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(54) Title: LATCH ORIENTATION MECHANISM

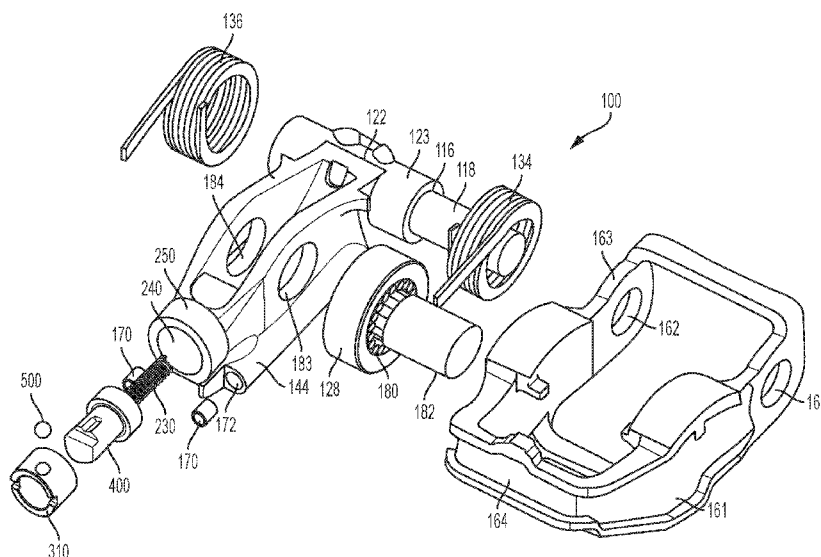


FIG. 1

(57) Abstract: A latch assembly comprises a hollow bore comprising a cylindrical inner surface. A latch comprises a base abutting the cylindrical inner surface. A body comprises a first end adjoining the base, a distal end distanced from the first end, and a groove extending from the distal end towards the first end. A sleeve surrounds the body and is fitted to the cylindrical inner surface. The sleeve comprises an opening, and a ball aligns the opening with the groove.

LATCH ORIENTATION MECHANISM

Field

[001] This application relates to a latch orientation mechanism for a switching rocker arm.

Background

[002] A rocker arm for a cam of an internal combustion engine comprises a reciprocating latching mechanism. The latching mechanism must be oriented during operation in order to latch and unlatch effectively. However, prior alignment mechanisms are difficult to align during manufacture. Prior alignment mechanisms are also prone to cracking an abutting sleeve.

SUMMARY

[003] The methods and devices disclosed herein overcome the above disadvantages and improves the art by way of a latch assembly, which comprises a hollow bore comprising a cylindrical inner surface. A latch comprises a base abutting the cylindrical inner surface. A body comprises a first end adjoining the base, a distal end distanced from the first end, and a groove extending from the distal end towards the first end. A sleeve surrounds the body and is fitted to the cylindrical inner surface. The sleeve comprises an opening, and a ball aligns the opening with the groove.

[004] Additional objects and advantages will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the disclosure. The objects and advantages will also be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[005] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the claimed invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[006] Figure 1 is an exploded view of a rocker arm assembly.

[007] Figure 2 is a perspective view of a latch assembly in an inner rocker arm.

[008] Figure 3 is a cross-section of a latch assembly in an inner rocker arm.

[009] Figure 4 is a view of a latch.

[010] Figure 5 is a view of a sleeve.

[011] Figure 6A is an alternative cross-section of a latch assembly extended in an inner rocker arm.

[012] Figure 6B is an alternative cross-section of a latch assembly retracted in an inner rocker arm.

[013] Figure 7 is a simplified view of latch and sleeve alignment.

DETAILED DESCRIPTION

[014] Reference will now be made in detail to the examples which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. Directional references such as “left” and “right” are for ease of reference to the figures.

[015] A rocker arm 100 is positioned between a rotating cam and a spring to lift and lower an engine valve affiliated with the rocker arm. The spring biases the rocker arm and the valve in one direction, and the cam rotates to press against the rocker arm to move the valve in the opposite direction. The rocker arm 100 can be affiliated with a lash adjuster to assist with the valve actuation.

[016] A rocker arm 100 can comprise switching mechanisms to permit selection of the extent of valve actuation. Figure 1 shows an inner rocker arm 122 and an outer rocker arm 164 that cooperate with a latch assembly 10 to permit switchable valve actuation.

[017] The inner arm houses the latch assembly 10 in a neck 250. The neck 250 has a hollow bore 240 with a cylindrical inner surface. Cylindrical inner surface comprises first bore surface 244 with a first bore diameter and a second bore surface 242 with a second bore diameter D3. The second bore diameter is greater than the first bore diameter.

[018] A latch 400 comprises a base 405 abutting the cylindrical inner surface 240. The base 405 reciprocates in the bore towards and away from end wall 246 of the

bore. The base 405 moves along the bore 240 in and out of adjacency to second bore surface 242.

[019] Hydraulic fluid can be supplied to a receptacle 440 through a fluid port 248. The receptacle 440 is oriented in the bore 240 to receive pressurized hydraulic fluid through the fluid port 248 in the bore 240. The second bore D3 diameter permits hydraulic fluid pressure control against the latch 400. Further control of latch action against the hydraulic fluid can be attained by forming one or more chamfers, such as angled edges 407, 409. An optional spring 230 biases the latch 400 away from the end wall 246.

[020] The latch comprises a body 460 with a first end 403 adjoining the base 405 and a distal end 401 distanced from the first end 403. A groove 430 extends from the distal end 401 towards the first end 403. Groove 430 is "V" shaped. The "V" shape is a departure from prior designs, which can be dado grooves. The "V" groove has fewer angles and greater stress resistance than the dado groove.

[021] A sleeve 310 surrounds the body 460 and is fitted to the cylindrical inner surface of the bore 240. The sleeve can be press-fit or slip-fit against first bore surface 244 so that the sleeve does not move during latch 400 motion. The sleeve can comprise alignment notches 330 to permit rotation of the sleeve 310 during the assembly process. The sleeve comprises an opening, which can be stepped opening 320 or tapered opening 322.

[022] A spherical ball 500 aligns the opening 320 or 322 with the groove 430. The ball 500 can be sized to roll in the groove 430 when the latch 400 reciprocates in the bore 240. The ball 500 can also be press-fit or slip-fit in the opening 320 or 322, or the ball freely floats in the opening. The ball departs from the orientation-sensitive pins of the prior art. In addition to being easier to align with the sleeve during assembly, the ball permits faster latch action during rocker arm use.

[023] During use, the base 405 reciprocates in the bore 240 while the body 460 reciprocates in the sleeve 310. As shown in Figure 7, the ball 500 prevents rotation, shown as the double-headed arrow, when the latch reciprocates in the bore. This permits alignment of switching features during rocker arm use.

[024] The distal end 401 of the latch further comprises a step forming a vertical portion 420 and a flat surface 410. The ball 500 in the opening 320, 322 aligns the flat surface 410 with respect to the bore 240 when the latch 400 reciprocates. When the latch is fully extended, as shown in Figure 6A, the flat surface 410 protrudes out of the neck 250 and the outer rocker arm 164 catches against the latch 400. That is, the cam cannot push the outer rocker arm down past the latch. Lower arm surface 165 abuts flat surface 410. The lower arm surface 165 selectively engages and disengages the latch 400 when the outer arm 164 pivots relative to the inner arm 122.

[025] But when the latch 400 recedes in to the bore 240, as shown in Figure 6B, the outer face 411 is withdrawn enough for the rear arm surface 167 to clear the end of the neck 250 and the latch 400. The cam can push the outer rocker arm farther and the valve experiences a different actuation height. By controlling the inward or outward motion of the latch 400, and the extent of outer rocker arm 164 travel, the engine valve is selectively operated.

[026] The bore 240 can connect via fluid port 248 with a hydraulic feed. Hydraulic control determines whether the latch is extended, as shown in Figure 6A, or retracted, as shown in figure 6B. Customary control, such as memory, processor, and programming, can control an affiliated fluid pressurizer, such as a bi-directional pump, or motor and bleed valve combination. Supplies and sumps can also couple to the hydraulic feed. The inner arm can optionally comprise galleries 144 to port the hydraulic fluid, and affiliated plugs 170 can prevent fluid loss through the galleries 144. Drilled or molded passageways connect the bore 240 to the galleries 144.

[027] To control the fluid pressure, the latch 400 can comprise various diameters. For example, the base 405 comprises a base diameter D_2 , and the body 460 comprises a body diameter D_1 smaller than the base diameter D_2 . The base 405 acts as a retaining wall for the fluid.

[028] The collar 123 of the inner arm comprises a pass-through 116 for a pivot axle 118. The pivot axle 118 connects the outer arm 164 to the inner arm 122. Optional torsion springs 134, 136 bias the outer rocker arm 164.

[029] The inner arm 122 can optionally comprise holes 183, 184 for receiving an axle 182 for an optional bearing assembly 128 with rollers 180 to assist with cam motion.

[030] A method for assembling a rocker arm is simplified using the ball and V-groove arrangement. The opening 320, 322 in the sleeve 310 is aligned with the “V” shaped groove 430 of the latch. The ball is inserted in to the opening 320 or 322 to couple the opening with the groove. Compared to pin-type designs, the ball is easier to feed in to assembly machinery, as it is not orientation-specific.

[031] The ball can freely float in the opening, which prevents the sleeve 310 from cracking during assembly. A small amount of “play” can remain between the ball and the opening 320 or 322, and the ball can roll or ride in the groove 430. The easy motion of the ball against the groove can permit faster latch action, thus improving valve action and engine efficiency. It is also possible to press-fit or slip fit the ball in to the opening 320 or 322. Compared to pin-type designs, the tolerances of the opening 320 or 322 can be relaxed when using the ball and groove.

[032] The assembly method can further comprise inserting the sleeve, the latch, and the ball in to the hollow bore 240 of the inner rocker arm 122 and fitting the sleeve against the cylindrical inner surface of the hollow bore 240.

[033] The method can further comprise connecting the outer rocker arm to the inner rocker arm by the pivot axle.

[034] Using an alignment notch 600 in the outer face 411 of the latch, the rocker arm 100 can be adjusted for alignment of the latch 400 with the outer arm 164. The rotation in Figure 7 can be manually applied to the sleeve 310 or the latch 400 or both to ensure that the flat surface 410 of the latch is positioned to catch the lower arm surface 165 when the latch 400 extends out of the bore. As above, the tolerances of the sleeve, the ball 500 and the groove 430 can be selected to ensure that latch action does not rotate the latch or the sleeve with respect to the outer arm 164.

[035] Other implementations will be apparent to those skilled in the art from consideration of the specification and practice of the examples disclosed herein. It is intended that the specification and examples be considered as exemplary only, with the true scope of the invention being indicated by the following claims.

WHAT IS CLAIMED IS:

1. A latch assembly, comprising:
 - a hollow bore comprising a cylindrical inner surface;
 - a latch comprising:
 - a base abutting the cylindrical inner surface;
 - a body comprising:
 - a first end adjoining the base;
 - a distal end distanced from the first end; and
 - a groove extending from the distal end towards the first end;
 - a sleeve surrounding the body and fitted to the cylindrical inner surface, the sleeve comprising an opening; and
 - a ball aligning the opening with the groove.
2. The latch assembly of claim 1, wherein the base reciprocates in the bore and wherein the body reciprocates in the sleeve.
3. The latch assembly of claim 1 or 2, wherein the ball rolls in the groove when the latch reciprocates in the bore.
4. The latch assembly of claim 1 or 2, wherein the ball is press-fit in the opening.
5. The latch assembly of claim 1 or 2, wherein the ball floats freely in the opening.
6. The latch assembly of claim 1, wherein the groove is "V" shaped.
7. The latch assembly of claim 1, wherein the opening is one of a tapered hole and a stepped hole.
8. The latch assembly of claim 1, wherein the distal end further comprises a step forming a flat surface, and wherein the ball in the opening aligns the flat surface with respect to the bore when the latch reciprocates in the bore.
9. The latch assembly of claim 1, further comprising a hydraulic feed connected to the bore, wherein the latch further comprises a receptacle, and wherein the hydraulic feed is connected to move the latch in the bore.
10. The latch assembly of claim 9, further comprising a spring in the receptacle, and the spring biases the latch away from the bore.

11. The latch assembly of claim 1, wherein the base comprises a base diameter, wherein the base abuts the cylindrical inner surface, and wherein the body comprises a body diameter smaller than the first base diameter.
12. The latch assembly of any one of claims 9-11, wherein the bore comprises an end surface, wherein the base comprises at least one angled edge facing the end surface.
13. The latch assembly of claim 12, wherein the base comprises at least two angled edges.
14. The latch assembly of claim 12, wherein the cylindrical inner surface of the bore comprises a first bore diameter surrounding the sleeve and a second bore diameter adjacent the end surface, and wherein the second bore diameter is greater than the first bore diameter.
15. A rocker arm comprising:
 - an inner arm, comprising:
 - a hollow bore comprising a cylindrical inner surface;
 - a latch comprising:
 - a base abutting the cylindrical inner surface;
 - a body comprising:
 - a first end adjoining the base;
 - a distal end displaced from the first end; and
 - a groove extending from the distal end towards the first end;
 - a sleeve surrounding the body and fitted to the cylindrical inner surface, the sleeve comprising an opening; and
 - a ball aligning the opening with the groove; and
 - at least one pass-through;
 - a pivot axle in the pass-through;
 - an outer arm connected to the pivot axle, the outer arm comprising an end face for selectively engaging and disengaging the latch when the outer arm pivots relative to the inner arm.
16. The rocker arm of claim 15, wherein the ball one of rolls, floats freely or is press-fit in the opening.

17. The rocker arm of claim 15, wherein the groove is "V" shaped.
18. The rocker arm of claim 15, wherein the base comprises a base diameter, wherein the base abuts the cylindrical inner surface, and wherein the body comprises a body diameter smaller than the first base diameter.
19. The rocker arm of claim 15, further comprising a hydraulic feed to the bore to supply pressurized fluid against the base, wherein the base reciprocates in the bore and wherein the body reciprocates in the sleeve in response to the pressurized fluid.
20. The rocker arm of claim 15, wherein the distal end further comprises a step forming a flat surface, and wherein the ball in the opening aligns the flat surface with respect to the bore when the latch reciprocates in the bore.
21. The rocker arm of one of claims 15 or 18-20, wherein the latch further comprises a receptacle, wherein the bore further comprises a fluid port, and wherein the receptacle is oriented in the bore to received pressurized hydraulic fluid through the fluid port in the bore.
22. The rocker arm of claim 21, further comprising a spring in the receptacle, and the spring biases the latch away from the bore.
23. A method for assembling a rocker arm, comprising:
 - aligning an opening in a sleeve with a "V" shaped groove of a latch;
 - inserting a ball in to the opening to couple the opening with the groove; and
 - inserting the sleeve, the latch, and the ball in to a hollow bore of an inner rocker arm and fitting the sleeve against a cylindrical inner surface of the hollow bore.
24. The method of claim 23, further comprising connecting an outer rocker arm to the inner rocker arm by a pivot pin in a pivot hole, the outer arm comprising an end face for selectively engaging and disengaging the latch when the outer arm pivots relative to the inner arm.

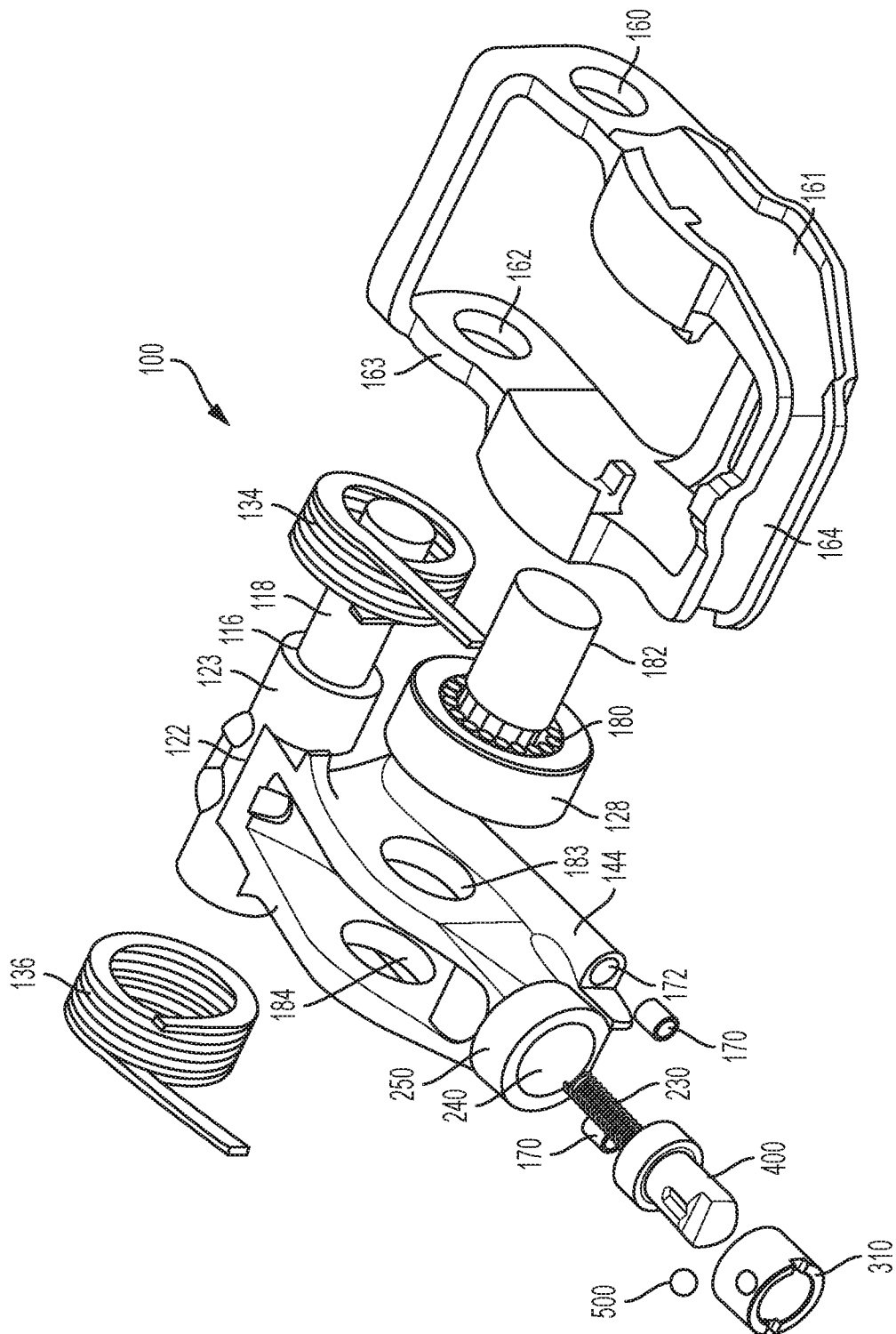


FIG. 1

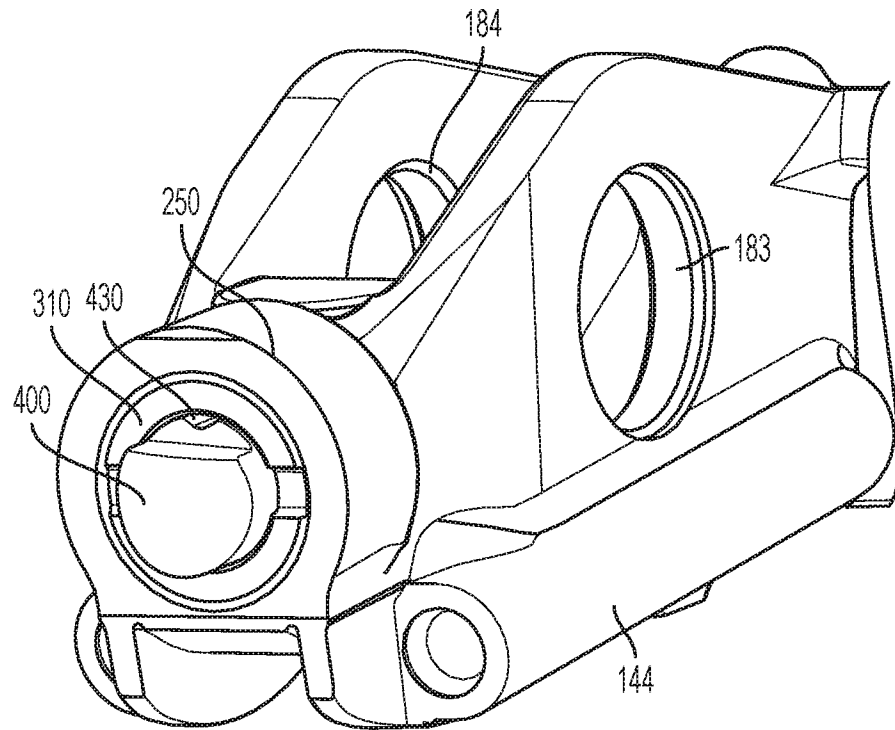


FIG. 2

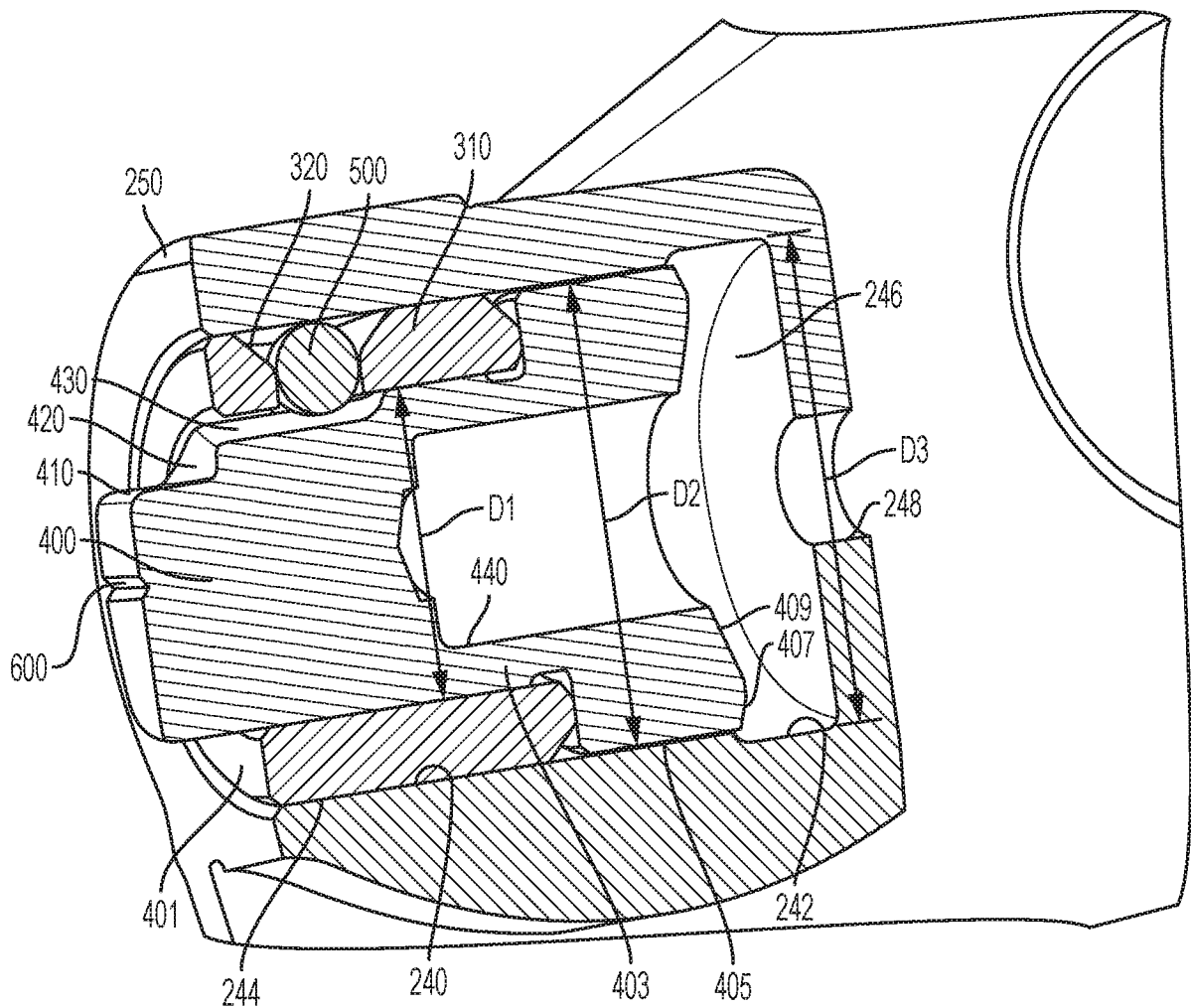


FIG. 3

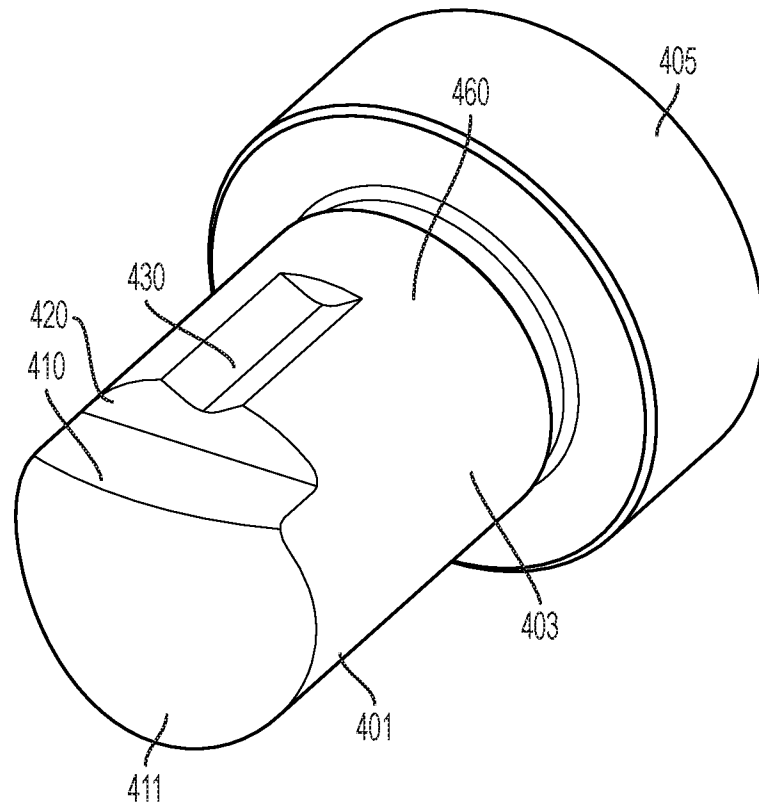


FIG. 4

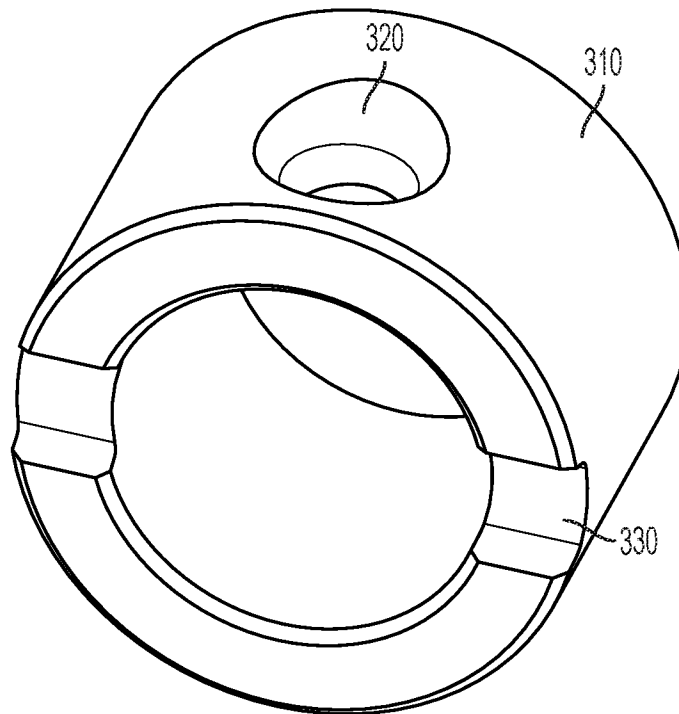


FIG. 5

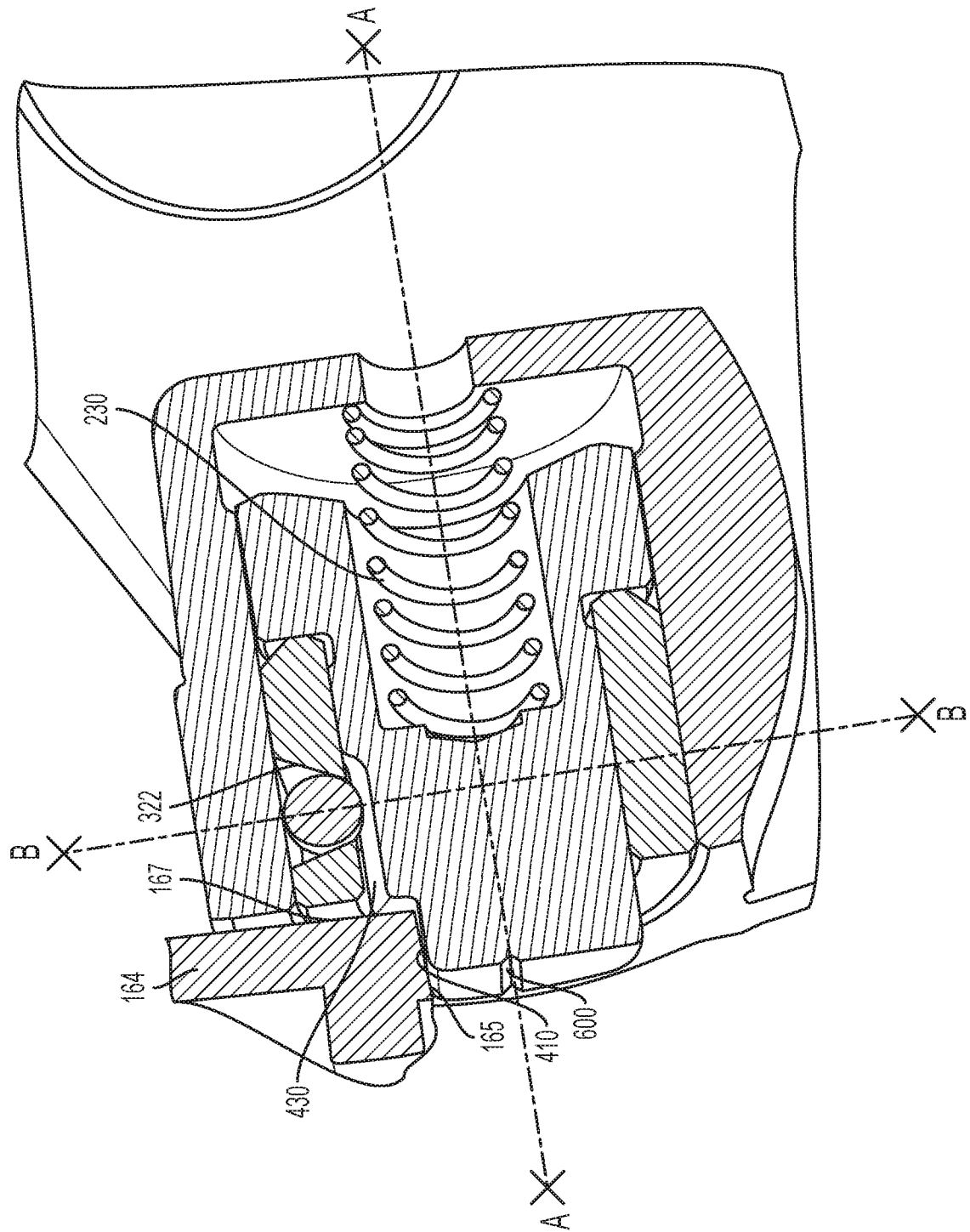
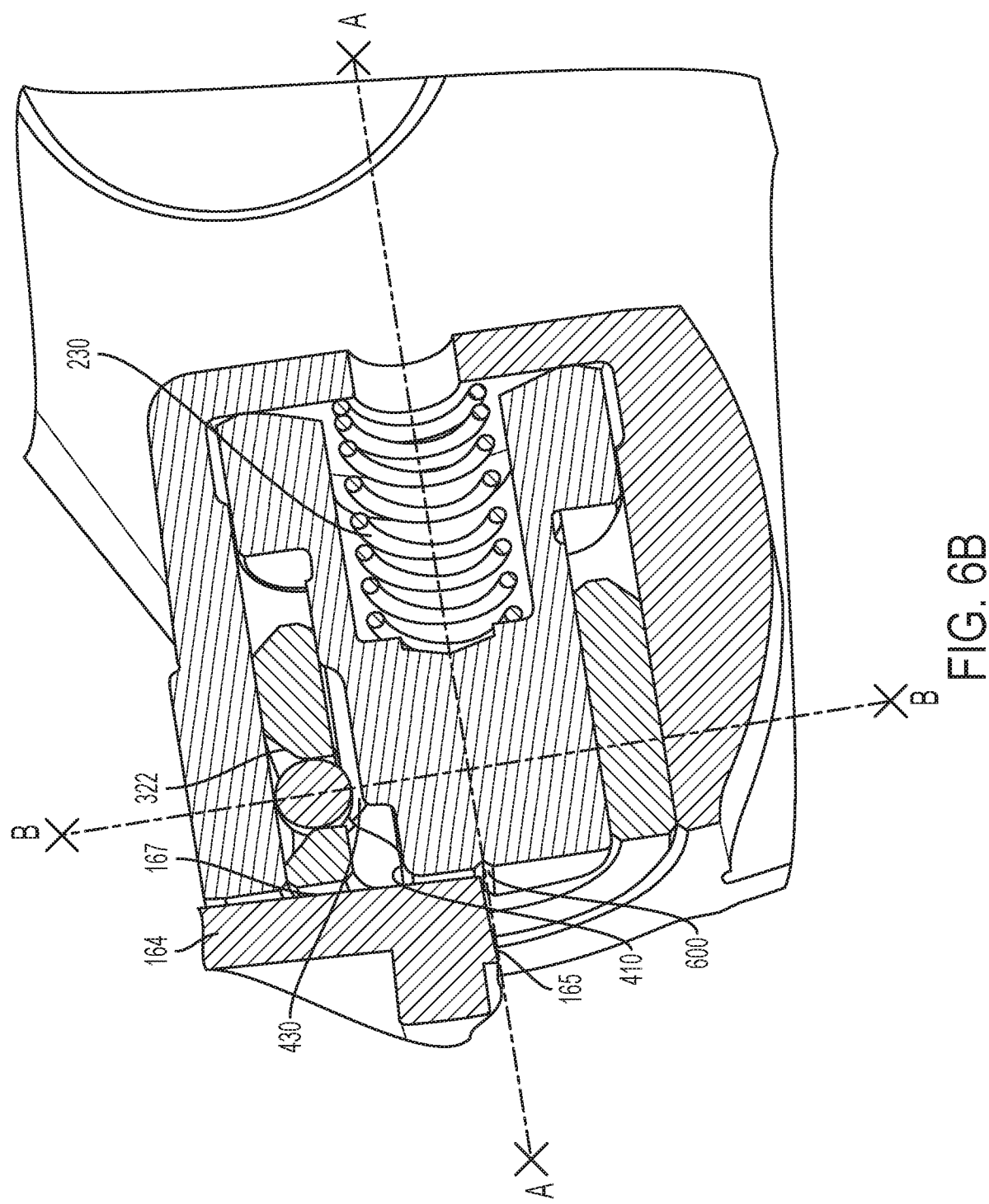


FIG. 6A



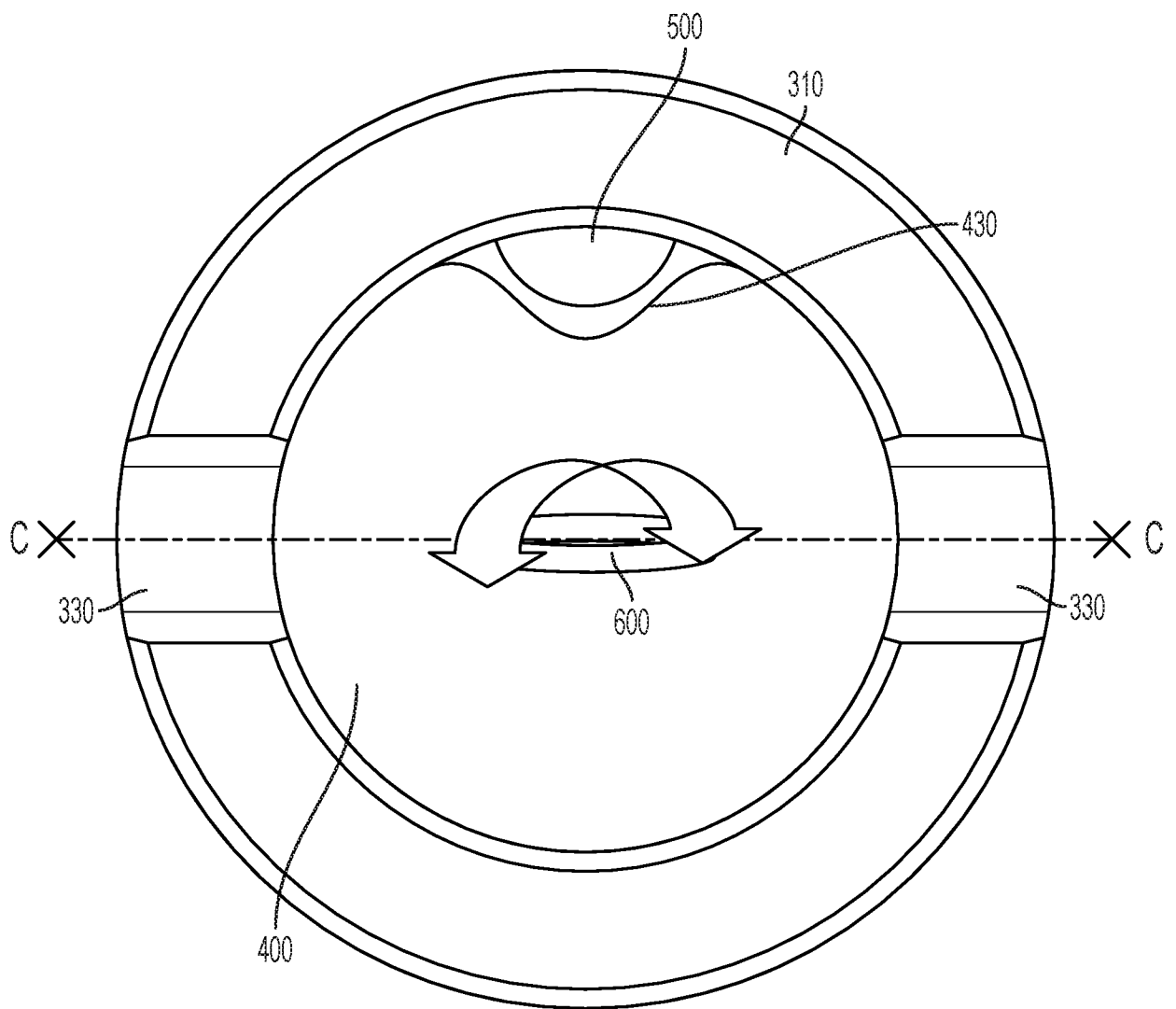


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/032622**A. CLASSIFICATION OF SUBJECT MATTER****F01L 1/18(2006.01)I, F01L 13/02(2006.01)I**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F01L 1/18; F01L 13/08; F01L 13/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: rocker arm, latch, groove, sleeve, ball, aligning, receptacle, and spring

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2013-0312506 A1 (EATON CORPORATION) 28 November 2013 See paragraphs [0234]-[0254], [0280]-[0287] and figures 19, 32-37.	1-24
Y	US 6966291 B1 (FISCHER et al.) 22 November 2005 See column 4, line 12 - column 5, line 13 and figures 1-1a.	1-24
A	US 2014-0290608 A1 (EATON CORPORATION) 02 October 2014 See paragraphs [0034]-[0053] and figures 2-10.	1-24
A	US 2014-0182539 A1 (JACOBS VEHICLE SYSTEMS, INC.) 03 July 2014 See paragraphs [0033]-[0034] and figures 6-7.	1-24
A	US 2009-0000584 A1 (RORIG et al.) 01 January 2009 See paragraphs [0026]-[0029] and figure 3.	1-24



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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