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(54) Valve actuation and rocker arm arrangement

(57) This disclosure is directed to a valve actuation and rocker arm arrangement for an internal combustion engine. The rocker arm arrangement (30) comprises a first rocker arm (31) and a second rocker arm (35), wherein the first (31) and second (35) rocker arms are pivotally mountable on a rocker shaft (39) and one of the first (31) or second (35) rocker arms is configured to be positioned within the other of the of the first (31) or second (35) rocker arms. The valve actuation arrangement (10) comprises a rocker arm arrangement (30) according to the disclosure, at least one inlet valve actuable by one of the first (31) or second (35) rocker arms, and at least one exhaust valve actuable by the other of the first (31) or second (35) rocker arms.

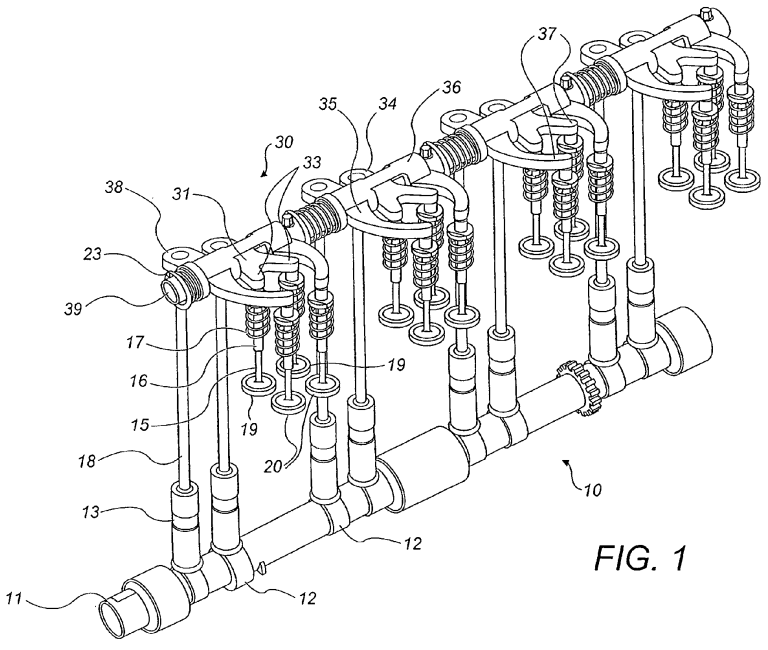

FIG. 1

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Description

Technical Field

[0001] This disclosure is directed to a valve actuation and rocker arm arrangement for an internal combustion engine.

Background

[0002] Internal combustion engines generally comprise a number of cylinders, each with at least one intake valve and at least one exhaust valve. A common arrangement is for each cylinder to have two intake valves and two exhaust valves, with the valves being actuated via a rocker arm and cam arrangement. Alternatively, there may be two of one type of valve and one of the other.

[0003] Overhead valve engines are internal combustion engines wherein the intake and exhaust valves are located in the cylinder head, while the camshaft may be placed in the cylinder block. In such an arrangement, the valves may be actuated by the camshaft through the intermediation of lifters (also known as tappets), push rods, and rocker arms, in that order. The valves and their associated mechanisms make up the valve train.

[0004] Preferably, the rocker arms for the intake and exhaust valves use a common rocker shaft in order to reduce the weight and space required for the mechanism. Such an arrangement is disclosed in WO-A-2010/057648.

[0005] Many engines utilise a diamond configuration for the intake and exhaust valves. Such an arrangement aids the use of a common rocker shaft. However, this configuration can lead to throttling of the intake and exhaust ports, as the width of each of the ports is restricted due to the orientation of the port and its needing to navigate between cylinder head bolt bosses, pushrod apertures and other restrictions to reach the valves.

[0006] Instead of a diamond valve configuration, a square valve pattern may be employed. In a square valve pattern, the intake and exhaust valves are disposed on the side of the cylinder head closest to their respective ports.

Summary

[0007] According to one aspect of the present disclosure there is provided a rocker arm arrangement (30) for an internal combustion engine, comprising:

a first rocker arm (31) comprising a first connecting body (32) and at least one first actuating lever (33)' projecting from the first connecting body (32) ; and
a second rocker arm (35) comprising a second connecting body (36) and at least one second actuating lever (37) projecting from the second connecting body (36) ; wherein
the first rocker arm (31) is pivotally mountable on a rocker shaft (39);
the second rocker arm (35) is pivotally mountable on the same rocker shaft (39); and
one of the first (31) or second (35) rocker arms is configured to be positioned within the other of the first (31) or second (35) rocker arms.

[0008] According to a further aspect of the present disclosure there is provided a valve actuation arrangement (10) for an internal combustion engine, comprising:

a rocker arm arrangement (30) according to any one of the preceding claims;
at least one inlet valve actuable by one of the first (31) or second (35) rocker arms; and
at least one exhaust valve actuable by the other of the first (31) or second (35) rocker arms.

[0009] One exemplary embodiment of a rocker arm arrangement for an internal combustion engine is as described with reference to, and as shown in the accompanying drawings.

Brief Description of the Drawings

[0010]

Figure 1 is a perspective view of a valve train incorporating a rocker arm arrangement according to the present disclosure;

Figure 2 is a more detailed perspective view of the rocker arm arrangement shown in Figure 1;

Figure 3 is a side view of the rocker arm arrangement of Figure 2; and

Figure 4 is a rear view of the rocker arm arrangement of Figure 2.

Detailed Description

[0011] Figure 1 illustrates a valve actuation arrangement 10 for an internal combustion engine (not shown) including a rocker arm arrangement 30 as described in further detail below. The valve actuation arrangement 10 shown is in the form of a valve train 10 suitable for use in an overhead valve engine with a substantially square shaped valve configuration. The valve train 10 is depicted as a valve train for a four-cylinder, four-stroke, inline internal combustion engine, having four valves per cylinder. One skilled in the art will recognize, however, that valve trains comprising the valve actuation 10 and rocker arm 30 arrangements described below may be used in many other types of overhead valve engines with any number of cylinders in any configuration, for example an inline or V-configuration.

[0012] The valve train 10 may include a camshaft 11

of a conventional design, having cam lobes 12. In total, the depicted camshaft 11 features eight cam lobes 12, two for each cylinder of the four-cylinder engine with which valve train 10 may be used. Lifters 13, such as hydraulic tappets, may abut camshaft 11 where cam lobes 12 are provided, so that a rotating motion of the camshaft 11 results in periodic activation of the lifters 13. Each lifter 13 may support a first end of an elongate push rod 18. A second end of the push rod 18 may normally be in contact with a first end 34,38 of an associated rocker arm 31,35. The operable connection between the second end of the push rod 18 and the first end 34,38 of the rocker arm 31,35 may be secured by a push rod retainer 23. The rocker arms 31,35 are pivotably mounted on a rocker shaft 39.

[0013] Actuation ends of a rocker arm 31,35, located opposite the first ends 34,38, may mechanically operate a pair of valves 19,20. Each valve 19,20 may be provided at an end of a valve stem 15 that may be slidably mounted within a valve stem guide 16. An upper end of each valve stem 15 may be connected to a valve spring 17 to bias the valve 19,20 towards its closed position, in touch with a valve seat (not shown).

[0014] In an alternative valve train arrangement, camshaft 11 may be an overhead camshaft that acts on the upper surface of rocker arm 31,35.

[0015] Figures 2 to 4 show the rocker arm arrangement 30 used in the valve actuation arrangement 10 of Figure 1. The rocker arm arrangement 30 may be disposed to actuate two inlet and two exhaust valves 19,20 in a substantially square valve arrangement. The two sets of valves 19,20 may be operated by two rocker arms 31 and 35. The rocker arms 31 and 35 may be pivotally mounted on a common rocker shaft 39. The substantially square shape formed by the valves 19,20 may be oriented such that two of its edges lie parallel to a longitudinal axis 40 of rocker shaft 39 and two of its edges lie perpendicular to longitudinal axis 40 of rocker shaft 39. One set of valves 19,20 may comprise the two valves 19 that are more closely disposed to rocker shaft 39, and the other set of valves 19,20 may comprise the two valves 20 that are more remotely disposed to rocker shaft 39. Either one of the sets of valves 19,20 may be inlet valves, and the other set may be exhaust valves.

[0016] Each set of inlet/exhaust valves 19 proximal to the rocker shaft 39 may be actuated by a first rocker arm 31. The first rocker arm 31 may have a 'split' configuration, namely a generally forked, Y- or C-shaped configuration comprising a connecting body 32, from which project two actuating levers 33, the ends of which each actuate one valve. The two actuating levers 33 may project in opposing directions from the connecting body 32. A cylindrical bore (not shown) may be provided through the body 32 to enable the pivotal mounting of the first rocker arm 31 on the rocker shaft 39.

[0017] The first rocker arm 31 may further comprise a single point of adjustment 34, to enable the actuation of the levers 33. The single point of adjustment 34 may be in the form of a protrusion 34 extending from the body 32 in an opposing direction to that of the actuating levers 33. The protrusion 34 may have a bore 42 through it to facilitate the actuation. The first rocker arm 31 pivots about rocker shaft 39, and may be driven by a pushrod 18, which may in turn be driven by the camshaft 11.

[0018] Each set of inlet/exhaust valves 20 distal to the rocker shaft 39 may be actuated by a second rocker arm 35. The second rocker arm 35 may also have a 'split' configuration, again being a generally forked, Y- or C-shaped configuration comprising a connecting body 36, from which project two actuating levers 37, the ends of which each actuate one valve. The two actuating levers 37 may project in opposing directions from the connecting body 36. A cylindrical bore 41 through the body 36 may enable the pivotal mounting of the second rocker arm 35 on the rocker shaft 39.

[0019] The second rocker arm 35 may further comprise a single point of adjustment, to enable the actuation of the levers 37. The single point of adjustment may be in the form of a protrusion 38 extending from the body 36 in an opposing direction to that of the actuating levers 37. The protrusion 38 may have a bore 43 through it to facilitate the actuation.

[0020] The second rocker arm 35 also pivots about rocker shaft 39, and may be driven by a pushrod 18, which may in turn be driven by the camshaft 11.

[0021] The first rocker arm 31 may be nested within the second rocker arm 35, such that the connecting body 32 of the first rocker arm 31 is positioned within and is substantially surrounded by the connecting body 36 of the second rocker arm 35. The two rocker arms 31, 35 may lie in substantially the same plane when not actuated by their respective pushrods. The actuating levers 37 of the second rocker arm 35 may be arcuate and may extend around the actuating levers 33 of the first rocker arm 31. This enables a substantially square valve arrangement to be achieved using two rocker arms 31, 35 disposed on a common rocker shaft 39.

[0022] Alternatively, the actuating levers 37 of the second rocker arm 35 may extend around the connecting body 32 of the first rocker arm 31. The ends of the actuating levers 33 of the first rocker arm 31 may then protrude past the ends of the actuating levers 37 of the second rocker arm 35.

[0023] In an alternative embodiment for use with an engine having only three valves per cylinder, first rocker arm 31 may be replaced by an individual rocker arm which may actuate a single inlet/exhaust valve.

[0024] In a further alternative embodiment, for use with an engine having only three valves per cylinder, or, in combination with the previous embodiment, for use with an engine having only two valves per cylinder, second rocker arm 35 may be replaced by an individual rocker arm which may actuate a single inlet/exhaust valve. In this embodiment the actuating lever of the second rocker arm 35 may be arcuate and extend around the actuating lever, or at least one of the actuating levers, of the first

rocker arm 31.

[0025] In a yet further alternative embodiment, the second rocker arm 35 may be nested within the first rocker arm 31, such that the connecting body 36 of the second rocker arm 35 is positioned within and is substantially surrounded by the connecting body 32 of the first rocker arm 31. This embodiment may co-operate with any of the previous embodiments with respect to the number and the arrangement of the actuating levers.

[0026] Rocker arms 31, 35 may be made from cast iron. Shaft 39 may be made from steel, which may be heat treated.

Industrial Applicability

[0027] The disclosure has industrial applicability in the manufacture and operation of valve trains for internal combustion engines.

[0028] During normal operation of the valve actuation arrangement 10 and rocker arm arrangement 30 therefor, the camshaft 11 with the cam lobes 12 may rotate, which in turn may cause the lifters 13 to move the push rods 18 reciprocally upward and downward. As a push rod 18 moves upward, the first end of the associated rocker arm 31,35 may move up accordingly, and may cause the rocker arm to pivot around the rocker shaft 39. The pivoting motion of the rocker arm 31,35 may be such that the actuating levers 33,37 of the rocker arm 31,35 may move downward, thereby displacing a set of inlet/exhaust valves 19,20 from their valve seats (not shown), by pressing on their respective valve stems 15 against the action of the valve springs 17. Due to the continuing rotational motion of the cam lobes 12, the push rod 18 may then move downward as the upward force on the push rod 18 is relieved and thus valve spring 17 may force the rocker arm 31,35 back into its starting position, thereby closing the valves 19,20.

Claims

1. A rocker arm arrangement (30) for an internal combustion engine, comprising:

   a first rocker arm (31) comprising a first connecting body (32) and at least one first actuating lever (33) projecting from the first connecting body (32); and
   a second rocker arm (35) comprising a second connecting body (36) and at least one second actuating lever (37) projecting from the second connecting body (36); wherein
   the first rocker arm (31) is pivotally mountable on a rocker shaft (39) ;
   the second rocker arm (35) is pivotally mountable on the same rocker shaft (39); and
   one of the first (31) or second (35) rocker arms is configured to be positioned within the other of the first (31) or second (35) rocker arms.

2. A rocker arm arrangement (30) according to claim 1, wherein one of the first (31) or second (35) rocker arms is nestable within the other of the first (31) or second (35) rocker arms on the rocker shaft (39).

3. A rocker arm arrangement (30) according to claim 1 or claim 2, wherein one of the first (31) or second (35) rocker arms is configured to be positioned within the other of the first (31) or second (35) rocker arms such that the first (32) or second (36) connecting body is positioned respectively within the second (36) or first (32) connecting body.

4. A rocker arm arrangement (30) according to claim 3, wherein one of the first (32) or second (36) connecting bodies (32) is substantially surrounded by the other of the first (32) or second (36) connecting bodies.

5. A rocker arm arrangement (30) according to any one of the preceding claims, further comprising:

   a first single point of adjustment to actuate the first rocker arm (31); and
   a second single point of adjustment to actuate the second rocker arm (35).

6. A rocker arm arrangement (30) according to any one of the preceding claims, wherein the at least one actuating lever (37) of the second rocker arm (35) is arcuate and extends around the at least one actuating lever (33) of the first rocker arm (31).

7. A rocker arm arrangement (30) according to any one of the preceding claims, wherein the first (31) and second (35) rocker arms extend away from the rocker shaft (39) in a substantially common direction.

8. A rocker arm arrangement (30) according to any one of the preceding claims, wherein the first rocker arm (31) comprises two first actuating levers (33) and the second rocker arm (35) comprises two second actuating levers (37).

9. A rocker arm arrangement (30) according to claim 8, wherein the ends of the two first actuating levers (33) and the ends of the two second actuating levers (37) comprise the four corners of a substantially square configuration.

10. A valve actuation arrangement (30) according to claim 9, wherein the substantially square configuration formed by the ends of the two first actuating levers (33) and the ends of the two second actuating levers (37) is oriented such that two of its edges lie parallel to a longitudinal axis (40) of the rocker shaft

(39) and two of its edges lie perpendicular to the longitudinal axis (40) of the rocker shaft (39).

11. A valve actuation arrangement (10) for an internal combustion engine, comprising:

a rocker arm arrangement (30) according to any one of the preceding claims;
at least one inlet valve actuable by one of the first (31) or second (35) rocker arms; and
at least one exhaust valve actuable by the other of the first (31) or second (35) rocker arms.

12. A valve actuation arrangement (10) according to claim 11, wherein the rocker arm arrangement (30) is pivotally mounted on a rocker shaft (39).

13. A valve actuation arrangement (10) according to claim 12, wherein:

the at least one inlet or exhaust valve is proximal to the rocker shaft (39) and configured for actuation by the first rocker arm (31) ; and
the other valve type is distal to the rocker shaft (39) and configured for actuation by the second rocker arm (35).

14. A valve actuation arrangement (10) according to any one of claims 11 to 13, wherein the first rocker arm (31) comprises two first actuating levers (33) and the second rocker arm (35) comprises two second actuating levers (37), and wherein the four valves comprise the four corners of a substantially square configuration.

15. A valve actuation arrangement (10) according to claim 14, wherein the substantially square configuration formed by the valves (19,20) is oriented such that two of its edges lie parallel to a longitudinal axis (40) of the rocker shaft (39) and two of its edges lie perpendicular to the longitudinal axis (40) of the rocker shaft (39).

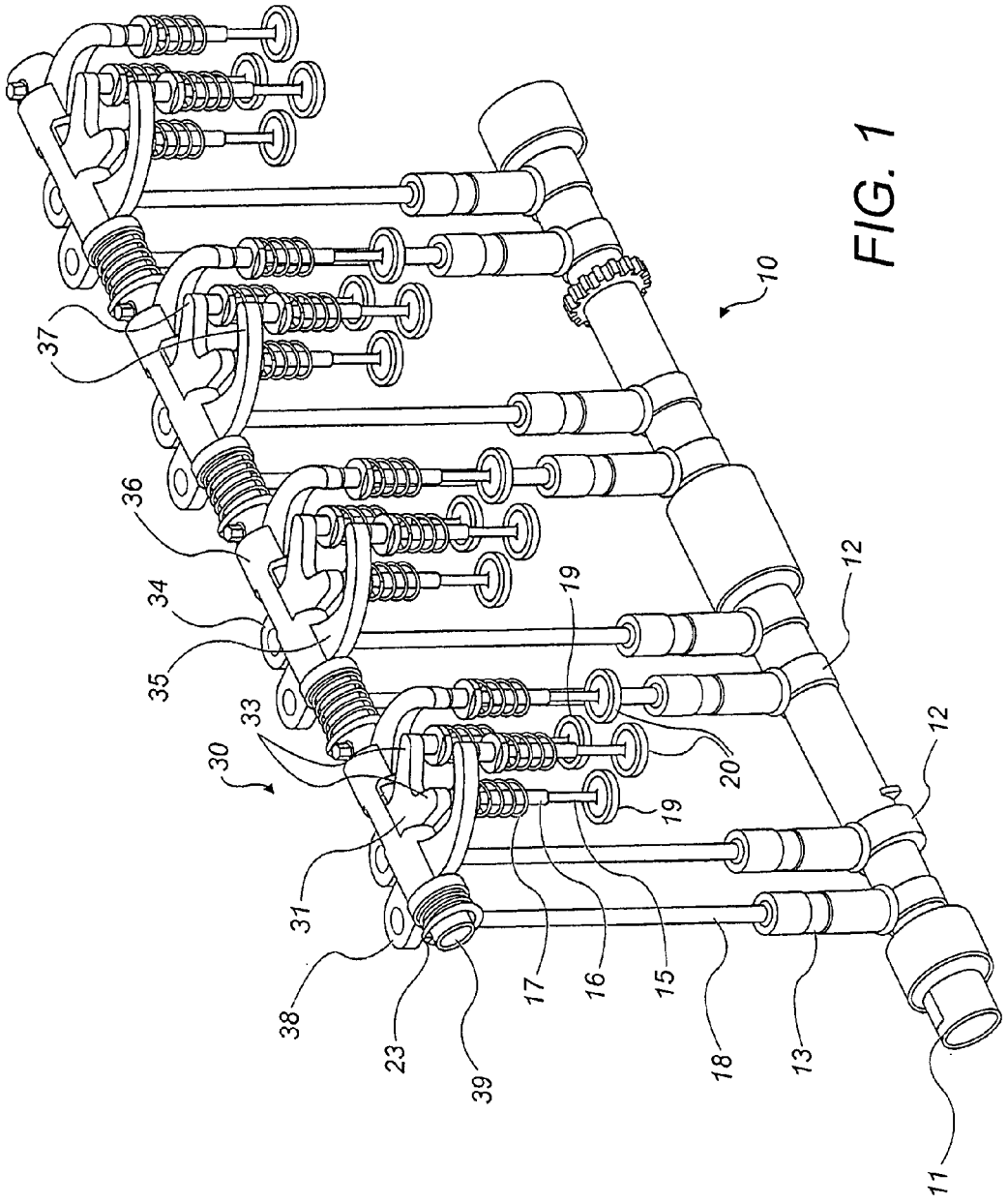

FIG. 1

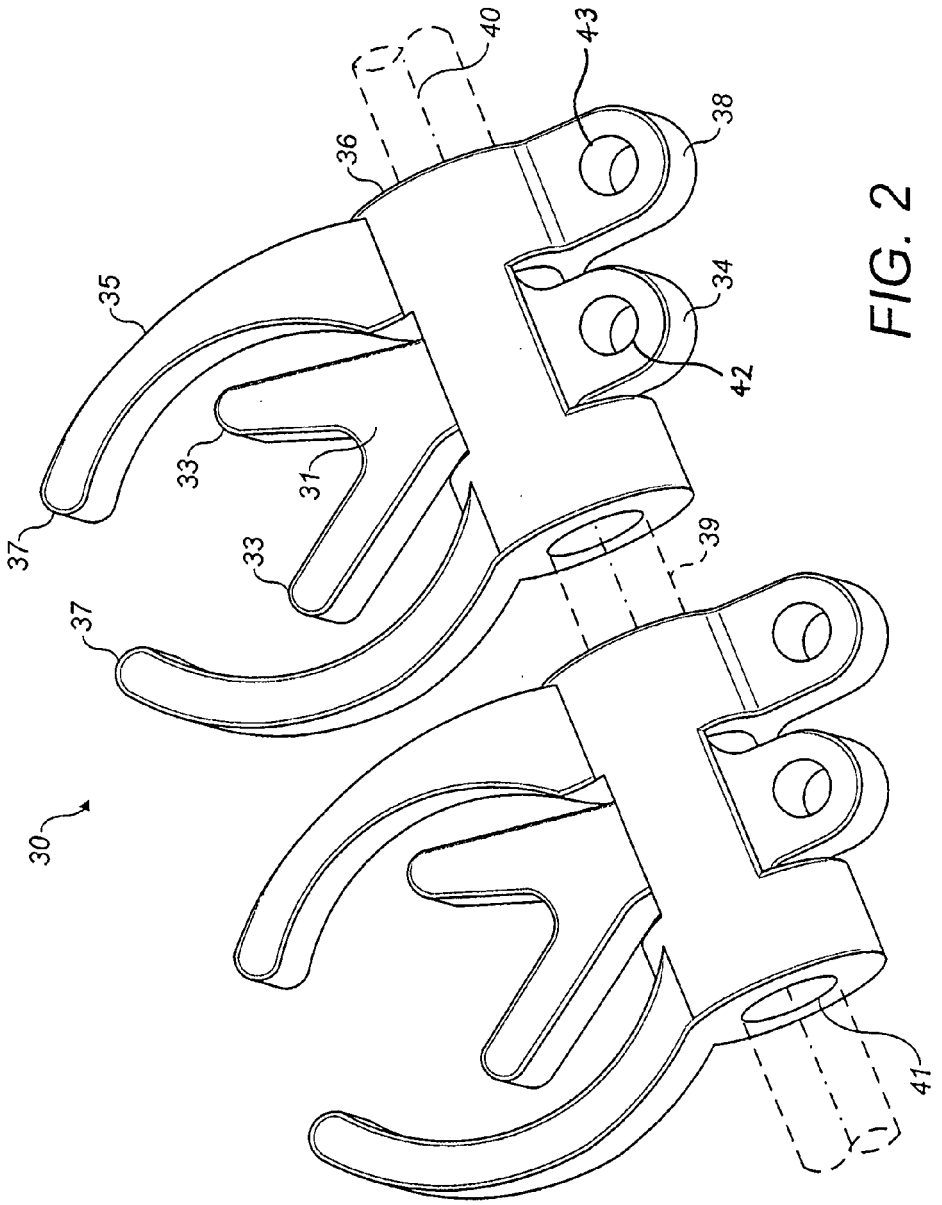

FIG. 2

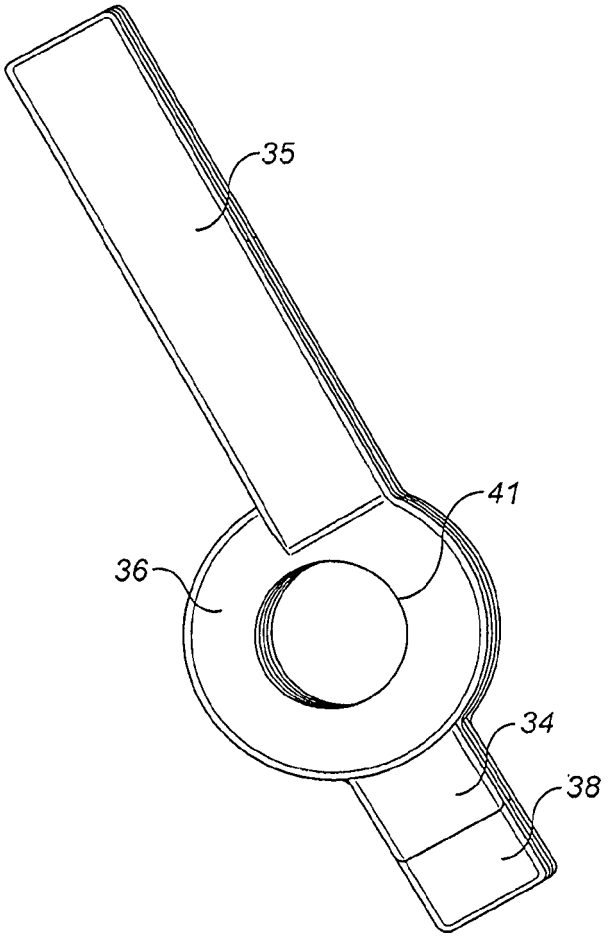

FIG. 3

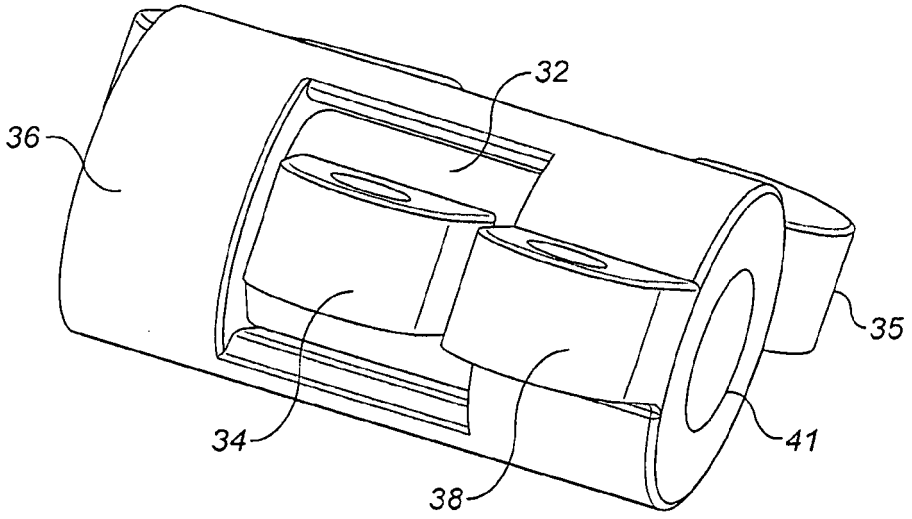

FIG. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 10 25 2145

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	* the whole document *	6	

Y	DE 20 25 305 A1 (DAIMLER BENZ AG) 9 December 1971 (1971-12-09)	6	
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TECHNICAL FIELDS SEARCHED (IPC)

F01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	26 April 2011	Klinger, Thierry

CATEGORY OF CITED DOCUMENTS

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DE 2025305 A1	09-12-1971	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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