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(54) Lubrication apparatus for engines

(57) A lubrication apparatus for an engine includes a crankshaft chamber (11), a camshaft chamber (12), and an oil reservoir chamber (13), wherein an oil-suction piping path is provided in the oil reservoir chamber (13), and is communicated between the crankshaft chamber (11) and the oil reservoir chamber (13). The oil-suction piping path includes, among others, a rotatable pipe (15) including a plurality of oil-suction orifices (152) located at wall of the rotatable pipe (15). No matter the engine is situated at any state of declination, at least one of the oil-suction orifices (152) and an air-suction vent (151) is kept under the surface of the lubricant, so that the engine can be appropriately lubricated. Further, a one-way valve (19) is arranged between the crankshaft chamber (11) and the oil reservoir chamber (13), where most of the lubricant can flow back to the oil reservoir chamber (13) during the descending stroke of a piston, so that a lubricant supply can be reduced.

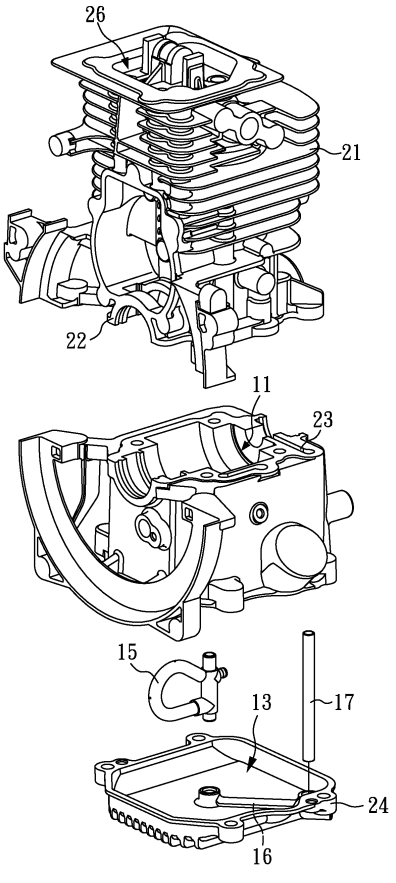

FIG. 1

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Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a lubrication apparatus for an engine, and more particularly, to a lubrication apparatus adapted to be used in a four-stroke internal combustion engine, where appropriate lubrication can be applied to the engine no matter the engine is situated at any state of declination.

2. Description of Related Art

[0002] A comparison between a four-stroke engine and a two-stroke engine shows that the former prevails over the latter in terms of cleaner exhaust and fuel saving. Under strict environmental regulations, compact-sized apparatuses for agricultural usage or compact-sized power devices for leisure usage have been changed into four-stroke engines, such as mowers, sawing machines, and so forth. In the above-mentioned applications, since apparatuses are likely to be operated at any directions, engines are required to be maneuvered at various angles of declination. This indicates that engine lubrication systems have to satisfy such demands that lubrication needs to accurately apply to engine components when engines are operated at various angles of declination.

[0003] Currently, hand-held four-stroke engines are, mostly, lubricated in such a manner that lubricant in an oil pan is first agitated by rotation of a fork, and then the lubricant is sucked into a crankcase for lubricating components such as a crankshaft, pistons and so forth. Nevertheless, such an agitating-lubricating manner not only causes power loss and reduces power output of the engine; but also causes lubricant-level changed when engines are declined such that quantity of the lubricant to be agitated becomes less and less. As a result, lubrication becomes insufficient and fails to achieve the purpose of lubrication.

[0004] Taiwan Patent No. I242622 discloses a lubrication apparatus for a four-stroke engine, comprising a crankshaft chamber independently formed in a cylinder block of the engine, a camshaft chamber, and an oil reservoir chamber, incorporated additionally with an oil distributing chamber in communication with the above chambers. The oil reservoir chamber stores lubricants, and there is arranged with an oil-suction piping path, together with a plurality of oil-suction orifices provided on wall of the oil-suction piping path, and an air-suction vent is provided at an end of the piping path. Therefore, upon rising of a piston where a negative-pressure status is effected in the crankshaft chamber, communication between the crankshaft chamber and the oil-suction pipe in the oil reservoir chamber is achieved through the oil distributing chamber, such that the air being sucked can flow rapidly in the oil-suction piping path. As such, a pressure difference so effected will atomize the lubricant sucked through the oil-suction orifices, and eventually the lubricant flows into the crankshaft chamber. During a descending stroke of the piston, the oil distributing chamber builds communication between the crankshaft chamber and the camshaft chamber, so that the atomized lubricant is distributed to the camshaft chamber for lubricating engine components.

[0005] As mentioned above, it is undesirable for the conventional lubrication apparatus because design in the oil distributing chamber is complicated. Besides, after review and simulation, the quantity of lubricant supplied by the negative-pressure effect for lubricating the engine is found, in the overall circulation cycle, much more than what is actually required.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to provide a lubrication apparatus for an engine, comprising a crankshaft chamber, a camshaft chamber, and an oil reservoir chamber. The crankshaft chamber is in communication with a space underneath a piston, and includes a crankshaft chamber inlet and a crankshaft chamber outlet. The oil reservoir chamber is provided for storing lubricants.

[0007] An oil-suction piping path is provided in the oil reservoir chamber, and is communicated between the crankshaft chamber inlet and the oil reservoir chamber. A first one-way valve is arranged between the crankshaft chamber and the oil reservoir chamber, where a valve inlet and a valve outlet are communicated, respectively, with the crankshaft chamber outlet and the oil reservoir chamber. The oil-suction piping path includes, among others, a rotatable pipe which is pivotally arranged along an axis of a cylinder block. The rotatable pipe includes a plurality of oil-suction orifices located at wall of the rotatable pipe and an air-suction vent at an end of the rotatable pipe. No matter the engine is situated any state of declination, the air-suction vent is kept above a surface of the lubricant, and that at least one of the oil-suction orifices is kept under the surface of the lubricant.

[0008] With the help of the oil-suction piping path and of the first one-way valve, the lubrication apparatus for an engine according to the present invention can supply an appropriate amount of lubricant to corresponding chambers either at a rising stroke or at a descending stoke of the piston. Besides, even under various declination states, a four-stroke engine can be appropriately lubricated, namely, unlike the conventional fork-supply manner which has an un-predetermined quantity of lubricant, or the prior art supply manner which has an over-supply of lubricant.

[0009] A crankshaft chamber may be defined by an upper crankcase and a lower crankcase which are anchored to each other. The oil-suction piping path may further include, in sequence, an oil-pan built-in passage, a connecting pipe, and a lower-crankcase built-in passage. The oil-pan built-in passage is connected with the

rotatable pipe, and that the lower-crankcase built-in passage with the crankshaft chamber inlet. The rotatable pipe may include a C-shaped tube.

[0010] In one embodiment, according to the present invention, the lubrication apparatus for an engine may further include a rocker arm chamber which, through a first communicating passage, is communicated with the crankshaft chamber. In the first communicating passage there is provided with a second one-way valve, where an inlet and an outlet of the second one-way valve are in communication with the rocker arm chamber and the camshaft chamber, respectively. The camshaft chamber can, through a second communicating passage, be communicated with the oil reservoir chamber.

[0011] Further, in another embodiment, the camshaft chamber can, through two communicating passages, be communicated with the oil reservoir chamber and the crankshaft chamber, respectively. In one of the two communicating passages there is arranged with a one-way relief valve for pressure release, wherein a valve inlet and a valve outlet of the one-way relief valve are communicated with the oil reservoir chamber and the camshaft chamber, respectively. The two communicating passages may be two piping paths independent from each other, or both have a common path section. In this embodiment, the lubrication apparatus for an engine may further include a rocker arm chamber. A second one-way valve is arranged between the rocker arm chamber and the crankshaft chamber, such that the rocker arm chamber and the crankshaft chamber are in a one-way communication, and that a valve inlet and a valve outlet of the second one-way valve are communicated with the rocker arm chamber and the crankshaft chamber, respectively.

[0012] Other objects, advantages, and novel features of the present invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is an exploded view illustrating a lubrication apparatus for an engine according to a first embodiment of the present invention;

FIG. 2 is a cross-sectional view illustrating the lubrication apparatus for an engine according to the first embodiment of the present invention;

FIG. 3 is a cross-sectional view illustrating a rotatable pipe according to the first embodiment of the present invention;

FIG. 4 is a cross-sectional view illustrating recycle of lubricant in a rocker arm chamber, as viewed from one angle, according to the first embodiment of the present invention;

FIG. 5 is a cross-sectional view illustrating a lubricant applied in the camshaft chamber/rocker arm chamber according to the first embodiment of present invention;

FIG. 6 is a cross-sectional view illustrating recycle of lubricant in the rocker arm chamber, as viewed from another angle, according to the first embodiment of the present invention;

FIG. 7 is a cross-sectional view illustrating recycle of lubricant in the camshaft chamber according to the first embodiment of the present invention;

FIG. 8 is a cross-sectional view illustrating recycle of lubricant in a rocker arm chamber, as viewed from one angle, according to a second embodiment of the present invention;

FIG. 9 is a cross-sectional view illustrating communication of the oil reservoir chamber and the camshaft chamber according to the second embodiment of the present invention;

FIG. 10 is a cross-sectional view illustrating recycle of lubricant in the rocker arm chamber, as viewed from another angle, according to the second embodiment of the present invention;

FIG. 11 is a cross-sectional view illustrating communication of the camshaft chamber and the crankshaft chamber according to the second embodiment of the present invention;

FIG. 12 is a cross-sectional view illustrating layout of a third communicating passage and a fourth communicating passage, independent from each other, according to the second embodiment of the present invention;

FIG. 13 is a cross-sectional view illustrating the lubrication apparatus for an engine according to a third embodiment of the present invention;

FIG. 14 is a cross-sectional view illustrating the lubrication apparatus for an engine according to a third embodiment of the present invention, as viewed from a different angle; and

FIG. 15 is a cross-sectional view illustrating a common path section for a fifth communicating passage and a sixth communicating passage according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0014] Referring to FIGs. 1 to 2, an exploded view and a cross-sectional view illustrating a lubrication apparatus for an engine according to the present invention, the lubrication apparatus is installed in a four-stroke engine including a cylinder block 21, an upper crankcase 22, a lower crankcase 23, and an oil pan 24. The upper crankcase 22 and the cylinder block 21 are integrally made in one piece; or on the other hand, are made separately from each other. The lower crankcase 23 and the upper crankcase 22 are configurated correspondingly to each other, and are anchored to each other by bolts. The upper crankcase 22 is formed, at underside, with a concave; and the lower crankcase 23 is formed, both at top and

underside, with a concave, respectively. A crankshaft chamber 11 is defined, together, by the lower concave of the upper crankcase 22 and the upper concave of the lower crankcase 23. An oil reservoir chamber 13 is defined, together, by the lower concave of the lower crankcase 23 and the oil pan 24.

[0015] According to the present invention, a crankshaft 29 is arranged in the crankshaft chamber 11, such that when the engine runs, the crankshaft 29 revolves. The cylinder block 21 is, inside, provided with a piston 25, and that the crankshaft chamber 11 is communicated with an internal space of the cylinder block 21, namely is communicated with a space underneath the piston 25. Inside the cylinder block 21, there is also provided with a camshaft chamber 12 accommodated with a cam device 28, and a rocker arm chamber 26 accommodated with a rocker arm assembly 27, where the camshaft chamber 12 and the rocker arm chamber 26 are communicated with each other directly. The rocker arm assembly 27 is, in a power-connection manner, connected with the cam device 28, and complies with the piston stroke for a timing control manner, so that air-fuel mixture and inlet/exhaust gas can be controlled.

[0016] The lubrication apparatus for an engine, according to the embodiment, comprises the crankshaft chamber 11, the camshaft chamber 12, and the oil reservoir chamber 13. The crankshaft chamber 11 includes a crankshaft chamber inlet 111 and a crankshaft chamber outlet 112. The oil reservoir chamber 13 is provided for storing lubricants, where an oil-suction piping path is provided in the oil reservoir chamber 13, and the oil reservoir chamber 13 is communicated with the crankshaft chamber 11 through the oil-suction piping path. Concretely speaking, the oil-suction piping path includes, in sequence, a rotatable pipe 15, an oil-pan built-in passage 16, a connecting pipe 17, and a lower-crankcase built-in passage 18.

[0017] According to the embodiment, the lower-crankcase built-in passage 18 is in connection with the crankshaft chamber inlet 111, and the rotatable pipe 15 is pivotally arranged along an axis X of the cylinder block 21. The rotatable pipe 15 includes three oil-suction orifices 152 located at wall of the rotatable pipe 15 and an air-suction vent 151 at an end of the rotatable pipe 15. According to various structures for the oil reservoir chamber 13 and a total amount of lubricant to be filled in the oil reservoir chamber 13, the rotatable pipe 15 is so designed that no matter the engine is situated at any state of declination, the air-suction vent 151 is kept above a surface of the lubricant and is communicated with the oil reservoir chamber 13, and that at least one of the three oil-suction orifices 152 is kept under the surface of the lubricant. Details of the rotatable pipe 15 will be described later.

[0018] Further, it should be noted that the oil-suction orifices 152 can be so arranged that under a planar visual angle, all the oil-suction orifices 152 are located at a remotest edge of the rotatable pipe 15. Preferably, this plane is constituted by the axis X of the cylinder block 21 and an axis Y of the crankshaft 29. Such a plane happens to be a plane on which the engine is posed rightly. By way of such an arrangement for the oil-suction orifices 152, the object of the present invention, i.e. "appropriate lubrication can be applied to the engine even though the engine is situated at various angles of declination" can be achieved easily. FIG. 2 shows clearly a relationship of the special arrangement of the oil-suction orifices 152.

[0019] A first one-way valve 19 is arranged between the crankshaft chamber 11 and the oil reservoir chamber 13, where a valve inlet 191 and a valve outlet 192 of the first one-way valve 19 are communicated, respectively, with the crankshaft chamber outlet 112 and the oil reservoir chamber 13, such that the lubricant can backflow from the crankshaft chamber 11, through a specific path, into the oil reservoir chamber 13.

[0020] Now referring to FIG. 3, a cross-sectional view illustrating the rotatable pipe according to the first embodiment of the present invention, the rotatable pipe 15 includes a C-shaped tube 15a and a straight tube 15b, wherein the straight tube 15b is provided with an upper portion 154 and a lower portion 153 which are opposite to each other, and independent from each other. The lower portion 153 is communicated with the C-shaped tube 15a, whereas the upper portion 154 is provided with a side opening 155. The rotatable pipe 15 can be pivotal such that the C-shaped tube 15a pivots about the straight tube 15b. Preferably, the side opening 155 is located adjacent to a center of the oil reservoir chamber 13 and slightly above the surface of the lubricant.

[0021] Now referring to FIGs. 4 and 6, cross-sectional views illustrating recycle of lubricant in the rocker arm chamber 26, as viewed from different angles, according to the present invention, the rocker arm chamber 26 is, through a first communicating passage 14, communicated with the crankshaft chamber 11. A second one-way valve 31 is arranged in the first communicating passage 14, such that the second one-way valve 31 opens toward the crankshaft chamber 11, namely, a valve inlet 311 is communicated with the rocker arm chamber 26 and a valve outlet 312 with the crankshaft chamber 11. As shown in FIG. 4, position P and position Q (indicates an outlet of the first communicating passage 14) are independent and separated from each other, though actually both the two positions P,Q are in the first communicating passage 14. The interrelation between the two positions P,Q can be clarified if reference is made to FIG. 6.

[0022] Further, referring to FIG. 7, a cross-sectional view illustrating recycle of lubricant in the camshaft chamber according to the first embodiment of the present invention, the camshaft chamber 12 is, through a second communicating passage 30, communicated with the oil reservoir chamber 13. To the effect, the upper portion 154 of the rotatable pipe 15 is connected to a passage inside the lower crankcase 23. Namely, lubrication-recycle paths of the rocker arm chamber 26 and of the camshaft chamber 12 are all constituted by the upper portion

154 of the rotatable pipe 15 together with built-in passages formed in the lower crankcase 23, the upper crankcase 22, and the cylinder block 21.

[0023] Referring to FIG. 5, a cross-sectional view illustrating lubricant applied in the camshaft chamber/rocker arm chamber according to the first embodiment of the present invention, a view taken from a view angle different from that taken from FIG. 4, it is noted that the path for flowing the lubricant for lubricating the camshaft chamber 12 is the same as the path for recycling the lubricant, and this is achieved by the second communicating passage 30. Because the art of oil passage built in the crankcase has been well known, no further description therefor is necessary.

[0024] As shown in FIGs. 2, 4 and 7, during a rising stroke of the piston 25, a negative-pressure status is produced in the crankshaft chamber 11. Due to the negative pressure, air is sucked into the oil-suction piping path through the air-suction vent 151, a pressure difference produced by a rapid flow of the air in the narrowed piping path will atomize the lubricant sucked through the oil-suction orifices 152. The atomized lubricant in the oil reservoir chamber 13 will, through the oil-suction piping path, reach to the crankshaft chamber 11, so that components inside the engine can be lubricated. FIG. 2 shows that during a rising stroke of the piston 25, the lubricant, due to the pressure difference, will not flow back into the oil reservoir chamber 13 from the first one-way valve 19.

[0025] On the other hand, the lubricant in the camshaft chamber 12 and in the rocker arm chamber 26, due to a positive pressure difference against the oil reservoir chamber 13, can flow back into the oil reservoir chamber 13 through the second communication passage 30 and the side opening 155, relating to a recycle for the lubricant. In FIG. 7, arrows indicate a flowing direction of the lubricant at this stage.

[0026] It should be noted that at this stage, there still is a positive pressure difference for the rocker arm chamber 26 against the crankshaft chamber 11, part of the lubricant in the rocker arm chamber 26 will flow into the crankshaft chamber 11 through the first communicating passage 14 and the second one-way valve 31. In other words, the rocker arm chamber 26 can use the first communicating passage 14 as a path for flowing the lubricant back into the crankshaft chamber 11 for purpose of appropriate oil discharge. Further, when the engine stands at a normal angle of use, the lubricant in the rocker arm chamber 26 and the camshaft chamber 12, at this stage, is still possible to flow back into the oil reservoir chamber 13, due to gravity, through the second communicating passage 30.

[0027] Now referring to FIGs. 2 and 5, it should be noted that in spite of the fact that FIG. 2 shows schematically a rising stroke of the piston 25, this figure is only used for explaining as to how, under the same structure, the engine is to be lubricated during a descending stroke. When the piston 25 is under a descending stroke, the crankshaft chamber 11 produces, through the same structure as shown in FIG. 2, a positive pressure. The positive pressure is so functioned as to discharge, from the crankshaft chamber 11, a great amount of the lubricant to the oil reservoir chamber 13 through the first one-way valve 19.

[0028] On the other hand, the lubricant in the oil reservoir chamber 13, due to a negative pressure difference for the camshaft chamber 12 and the rocker arm chamber 26 against the oil reservoir chamber 13, can flow to the camshaft chamber 12 and the rocker arm chamber 26 through the side opening 155, the upper portion 154, and the second communicating passage 30 so as to lubricate the cam device 28 and the rocker arm assembly 27. In the meantime, the second one-way valve 31 in the first communicating passage 14 will stop the lubricant flowing from the crankshaft chamber 11 to the rocker arm chamber 26. Arrows in FIG. 5 indicates a flowing direction of the lubricant at this stage.

[0029] In the present invention, a forced lubrication is applied. That is to say, the negative-pressure effect is used to bring the lubricant, during the rising stroke of the piston 25, to the crankshaft chamber 11 for lubrication; while during the descending stroke of the piston 25, to bring the lubricant to the camshaft chamber 12 for lubrication. In the meantime, recycle of the lubricant is carried out during the two strokes so as to solve, effectively, the problem of the prior art where quantity of lubricant supplied by the negative-pressure effect for lubricating the engine is much more than what is actually required.

[0030] Further, referring to FIGs. 8 and 10, cross-sectional views illustrating recycle of lubricant in the rocker arm chamber, as viewed from different angles, according to the second embodiment of the present invention, the second embodiment is substantially similar to the first embodiment, in terms of structure, except that a one-way relief valve 32 for pressure release is arranged on a third communicating passage 30a which acts to communicate the oil reservoir chamber 13 and the camshaft chamber 12.

[0031] In the second embodiment of the present invention, as described for the first embodiment, the rocker arm chamber 26 is, through the first communicating passage 14, communicated with the crankshaft chamber 11. The second one-way valve 31 is arranged in the first communicating passage 14, such that the second one-way valve 31 opens toward the crankshaft chamber 11, namely, the valve inlet 311 is communicated with the rocker arm chamber 26 and the valve outlet 312 with the crankshaft chamber 11. For clear understanding purpose, position P and position Q shown in FIG. 8 can correspond to those shown in FIG. 10.

[0032] Now referring to FIGs. 2, 9, and 11, FIG. 9 is a cross-sectional view illustrating communication of the oil reservoir chamber and the camshaft chamber, FIG. 11 is a cross-sectional view illustrating communications between the camshaft chamber and the crankshaft chamber according to the second embodiment of the present

invention, a fourth communicating passage 113a is interposed between the crankshaft chamber 11 and the camshaft chamber 12. The third communicating passage 30a is provided between the oil reservoir chamber 13 and the camshaft chamber 12; and that in the third communicating passage 30a there is provided with the one-way relief valve 32, with a valve inlet 321 communicated with the oil reservoir chamber 13, and with a valve outlet 322 communicated with the camshaft chamber 12.

[0033] When the piston 25 is under a descending stroke, the crankshaft chamber 11 has a pressure greater than that of the camshaft 12. After lubricating relevant components of the crankshaft chamber 11, the lubricant, on the one hand, through the first one-way valve 19, flows back into the oil reservoir chamber 13 in a great amount; and on the other, a little amount of the lubricant is delivered, through the fourth communicating passage 113a, to the camshaft chamber 12 to lubricate relevant components.

[0034] In the meantime, the positive pressure of the crankshaft chamber 11 exerting on the oil reservoir chamber 13 will force and release the pressure of the oil reservoir chamber 13 to the camshaft chamber 12 through the upper portion 154 of the rotatable pipe 15, the one-way relief valve 32, and the third communicating passage 30a.

[0035] At this stage, the second one-way valve 31 (see FIG. 10) of the first communicating passage 14 acts to retard the lubricant flowing from the crankshaft chamber 11 to the rocker arm chamber 26, so that an inappropriate and additional amount of the lubricant can be avoided.

[0036] Further referring to FIGs. 2, 8 and 10, when the piston 25 is at a rising stroke, the crankshaft chamber 11 will be subject to a negative pressure. Under the circumstances, the oil-suction piping path will suck in air through the air-suction vent 151, so that the air flowing rapidly in the narrower piping path will produce a pressure difference, making the lubricant entering into the oil-suction orifices 152 atomized. The atomized lubricant in the oil reservoir chamber 13 will reach to the crankshaft chamber 11 through the oil-suction piping path, so that components inside the engine can be lubricated. The lubricant inside the engine will not flow back to the oil reservoir chamber 13 through the first one-way valve 19.

[0037] Further, at this moment the camshaft chamber 12 has a pressure greater than that of the crankshaft chamber 11, and because the lubricant in the camshaft chamber 12 cannot flow reversely back to the oil reservoir chamber 13 through the one-way relief valve 32, the lubricant in the camshaft chamber 12, due to a pressure difference, is sucked back to the crankshaft chamber 11 through the fourth communicating passage 113a.

[0038] At this stage, the rocker arm chamber 26, relative to the crankshaft chamber 11, has a positive pressure difference. As such, part of the lubricant in the rocker arm chamber 26 will flow into the crankshaft chamber 11 through the first communicating passage 14 and the second one-way valve 31. In other words, the rocker arm chamber 26 can use the first communicating passage 14 as a path for flowing the lubricant back to the crankshaft chamber 11 so as to discharge the lubricant effectively.

[0039] References may be made to FIGs. 8, 9 and 11, and to 12, a cross-sectional view illustrating layout of the third communicating passage 30a and the fourth communicating passage 113a independent from each other according to the second embodiment of the present invention. Location marks M1, N1, F, and G are employed for explanation conveniently.

[0040] Referring to FIG. 13, a cross-sectional view illustrating a lubrication apparatus for an engine according to a third embodiment of the present invention, to FIG. 14, a cross-sectional view illustrating the lubrication apparatus for an engine according to the third embodiment of the present invention, as viewed from a different angle; and to FIG. 15, a cross-sectional view illustrating a common section for a fifth communicating passage and a sixth communicating passage according to the third embodiment of the present invention, this embodiment is similar to the second embodiment, except that the former adopts a three-way path to communicates the crankshaft chamber 11, the oil reservoir chamber 13, and the camshaft chamber 12. There are provided with first, second and third path sections P1, P2, P3 extending from an intersection O, wherein the first path section P1 is communicated with the crankshaft chamber 11, the second path section P2 with the camshaft chamber 12, and the third path section P3 with the oil reservoir chamber 13.

[0041] Therefore, the camshaft chamber 12 and the oil reservoir chamber 13 are communicated with each other through the second path section P2 and the third path section P3 which constitute a fifth communicating passage 30b; whereas the camshaft chamber 12 and the crankshaft chamber 11 are communicated with each other through the first path section P1 and the second path section P2 which constitute a sixth communicating passage 113b. The third one-way valve 32 of the fifth communicating passage 30b is arranged in the third path section P3. Both the fifth and the sixth communicating passages 30b, 113b have a common path section, i.e. the second path section P2.

[0042] Of course, the path for pressure release can alternatively be an external piping path, and it is not intended to limit it to the built-in version in the embodiment.

[0043] Although the present invention has been explained in relation to its preferred embodiments, it is to be understood that many other possible modifications and variations can be made without departing from the scope of the invention as hereinafter claimed.

Claims

1. A lubrication apparatus for an engine, comprising:

a crankshaft chamber, being in communication with a space underneath a piston, and including

a crankshaft chamber inlet and a crankshaft chamber outlet;
a camshaft chamber; and
an oil reservoir chamber for storing lubricants;
wherein an oil-suction piping path is provided in the oil reservoir chamber, and is communicated between the crankshaft chamber inlet and the oil reservoir chamber, and a first one-way valve is arranged between the crankshaft chamber and the oil reservoir chamber, where a valve inlet and a valve outlet are communicated, respectively, with the crankshaft chamber outlet and the oil reservoir chamber, and wherein the oil-suction piping path includes a rotatable pipe which is pivotally arranged along an axis of a cylinder block, and the rotatable pipe includes a plurality of oil-suction orifices located at wall of the rotatable pipe and an air-suction vent at an end of the rotatable pipe, and no matter the engine is situated at any state of declination, the air-suction vent is kept above a surface of the lubricant, and at least one of the oil-suction orifices is kept under the surface of the lubricant.

2. The lubrication apparatus for an engine as claimed in claim 1, wherein the oil-suction piping path further includes, in sequence, an oil-pan built-in passage, a connecting pipe, and a lower-crankcase built-in passage, and wherein the oil-pan built-in passage is connected with the rotatable pipe, and the lower-crankcase built-in passage with the crankshaft chamber inlet.

3. The lubrication apparatus for an engine as claimed in claim 1, further comprising a rocker arm chamber which, through a first communicating passage, is communicated with the crankshaft chamber, wherein in the first communicating passage there is provided with a second one-way valve, and a valve inlet and a valve outlet of the second one-way valve are in communication with the rocker arm chamber and the crankshaft chamber, respectively.

4. The lubrication apparatus for an engine as claimed in claim 3, wherein the camshaft chamber is, through a second communicating passage, communicated with the oil reservoir chamber.

5. The lubrication apparatus for an engine as claimed in claim 1, wherein the camshaft chamber is, through two communicating passages, communicated with the oil reservoir chamber and the crankshaft chamber, respectively, and in one of the two communicating passages there is arranged with a one-way relief valve for pressure release, and wherein a valve inlet and a valve outlet of the one-way relief valve are communicated with the oil reservoir chamber and the camshaft chamber, respectively.

6. The lubrication apparatus for an engine as claimed in claim 5, wherein the two communicating passages refer to a third communicating passage and a fourth communicating passage which both are independent from each other.

7. The lubrication apparatus for an engine as claimed in claim 5, wherein the two communicating passages refer to a fifth communicating passage and a sixth communicating passage which both have a common path section.

8. The lubrication apparatus for an engine as claimed in claim 5, further comprising a rocker arm chamber, where a second one-way valve is arranged between the rocker arm chamber and the crankshaft chamber, such that the rocker arm chamber and the crankshaft chamber are in a one-way communication, and where a valve inlet and a valve outlet of the second one-way valve are communicated with the rocker arm chamber and the crankshaft chamber, respectively.

9. The lubrication apparatus for an engine as claimed in claim 1, wherein the rotatable pipe includes a C-shaped tube.

10. The lubrication apparatus for an engine as claimed in claim 1, wherein the crankshaft chamber is defined by an upper crankcase and a lower crankcase which are anchored to each other.

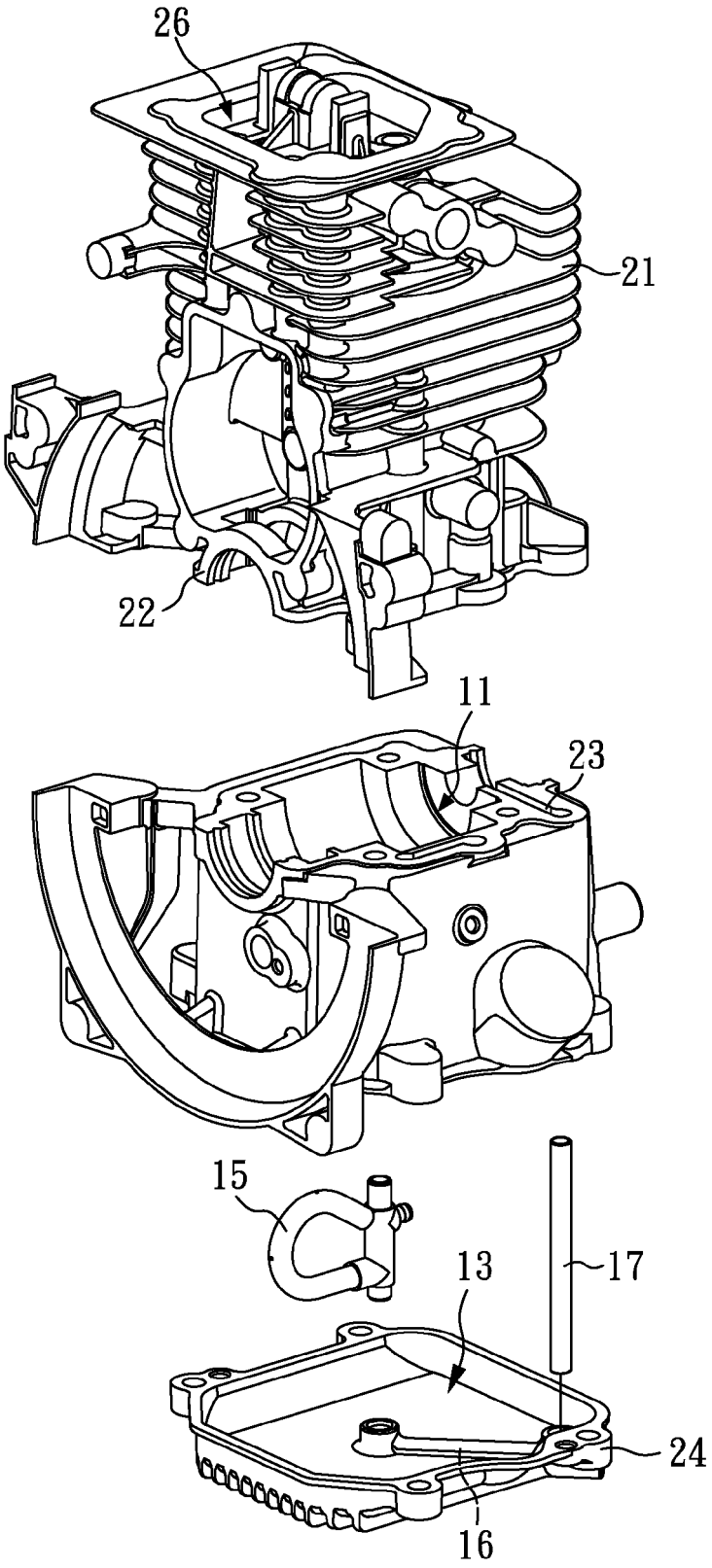

FIG. 1

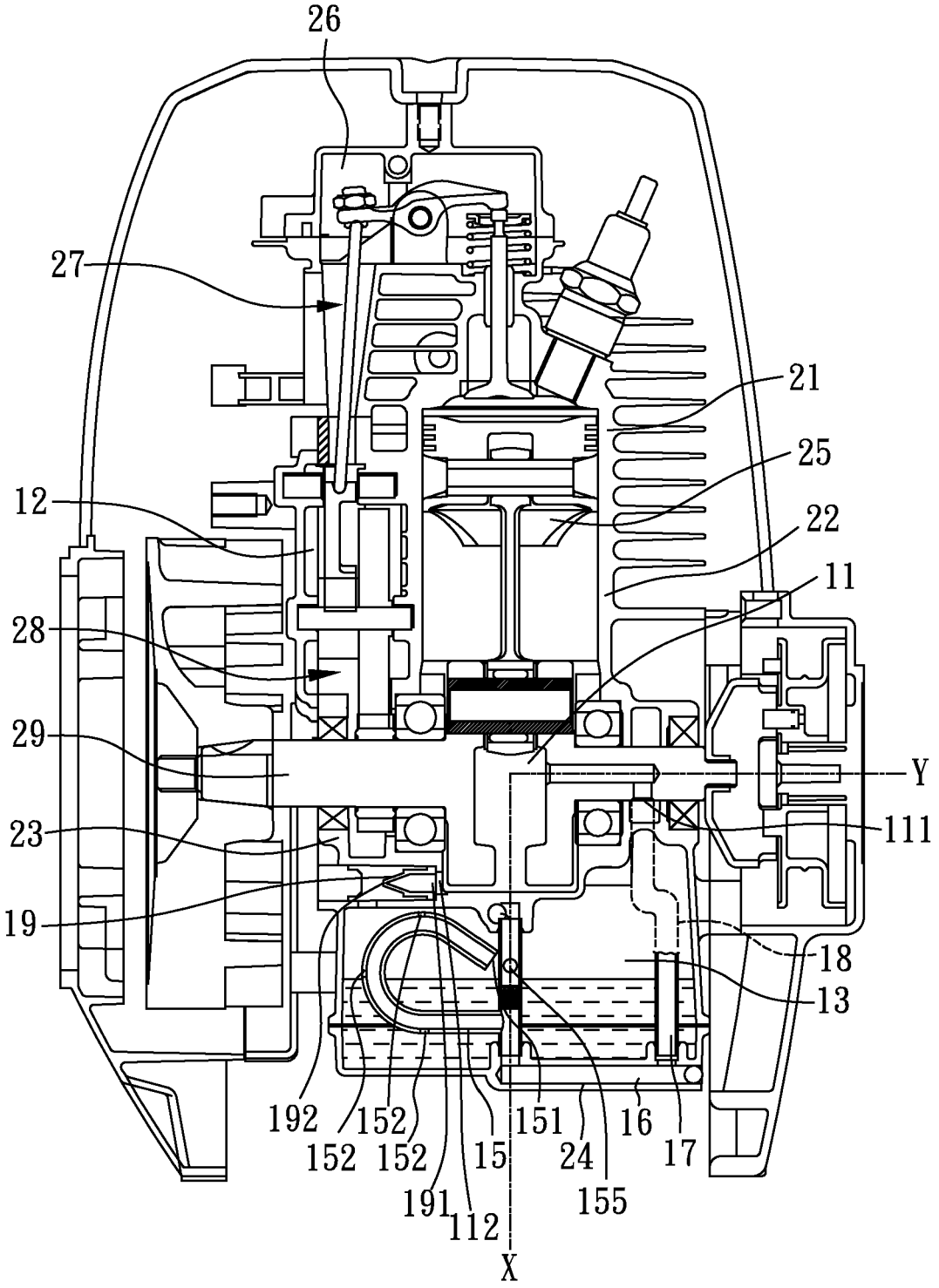
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FIG. 2

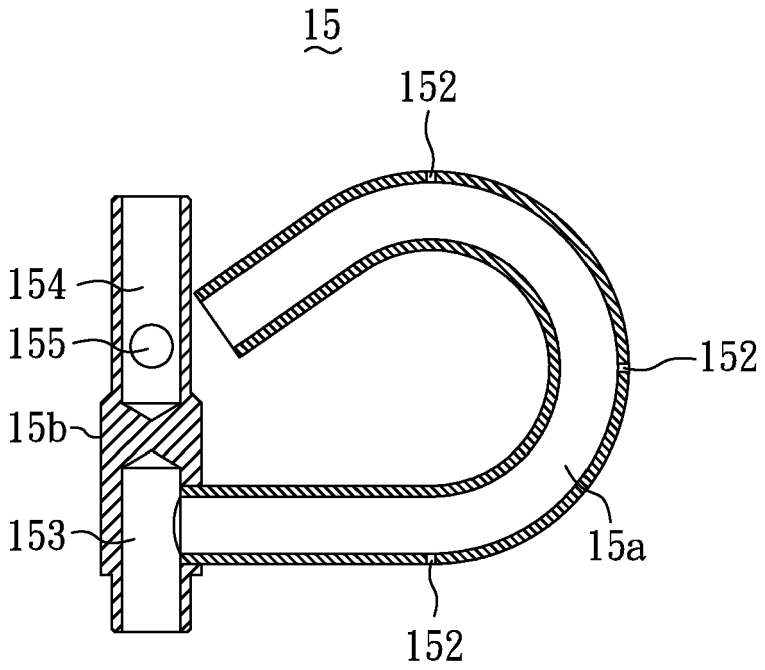

FIG. 3

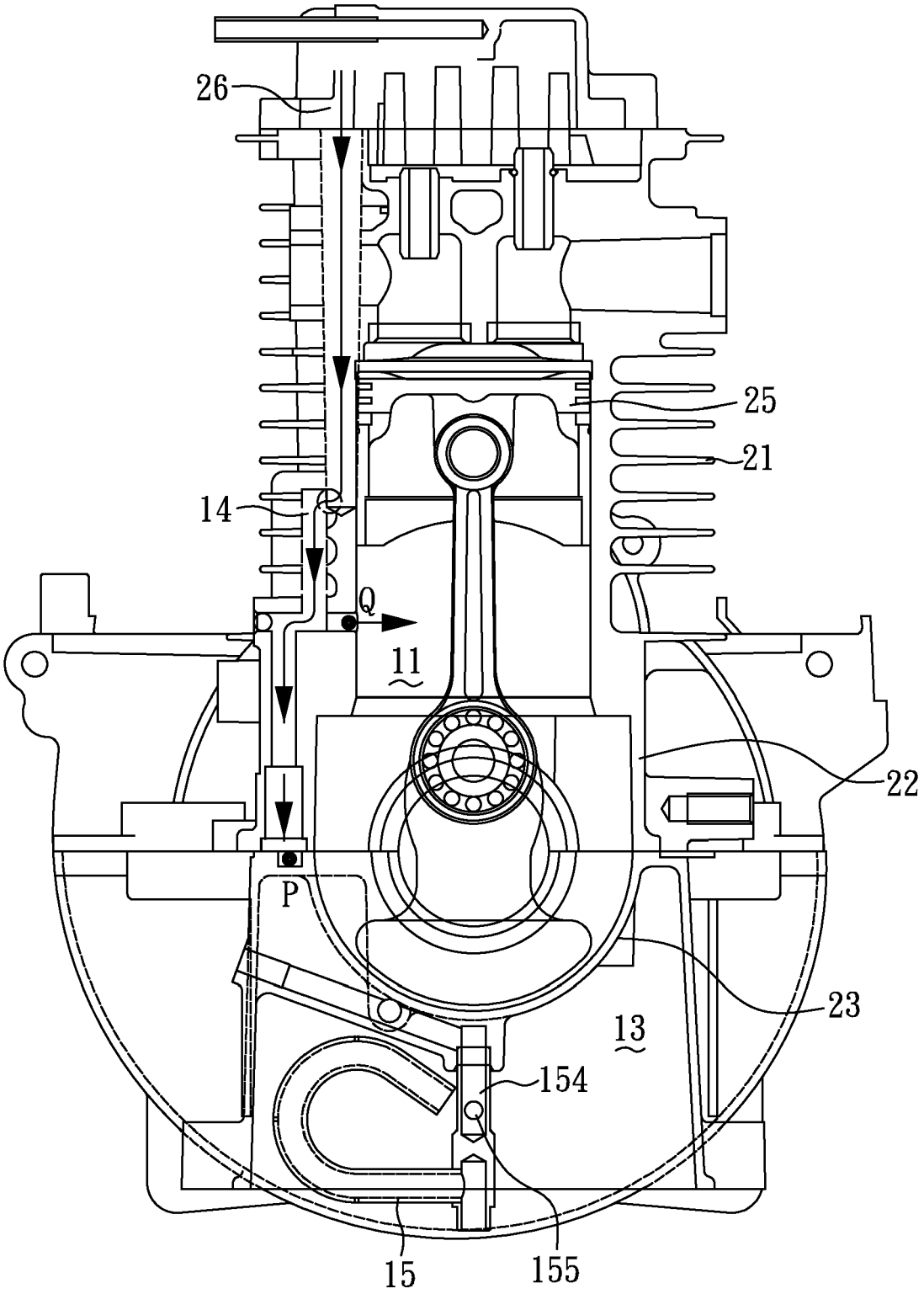

FIG. 4

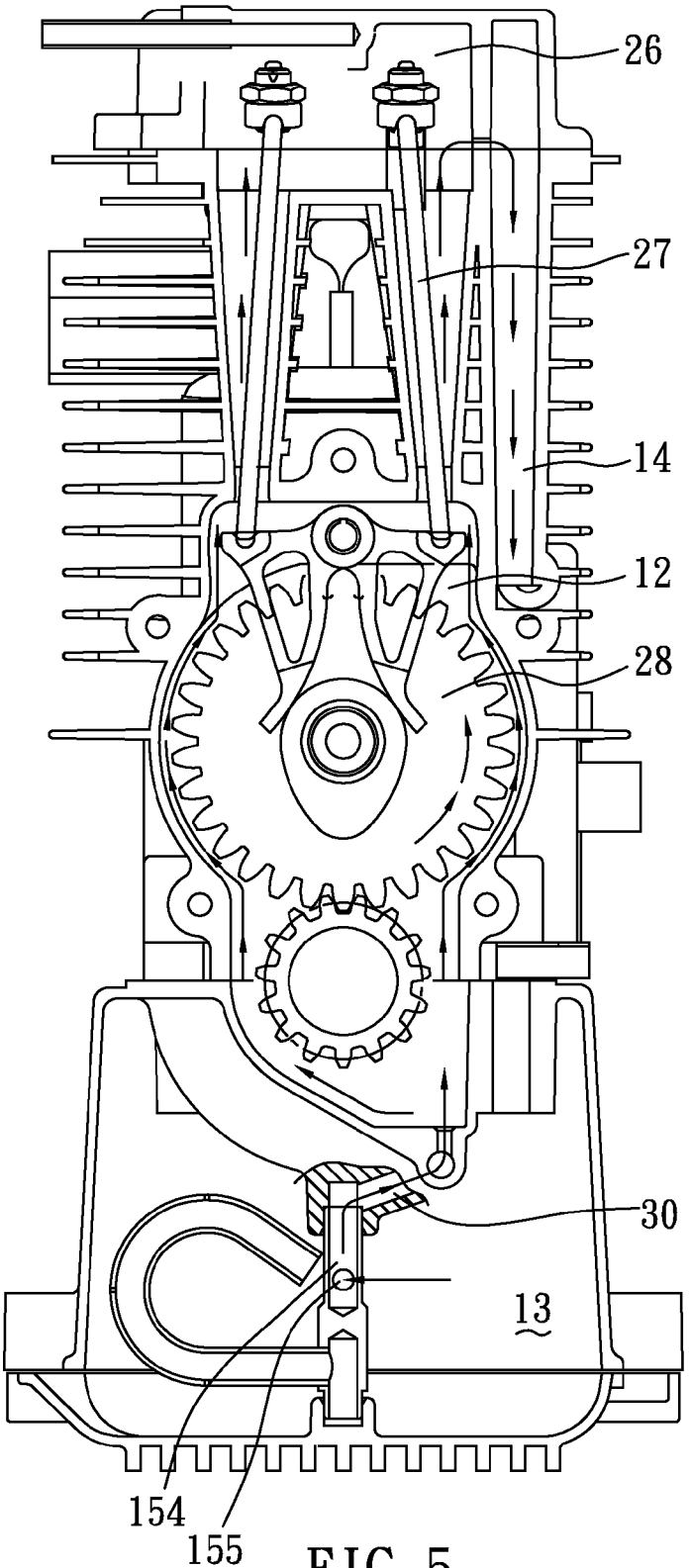

FIG. 5

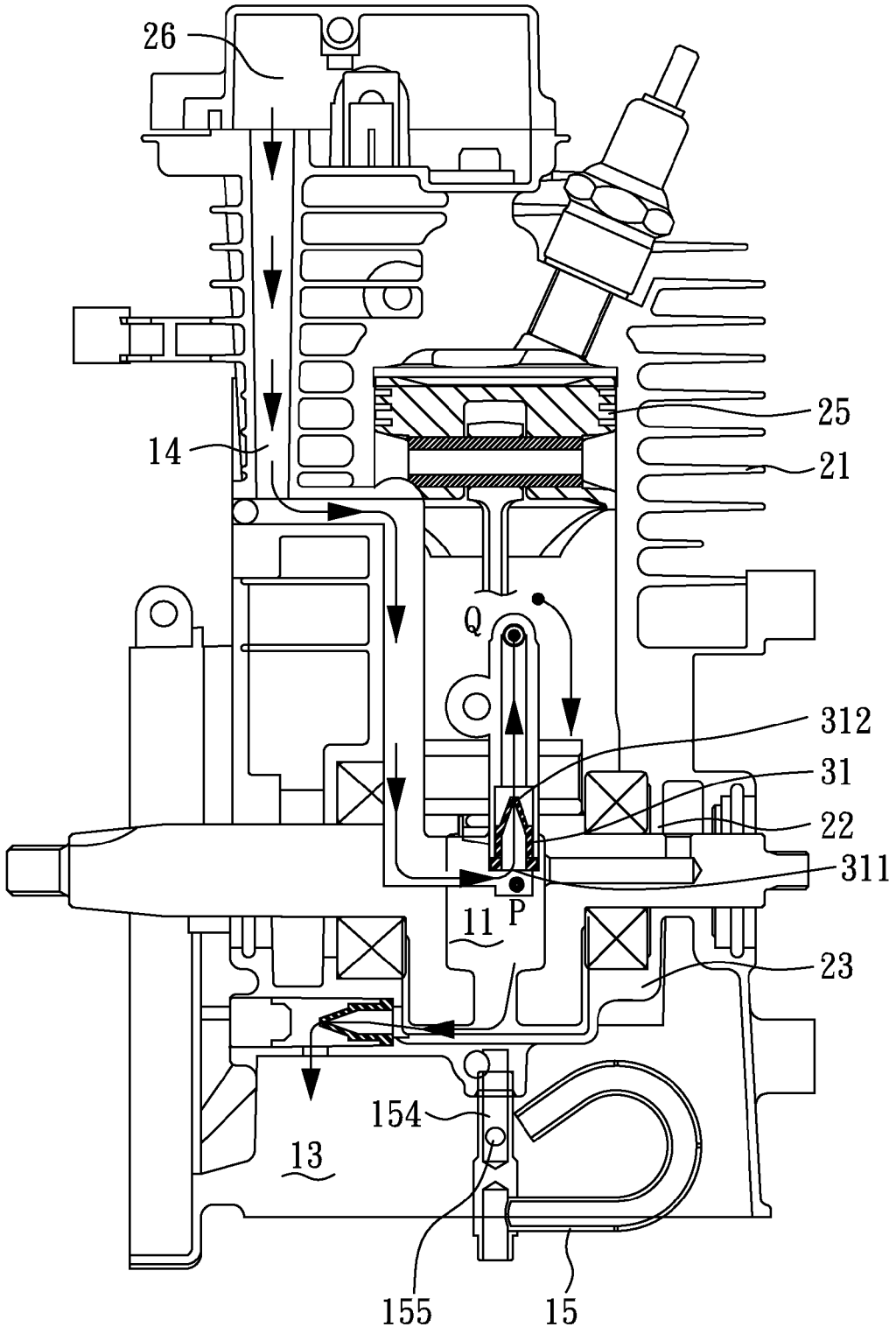

FIG. 6

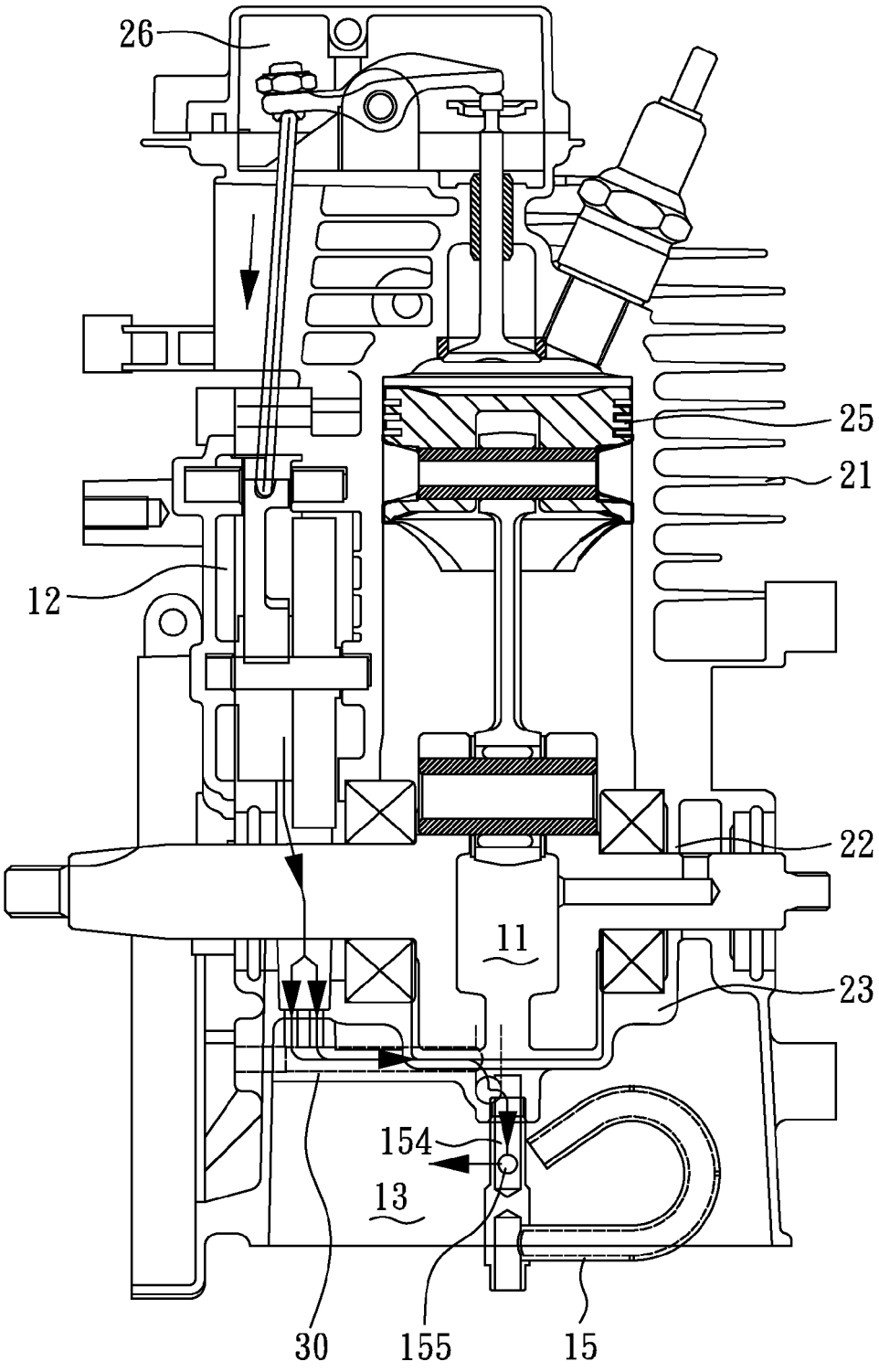

FIG. 7

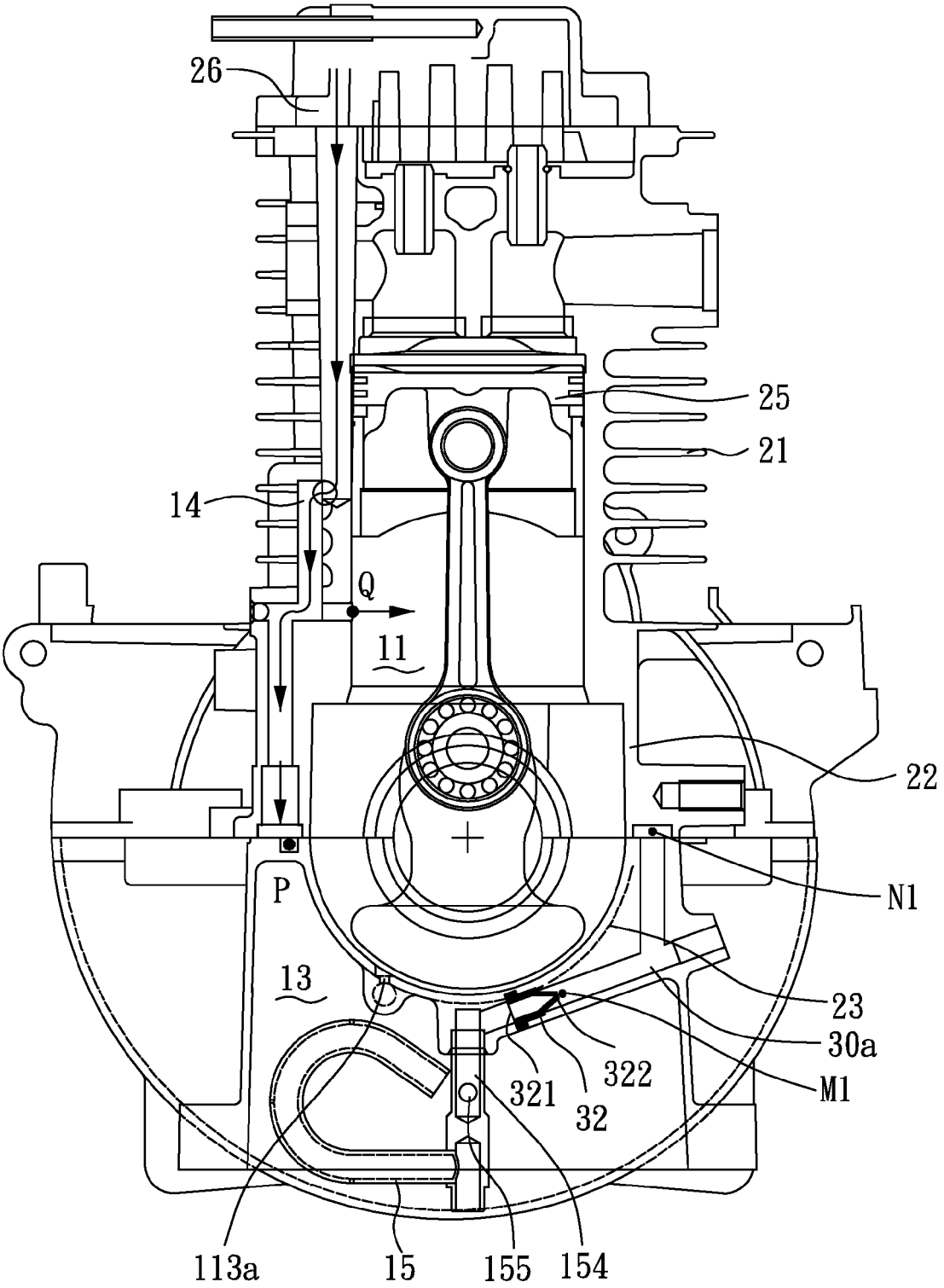

FIG. 8

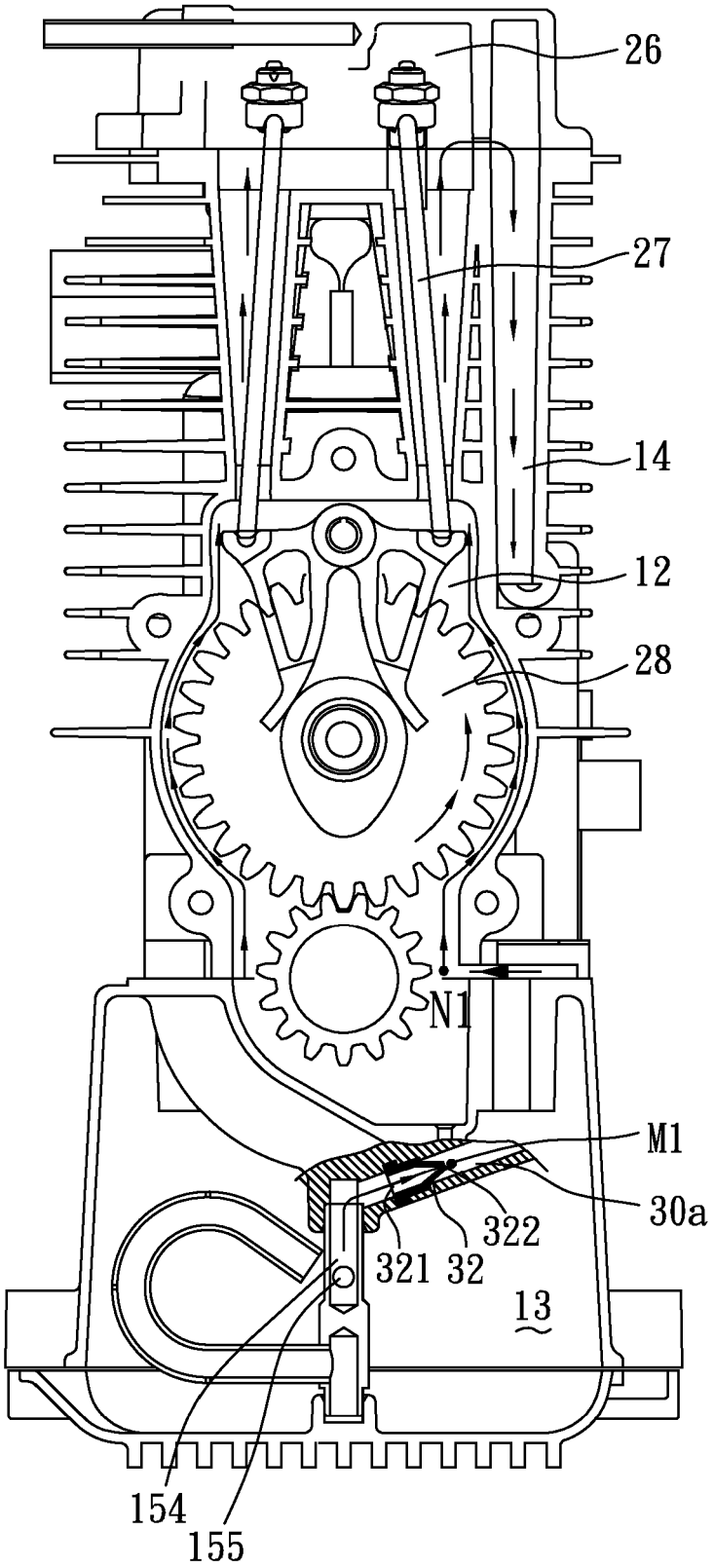

FIG. 9

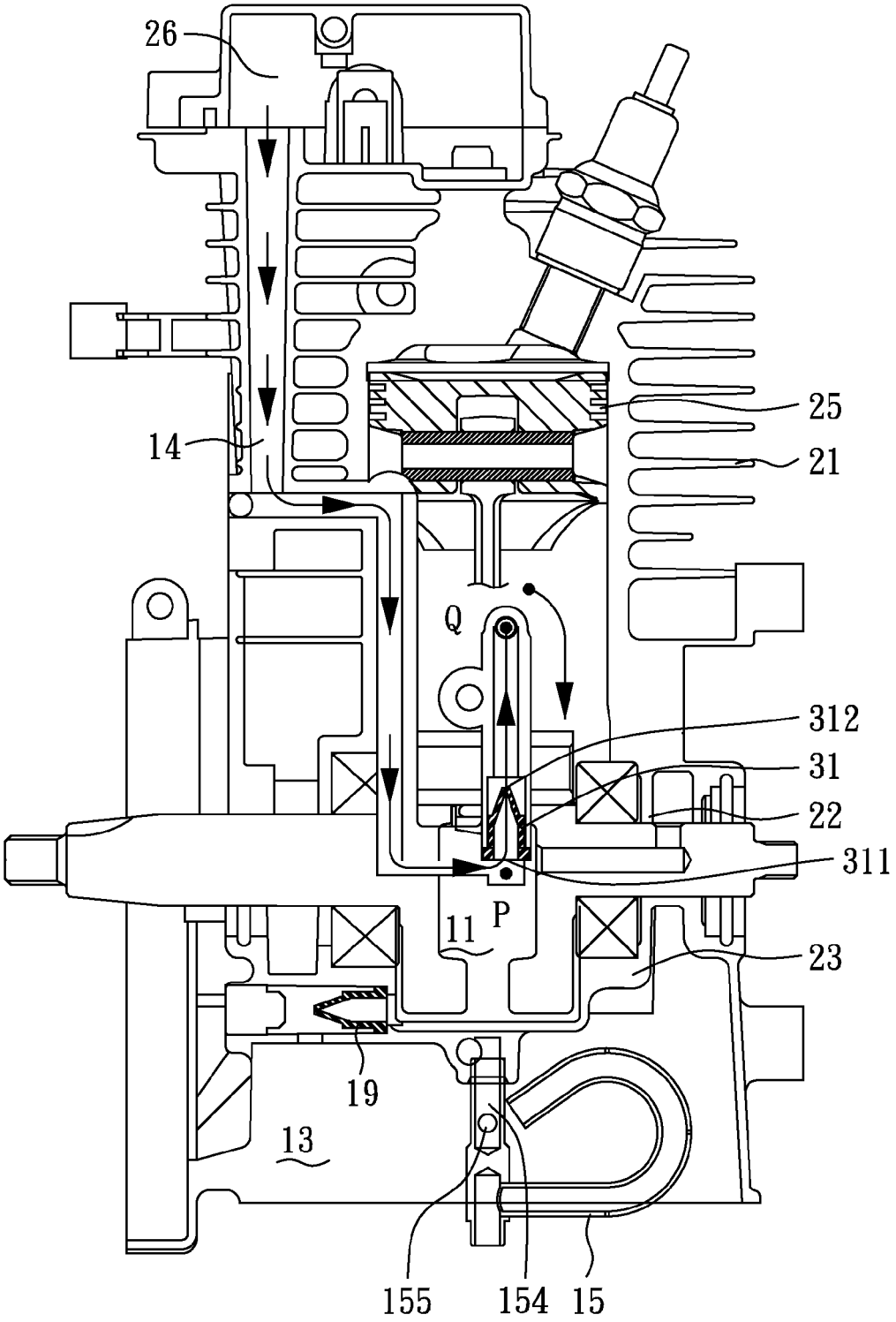

FIG. 10

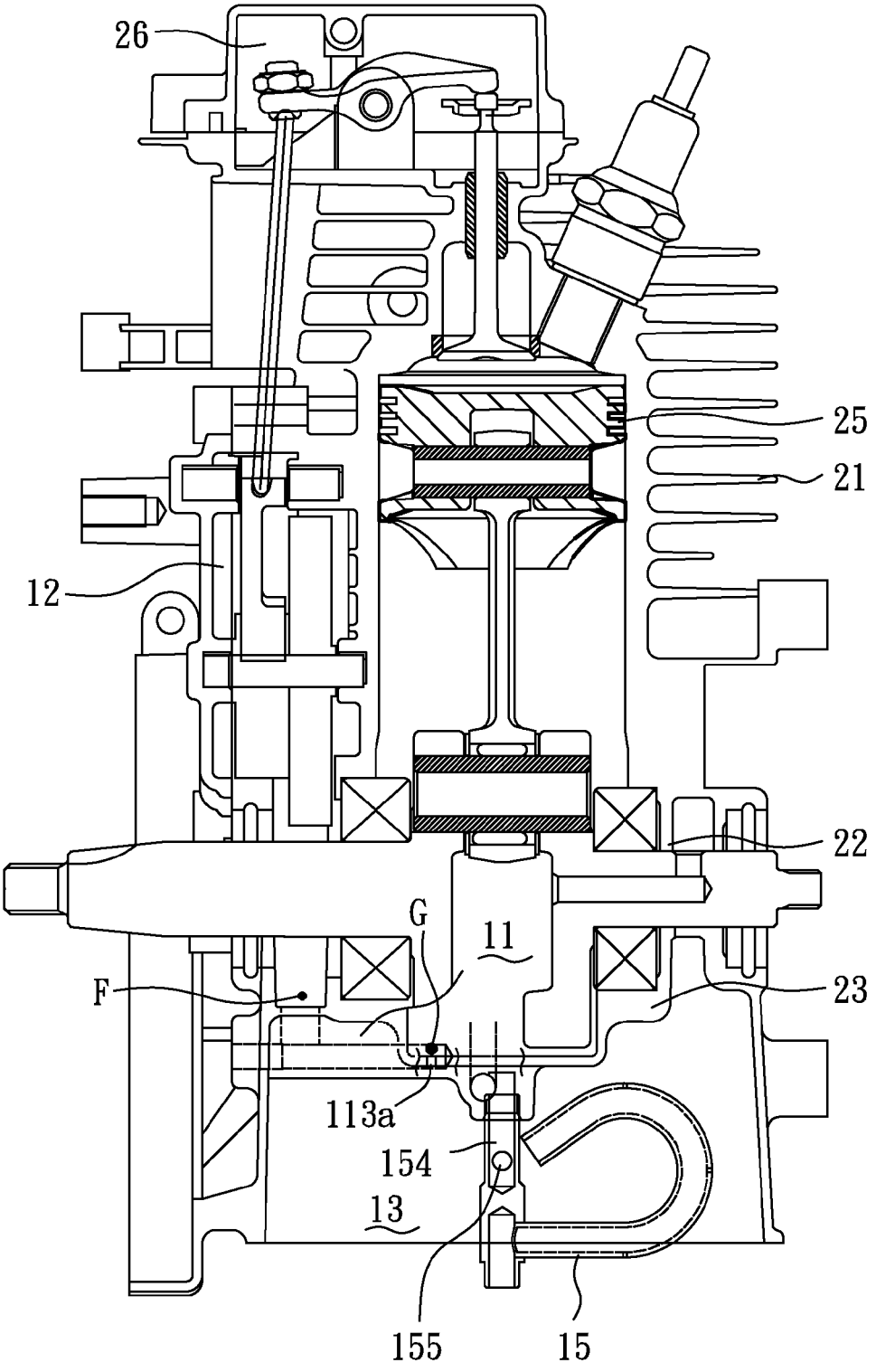

FIG. 11

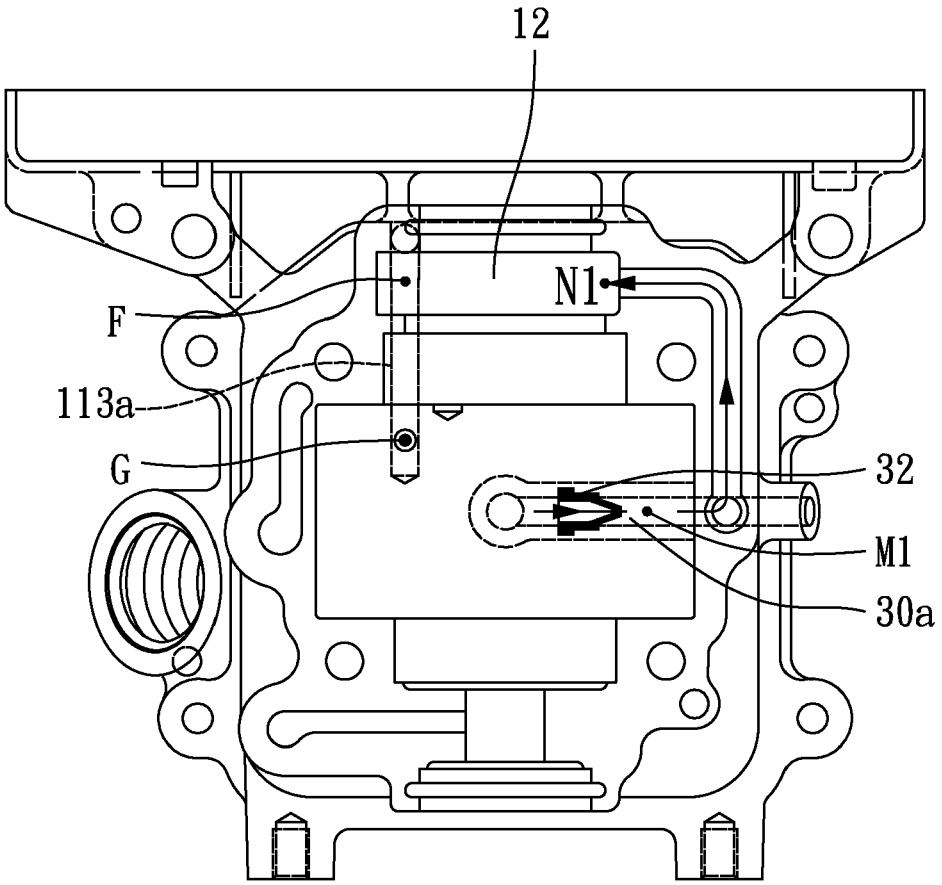

FIG. 12

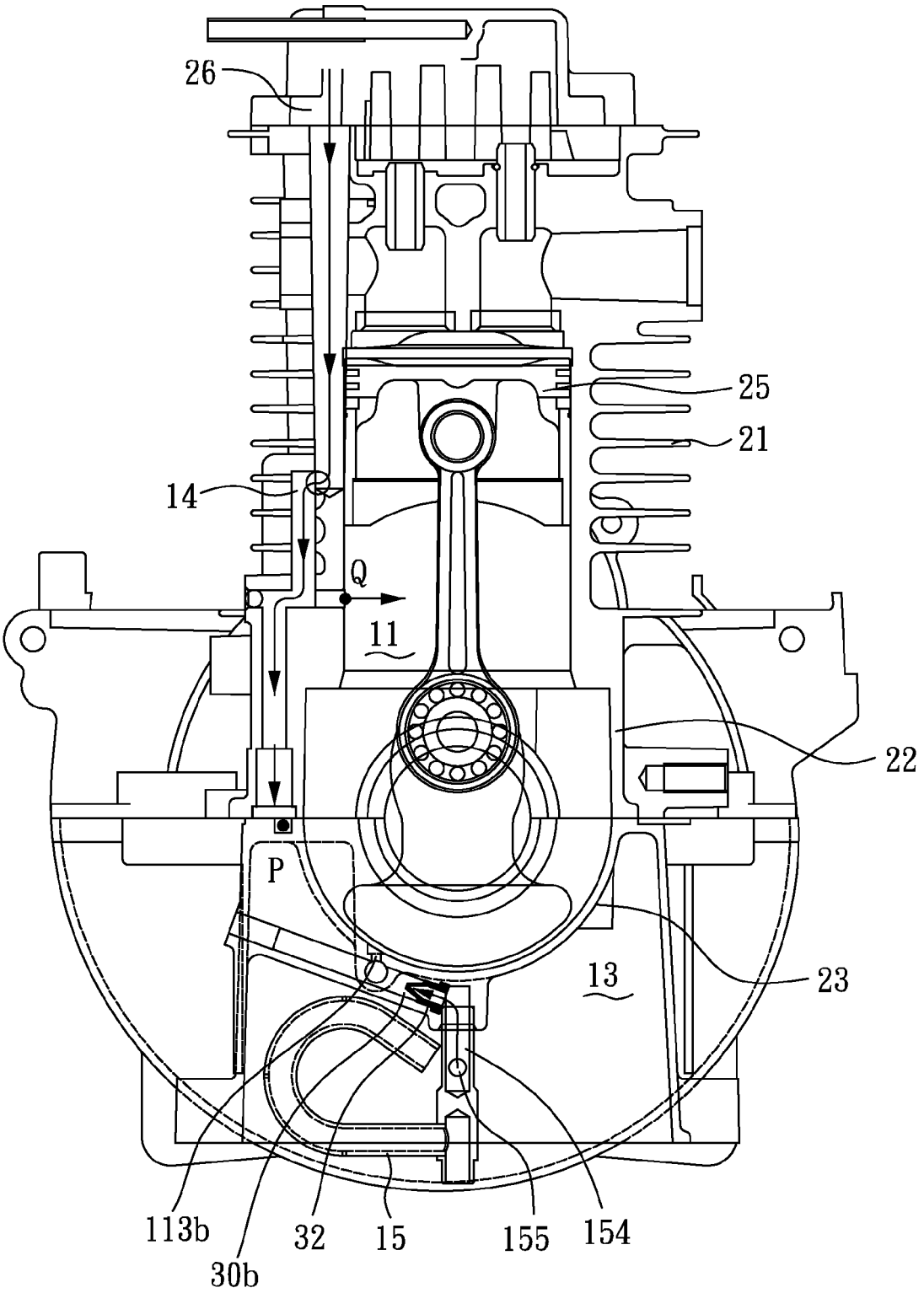

FIG. 13

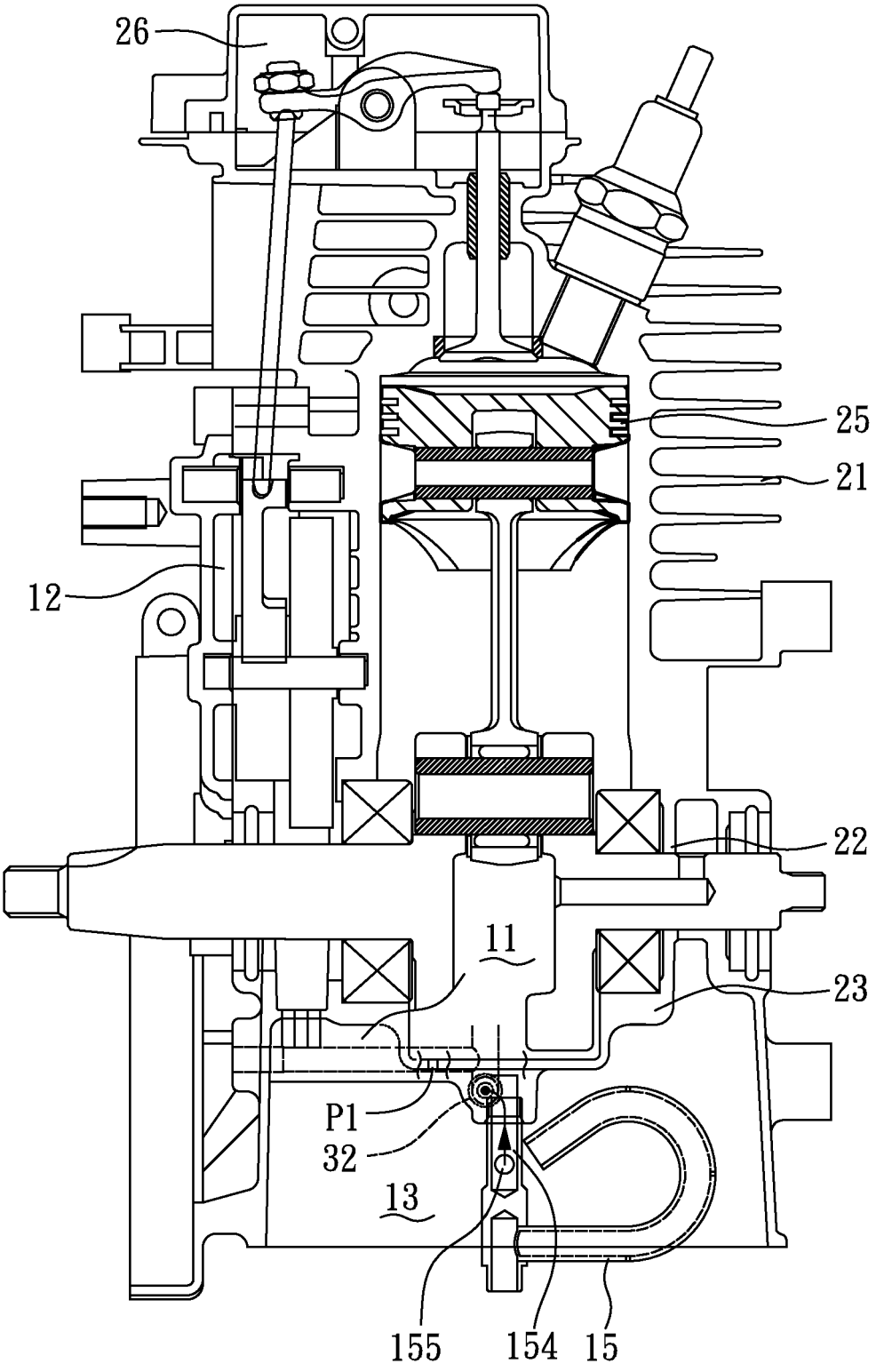

FIG. 14

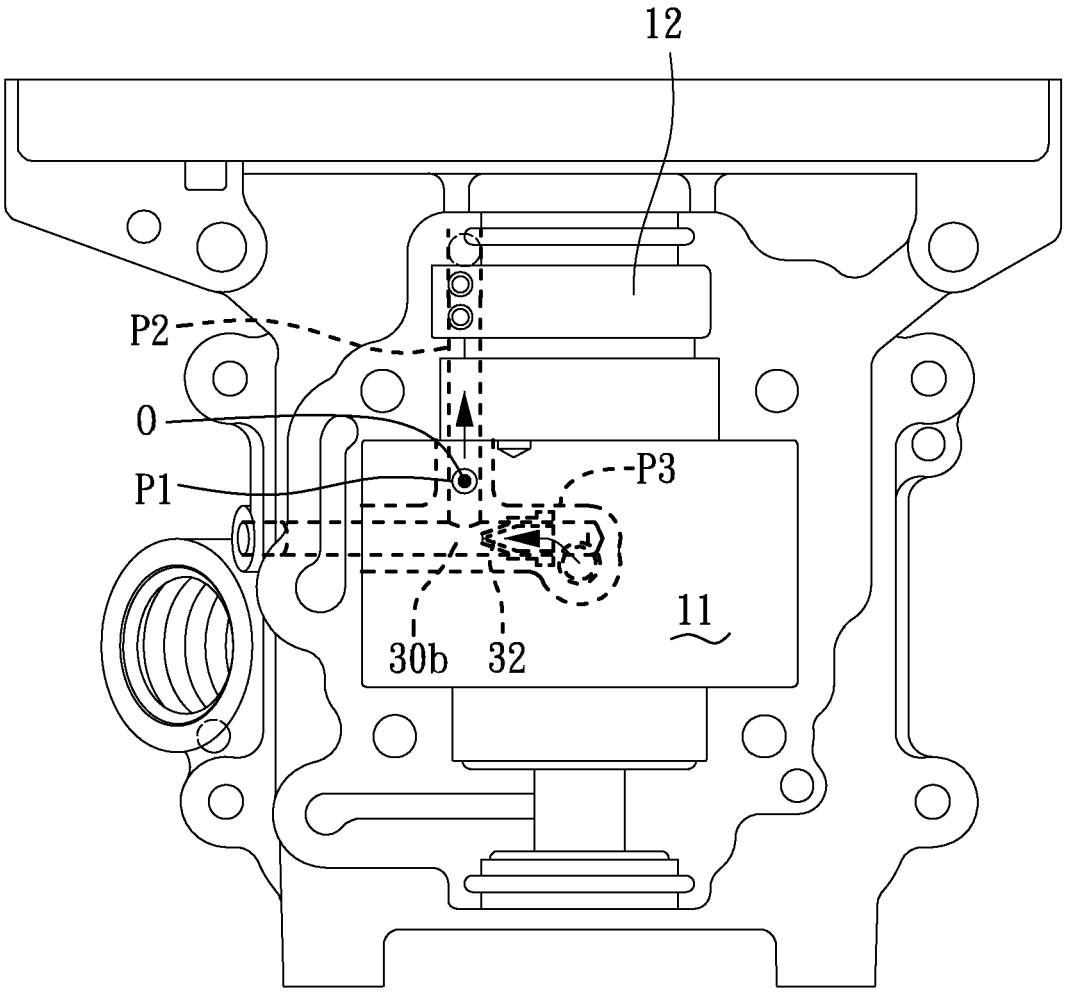

FIG. 15

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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