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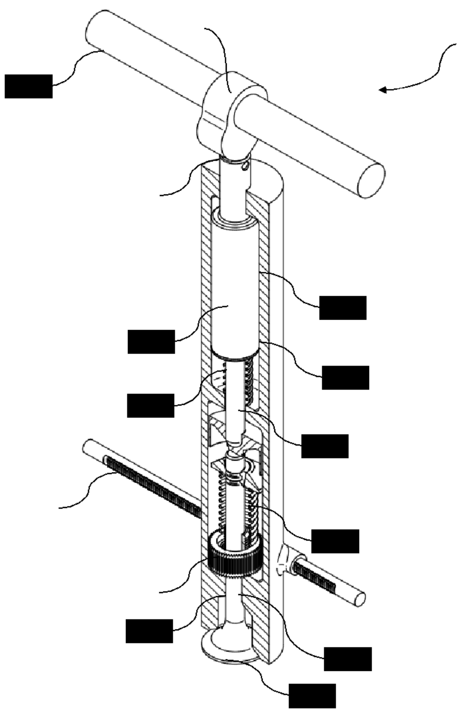
(54) Title: AN ARRANGEMENT FOR VARYING VALUE TIMING IN INTERNAL COMBUSTION ENGINES

(57) Abstract: According to an embodiment of the invention, an arrangement 102 for achieving variable valve timing in a valve operating mechanism 100 is disclosed. The valve operating mechanism 100 have a cam arrangement and a valve arrangement. The arrangement 102 for achieving variable valve timing includes a damper. The damper is arranged between the cam arrangement and the valve arrangement. The damper is arranged in such a manner that it transmits the movement of the cam arrangement to the valve arrangement and enables achieving variable valve timing in the internal combustion engine.



<u>FORM 2</u>

THE PATENTS ACT 1970
(39 OF 1970)
&
The Patent Rules, 2003
Complete Specification
(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

An arrangement for varying valve timing in internal combustion engines

2. APPLICANT(S)

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification particularly describes the invention and the manner in which it is performed.

FIELD OF INVENTION

The invention generally relates to an arrangement for operating valves in an internal combustion engine, and more particularly to an arrangement for achieving variable valve timing in the internal combustion engine.

BACKGROUND

A valve operating system in an internal combustion engine is commonly used for controlling the flow of the air/fuel mixture into and out of the combustion chamber. A typical valve operating system in an internal combustion engine includes a driving cam rotatable in timed relation to the engine revolution. In a cam-in-block layout, the cam is located within the engine block, and operates directly on the valves, or indirectly via pushrods and rocker arms. In an overhead camshaft layout, the cam is located above the valves within the cylinder head, and operates either indirectly or directly on the valves. The valves are normally seated at the port of the combustion chamber and undergo lifting based on the movement of the cam. However, the typical valve operating systems are usually inefficient as the valves operate at the same rate for all engine speeds and conditions.

To improve the efficiency of the internal combustion engines, variable valve timing systems are commonly employed in the internal combustion engines. By variably controlling the valve lifting and operating timings, the intake of fresh air or air-fuel mixture and the exhaust of burned gases can be effectively controlled. There are numerous ways available by which the valve timing can be controlled but the efficiency of those systems is either very limited or those systems are complicated to be used in the internal combustion engines.

Hence there is a need for an improved arrangement for varying valve timing in internal combustion engines.

SUMMARY OF THE INVENTION

According to an embodiment of the invention, an arrangement for achieving variable valve timing in a valve operating mechanism is disclosed. The valve operating mechanism have a cam arrangement and a valve arrangement. The arrangement for achieving variable valve timing includes a damper. The damper is arranged between the cam arrangement and the valve arrangement. The damper is arranged in such a manner that it transmits the movement of the cam arrangement to the valve arrangement and enables achieving variable valve timing in the internal combustion engine.

BRIEF DESCRIPTION OF DRAWINGS

Other objects, features, and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings wherein, like reference numerals denote corresponding parts throughout the several views.

Figure 1 illustrates a partial cross-sectional isometric view of a valve operating mechanism according to an embodiment of the invention.

Figure 2 illustrates a partial cross-sectional front view of the valve operating mechanism according to an embodiment of the invention.

Figure 3 illustrates a cross-sectional front view of the valve operating mechanism according to an embodiment of the invention.

Figure 4 illustrates an isometric view of a hydraulic damper according to an embodiment of the invention.

Figure 5 illustrates a cross-sectional front view of the hydraulic damper according to an embodiment of the invention.

Figure 6 illustrates an isometric view of a pneumatic damper according to another embodiment of the invention.

Figure 7 illustrates a cross-sectional front view of the pneumatic damper according to another embodiment of the invention.

Figure 8 illustrates a front view of the valve operating mechanism with a rocker arm, according to another embodiment of the invention.

DETAILED DESCRIPTION OF DRAWINGS

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of exemplary embodiments. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skilled in the art will recognize that various changes and modifications of the embodiments described herein can be made without departing from the scope and spirit of the invention. In addition, descriptions of well-known functions and constructions are omitted for clarity and conciseness.

Figure 1, Figure 2 and Figure 3 illustrates a partial cross-sectional isometric view, a partial cross-sectional front view and a cross-sectional front view respectively of a valve operating mechanism 100, according to an embodiment of the invention. The valve operating mechanism 100 may include an arrangement 102 for achieving variable valve timing in an internal combustion engine (not shown in figures). The arrangement 102 for achieving variable valve timing may be employed in the internal combustion engine having a valve arrangement. The valve arrangement may include an intake valve or an exhaust valve, where the intake valve allows fresh air or air-fuel mixture to enter a combustion chamber and the exhaust valve allows the burned gases to flow out of the combustion chamber. It should be noted that the system 102 for achieving variable valve timing may be employed in any internal combustion engine having one or more valves 104. According to an embodiment, the internal combustion engine may be a two-stroke engine. According to another embodiment, the internal combustion engine may be a four-stroke engine. The arrangement 102 for achieving variable valve timing may enable the valve operating mechanism 100 to vary valve 102 lifting and valve 102 operating duration, which would result in improving the efficiency of the internal combustion engine.

The valve operating mechanism 100 may include a cam arrangement. The cam arrangement may include a camshaft 106 that rotates in relation to the speed of the internal combustion engine. The camshaft 106 is driven by a crankshaft (not shown in figures). It will be apparent to a person skilled in the art that the crankshaft may drive the camshaft 106 via gearwheels, a toothed belt, a timing chain or any suitable arrangement known in the art. As appreciated by those skilled in the art, the camshaft 106 may be made of materials such as, but not limited to, grey cast iron, ductile cast iron, heat-treated steel, nitride steel etc. According to an embodiment, the valve operating mechanism 100 may include only one camshaft 106. According to another embodiment, the valve operating mechanism 100 may include a plurality of camshafts 106. It should be noted that the valve operating mechanism 100 disclosed herein includes only one camshaft 106.

The cam arrangement further includes at least one or more cams 108 disposed on the camshaft 106. According to an embodiment, the camshaft 106 may include only one cam 108. According to another embodiment, the camshaft 106 may include a plurality of cams 108. For the purpose of illustration, the words ‘cam’ and ‘cam lobe’ may be used interchangeably in the specification without restricting the scope of the invention in any way. Each of the cams 108 may have a predefined profile that determines the valve 104 lift and valve 104 operation for different speed ranges of the internal combustion engine. The cam 108 may transform the rotary motion of the camshaft 106 into a linear motion of the valve 104. It should be noted that the valve operating mechanism 100 as disclosed herein may operate only one cam 108.

The cam arrangement further includes a cam follower 110. The cam follower 110 may be arranged to follow the cam 108 profile. For the purpose of illustration, the cam follower 110 may be a roller bearing configured to move on the profile of the cam 108. The cam 108 may operate the valve 104 via the cam follower 110 and the arrangement 102 arranged between the cam 108 and the valve 104.

The valve operating mechanism 100 may further include a valve arrangement. The valve arrangement allows or stops the flow of fresh air or air-fuel mixture into the combustion chamber and the burned gases out of the combustion chamber. The valve arrangement may include the valve 104 arranged on a port of the combustion chamber. The valve 104 may be configured to move between an open position and a closed position. According to an embodiment, the valve 104 may be a poppet valve. According to another embodiment, the valve 104 may not be limited to a poppet valve and other valves known in the art may also be used. The valve 104 may have a head 112 that opens and closes the port on the combustion chamber. The valve head 112 may be a round or an oval plug that sits on the port. The valve 104 may further have a stem 114 extending from the head 112 of the valve 104. The valve arrangement may further include a valve spring 116. The valve spring 116 may be arranged on the valve 104 to keep the valve 104 in the closed position when the cam 108 is not lifting the valve 104. The valve arrangement may further include a valve retainer 148 to maintain the valve 104 in position.

According to an embodiment, the arrangement 102 for achieving variable valve timing in the valve operating mechanism 100 may include a preload adjuster nut 118. The preload adjuster nut 118 may be used to adjust the preload of the valve spring 116. For the purpose of illustration, the preload of the valve spring 116 is the force that the valve spring 116 is acting on the valve 104 to keep the valve 104 in the closed position. According to an embodiment, the preload adjuster nut 118 may be a threaded pinion that may be operated by a rack 146. According to an embodiment, the preload adjuster nut 118 may include an actuator for adjusting the preload. It will be apparent to a person skilled in the art that the actuator for adjusting the preload may be a linear actuator.

According to an embodiment of the invention, the arrangement 102 for achieving variable valve timing in the valve operating mechanism 100 may include a linear damper 120. The linear damper 120 may be arranged between the cam arrangement and the valve arrangement. The linear damper 120 may be arranged to transmit the motion of the cam arrangement to the valve arrangement. The linear damper 120 may be configured to achieve variable valve timing in the valve operating mechanism 100.

According to an embodiment, the linear damper 120 may be a hydraulic damper 122. Figure 4 and Figure 5 illustrated an isometric view and a cross-sectional front view respectively of the hydraulic damper 122. The hydraulic damper 122 may be a cylinder 124 and a piston 126 arrangement, having a viscous hydraulic fluid within the cylinder 124. The cylinder 124 end of the hydraulic damper 122 may be engaged to the cam 108 via the cam follower 110. The cam follower 110 may convert the rotational movement of the cam 108 into a linear movement of the hydraulic damper 122. The piston 126 of the hydraulic damper 122 may be engaged to the stem 114 of the valve 104 via a piston rod 128. For the purpose of illustration, the hydraulic damper 122 may be linearly arranged between the cam arrangement and the valve arrangement. Based on the movement of the cam 108, the hydraulic damper 122 may move in a reciprocating motion. It will be apparent to a person skilled in the art that the hydraulic damper 122 may lift the valve 104 when the hydraulic damper 122 overcomes the preload of the valve spring 116. According to an embodiment, the hydraulic damper 122 may be a single acting damper. According to another embodiment, the hydraulic damper 122 may be a double acting damper. The hydraulic damper 122 may further include a damper spring 130. The damper spring 130 may be configured to return the cylinder 124 to a predefined position when the cam 108 is not lifting the hydraulic damper 122. According to an embodiment, the hydraulic damper 122 may further include an accumulator 132 to store the hydraulic fluid.

According to another embodiment, the linear damper 120 may be a pneumatic damper 134. Figure 6 and Figure 7 illustrates an isometric view and a cross-sectional front view respectively of the pneumatic damper 134. The pneumatic damper 134 may be a cylinder 136 and piston 138 arrangement having air within the cylinder 134. The cylinder 136 end of the pneumatic damper 134 may be engaged to the cam arrangement via the cam follower 110. The cam follower 110 may convert the rotational movement of the cam 108 into a linear movement of the pneumatic damper 134. The piston 138 of the pneumatic damper 134 may be engaged to the stem 114 of the valve via a piston rod 140. For the purpose of illustration, the pneumatic damper 134 may be linearly arranged between the cam arrangement and the valve arrangement. Based on the movement of the cam 108, the pneumatic damper 134 may move in a reciprocating motion. It will be apparent to a person skilled in the art that the pneumatic damper 134 may lift the valve 104 when the pneumatic damper 134 overcomes the preload of the valve spring 116. According to an embodiment, the pneumatic damper 134 may be a single acting damper. According to another embodiment, the pneumatic damper 134 may be a double acting damper. In the double acting pneumatic damper 134, a one-way valve 142 may be provided. The pneumatic damper 134 may further include a damper spring. The damper spring may be configured to return the cylinder to a predefined position when the cam is not lifting the pneumatic damper.

According to yet another embodiment, the linear damper 120 may be a shock absorber.

According to another embodiment of the invention, the arrangement 102 for achieving variable valve timing in the valve operating mechanism 100 may include a rocker arm 144. Figure 8 illustrates a front view of the arrangement 102 for achieving variable valve timing with the rocker arm 144. The rocker arm 144 may be pivotally mounted between the linear damper 120 and the valve 104. The rocker arm 144 may be an oscillating arm that may transmit the movement from the linear damper 120 to the valve 104. For the purpose of illustration, one end of the rocker arm may be acted upon by the piston rod 126 of the linear damper 120 and the other end of the linear damper 120 may act on the valve stem 114.

According to another embodiment, the arrangement 102 for achieving variable valve timing in the valve operating mechanism 100 may include a rotary damper (not shown in figures). In the valve operating mechanism 100 with the rotary damper, the linear damper 120 may be replaced by a push rod. The pushrod may be arranged between the cam arrangement and the rotary damper. The rotary damper may be pivoted between the pushrod and the valve stem 114. Based on the rotational movement of the cam 108, the pushrod may move in a linear motion. The linear movement of the pushrod may act on one end of the rotary damper. The other end of the rotary damper may act on the valve stem 114 and may cause the valve to open or close accordingly.

It should be noted that the variable valve timing in the internal combustion engine may be achieved by varying the damping coefficient of the damper 120. According to an embodiment, the damper 120 for achieving variable valve timing may be arranged in the engine cooling circuit to maintain the working fluid at an operating temperature.

It is understood that the above description is intended to be illustrative, and not restrictive. It is intended to cover all alternatives, modifications and equivalents as may be included within the spirit and scope of the invention as defined in the appended claims. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms “including” and “in which” are used as the plain-English equivalents of the respective terms “comprising” and “wherein,” respectively.

We claim:

1. An arrangement 102 for achieving variable valve timing in a valve operating mechanism 100, the valve operating mechanism 100 having a cam arrangement and a valve arrangement, the arrangement 102 comprising:

   a damper, the damper being arranged between the cam arrangement and the valve arrangement, wherein the damper being arranged to transmit the movement of the cam arrangement to the valve arrangement.

2. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the damper is a linear damper 120.

3. The arrangement 102 for achieving variable valve timing as claimed in claim 2, wherein the linear damper 120 comprising:

   a cylinder 124 and a piston 126 arrangement, the cylinder 124 having a cylinder end is engaged to the cam arrangement and the piston 126 having a piston rod 128 is engaged to the valve arrangement; and

   a damper spring 130 for returning the cylinder 124 to a predefined position.

4. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the damper is a rotary damper.

5. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the cam arrangement comprising:

   a camshaft 106 rotatable in relation to an engine speed; and

   a cam 108 disposed on the camshaft 106 and have a predefined profile.

6. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the valve arrangement comprising:

    a valve 104 arranged on a port of an internal combustion engine and is movable between an open and a closed position;

    a stem 114 extending from the valve 104; and

    a valve spring 116 arranged to move the valve 104 to the closed position.

7. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the arrangement 102 includes a preload adjuster nut 118 to adjust the preload of the valve spring 116.

8. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the damper opens the valve 104 when the damper overcomes the preload of the valve spring 116.

9. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the variable valve timing is achieved by varying the damping coefficient of the damper.

10. The arrangement 102 for achieving variable valve timing as claimed in claim 1, wherein the damper is a hydraulic damper 122 or a pneumatic damper 134.

Dated this 27th day of September 2019

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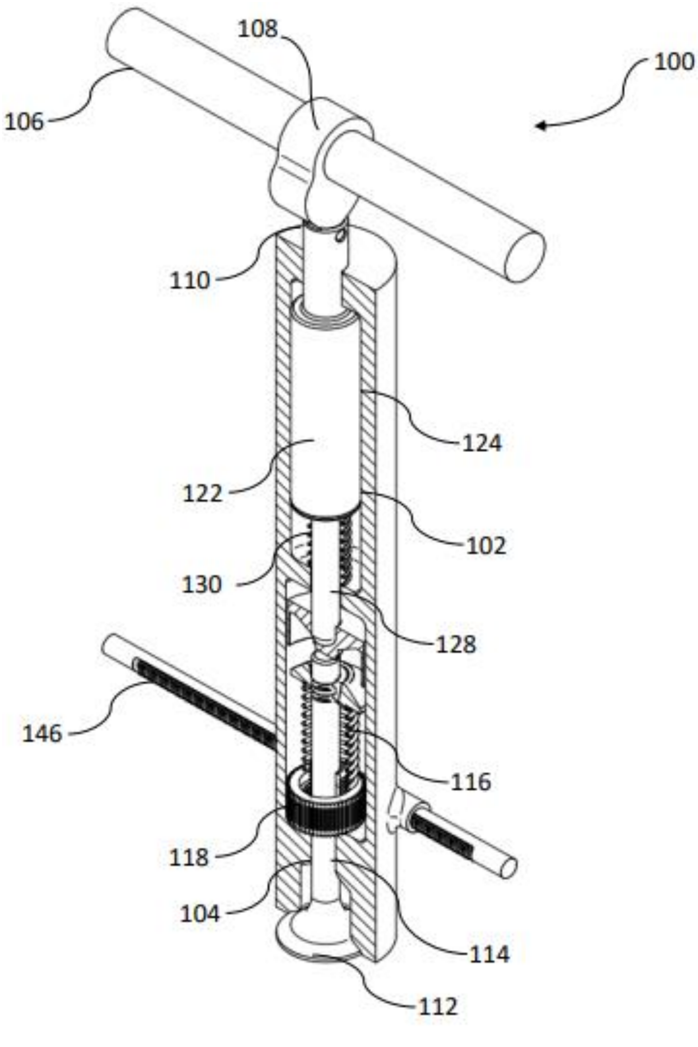
ABSTRACT

An Arrangement For Varying Valve Timing In Internal Combustion Engines

According to an embodiment of the invention, an arrangement 102 for achieving variable valve timing in a valve operating mechanism 100 is disclosed. The valve operating mechanism 100 have a cam arrangement and a valve arrangement. The arrangement 102 for achieving variable valve timing includes a damper. The damper is arranged between the cam arrangement and the valve arrangement. The damper is arranged in such a manner that it transmits the movement of the cam arrangement to the valve arrangement and enables achieving variable valve timing in the internal combustion engine.



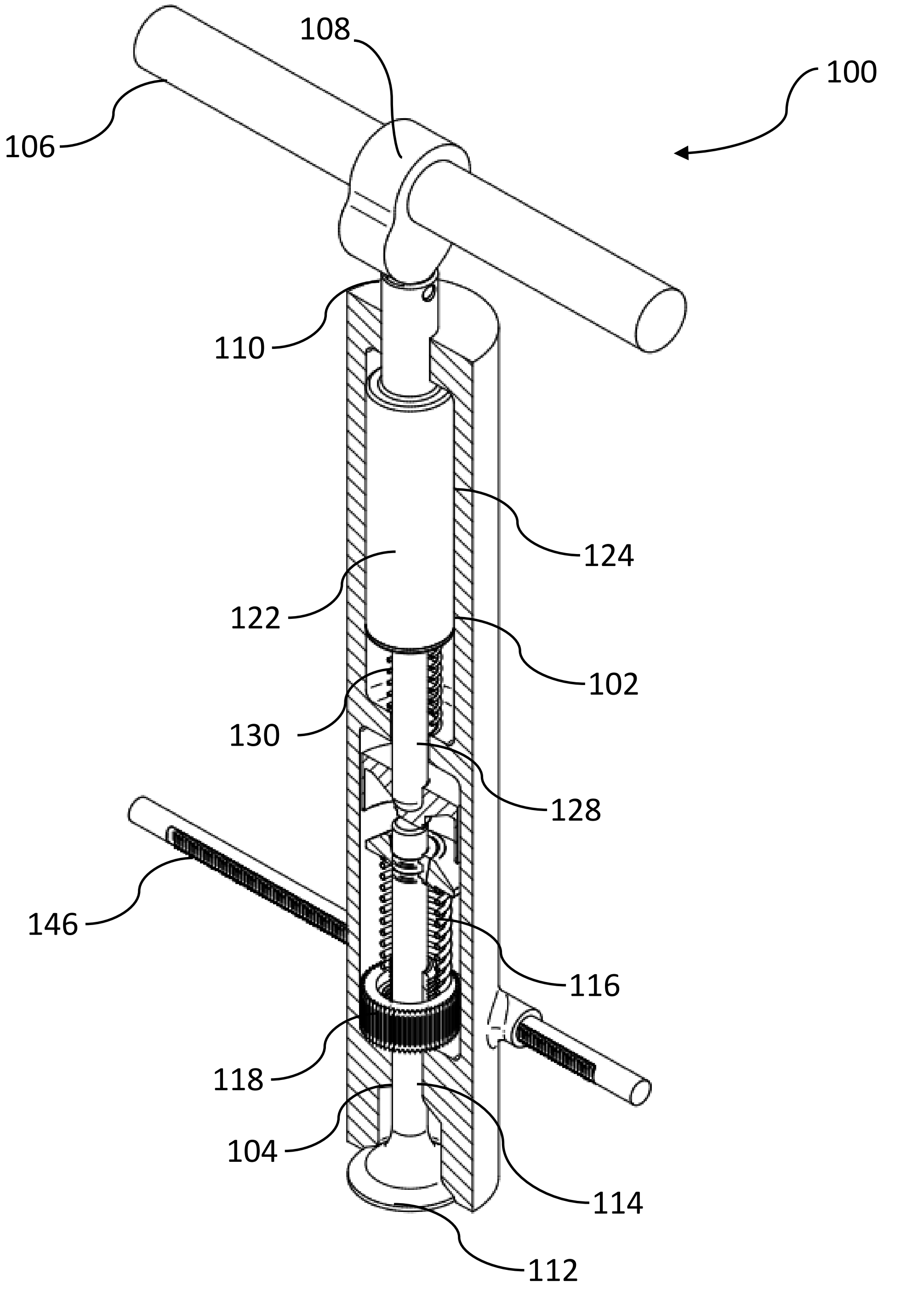


Figure 1

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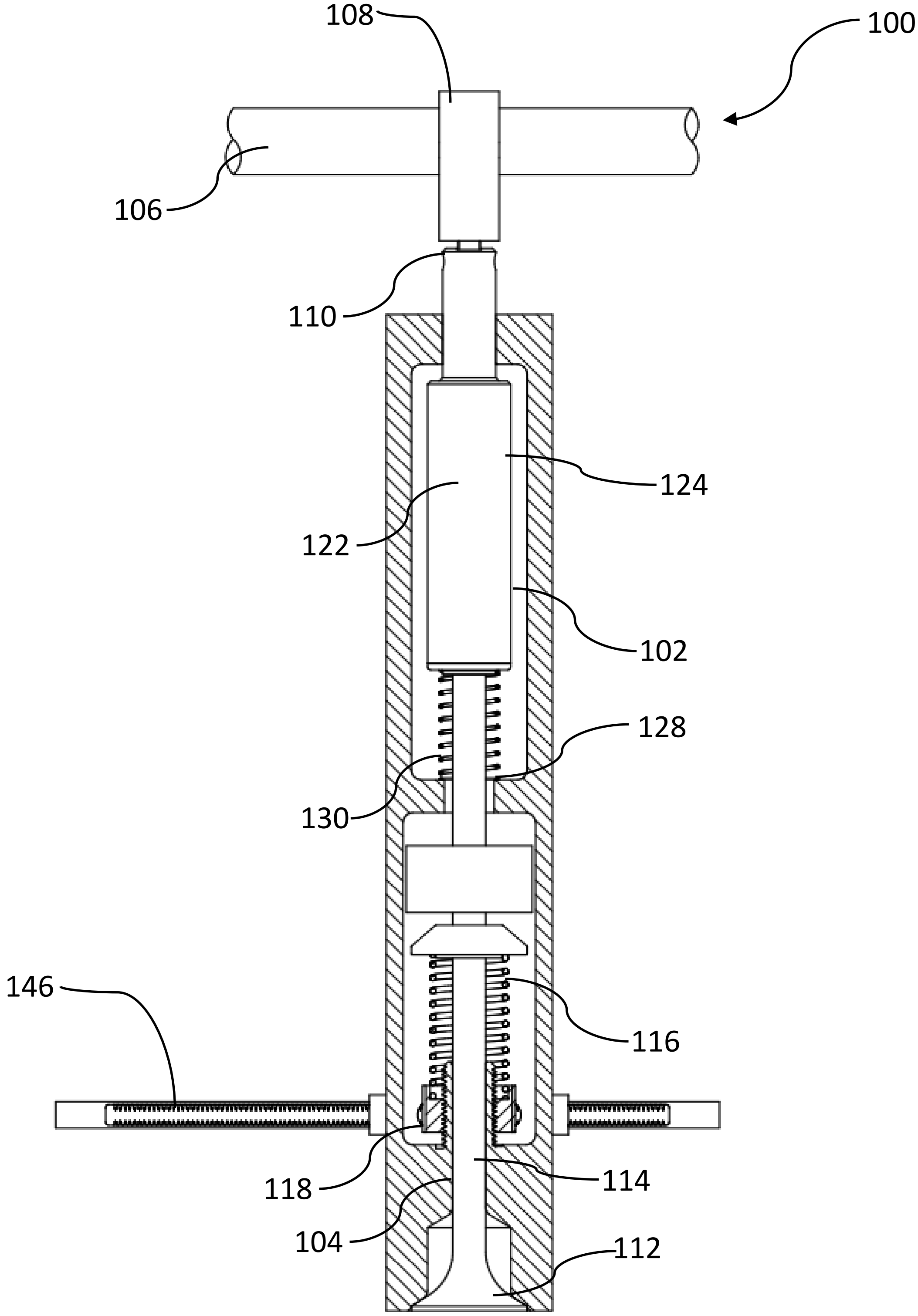

Figure 2

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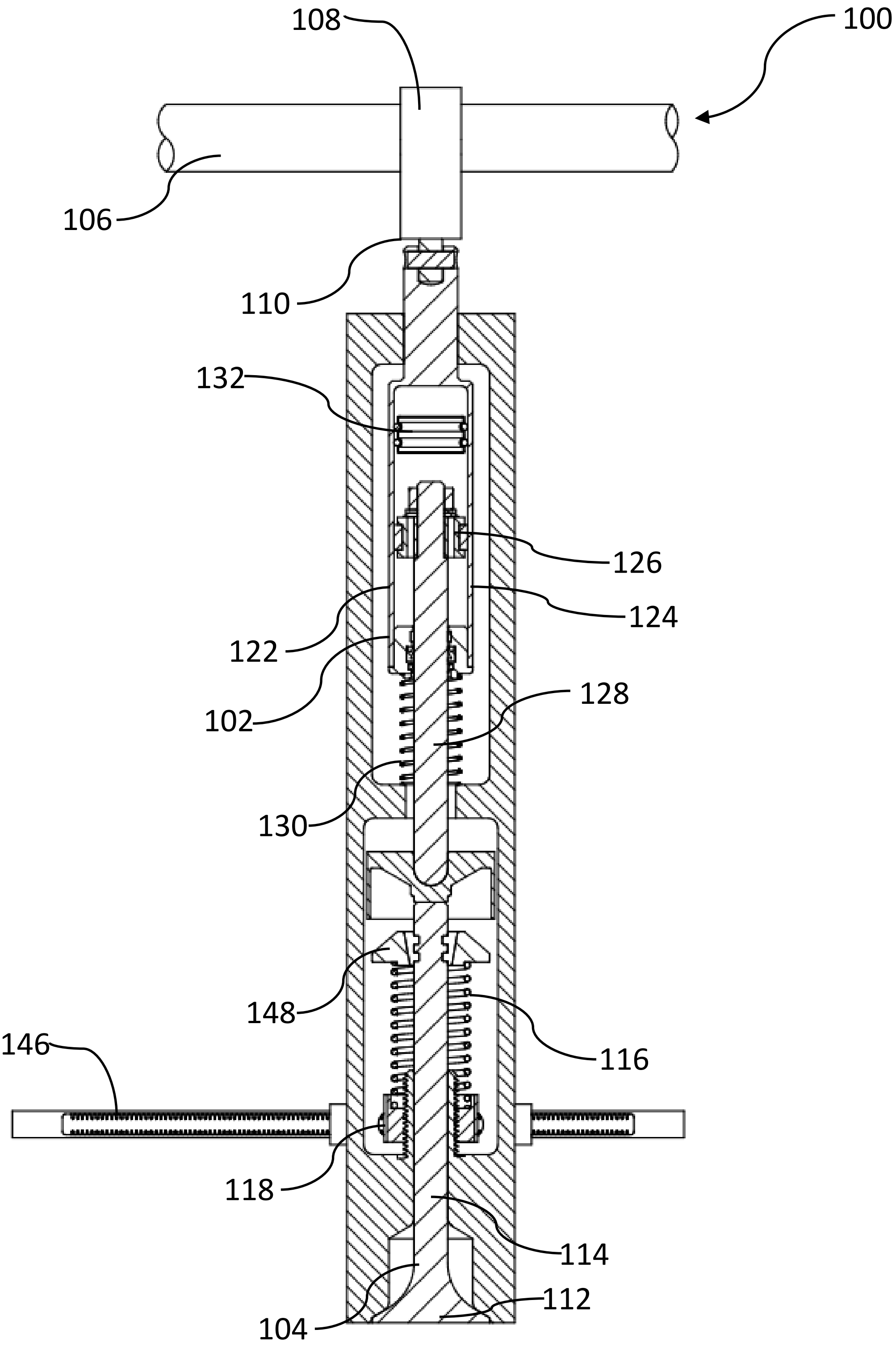

Figure 3

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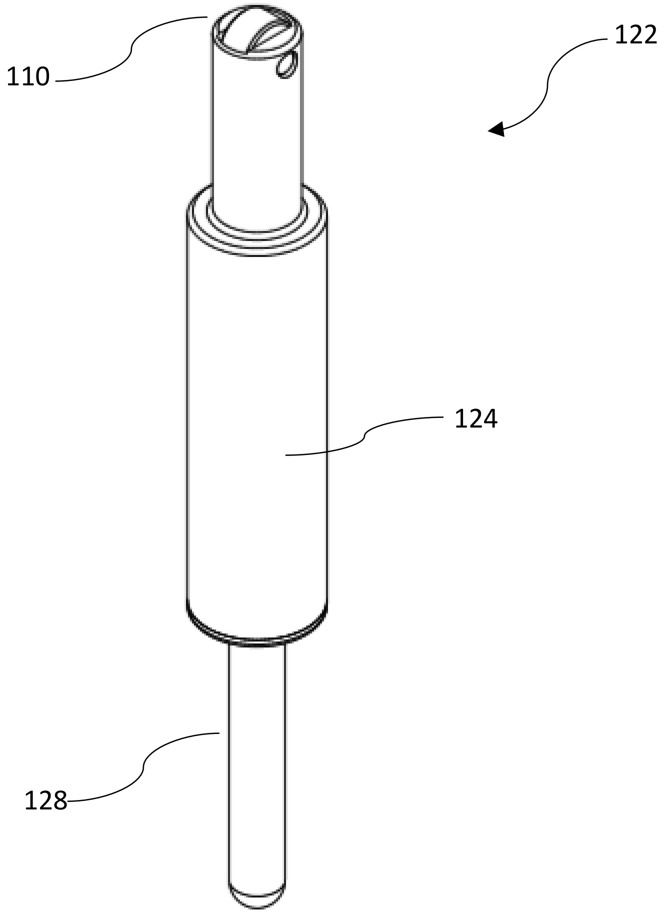

Figure 4

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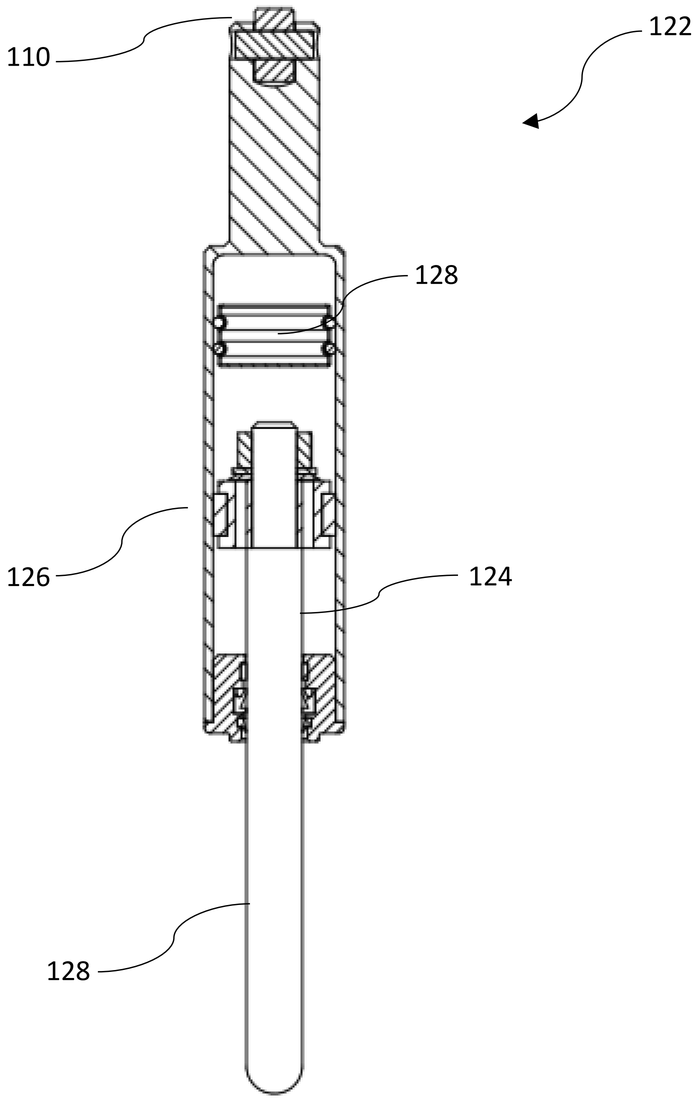

Figure 5

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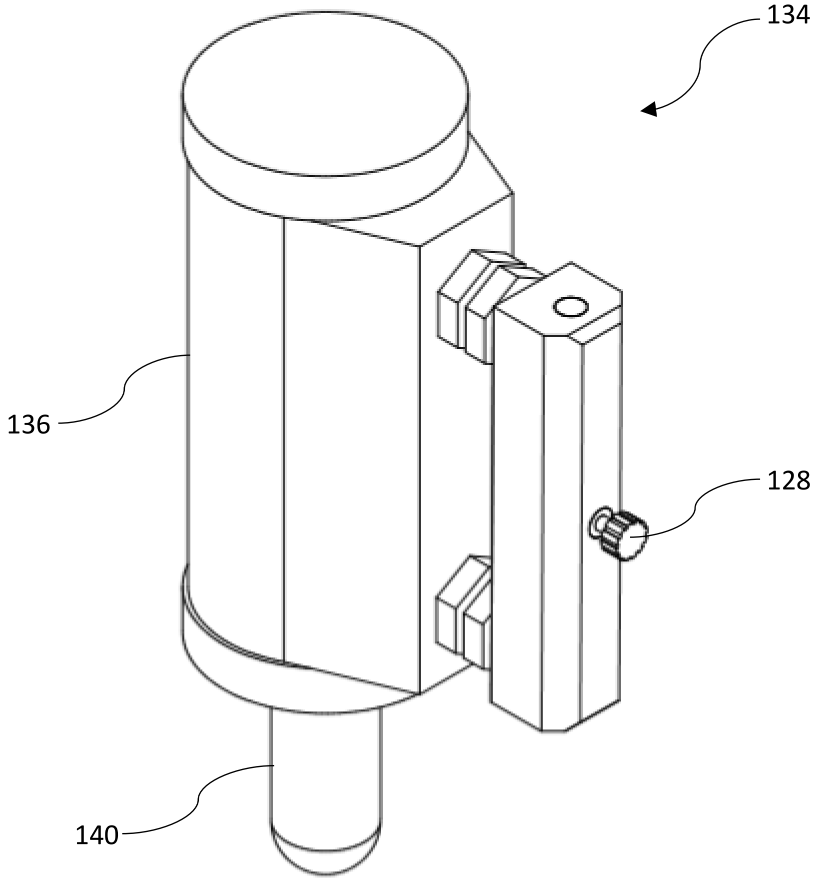

Figure 6

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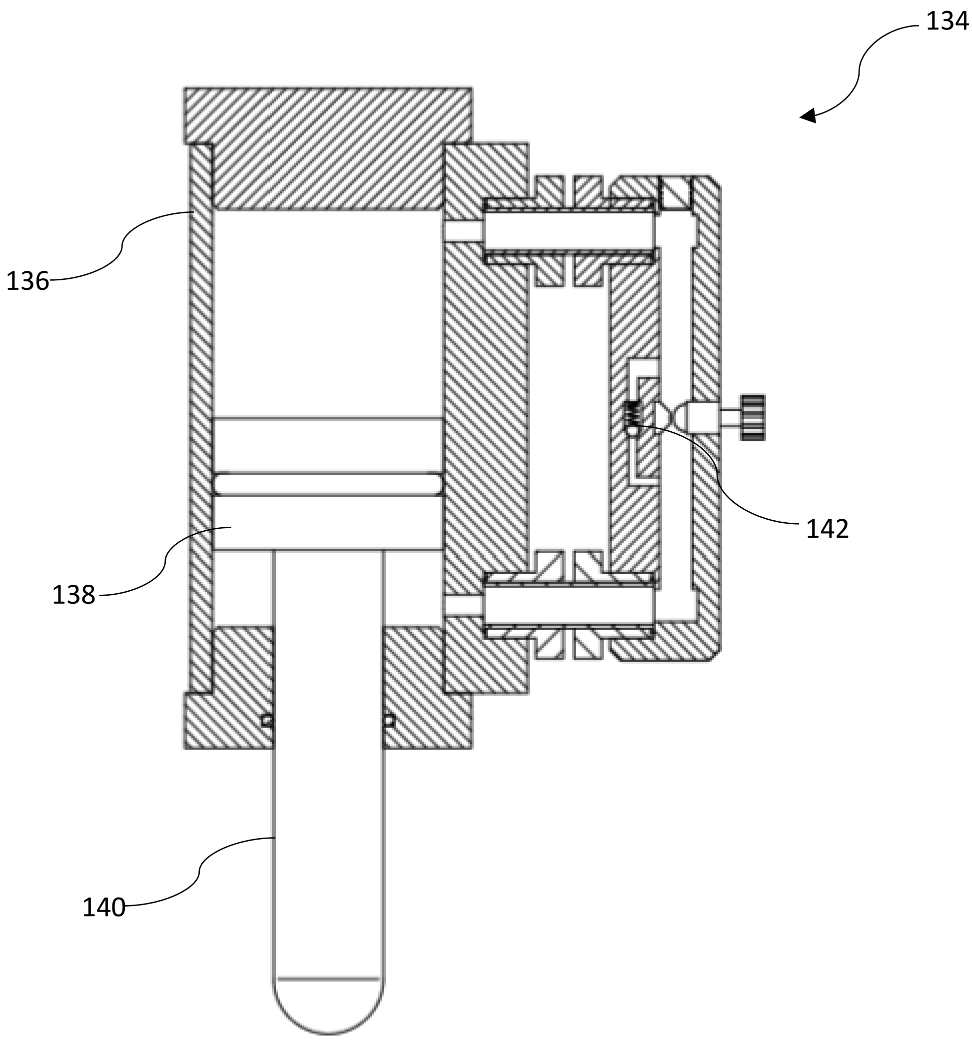

Figure 7

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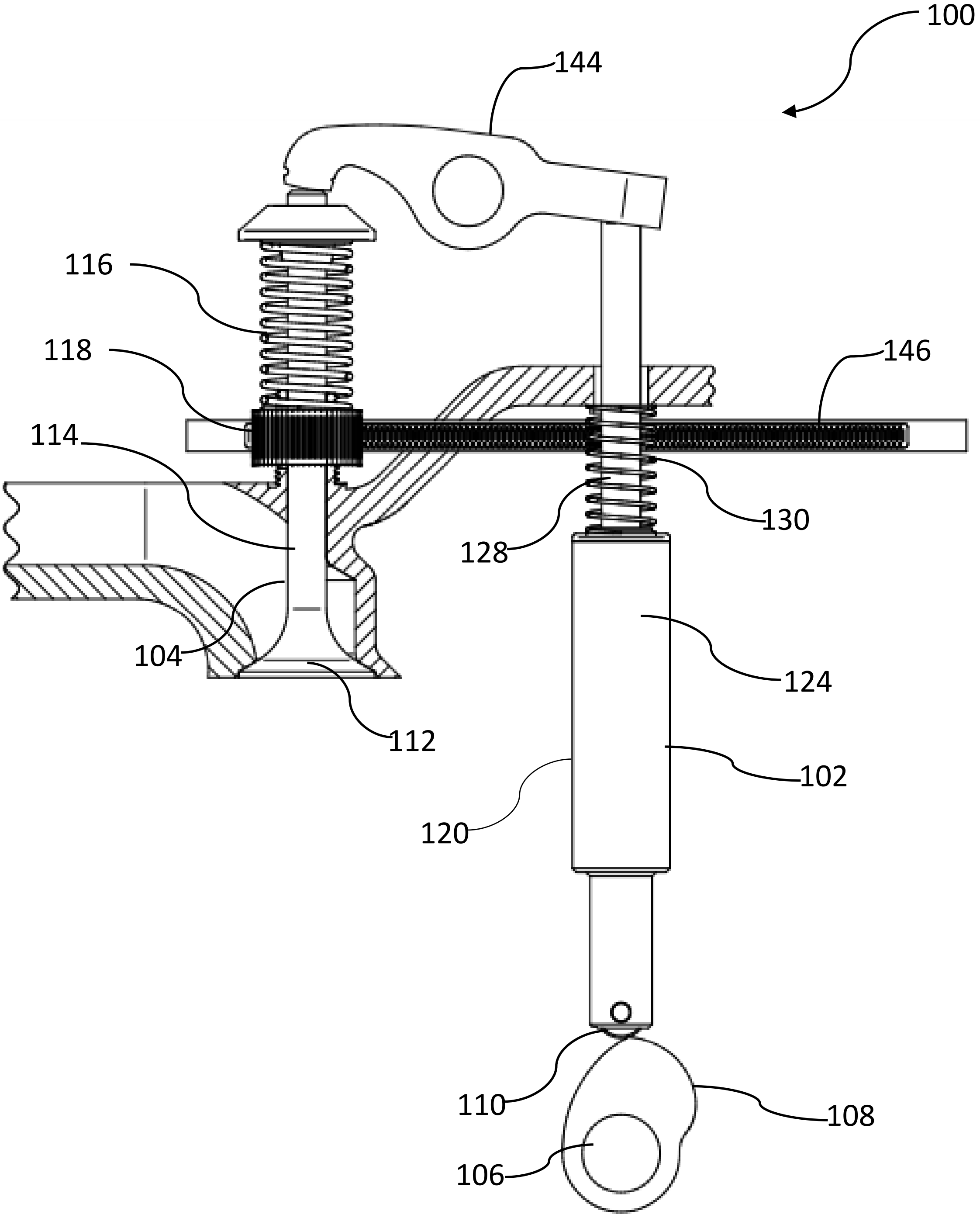

Figure 8

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