine. Fig. 1 is a cross sectional diagram of a portion of the engine 1. As shown in Fig. 1, the engine 1 includes a crank shaft 2, a crank case 3, and a cylinder section 4. The crank case 3 accommodates the crank shaft 2. The cylinder section 4 includes a cylinder body 5, a cylinder head 6, and a head cover 7. The cylinder body 5 is connected to the crank case 3. The cylinder body 5 may be integrated with the crank case 3 or the cylinder body 5 and the crank case may be separate. The cylinder body 5 accommodates a piston 8. The piston 8 is joined to the crank shaft 2 via a connecting rod 9.

**[0019]** Here, in the present embodiment, a direction from the cylinder head 6 toward the head cover 7 in a direction of a cylinder axis Ax1 of the cylinder body 5 is referred to as a "head cover side". A direction from the cylinder head 6 toward the cylinder body 5 in the direction of the cylinder axis Ax1 is referred to as a "cylinder body side".

**[0020]** The cylinder head 6 is arranged on the head cover side of the cylinder body 5. The cylinder head 6 is attached to the cylinder body 5. The head cover 7 is arranged on the head cover side of the cylinder head 6. The head cover 7 is attached to the cylinder head 6. The cylinder axis Ax1 is perpendicular with regard to a central

axis Ax2 of the crank shaft 2 (referred to below as a "crank axis Ax2"). The cylinder head 6 includes a combustion chamber 11. A spark plug 12 is attached to the cylinder head 6. A front end section of the spark plug 12 is arranged to face the combustion chamber 11. A base end section of the spark plug 12 is arranged at an outer section of the engine 1. A valve gear 13 is accommodated in the cylinder head 6 and the head cover 7.

**[0021]** The valve gear 13 is a mechanism for opening and closing exhaust valves 24 and 25 and intake valves 26 and 27 which will be described later. The valve gear 13 adopts a SOHC (single overhead cam shaft) mechanism. The valve gear 13 adopts a so-called variable valve gear which switches the timing of the opening and closing of the intake valves 26 and 27. The valve gear 13 includes a cam shaft 14. The cam shaft 14 is supported by the cylinder head 6. A central axis Ax3 of the cam shaft 14 (referred to below as a "cam axis Ax3") is perpendicular with regard to the cylinder axis Ax1. The cam axis Ax3 is parallel to the crank axis Ax2.

**[0022]** The cam shaft 14 includes a first cam shaft end section 141 and a second cam shaft end section 142. A first cam shaft driving section 143 is provided at the first cam shaft end section 141. The first cam shaft driving section 143 is a sprocket. The first cam shaft driving section 143 meshes with a cam chain 15 and the cam chain 15 is joined to the cam shaft 14. A second cam shaft driving section 201 is provided in the crank shaft 2. The second cam shaft driving section 201 is a sprocket. The second cam shaft driving section 201 meshes with the cam chain 15 and the cam chain 15 is joined to the crank shaft 2. That is, the cam chain 15 is wound around the first cam shaft driving section 143 of the cam shaft 14 and the second cam shaft driving section 201 of the crank shaft 2. The cam shaft 14 is rotated by the rotation of the crank shaft 2 being transmitted to the cam shaft 14 via the cam chain 15.

**[0023]** The cam chain chamber 16 is provided in the cylinder head 6 and the cylinder body 5. The cam chain 15 is arranged in the cam chain chamber 16. The cam chain chamber 16 is arranged in a direction which is perpendicular to the cylinder axis Ax1 with regard to the combustion chamber 11. That is, the cam chain chamber 16 is arranged to line up with the combustion chamber 11 in the direction of the cam axis Ax3.

**[0024]** A water pump 17 is joined to the first cam shaft end section 141. The water pump 17 is arranged in the direction of the cam axis Ax3 of the cam shaft 14. The water pump 17 is connected to a cooling liquid path which is not shown in the diagrams and a radiator 19 in the engine 1 via a cooling liquid hose 18. The water pump 17 circulates a cooling liquid in the engine 1 due to being driven by the rotation of the cam shaft 14.

**[0025]** Fig. 2 is a diagram where the cylinder head 6 and the head cover 7 are viewed from a direction which is perpendicular to the cylinder axis Ax1 and the cam axis Ax3. Fig. 3 is a cross sectional diagram where the cylinder head 6 and the head cover 7 are viewed from a direction which is perpendicular to the cylinder axis Ax1 and the cam axis Ax3. Here, the water pump 17 is removed from the cylinder head 6 and the head cover 7 in Fig. 2 and Fig. 3.

**[0026]** The cylinder head 6 includes a first end section 601 and a second end section 602. The first end section 601 is arranged to face an end section 701 of the head cover 7 in the direction of the cylinder axis Ax1. The second end section 602 is arranged to face an end section of the cylinder body 5 in the direction of the cylinder axis Ax1. The first end section 601 and the second end section 602 extend in a direction which is perpendicular with regard to the cylinder axis Ax1.

**[0027]** As shown in Fig. 3, a first virtual plane P1 which includes the first end section 601 of the cylinder head 6 and a second virtual plane P2 which includes the end section 701 of the head cover 7 overlap with the cam shaft 14. In detail, the first virtual plane P1 and the second virtual plane P2 are positioned more to the head cover side than the cam axis Ax3. Here, a gasket 21 is interposed between the first end section 601 of the cylinder head 6 and the end section 701 of the head cover 7.

**[0028]** The cylinder head 6 includes a first cylinder side wall 603 and a second cylinder side wall 604. The first cylinder side wall 603 and the second cylinder side wall 604 are arranged to face the direction of the cam axis Ax3. The second cylinder side wall 604 is closer to the cam chain chamber 16 than the first cylinder side wall 603. The second cylinder side wall 604 is closer to the first cam shaft driving section 143 than the first cylinder side wall 603.

**[0029]** The head cover 7 includes a first cover side wall 702 and a second cover side wall 703. The first cover side wall 702 and the second cover side wall 703 are arranged to face the direction of the cam axis Ax3. The first cover side wall 702 is positioned on the head cover side of the first cylinder side wall 603 and is connected to the first cylinder side wall 603. The second cover side wall 703 is positioned on the head cover side of the second cylinder side wall 604 and is connected to the second cylinder side wall 604. The second cover side wall 703 is closer to the cam chain chamber 16 than the first cover side wall 702. The second cover side wall 703 is closer to the first cam shaft driving section 143 than the first cover side wall 702.

**[0030]** Fig. 4 and Fig. 5 are perspective diagrams of an inner section of the cylinder head 6. Fig. 6 is a diagram where an inner section of the cylinder head 6 is viewed from the direction of the cylinder axis Ax1. As shown in Fig. 6, the first cylinder side wall 603 includes a first protruding wall section 605, a second protruding wall section 606, and a concave section 607. The first protruding wall section 605 and the second protruding wall section 606 have a shape which protrudes to the outside of the cylinder head 6 in the direction of the cam axis Ax3. The concave section 607 is positioned between the first protruding wall sections 605 and the second protruding wall section 606. The concave section 607 has a shape which

is depressed toward the inside of the cylinder head 6 in the direction of the cam axis Ax3. The spark plug 12 described above is attached to the first cylinder side wall 603. The base end section of the spark plug 12 is positioned in the concave section 607 in the first cylinder side wall 603. That is, the base end section of the spark plug 12 is positioned between the first protruding wall section 605 and the second protruding wall section 606 when viewed from the direction of the cylinder axis Ax1.

**[0031]** The cylinder head 6 includes a third cylinder side wall 608 and a fourth cylinder side wall 609. The third cylinder side wall 608 and the fourth cylinder side wall 609 are arranged to line up in a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1. A connecting section 610 of an exhaust pipe (which is not shown in the diagram) is provided in the third cylinder side wall 608. As shown in Fig. 4, a connecting section 611 of an intake pipe (which is not shown in the diagram) is provided in the fourth cylinder side wall 609.

**[0032]** The cylinder head 6 includes a first support wall 612 and a second support wall 613. The first support wall 612 and the second support wall 613 are arranged to line up in the direction of the cam axis Ax3. The first support wall 612 and the second support wall 613 support the cam shaft 14 such that the cam shaft 14 is able to rotate. As shown in Fig. 3, the first support wall 612 supports the cam shaft 14 via a first bearing 22. The second support wall 613 supports the cam shaft 14 via a second bearing 23. The first support wall 612 and the second support wall 613 are arranged between the first cam shaft driving section 143 and the first cylinder side wall 603. The second support wall 613 is closer to the first cam shaft driving section 143 than the first support wall 612. The second support wall 613 is arranged between the first support wall 612 and the first cam shaft driving section 143 in the direction of the cam axis Ax3. The top section of the first support wall 612 is positioned more to the head cover side than the first end section 601 of the cylinder head 6. The top section of the second support wall 613 is positioned more to the head cover side than the first end section 601 of the cylinder head 6.

**[0033]** Fig. 7 is a cross sectional diagram where an inner section of the cylinder head 6 is viewed from the direction of the cam axis Ax3. As shown in Fig. 4 to Fig. 7, the intake valves 26 and 27 and the exhaust valves 24 and 25 are attached to the cylinder head 6. As shown in Fig. 7, the cylinder head 6 includes an intake port 614 and an exhaust port 615 which are linked to the combustion chamber 11. The intake valves 26 and 27 open and close the intake port 614. As shown in Fig. 6, the intake valves 26 and 27 include a first intake valve 26 and a second intake valve 27. The first intake valve 26 and the second intake valve 27 are arranged to line up in the direction of the cam axis Ax3. As shown in Fig. 7, an intake valve spring 261 is attached to the first intake valve 26. The intake valve spring 261 presses the first intake valve 26 in a direction so that the first intake valve 26 closes the intake port 614. In the same manner, an intake valve spring 271 (refer to Fig. 4) is attached to the second intake valve 27 and the second intake valve 27 is pressed in a direction so that the second intake valve 27 closes the intake port 614.

**[0034]** The exhaust valves 24 and 25 open and close the exhaust port 615. As shown in Fig. 6, the exhaust valves 24 and 25 include a first exhaust valve 24 and a second exhaust valve 25. The first exhaust valve 24 and the second exhaust valve 25 are arranged to line up in the direction of the cam axis Ax3. As shown in Fig. 5 and Fig. 7, an exhaust valve spring 241 is attached to the first exhaust valve 24. The exhaust valve spring 241 presses the first exhaust valve 24 in a direction so that the first exhaust valve 24 closes the exhaust port 615. An exhaust valve spring 251 is attached to the second exhaust valve 25 and the second exhaust valve 25 is pressed in a direction so that the second exhaust valve 25 closes the exhaust port 615.

**[0035]** As shown in Fig. 3, the cam shaft 14 includes a first intake cam 144, a second intake cam 145, and an exhaust cam 146. The first intake cam 144, the second intake cam 145, and the exhaust cam 146 are arranged to line up in the direction of the cam axis Ax3. The exhaust cam 146 is the closest to the first cam shaft driving section 143 out of the first intake cam 144, the second intake cam 145, and the exhaust cam 146. The first intake cam 144 is the farthest from the first cam shaft driving section 143 out of the first intake cam 144, the second intake cam 145, and the exhaust cam 146. The second intake cam 145 is arranged between the first intake cam 144 and the exhaust cam 146 in the direction of the cam axis Ax3.

**[0036]** As shown in Fig. 7, the valve gear 13 includes an exhaust rocker shaft 31 and an exhaust rocker arm 32. The exhaust rocker shaft 31 is arranged to be parallel to the cam shaft 14. The exhaust rocker shaft 31 is supported by the cylinder head 6. In detail, the exhaust rocker shaft 31 is supported by the first support wall 612 and the second support wall 613. The central axis of the exhaust rocker shaft 31 is positioned more to the head cover side than the cam axis Ax3.

**[0037]** The exhaust rocker arm 32 is supported by the exhaust rocker shaft 31 so as to be able to swing centered on the exhaust rocker shaft 31. The exhaust rocker arm 32 is provided so as to be able to operate the exhaust valves 24 and 25. The exhaust rocker arm 32 includes an arm body 321, a roller support section 322, a roller 323, and an exhaust valve pressurizing section 324.

**[0038]** The arm body 321 includes a through hole 327 and the exhaust rocker shaft 31 passes through the through hole 327. The roller support section 322 protrudes from the arm body 321 to the cam shaft 14 side. The roller support section 322 supports the roller 323 so as to be able to rotate. The rotation central axis of the roller 323 is parallel to the cam axis Ax3. The roller 323 is positioned on the cam shaft 14 side of the exhaust rocker shaft 31. The roller 323 comes into contact with the exhaust cam 146 and is rotated due to rotation of the

exhaust cam shaft 146.

**[0039]** The exhaust valve pressurizing section 324 protrudes from the arm body 321 to the opposite side to the cam shaft 14. That is, the exhaust valve pressurizing section 324 protrudes from the arm body 321 to an end section of the first exhaust valve 24, that is, a stem end 242 side (referred to below as "exhaust valve side"). As shown in Fig. 5 and Fig. 6, a first adjusting screw 325 and a second adjusting screw 326 are provided at the tips of the exhaust valve pressurizing section 324. The tip of the first adjusting screw 325 opposes the stem end 242 of the first exhaust valve 24. The tip of the second adjusting screw 326 opposes an end section of the second exhaust valve 25, that is, a stem end 252.

**[0040]** When the roller 323 is pressed up by the exhaust cam 146, the exhaust valve pressurizing section 324 presses the stem end 242 in the first exhaust valve 24 and the stem end 252 in the second exhaust valve 25 down due to the exhaust rocker arm 32 swinging. Due to this, the exhaust port 615 is opened by the first exhaust valve 24 and the second exhaust valve 25 being pressed down. When the roller 323 is not pressed up by the exhaust cam 146, the exhaust port 615 is closed by the first exhaust valve 24 and the second exhaust valve 25 being pressed up by the exhaust valve springs 241 and 251.

**[0041]** As shown in Fig. 3, the valve gear 13 includes an intake rocker shaft 33, an intake rocker arm 34, a switching pin member 35, and an actuator 39. The intake rocker shaft 33 is arranged to be parallel to the cam shaft 14. The intake rocker shaft 33 is supported by the cylinder head 6. In detail, the intake rocker shaft 33 is supported by the first support wall 612 and the second support wall 613. The central axis of the intake rocker shaft 33 is positioned more to the head cover side than the cam axis Ax3.

**[0042]** The intake rocker arm 34 includes a first rocker arm 36 and a second rocker arm 37. The first rocker arm 36 is supported by the intake rocker shaft 33 so as to be able to swing centered on the intake rocker shaft 33. The first rocker arm 36 is provided as to be able to operate the intake valves 26 and 27. The first rocker arm 36 includes a first arm body 361 shown in Fig. 3, a first roller support section 362 shown in Fig. 6, a first roller 363, an intake valve pressurizing section 364, and a first linking section 365.

**[0043]** As shown in Fig. 3, the first arm body 361 includes a through hole 356 and the intake rocker shaft 33 passes through the through hole 366. The first roller support section 362 protrudes from the first arm body 361 to the cam shaft 14 side. The first roller support section 362 supports the first roller 363 so as to be able to rotate. The rotation central axis of the first roller 363 is parallel to the cam axis Ax3. The first roller 363 is positioned on the cam shaft 14 side of the intake rocker shaft 33. The first roller 363 comes into contact with the first intake cam 144 and is rotated due to rotation of the first intake cam 144.

**[0044]** The intake valve pressurizing section 364 protrudes from the first arm body 361 to the opposite side to the cam shaft 14. That is, the intake valve pressurizing section 364 protrudes from the first arm body 361 to a stem end 262 side of the first intake valve 26 (referred to below as "intake valve side"). As shown in Fig. 6, a first adjusting screw 367 and a second adjusting screw 368 are provided at the tip of the intake valve pressurizing section 364. The tip of the first adjusting screw 367 opposes the stem end 262 of the first intake valve 26. The tip of the second adjusting screw 368 opposes a stem end 272 of the second intake valve 27.

**[0045]** The first linking section 365 is connected to the intake valve pressurizing section 364. The first linking section 365 is positioned more to the head cover side than the intake rocker shaft 33. The first linking section 365 is positioned more to the intake valve side than the intake rocker shaft 33. The first linking section 365 is positioned more to the head cover side than the intake valve pressurizing section 364. As shown in Fig. 3, the first linking section 365 includes a through hole 369. The through hole 369 extends in the direction of the cam axis Ax3. The switching pin member 35 is inserted into the through hole 369.

**[0046]** As shown in Fig. 7, the second rocker arm 37 is supported so as to be able to rotate centered on the intake rocker shaft 33. The second rocker arm 37 is arranged to line up with the first rocker arm 36 in the direction of the cam axis Ax3. The second rocker arm 37 is arranged at the cam chain chamber 16 side of the first rocker arm 36. That is, the second rocker arm 37 is closer to the first cam shaft driving section 143 than the first rocker arm 36. The second rocker arm 37 includes a second arm body 371, a second roller support section 372, a second roller 373, and a second linking section 374.

**[0047]** The second arm body 371 includes a through hole 375 and the intake rocker shaft 33 passes through the through hole 375. The second roller support section 372 protrudes from the second arm body 371 to the cam shaft 14 side. The second roller support section 372 supports the second roller 373 so as to be able to rotate. The rotation central axis of the second roller 373 is parallel to the cam axis Ax3. The second roller 373 is positioned on the cam shaft 14 side of the intake rocker shaft 33. The second roller 373 comes into contact with the second intake cam 145 and is rotated due to rotation of the second intake cam 145.

**[0048]** The second linking section 374 protrudes from the second arm body 371 to the opposite side to the cam shaft 14. That is, the second linking section 374 protrudes from the second arm body 371 to the intake valve side. The second linking section 374 is positioned more to the head cover side than the intake rocker shaft 33. The second linking section 374 is positioned more to the head cover side than the intake valve pressurizing section 364. As shown in Fig. 3, the second linking section 374 includes a through hole 376. The through hole 376 extends in the direction of the cam axis Ax3. The through hole 376 of the second linking section 374 is arranged to line

up with the through hole 369 of the first linking section 365 in the direction of the cam axis Ax3. Accordingly, it is possible for the switching pin member 35 to be inserted into the through hole 376 of the second linking section 374.

**[0049]** The valve gear 13 includes a pressing member 38 shown in Fig. 6. The pressing member 38 presses the second rocker arm 37 in a direction where the second roller 373 applies pressure to the cam shaft 14. In the present embodiment, the pressing member 38 is a coil spring and the intake rocker shaft 33 runs through the pressing member 38. The second rocker arm 37 includes a first support member 41. The first support member 41 supports one end of the pressing member 38. The first support member 41 has the shape of a pin and protrudes from the second rocker arm 37 in the direction of the cam axis Ax3. Fig. 8 is a cross sectional diagram of the vicinity of the second support wall 613 and the pressing member 38.

**[0050]** As shown in Fig. 8, the valve gear 13 includes a second support member 42. The second support member 42 supports the other end of the pressing member 38. The second support member 42 is configured by a member which is bent and has a cross sectional shape with an L shape. A step section 619 is provided in the second support wall 613 and the second support member 42 is supported in the step section 619.

**[0051]** As shown in Fig. 3, the switching pin member 35 is able to be moved in the axial direction of the cam shaft 14 and is provided to be able to be moved between a first position and a second position. The switching pin member 35 is arranged to span between the through hole 369 of the first linking section 365 and the through hole 376 of the second linking section 374 at the first position. Due to this, the switching pin member 35 links the first rocker arm 36 and the second rocker arm 37 at the first position and the first rocker arm 36 and the second rocker arm 37 swing in an integrated manner. In this state, the switching pin member 35 swings together with the first rocker arm 36 and the second rocker arm 37.

**[0052]** The switching pin member 35 is arranged at the through hole 369 of the first linking section 365 and is not arranged at the through hole 376 of the second linking member 374 at the second position. Due to this, the switching pin member 35 does not link the first rocker arm 36 and the second rocker arm 37 at the second position and the first rocker arm 36 and the second rocker arm 37 swing independently from each other. In this state, the switching pin member 35 swings together with the first rocker arm 36.

**[0053]** An elastic member 44 is provided in the first linking section 365. The elastic member 44 is arranged in the through hole 369 of the first linking section 365. The elastic member 44 presses the switching pin member 35 in a direction from the first position toward the second position. Accordingly, when the switching pin member 35 is not pressurized by the actuator 39, the switching pin member 35 is held at the second position by the elastic member 44. When the switching pin member 35 is pressurized by the actuator 39, the switching pin member 35 moves from the second position to the first position against the pressing force of the elastic member 44.

**[0054]** As shown in Fig. 7, the switching pin member 35 is positioned more to the head cover side than the first end section 601 of the cylinder head 6 and the end section 701 of the head cover 7. Accordingly, the switching pin member 35 overlaps with the head cover 7 when viewed from the axial direction of the cam shaft 14. As shown in Fig. 7, the switching pin member 35 is positioned on the intake valve side of the intake rocker shaft 33. That is, the switching pin member 35 is positioned between the intake rocker shaft 33 and the stem end 262 of the first intake valve 26 in a direction which is perpendicular to the cylinder axis Ax1 and the axis of the cam shaft 14. The distance between the shaft center of the intake rocker shaft 33 and the shaft center of the switching pin member 35 is shorter than the distance between the shaft center of the intake rocker shaft 33 and the stem end 262 of the first intake valve 26 when viewed from the axial direction of the cam shaft 14. In addition, the intake rocker shaft 33 is positioned between the switching pin member 35 and the first roller 363 in a direction which is perpendicular to the cylinder axis Ax1 and the axis of the cam shaft 14. In the same manner, the intake rocker shaft 33 is positioned between the switching pin member 35 and the second roller 372 in a direction which is perpendicular to the cylinder axis Ax1 and the axis of the cam shaft 14.

**[0055]** Fig. 9 illustrates a state where the first rocker arm 36 and the second rocker arm 37 swing using dashed lines. When the switching pin member 35 is positioned at the first position, the first rocker arm 36 is linked to the second rocker arm 37 and swings with the second rocker arm 367 in an integrated manner. As a result, when the second roller 373 is pressed up by the second intake cam 145, due to the second rocker arm 37 swinging centered on the intake rocker shaft 33, the first rocker arm 35 also swings in a direction which lowers the intake valve pressurizing section 364. Due to this, the tip of the first adjusting screw 367 presses down the stem end 262 of the first intake valve 26 and the tip of the second adjusting screw 368 presses down the stem end 272 of the second intake valve 27. Due to this, the first intake valve 26 and the second intake valve 27 open the intake port 614. When the second roller 373 is not pressed up by the second intake cam 145, the intake port 614 is closed off by the first intake valve 26 and the second intake valve 27 being pressed up by the intake valve springs 261 and 271.

**[0056]** When the switching pin member 35 is positioned at the second position, the first rocker arm 36 swings independently of the second rocker arm 37. As a result, when the first roller 363 is pressed up by the first intake cam 144, the first rocker arm 36 swings centered on the intake rocker shaft 33 in a direction where the

intake valve pressurizing section 364 is lowered, Due to this, the tip of the first adjusting screw 367 presses down the stem end 262 of the first intake valve 26 and the tip of the second adjusting screw 368 presses down the stem end 272 of the second intake valve 27. Due to this, the first intake valve 26 and the second intake valve 27 open the intake port 614. When the first roller 363 is not pressed up by the first intake cam 144, the intake port 614 is closed off by the first intake valve 26 and the second intake valve 27 being pressed up by the intake valve springs 261 and 271.

**[0057]** Here, the shapes of the first intake cam 144 and the second intake cam 145 are set so that the second intake cam 145 presses up the second roller 373 before the tip of the first intake cam 144 reaches the first roller 363. As a result, when the switching pin member 35 is positioned at the first position, the rotation of the first intake cam 144 is not transmitted to the first rocker arm 36 due to the operation of the first rocker arm 36 by rotating of the second intake cam 145. Accordingly, when the switching pin member 35 is positioned at the first position, the opening and closing operation of the first intake valve 26 and the second intake valve 27 are performed according to the rotation of the second intake cam 145. On the other hand, when the switching pin member 35 is positioned at the second position, the rotation of the second intake cam 145 is not transmitted to the first rocker arm 36. As a result, when the switching pin member 35 is positioned at the second position, the opening and closing operation of the first intake valve 26 and the second intake valve 27 is performed according to the rotation of the first intake cam 144.

**[0058]** The actuator 39 is an electromagnetic solenoid and switches the position of the switching pin member 35 from the second position to the first position by pressurizing the switching pin member 35 in the axial direction of the cam shaft 14 due to the flow of electricity, When the flow of electricity to the actuator 39 stops, the position of the switching pin member 35 is returned from the first position to the second position due to the elasticity of the elastic member 44.

**[0059]** As shown in Fig. 6, the actuator 39 overlaps with the first end section 601 of the cylinder head 6 when viewed from the direction of the cylinder axis Ax1. That is, a portion of the actuator 39 is positioned more to the inner side of the cylinder head 6 than the first end section 601 of the cylinder head 6. The actuator 39 is arranged at the opposite side to the cam chain chamber 16 with regard to the cam shaft 14 when viewed from the direction of the cylinder axis Ax1. An extended line of the cam axis Ax3 is positioned between the connecting section 610 of the exhaust pipe and the actuator 39 when viewed from the direction of the cylinder axis Ax1. As shown in Fig. 3, the actuator 39 is positioned more to the head cover side than the first end section 601 of the cylinder head 6.

**[0060]** The actuator 39 includes a rod 391 which pressurizes the switching pin member 35 and a body section 392 which drives the rod 391. The central axis of the rod 391 is parallel to the cam axis Ax3, The rod 391 is arranged so as to overlap with the switching pin member 35 in the swinging range of the switching pin member 35 when viewed from the direction of the cam axis Ax3. The rod 391 pressurizes the switching pin member 35 by being driven by the body section 392. The rod 391 is arranged to be close to the first support wall 612 described above. As shown in Fig. 4, the first support wall 612 includes a concave section 620 which opposes the side surface of the rod 391. The concave section 620 has a shape which is depressed so as to avoid the rod 391.

**[0061]** The actuator 39 is attached to the head cover 7. In detail, the body section 392 is attached to the head cover 7. The rod 391 is supported by the head cover 7. As shown in Fig. 3, a through hole 704 is provided in the head cover 7 and the rod 391 runs through the through hole 704. As shown in Fig. 6, the actuator 39 is positioned more to the intake valves 26 and 27 side than the extended line of the axis of the spark plug 12 when viewed from the direction of the cylinder axis Ax1. The spark plug 12 is arranged to line up with the cam shaft 14 in the direction of the cam axis Ax3 when viewed from the direction of the cylinder axis Ax1.

**[0062]** Fig. 10 is a diagram where the cylinder head 6 and the head cover 7 are viewed from the direction of the cylinder axis Ax1. As shown in Fig. 2 and Fig. 10, the actuator 39 is attached to the head cover 7 at the outside of the engine 1. The actuator 39 is attached to the first cover side wall 702. The actuator 39 is arranged so as to not overlap with an extended line of the axis of the spark plug 12. A first boss section 705 and a second boss section 706 are provided in the first cover side wall 702. The first boss section 705 and the second boss section 706 protrude from the first cover side wall 702 toward the outside of the cylinder head 6 in the direction of the cam axis Ax3. The first boss section 705 and the second boss section 706 are arranged to line up in a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1. The actuator 39 includes a flange section 393 which protrudes from the body section 392. The flange section 393 is fixed to the first boss section 705 and the second boss section 706 using bolts 51 and 52. Due to this, the actuator 39 is fixed to the first cover side wall 702.

**[0063]** Fig. 11 is a cross sectional diagram of a portion of the engine 1 which is viewed from a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1. As shown in Fig. 11, the cylinder head 6, the cylinder body 5, and the crank case 3 are fastened by a first fastening bolt 61 and a second fastening bolt 62. The cylinder head 6, the cylinder body 5, and the crank case 3 are fastened by a third fastening bolt and a fourth fastening bolt which are not shown in the diagram. The first fastening bolt 61 includes a first head section 65. The second fastening bolt 62 includes a second head section 66. The third fastening bolt includes a third head section 67 which is shown in Fig. 6. The fourth fastening bolt includes a fourth head section 68 which is shown in Fig. 6. The first to the fourth head sections 65 to 68 fix the cylinder head

6. The first head section 65 is configured by a shaft section of the first fastening bolt 61 and a nut which is separate but may be integral with the shaft section of the first fastening bolt 61. The second to the fourth head sections 66 to 68 are the same as the first head section 65.

**[0064]** The first head section 65 and the second head section 66 are arranged to line up in the direction of the cam axis Ax3. The third head section 67 and the fourth head section 68 are arranged to line up in the direction of the cam axis Ax3. The first head section 65 and the third head section 67 are arranged to line up in a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1. The second head section 66 and the fourth head section 68 are arranged to line up in a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1.

**[0065]** The first head section 65 is arranged between the first cylinder side wall 603 and the second head section 66 in the direction of the cam axis Ax3. The first cylinder side wall 603 is closer to the first head section 65 than the second cylinder side wall 604. The first head section 65 is arranged in the first protruding wall section 605 of the first cylinder side wall 603. The first head section 65 overlaps with the actuator 39 when viewed from the direction of the cylinder axis Ax1 of the cylinder body 5. The axis of the switching pin member 35 is positioned on the intake rocker shaft 33 side with regard to the center of the first head section 65 in a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1. The axis of the switching pin member 35 is positioned between the center of the first head section 65 and the intake rocker shaft 33 in a direction which is perpendicular to the cam axis Ax3 and the cylinder axis Ax1.

**[0066]** The second head section 66 is arranged between the second cylinder side wall 604 and the first head section 65 in the direction of the cam axis Ax3. The second cylinder side wall 604 is closer to the second head section 66 than the first cylinder side wall 603. The cam shaft driving section 143 is arranged between the second cylinder side wall 604 and the second head section 66 in the direction of the cam axis Ax3. The second head section 66 is arranged on the second support wall 613. The first head section 65 and the second head section 66 are arranged on the intake valve side with regard to the cam axis Ax3. The distance between the first cylinder side wall 603 and the first head section 65 in the direction of the cam axis Ax3 is shorter than the distance between the second cylinder side wall 604 and the second head section 66 in the direction of the cam axis Ax3.

**[0067]** The third head section 67 is arranged between the first cylinder side wall 603 and the fourth head section 68 in the direction of the axis Ax3, The first cylinder side wall 603 is closer to the third head section 67 than the second cylinder side wall 604. The third head section 67 is arranged in the second protruding wall section 606 of the first cylinder side wall 603.

**[0068]** The fourth head section 68 is arranged between the second cylinder side wall 604 and the third head section 67 in the direction of the cam axis Ax3. The second cylinder side wall 604 is closer to the fourth head section 68 than the first cylinder side wall 603. The cam shaft driving section 143 is arranged between the second cylinder side wall 604 and the fourth head section 68 in the direction of the cam axis Ax3. The fourth head section 68 is arranged on the second support wall 613. The third head section 67 and the fourth head section 68 are arranged on the exhaust valve side with regard to the cam axis Ax3. The distance between the first cylinder side wall 603 and the third head section 67 in the direction of the cam axis Ax3 is shorter than the distance between the second cylinder side wall 604 and fourth head section 68 in the direction of the cam axis Ax3.

**[0069]** As shown in Fig. 11, the inner surface of the first cover side wall 702 and the inner surface of the second cover side wall 703 are inclined so that between the first cover side wall 702 and second cover side wall 703 becomes narrower toward the head cover side.

**[0070]** The cylinder head 6 includes a first through hole 621 where the first fastening bolt 61 is arranged and a second through hole 622 through which the second fastening bolt 62 is arranged. The first through hole 621 and the second through hole 622 extend in the direction of the cylinder axis Ax1. The second through hole 622 is provided to pass through the second support wall 613. As shown in Fig. 12, a distance D1 to the first head section 65 in a direction of the cylinder axis Ax1 from the third virtual plane P3 which includes the crank axis Ax2 and is perpendicular to the cylinder axis Ax1 of the cylinder body 5 is shorter than a distance D2 to the second head section 66 in a direction of the cylinder axis Ax1 from the third virtual plane P3. That is, the first head section 65 is positioned more to the cylinder body side than the second head section 66.

**[0071]** The first fastening bolt 61 does not overlap with the head cover 7 when viewed from the direction of the cam axis Ax3. That is, the first head section 65 is positioned more to the cylinder body side than the first end section 601 of the cylinder head 6. The second fastening bolt 62 overlaps with the head cover 7 when viewed from the direction of the cam axis Ax3. That is, the second head section 66 is positioned more to the head cover side than the first end section 601 of the cylinder head 6.

**[0072]** Although omitted in the diagram, the third head section 67 is positioned at the same height as the first head section 65 and the fourth head section 68 is positioned at the same height as the second head section 66. Accordingly, the third head section 67 is positioned more to the cylinder body side than the fourth head section 68.

**[0073]** In an engine where the switching pin member is positioned more to the opposite side of the end section of the valve than the rocker shaft when viewed from the axial direction of the cam shaft as in engines according to techniques in the background art, when the rocker arms rotate around the rocker shaft in a direction in which the end section of the valve is pressed down, the switch-

ing pin member is moved upward which is the opposite direction. As a result, it is necessary to secure a large clearance between the cylinder head, which is positioned above the switching pin member, and the switching pin member. In this case, the size of the engine increases. In contrast to this, the switching pin member 35 is moved to the cylinder body side when the intake valves 26 and 27 are pressed down to the cylinder body side in the engine 1 according to the present embodiment. As a result, it is possible to reduce the clearance on the head cover side of the switching pin member 35 compared to a case where the switching pin member 35 is moved to the head cover side when the intake valves 26 and 27 are pressed down to the cylinder body side. Due to this, it is possible to reduce the size of the valve gear 13 and it is possible to reduce the size of the engine 1.

**[0074]** The distance between the shaft center of the intake rocker shaft 33 and the shaft center of the switching pin member 35 is shorter than the distance between the shaft center of the intake rocker shaft 33 and the stem end 262 of the first intake valve 26. In this case, since the distance between the intake rocker shaft 33 and the switching pin member 35 is short, the movement distance of the switching pin member 35 when swinging is short. As a result, it is possible to reduce the diameter of the rod 391. When the diameter of the rod 391 is reduced, it is possible to reduce the size of the body section 392 since the drive force for moving the rod 391 is smaller, and it is possible to reduce the size of the engine 1.

**[0075]** Since the first rocker arm 36 has the first roller 363, it is possible to reduce friction loss between the cam shaft 14 and the first rocker arm 36. Due to this, it is possible to improve fuel efficiency of the engine 1. In addition, the weight of the first rocker arm 36 on the cam shaft 14 side is heavier due to the weight of the first roller 363, but force for pressing down the intake valves 26 and 27 is reduced due to the weight of the switching pin member 35. Due to this, it is possible to improve fuel efficiency of the engine 1.

**[0076]** The first roller 363 is positioned on the cam shaft 14 side with regard to the intake rocker shaft 33 when viewed from the direction of the cam axis Ax3. Accordingly, the first roller 363 and the switching pin member 35 are arranged to be opposite to each other with regard to the intake rocker shaft 33 when viewed from the direction of the cam axis Ax3. In an engine where the switching pin member is positioned more to the opposite side of the end section of the valve than the rocker shaft when viewed from the axial direction of the cam shaft as in engines according to techniques in the background art, the roller which comes into contact with the cam of the cam shaft is arranged below the switching pin member. As a result, it is not easy for the position of the switching pin member to be lowered downward since the clearance between the cylinder head cover, which is positioned above the switching pin member, and the switching pin member is small. Furthermore, if the switching pin member is arranged between the rocker shaft and the roller by the distance between the rocker shaft and the roller being increased, it is possible to lower the position of the switching pin member downward while avoiding interference with the roller. However, in this case, the rocker arm is lengthened and the size of the variable valve gear is increased. As a result, the size of the engine increases. In contrast to this, since the first roller 363 and the switching pin member 35 are arranged to be opposite to each other with regard to the intake rocker shaft 33, it is possible to arrange the switching pin member 35 at a position which is close to the intake rocker shaft 33 while avoiding interference with the first roller 363 in the engine 1 according to the present embodiment. Due to this, it is possible to reduce the diameter of the rod 391 and it is possible to reduce the size of the engine 1.

**[0077]** The second roller 373 is positioned on the cam shalt 14 side with regard to the intake rocker shaft 33 when viewed from the direction of the cam axis Ax3. Accordingly, the second roller 373 and the switching pin member 35 are arranged to be opposite to each other with regard to the intake rocker shaft 33. In an engine where the switching pin member is positioned more to the opposite side of the end section of the valve than the rocker shaft when viewed from the axial direction of the cam shaft as in engines according to techniques in the background art, the roller which comes into contact with the cam of the cam shaft is arranged below the switching pin member. As a result, it is not easy for the position of the switching pin member to be lowered downward since the clearance between the cylinder head cover, which is positioned above the switching pin member, and the switching pin member is small. Furthermore, if the switching pin member is arranged between the rocker shaft and the roller by the distance between the rocker shaft and the roller being increased, it is possible to lower the position of the switching pin member downward while avoiding interference with the roller. However, in this case, the rocker arm is lengthened and the size of the variable valve gear is increased. As a result, the size of the engine increases. In contrast to this, since the second roller 373 and the switching pin member 35 are arranged to be opposite to each other with regard to the intake rocker shaft 33, it is possible to arrange the switching pin member 35 at a position which is close to the intake rocker shaft 33 while avoiding interference with the second roller 373 in the engine 1 according to the present embodiment. Due to this, it is possible to reduce the diameter of the rod 391 and it is possible to reduce the size of the engine 1.

**[0078]** The axis of the switching pin member 35 is positioned on the intake rocker shaft 33 side with regard to the center of the first head section 65. Accordingly, it is possible to shorten the first rocker arm 36 and the second rocker arm 37 since the switching pin member 35 is close to the intake rocker shaft 33. Due to this, it is possible to reduce the size of the valve gear 13 and it is possible to reduce the size of the engine 1.

**[0079]** The actuator 39 is attached to the first cylinder side wall 603 and does not overlap with the extended line

of the axis of the spark plug 12. Accordingly, it is possible to suppress the actuator 39 interfering with the moving in and out of the spark plug 12 even when the actuator 39 is arranged to be close to the spark plug 12. In addition, it is possible to further reduce the size of the engine 1 by arranging the actuator 39 to be close to the spark plug 12.

**[0080]** Above, an embodiment of the present invention has been described, but the present invention is not limited to the embodiment described above and various modifications are possible in a scope which does not depart from the scope of the invention.

**[0081]** The engine 1 is not limited to a water cooled single cylinder engine. For example, the engine 1 may be an air cooled engine.

**[0082]** The number of exhaust valves is not limited to two and may be one or three or more. The number of intake valves is not limited to two and may be one or three or more.

**[0083]** The positions of the first head section 65, the second head section 66, the third head section 67, and the fourth head section 68 are not limited to the positions in the embodiment described above and may be modified. For example, in the embodiment described above, the first head section 65 does not overlap with the head cover 7 in the direction of the cam shaft 14, but the first head section 65 may overlap with the head cover 7 in the direction of the cam shaft 14. That is, the first head section 65 may be arranged more to the head cover side than the end section 701 of the head cover 7.

**[0084]** The first virtual plane P1 which includes the first end section 601 of the cylinder head 6 and the second virtual plane P2 which includes the end section 701 of the head cover 7 may be arranged at the same height as the cam axis Ax3 or more to the cylinder body side than the cam axis Ax3. Alternatively, the first virtual plane P1 and the second virtual plane P2 may not overlap with the cam shaft 14.

**[0085]** The configuration and arrangement of the valve gear 13 are not limited to the embodiment described above and may be modified- For example, the actuator 39 may be attached to the cylinder head 6. Alternatively, the actuator 39 may be arranged beside the cylinder head 6. Alternatively, the actuator 39 may be arranged so as to not overlap with the end section 701 of the head cover 7 when viewed from the direction of the cylinder axis Ax1. Alternatively, the actuator 39 may be arranged so as to not overlap with the first head section 65 when viewed from the direction of the cylinder axis Ax1. Without being limited to a portion of the actuator 39, all of the actuator 39 may be positioned more to the inner side than the first end section 601 of the cylinder head 6.

**[0086]** The distance between the intake rocker shaft 33 and the switching pin member 35 may be equal to or more than the distance between the intake rocker shaft 33 and the stem end 262 of the first intake valve 26. The axis of the switching pin member 35 may be positioned on the opposite side to the intake rocker shaft 33 with regard to the center of the first head section 65. The actuator 39 may overlap with an extended line of the axis of the spark plug 12.

**[0087]** In the embodiment described above, the mechanism which switches the timing of the opening and closing of the valves using the actuator is adopted in the intake valves but may be adopted in the exhaust valves. That is, a mechanism which is the same as the mechanism which includes the first rocker arm 36, the second rocker arm 37, the switching pin member 35, and the actuator 39 described above may be provided in order to open and close the exhaust valves.

## Claims

1. An engine (1) which is a single cylinder engine comprising:

   a cylinder section (4) including a combustion chamber (11);
   a valve (24 - 27) supported by the cylinder section (4), the valve (24 - 27) being configured to open and close an exhaust port (615) or an intake port (614) in the combustion chamber (11);
   a cam shaft (14) including an intake cam (144, 145) and an exhaust cam (146), the cam shaft (14) being supported by the cylinder section (4);
   a rocker shaft (33) supported by the cylinder section (4), the rocker shaft (33) being parallel to the cam shaft (14);
   a first rocker arm (36) supported by the rocker shaft (33), the first rocker arm (36) including one end section configured to be able to make contact with the cam shaft (14) and the other end section configured to be able to make contact with the valve (24 - 27), the first rocker arm (36) being configured to be operated in a direction in which the value (24 - 27) is pressed down;
   a second rocker arm (37) supported by the rocker shaft (33), the second rocker arm (37) including one end section configured to be able to make contact with the cam shaft (14), the second rocker arm (37) being arranged to line up with the first rocker arm (36) in an axial direction of the cam shaft (14);
   a switching pin member (35) configured to be moved in the axial direction of the cam shaft (14), the switching pin member (35) being configured to be moved between a first position at which the first rocker arm (36) and the second rocker arm (37) are linked and a second position at which the first rocker arm (36) and the second rocker arm (37) are not linked, the switching pin member (35) being configured to swing together with the first rocker arm (36) and the second rocker arm (37) at the first position; and
   an actuator (39) configured to switch the position of the switching pin member (35) between the

first position and the second position by pressurizing the switching pin member (35) in the axial direction of the cam shaft (14),
wherein the switching pin member (35) is positioned on an end section side of the valve (24 - 27) with regard to the rocker shaft (33) when viewed from the axial direction of the cam shaft (14).

**2.** The engine (1) according to Claim 1, wherein the actuator (39) includes a rod (391) for pressurizing the switching pin member (35) and a body section (392) for driving the rod (391).

**3.** The engine (1) according to Claim 1 or 2, wherein a distance between the rocker shaft (33) and the switching pin member (35) is shorter than a distance between the rocker shaft (33) and the end section of the valve (24 - 27).

**4.** The engine (1) according to any of Claims 1 to 3, wherein the first rocker arm (36) includes a first roller (362) configured to come into contact with the intake cam (144, 145) or the exhaust cam (146), and the first roller (362) is positioned on the cam shaft side with regard to the rocker shaft (33) when viewed from the axial direction of the cam shaft (14).

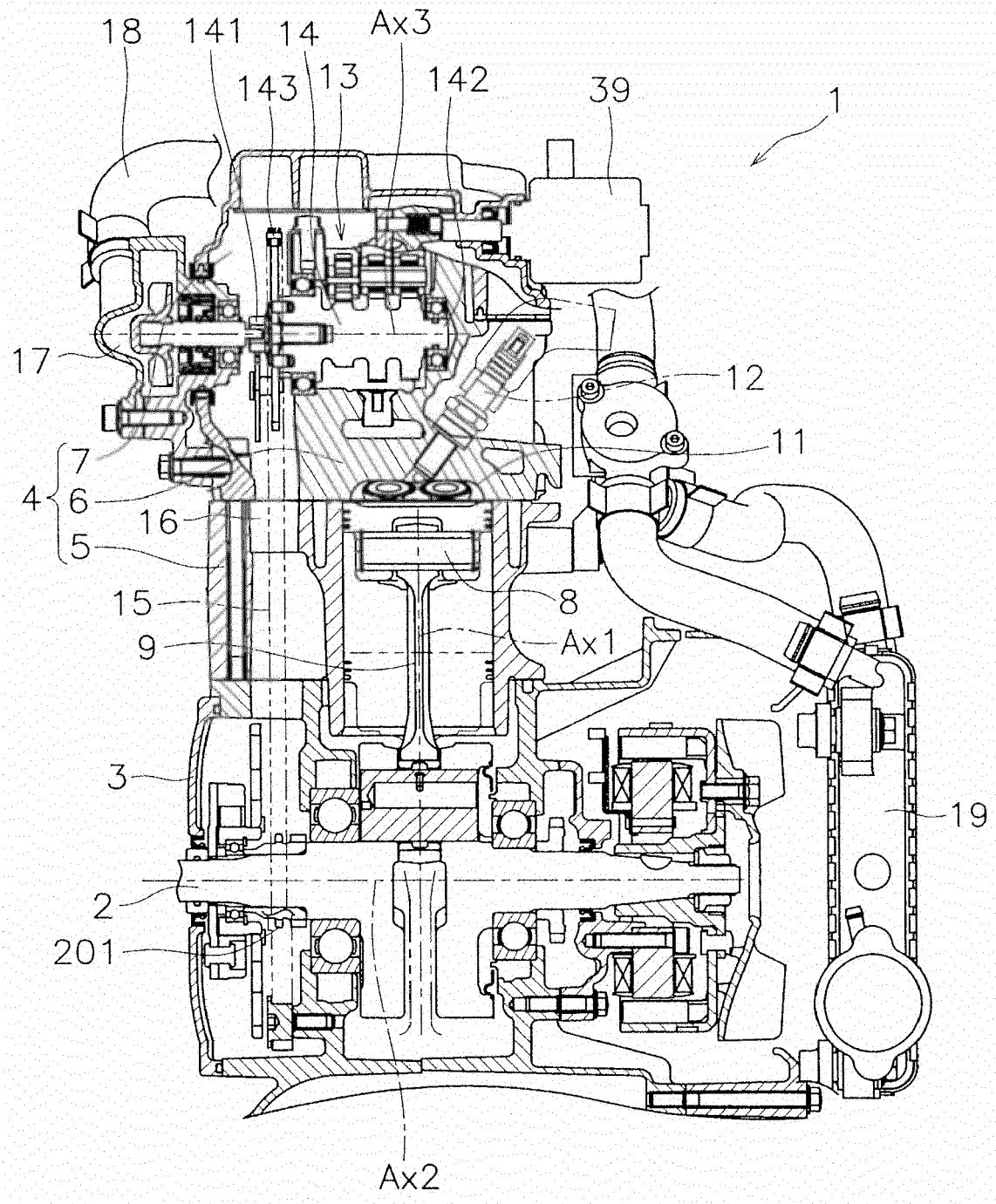
**5.** The engine (1) according to any of Claims 1 to 4, wherein the second rocker arm (37) includes a second roller (373) configured to come into contact with the intake cam (144, 145) or the exhaust cam (146), and the second roller (373) is positioned on the cam shaft side with regard to the rocker shaft (33) when viewed from the axial direction of the cam shaft (14).

**6.** The engine (1) according to any of Claims 1 to 5, further comprising a fastening bolt (61, 62) arranged on the valve side with regard to an axis (Ax3) of the cam shaft (14).

**7.** The engine (1) according to Claim 6, wherein an axis of the switching pin member (35) is positioned on the rocker shaft side with regard to a centre of a head section (65, 66) of the fastening bolt (61, 62).

**8.** The engine (1) according to any of Claims 1 to 7, further comprising a spark plug (12) attached to a side section of the cylinder section (4) in the axial direction of the cam shaft (14), the spark plug (12) being supported by the cylinder section (4).

**9.** The engine (1) according to Claim 8, wherein the actuator (39) is attached to the side section of the cylinder section (4) and does not overlap with an extended line of an axis of the spark plug (12).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Ax2

FIG. 1

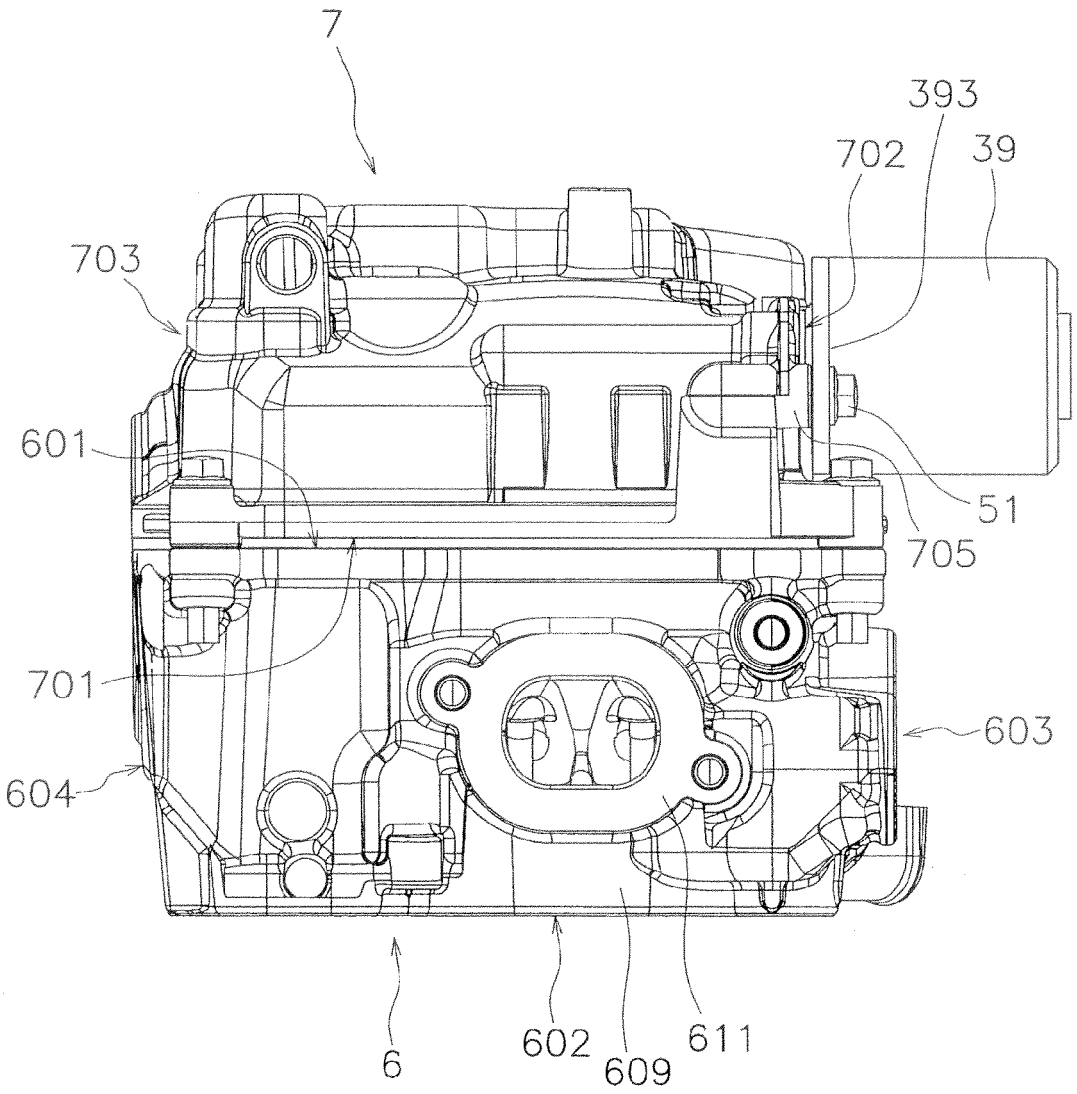
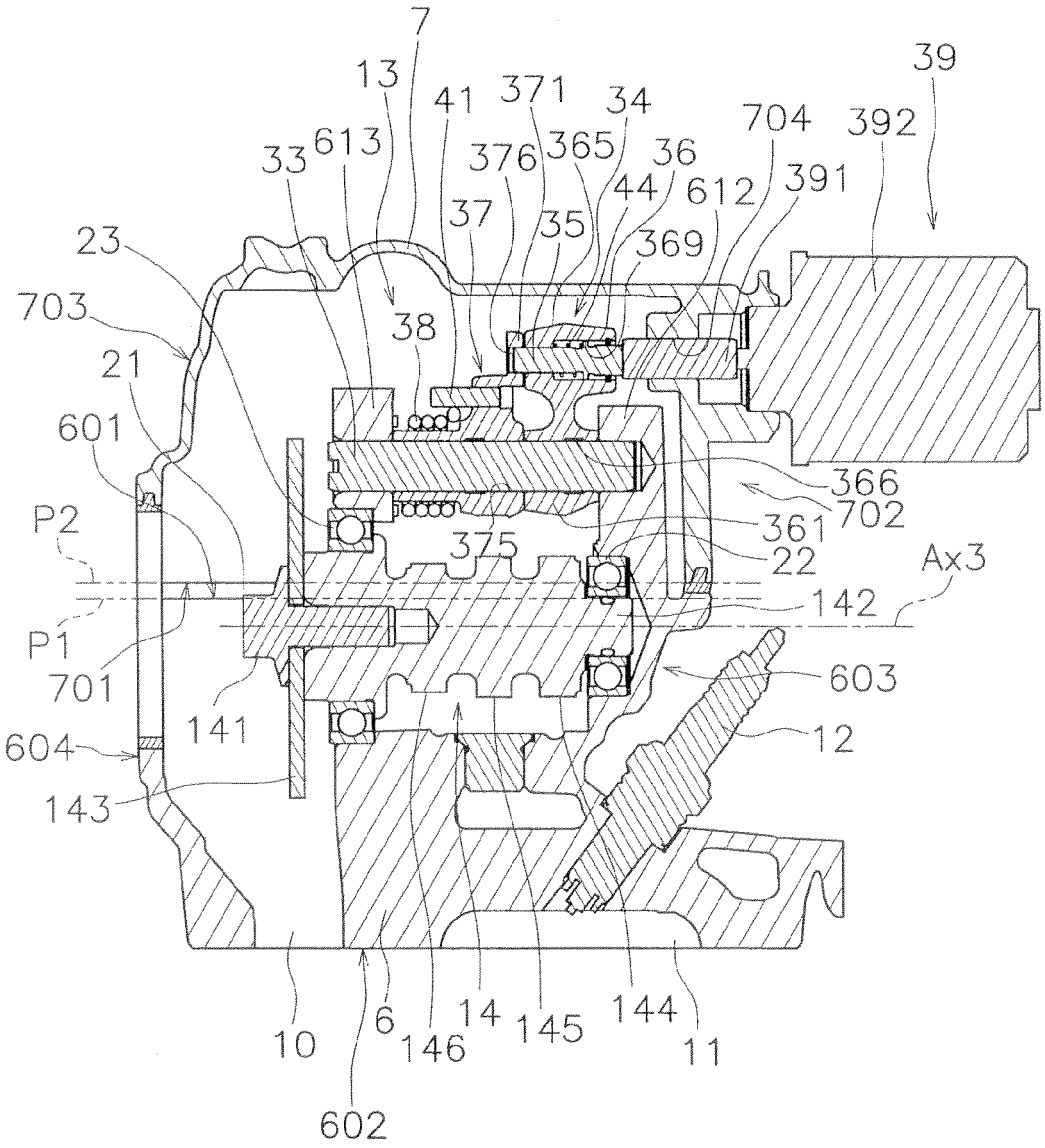



FIG. 2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21
601
366
702
361
P2
375
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6
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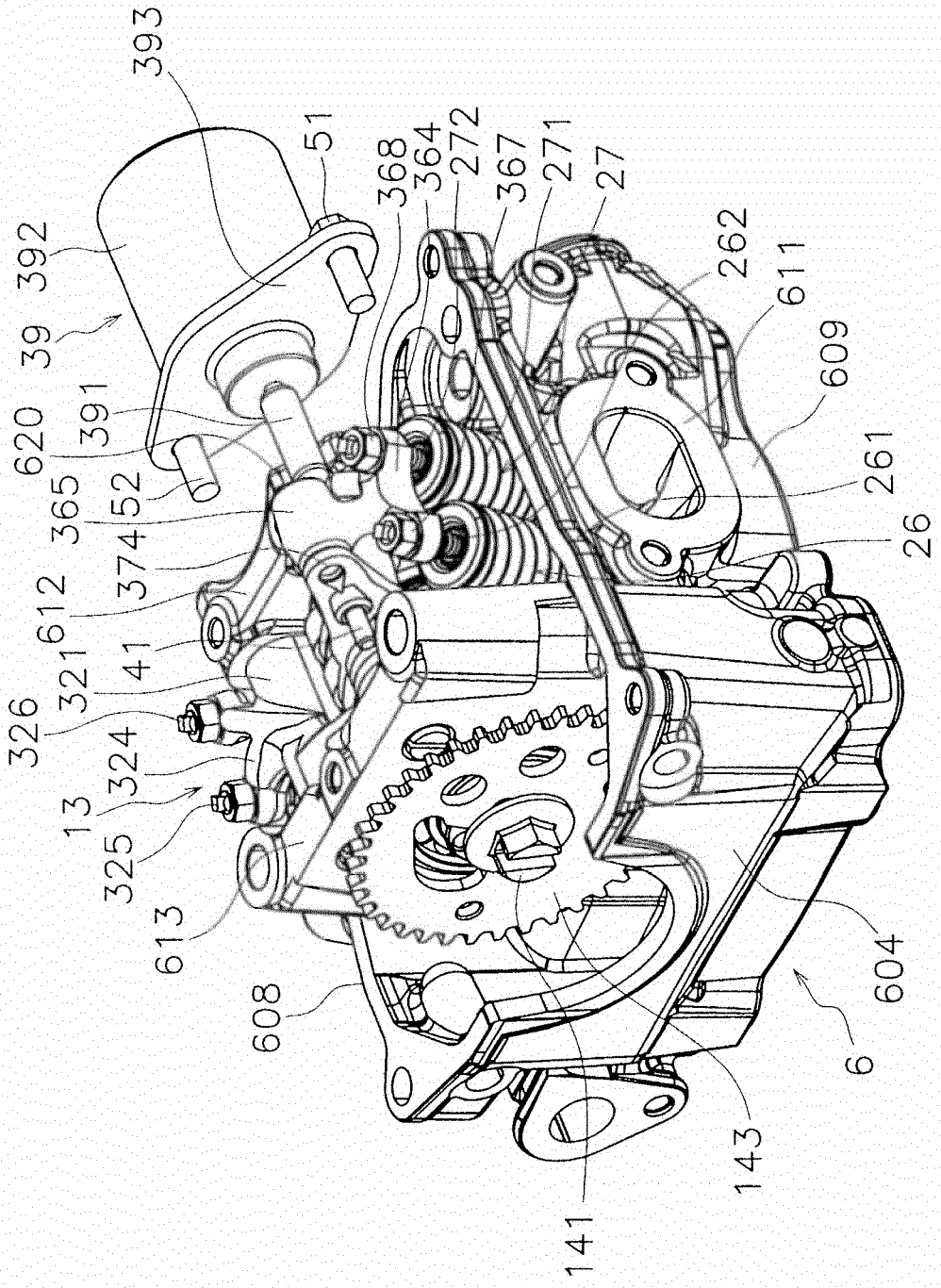
144
146
11
602

FIG. 3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604
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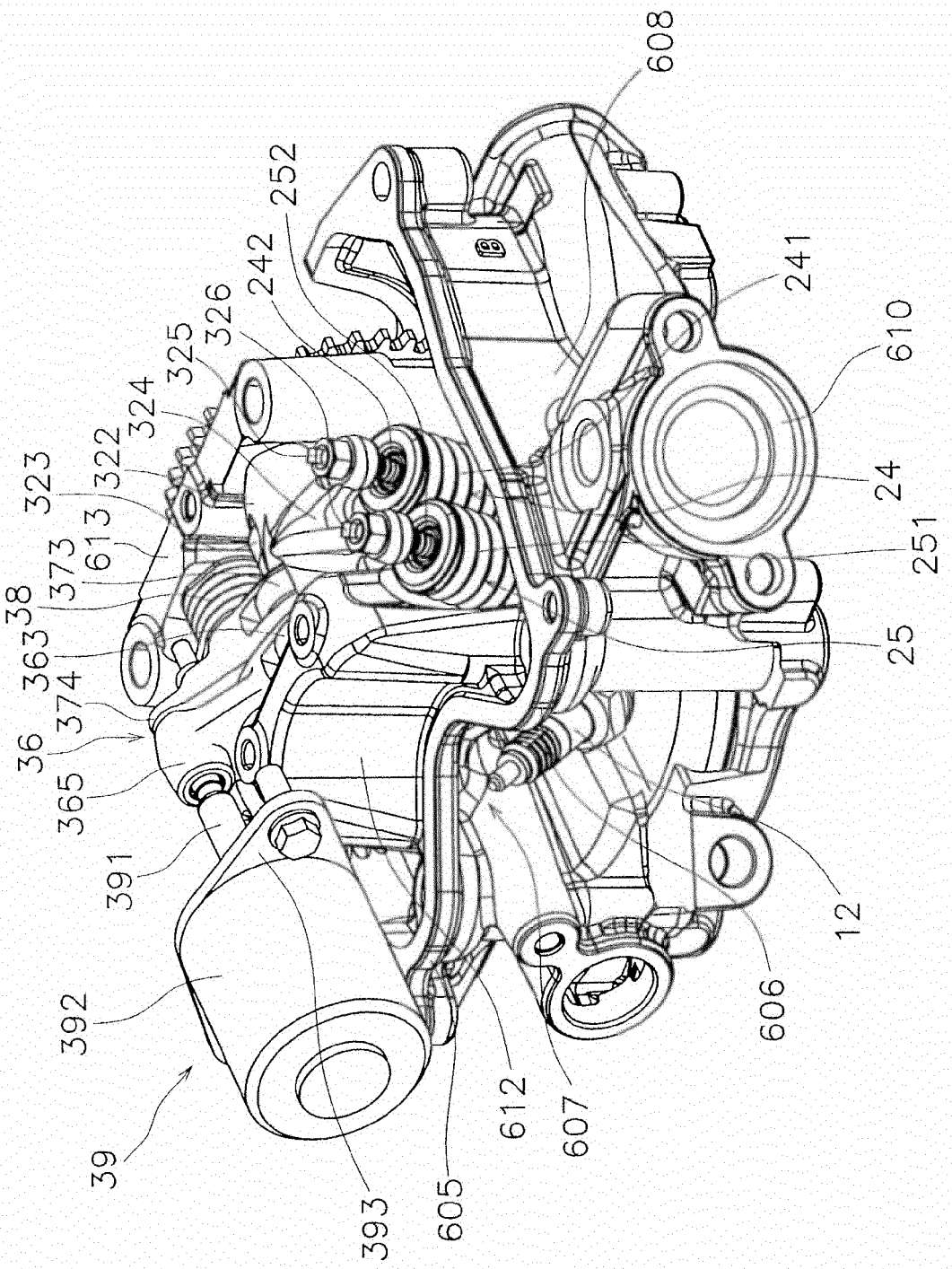
392

FIG. 4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24
610
241

FIG. 5

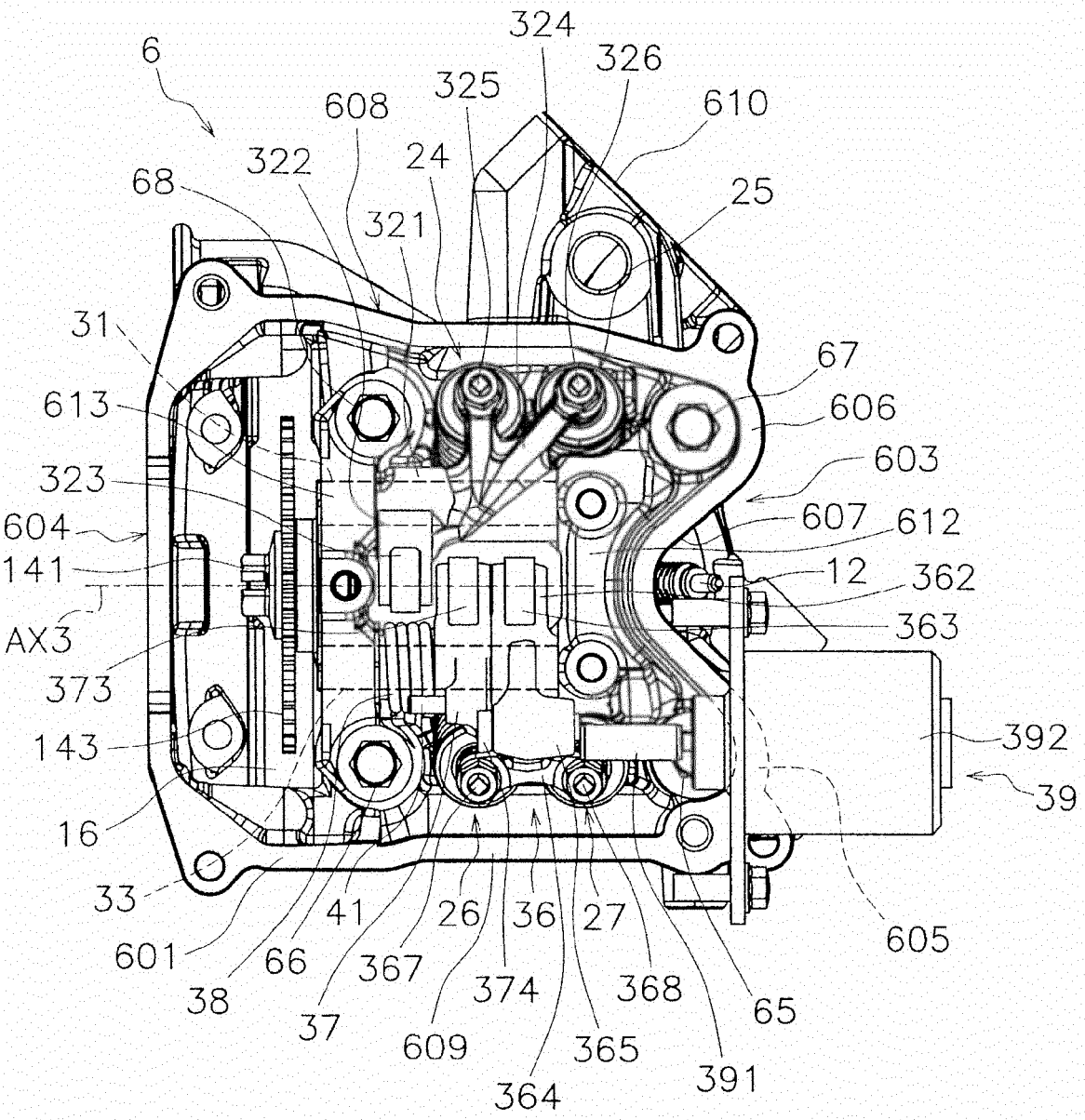
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FIG. 6

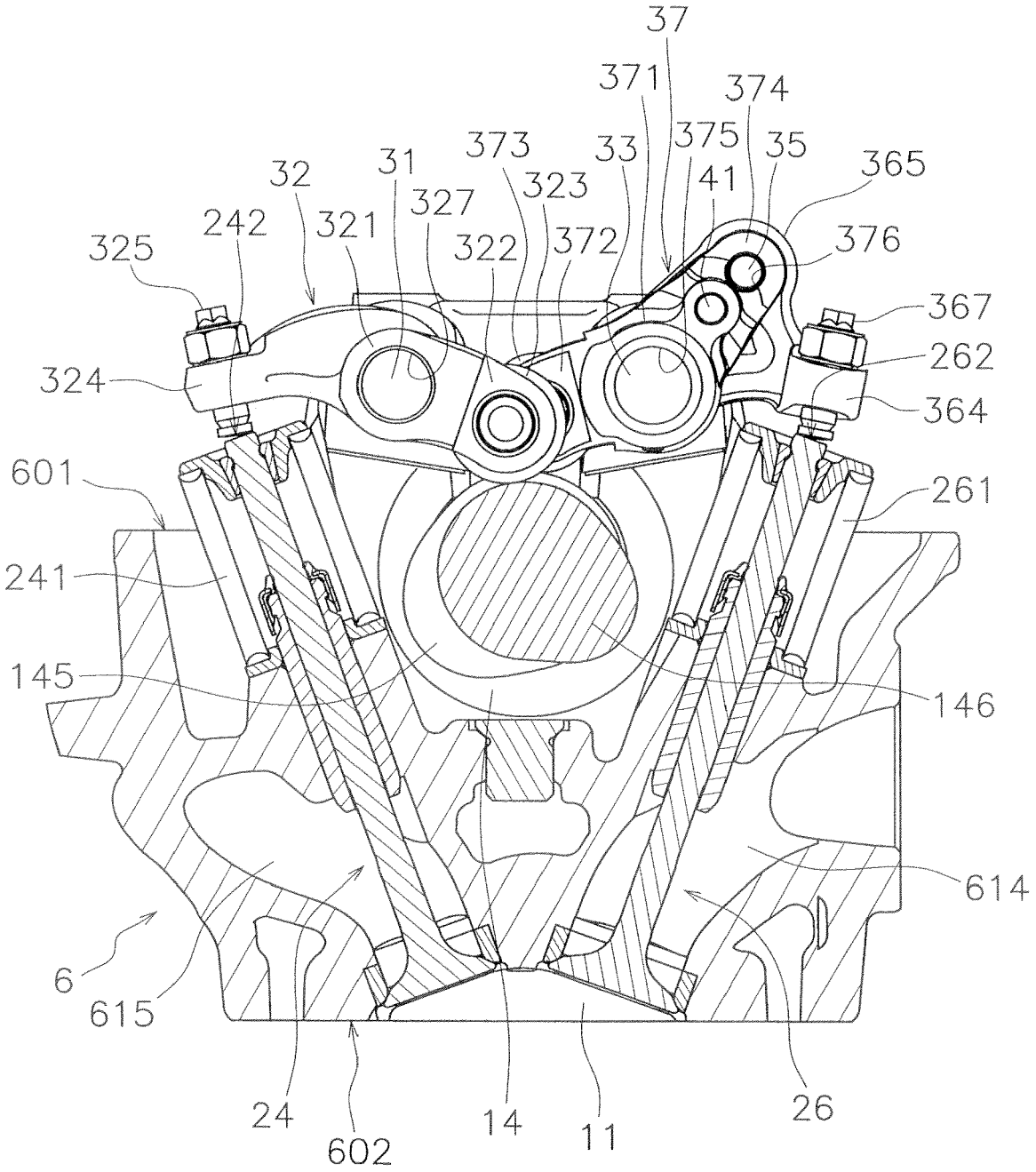
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FIG. 7

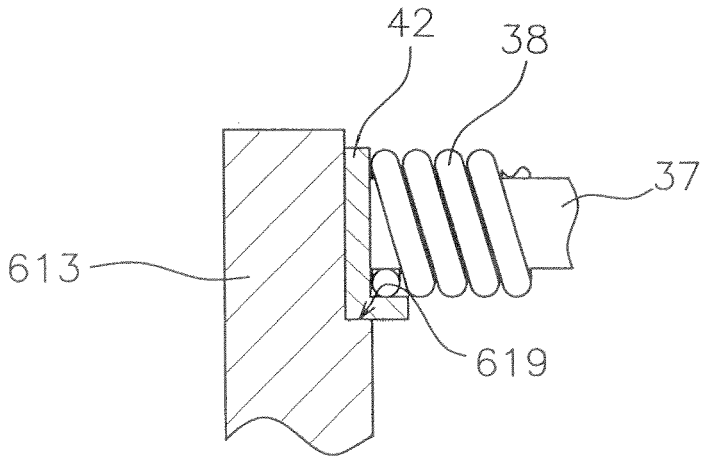


FIG. 8

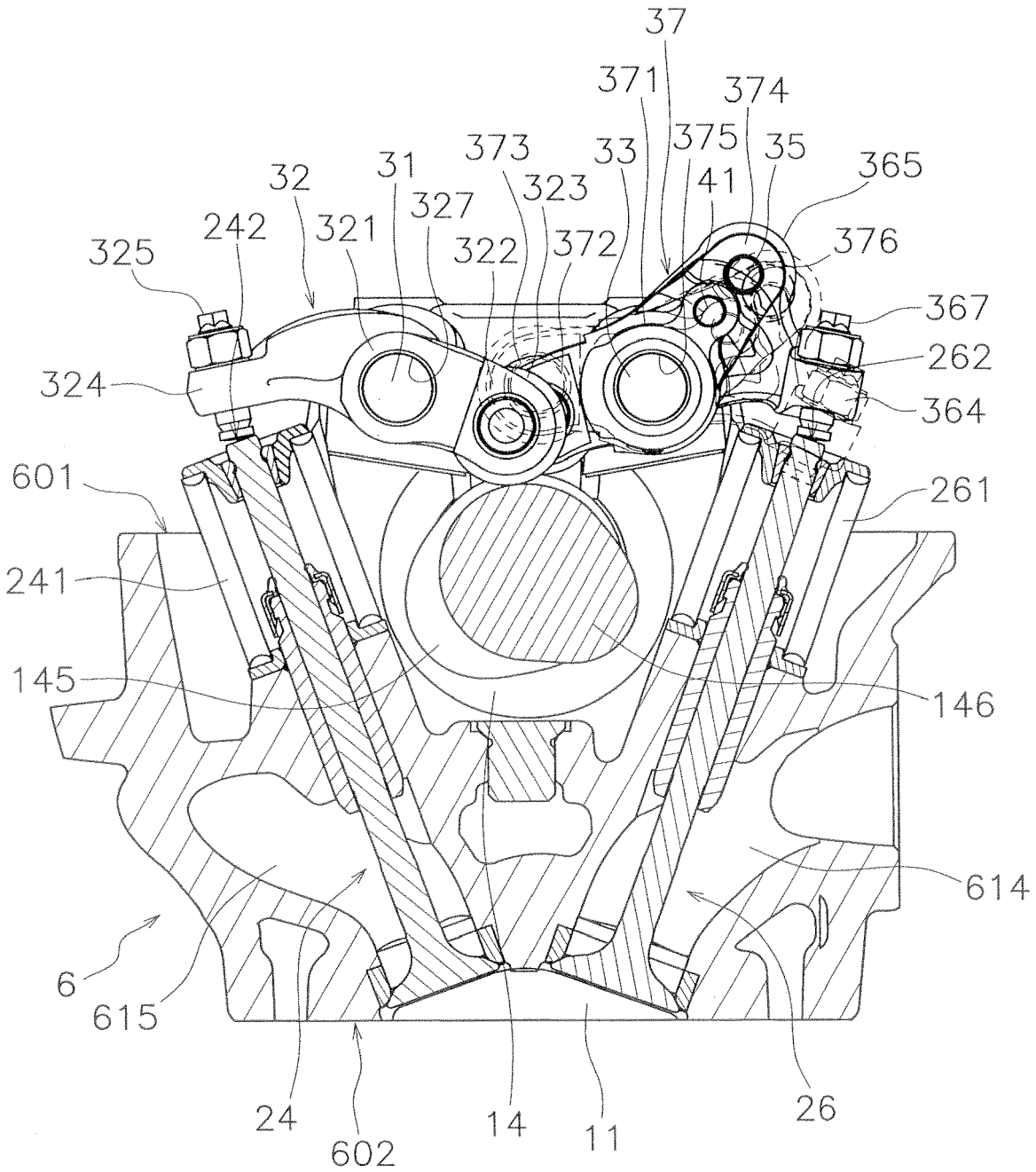
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FIG. 9

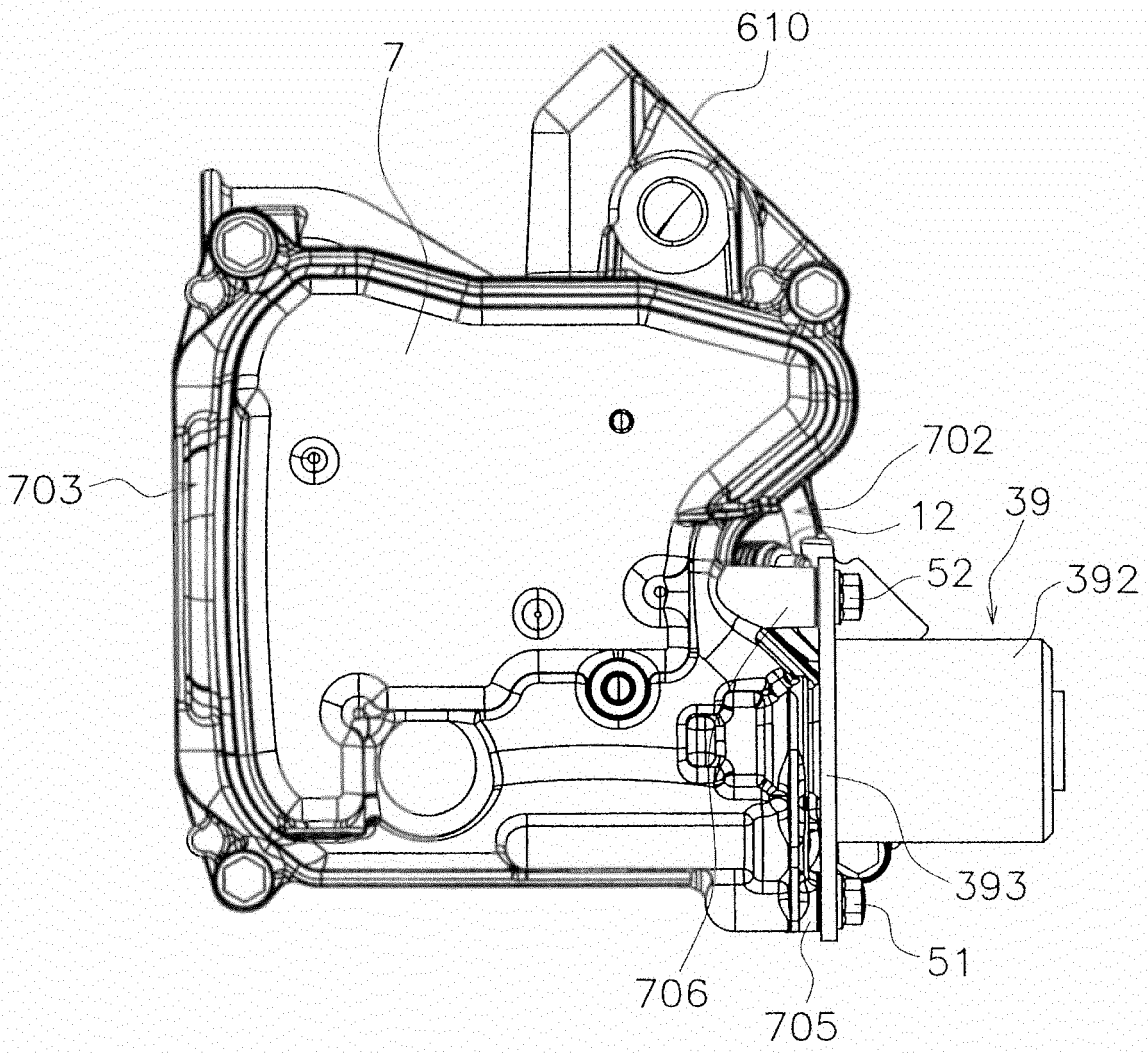


FIG. 10

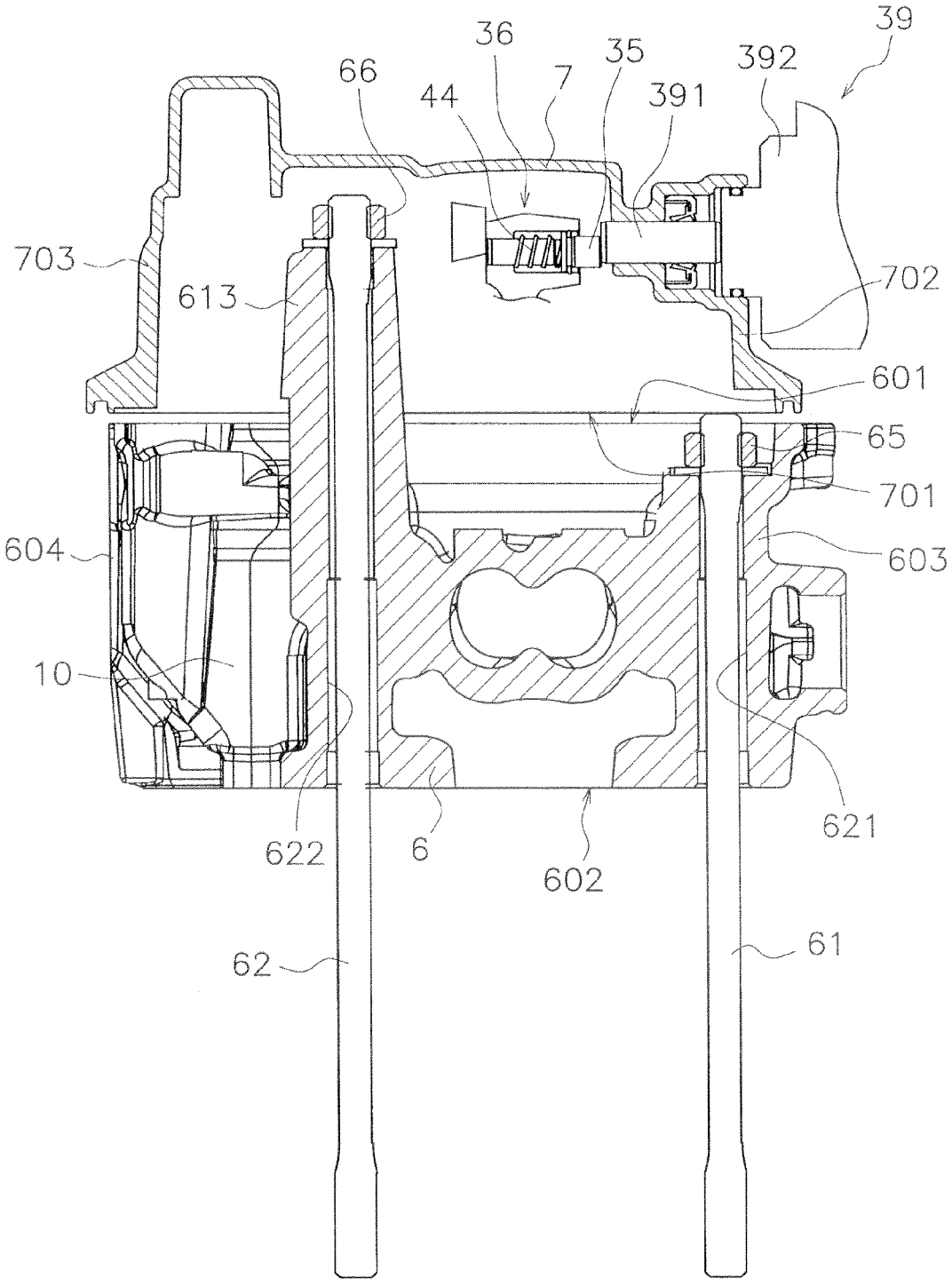
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FIG. 11

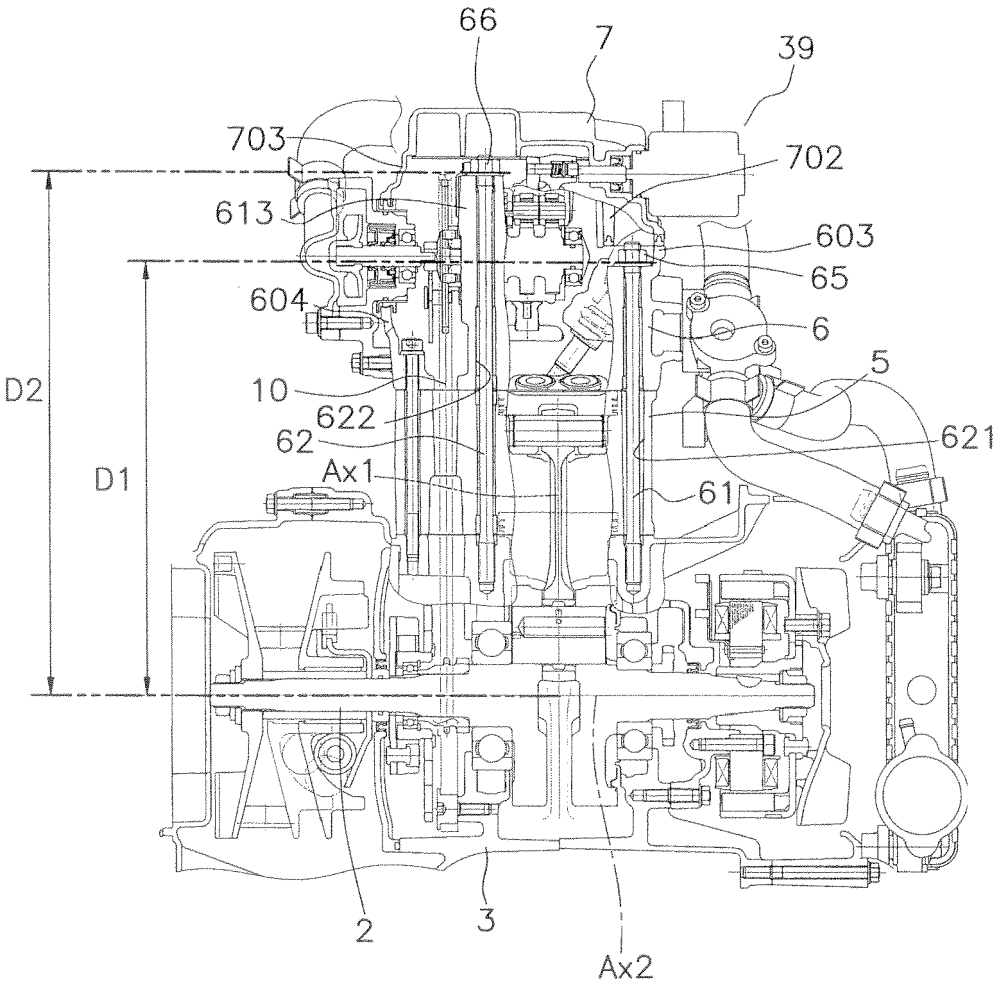


FIG. 12

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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