US006976462B2

(12) **United States Patent**
Jesel

(10) **Patent No.: US 6,976,462 B2**
(45) **Date of Patent: Dec. 20, 2005**

(54) **DOUBLE ROLLER CAM FOLLOWER**

(75) Inventor: **Daniel H. Jesel**, Lakewood, NJ (US)

(73) Assignee: **Jesel, Inc.**, Lakewood, NJ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/956,332**

(22) Filed: **Oct. 4, 2004**

(65) **Prior Publication Data**

US 2005/0183683 A1 Aug. 25, 2005

Related U.S. Application Data

(60) Provisional application No. 60/507,528, filed on Oct. 2, 2003.

(51) **Int. Cl.**[7] **F01L 1/18**
(52) **U.S. Cl.** **123/90.44**; 123/90.39; 123/90.41; 123/90.43; 123/90.45; 123/90.2; 123/90.27; 123/90.31; 74/569; 74/519; 74/559; 384/58; 384/548; 384/549
(58) **Field of Search** 123/90.44, 90.2, 123/90.27; 74/569

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,060,606 A *	10/1991	Hubbard	....	123/90.39
5,074,261 A *	12/1991	Hamburg et al.	....	123/90.39
5,596,958 A *	1/1997	Miller	....	123/90.23

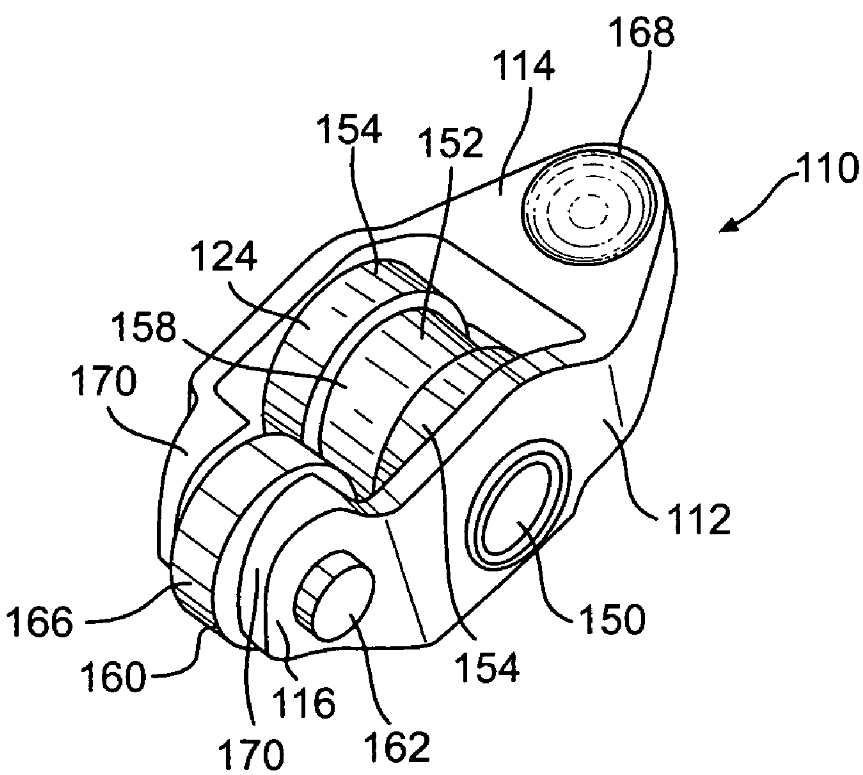
* cited by examiner

Primary Examiner—Thomas Denion
Assistant Examiner—Kyle M. Riddle
(74) *Attorney, Agent, or Firm*—Harbin King & Klima

(57) **ABSTRACT**

A double roller cam follower includes a longitudinal beam having a first end and a second end, a cam roller rotationally mounted on the beam for engaging a cam lobe and a valve stem roller rotationally mounted on the second end of the beam for engaging a valve stem. The cam roller includes a stepped outer circumference having a larger diameter at its sides to engage the cam lobe and a smaller diameter positioned centrally between the flanking larger diameters to provide clearance between the cam roller and the valve stem roller.

23 Claims, 6 Drawing Sheets



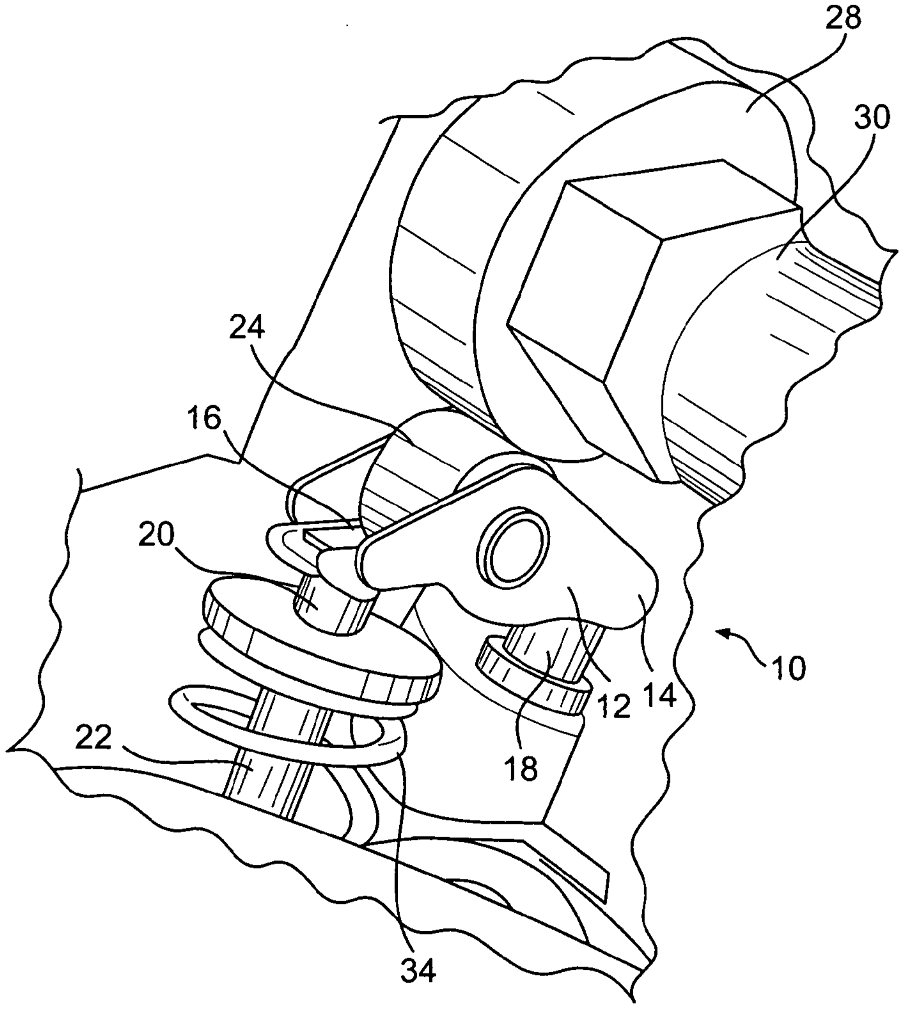


FIG. 1
PRIOR ART

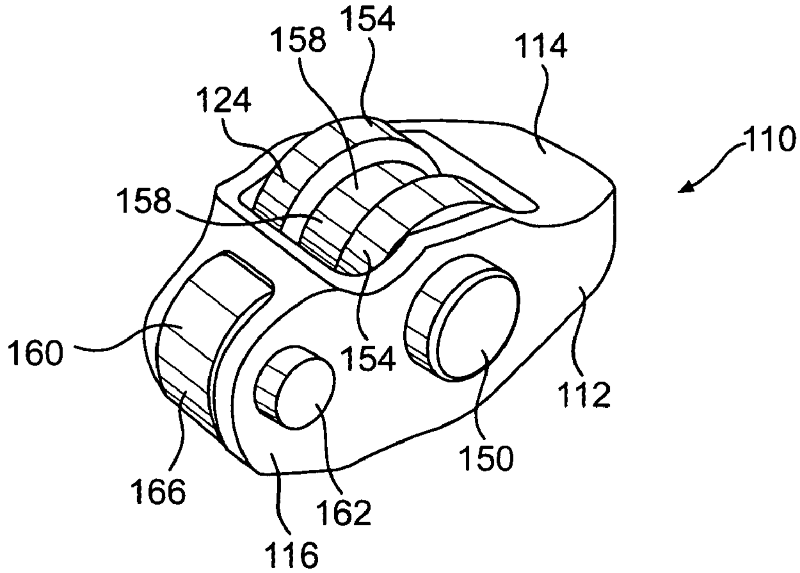

154
158
114
124
110
158
160
154
112
150
166
162
116

FIG. 2

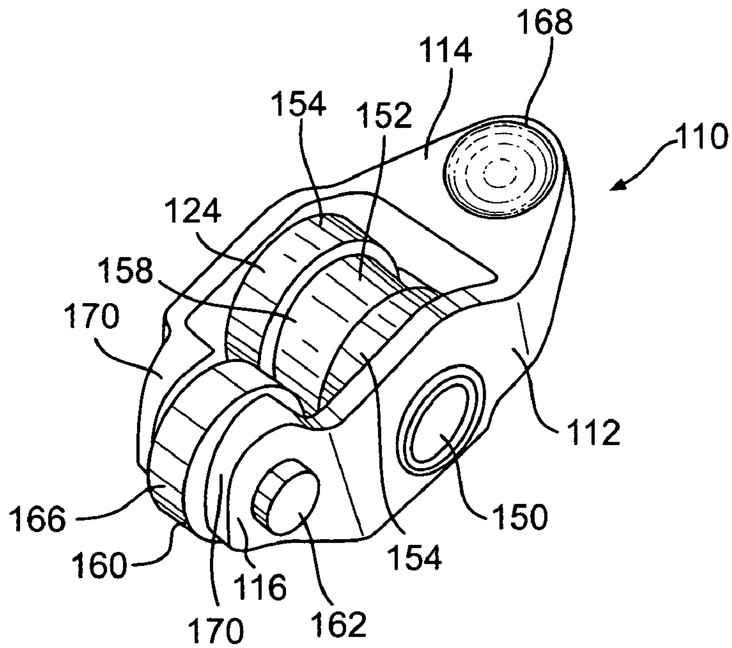

168
114
110
154
152
124
158
170
112
166
150
154
160
116
170
162

FIG. 3

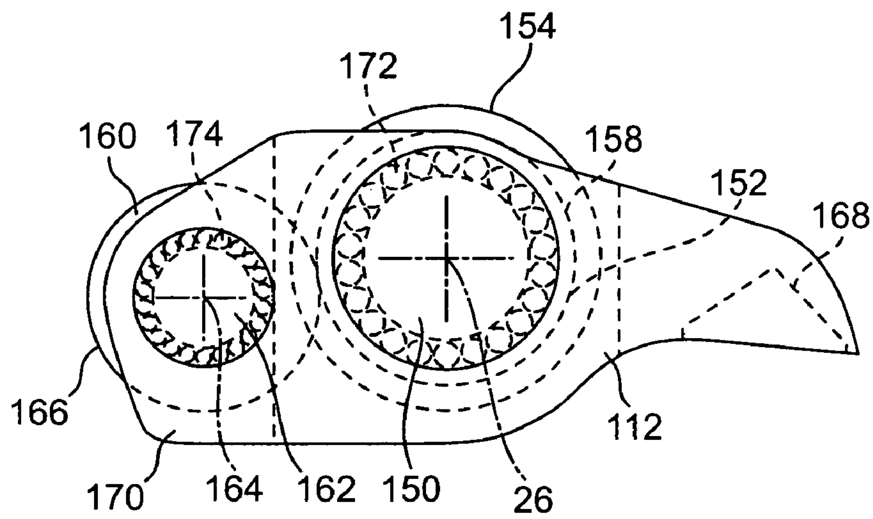

154
172
160
174
158
152
168
166
112
170
164
162
150
26

FIG. 4

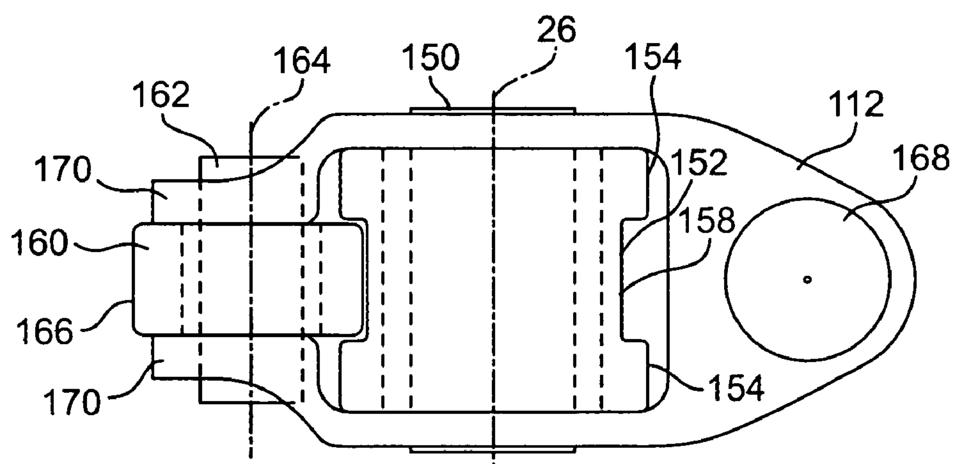

26
164
150
154
162
112
170
152
168
160
158
166
154
170

FIG. 5

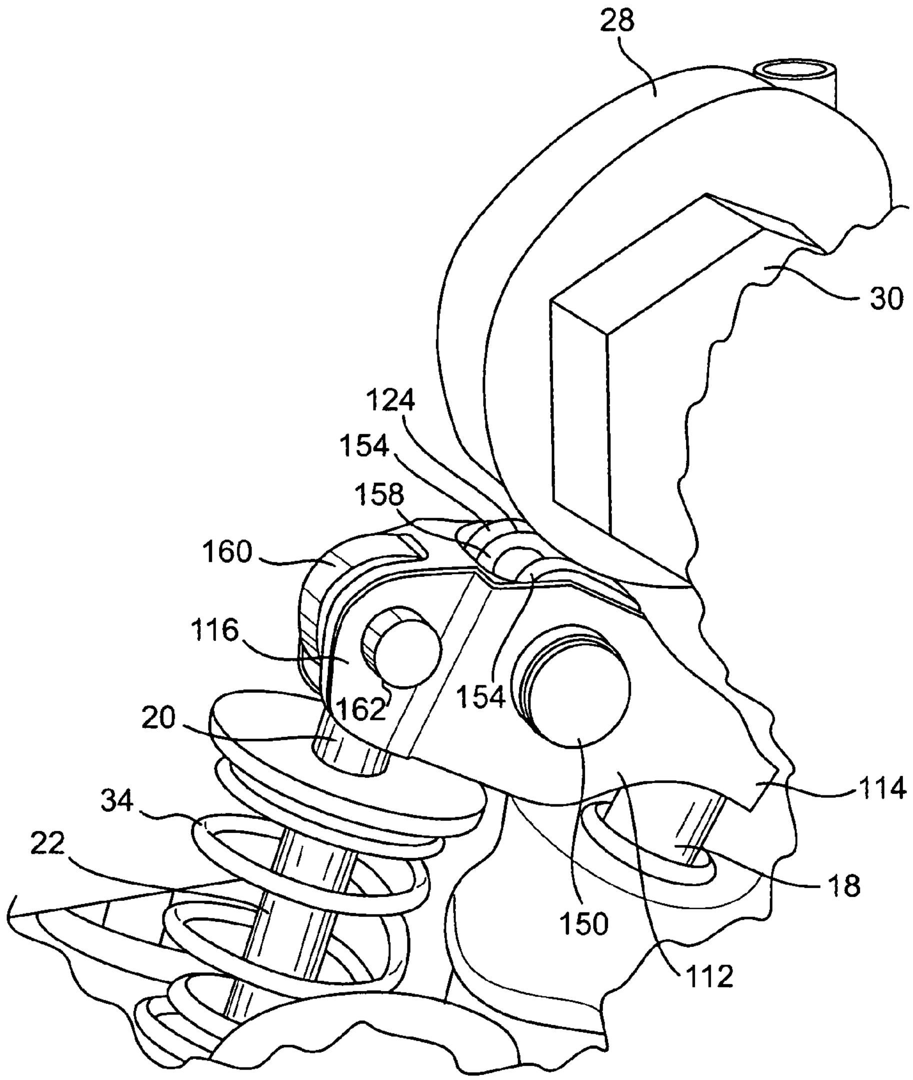


FIG. 6

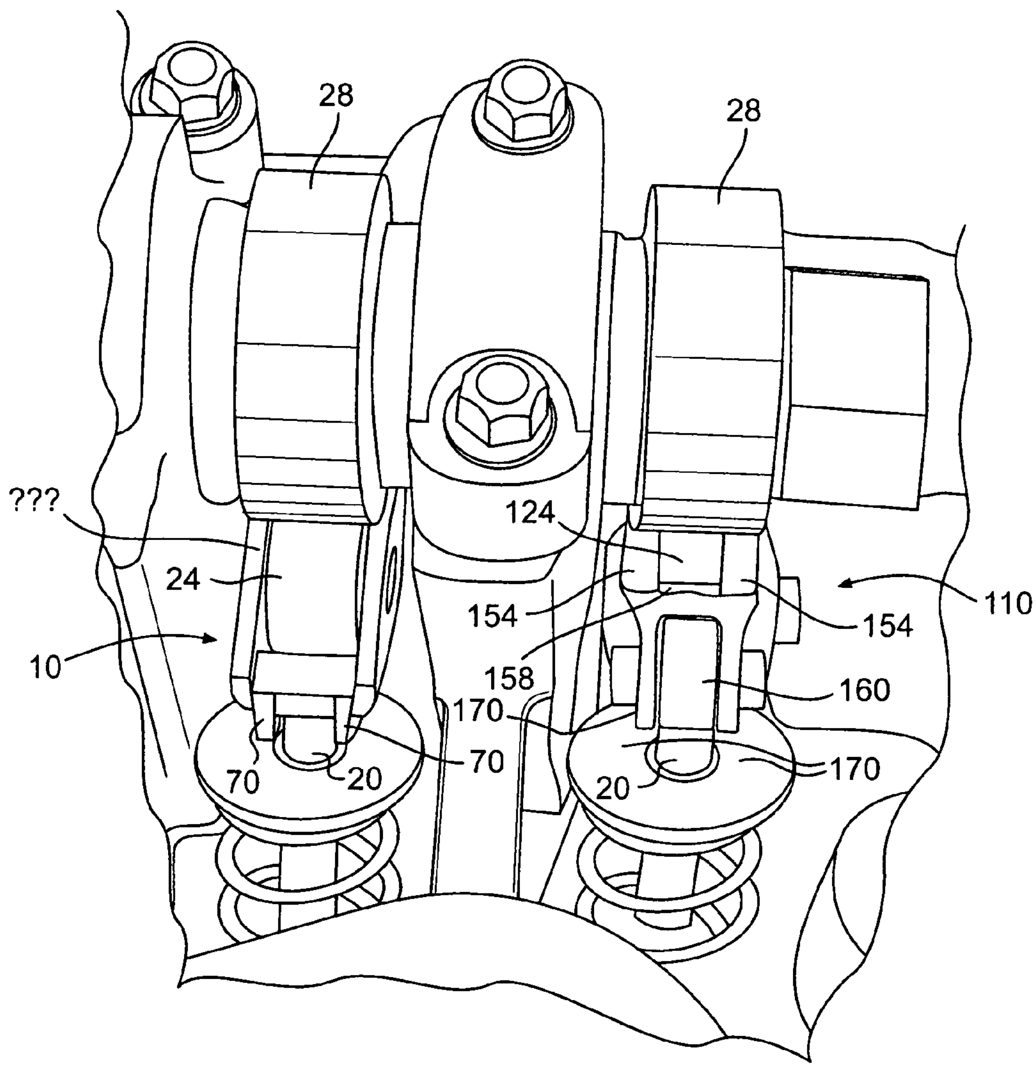


FIG. 7

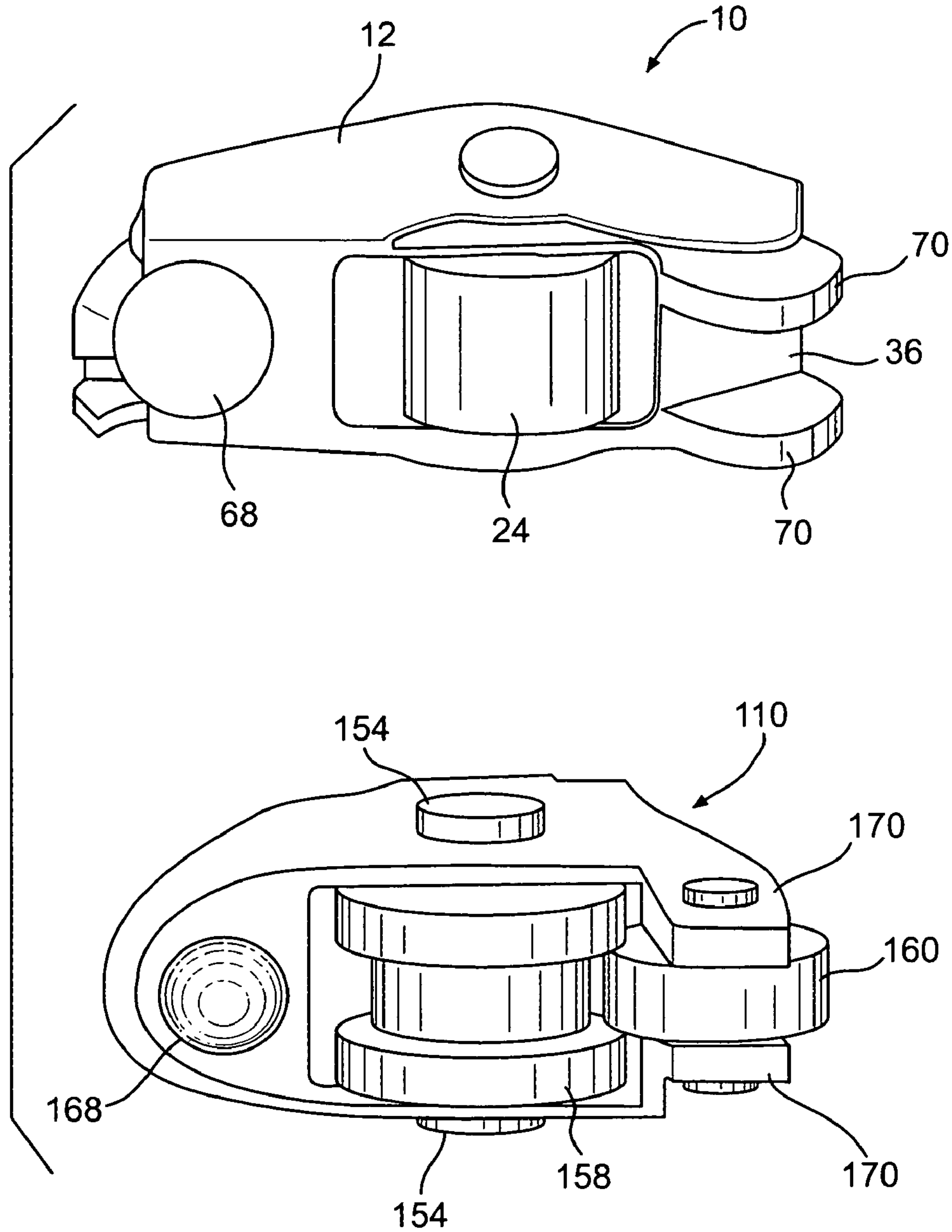


FIG. 8

DOUBLE ROLLER CAM FOLLOWER

This application claims priority to U.S. Provisional Patent Application No. 60/507,528, filed Oct. 2, 2003, entitled "Double Roller Cam Follower", the entirety of which is incorporated by reference herein.

FIELD OF THE INVENTION

The present invention relates to a cam follower which is positioned between a camshaft and a valve in an overhead cam engine, and particularly, to a roller cam follower.

BACKGROUND OF THE INVENTION

In certain known types of overhead cam engines, the lobes of the camshaft directly contact the respective valves to actuate the valves. In other known types of overhead cam engines, the lobes of the cam do not directly contact the valves for valve actuation. Rather, a cam follower is positioned between the cam lobe and the valve stem and the cam lobe actuates the cam follower which, in turn, actuates the valve.

In a specific type of such an engine, such as a General Motors Northstar®, High Value V6® or Ecotech® engine, as shown in FIG. **1** (Prior Art), the cam follower **10** has a longitudinal beam **12** having a first end **14** and a second end **16**. The first end **14** rests on a static hydraulic lash adjuster **18** via seat **68** on the beam **12** and the second end **16** bears on the valve stem **20** to actuate the valve **22**. A cam roller **24** having an axis of rotation **26** perpendicular to a longitudinal plane of the follower beam **12** is rotationally mounted on the beam **12** between the first end **14** and the second end **16** to contact and provide a low friction engagement with the cam lobe **28** of camshaft **30**. Thus, the cam lobe **28** rotates against the follower cam roller **24**, thereby moving the cam roller **24** and cam follower **10** in a direction of actuation. Since the first end **14** of the follower beam **12** rests on the static hydraulic lash adjuster **18** via seat **68**, the movement of the cam lobe **28** and cam roller **24** is transmitted to the valve stem **20**. The second end **16** of the follower beam **12** includes generally a polished curved surface **36** (see FIG. **8**) that engages the valve stem **20** to actuate the valve **22**. This is a relatively high friction engagement, especially with the forces resulting from actuating the valve **22** against the force of the valve spring **34**. Fingers **70** (see FIGS. **1**, **7** and **8**) maintain alignment of the follower **10** with the valve stem **20**.

It is known to also provide valve stem rollers on overhead valve engine rocker arms to provide a low friction engagement between the rocker arm and the valve stem. However, in the typical roller cam follower **10** discussed above, which is generally significantly smaller than a counterpart rocker arm, the geometry and dimensions of the roller cam follower **10** prevent use of a valve stem roller at the second end **16** of the follower beam **12** for engaging the valve stem **20** because the follower beam **12** has insufficient length to correctly position a valve stem roller of a proper diameter over the valve stem **20** while avoiding interference between the valve stem roller and the cam roller **24**.

It is therefore an object of the present invention to provide a roller cam follower that includes both a cam roller and a valve stem roller.

It is a further object of the present invention to provide a roller cam follower that reduces friction in the valve train as compared to conventional roller cam followers.

It is a further object of the present invention to provide a roller cam follower that includes both a cam roller and a valve stem roller within the same length as allowed by a conventional follower beam.

Other objects of the present invention will be apparent from the description below.

SUMMARY OF THE INVENTION

The present invention is a double roller cam follower that includes a longitudinal beam having a first end and a second end, a cam roller rotationally mounted on the beam for engaging a cam lobe and a valve stem roller rotationally mounted on the second end of the beam for engaging a valve stem. The cam roller includes a stepped outer circumference having a larger diameter at its sides to engage the cam lobe and a smaller diameter positioned centrally between the flanking larger diameters to provide clearance between the cam roller and the valve stem roller.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** (Prior Art) is a perspective view of a conventional roller cam follower mounted on an engine;

FIG. **2** is a top perspective view of a double roller cam follower of the present invention;

FIG. **3** is a bottom perspective view of the double roller cam follower of FIG. **2**;

FIG. **4** is a side schematic view of the double roller cam follower of FIG. **2**;

FIG. **5** is a bottom schematic view of the double roller cam follower of FIG. **2**;

FIG. **6** is a side perspective view of the double roller cam follower of FIG. **2** mounted on an engine;

FIG. **7** is a perspective view from a valve side comparing the double roller cam follower of the present invention (on the right) with a conventional roller cam follower (on the left), both mounted on an engine; and

FIG. **8** is a bottom perspective view comparing the double roller cam follower of the present invention (on the bottom) with a conventional roller cam follower (on the top).

DETAILED DESCRIPTION OF THE INVENTION

A double roller cam follower **110** includes a longitudinal beam **112** having a first end **114** and a second end **116**. See FIGS. **2**–**7**. A cam roller **124** is rotationally mounted on a roller axle **150** mounted to the longitudinal beam **112** transversely to a longitudinal plane of the beam **112** to provide the cam roller **124** an axis of rotation **26**. The cam roller **124** is preferably rotationally mounted on the roller axle **150** with roller bearings **172**, in this case shown as needle bearings (see FIG. **4**), although other types of bearings or bushings can also be used or the cam roller **124** can be mounted directly on the roller axle **150**.

The cam roller **124** includes a stepped outer surface **152** having larger diameter portions **154** at its outer sides and a smaller diameter portion **158** positioned centrally on the cam roller **124** between the flanking larger diameter portions **154**. The diameter of the larger diameter portions **154** is preferably set the same as the diameter of a conventional cam follower **24** so that the geometry between the components is maintained, although the dimensions can be changed if desired.

A valve stem roller **160** is rotationally mounted on a roller axle **162** mounted to the longitudinal beam **112** transversely to the longitudinal plane of the beam **112** to provide the valve stem roller **160** an axis of rotation **164** that is parallel with the axis of rotation **26**. The valve stem roller **160** is preferably rotationally mounted on the roller axle **162** with roller bearings **174**, in this case shown as needle bearings (see FIG. **4**), although other types of bearings or bushings can also be used or the valve stem roller **160** can be mounted directly on the roller axle **162**. The valve stem roller **160** has an outer diameter **166**.

The smaller diameter portion **158** of the stepped outer surface **152** of the cam roller **124** provides clearance between the cam roller **124** and the valve stem roller **160**. The diameter of the smaller diameter portion **158** is set to accommodate the diameter **166** of the valve stem roller **160** with the desired clearance between the two components, while still providing sufficient diameter to house any bearing or bushing in the cam roller **124**. Alternatively, two separate bearings or bushings can be mounted only in the larger diameter portions **154** of the cam roller **124** so that the minimum diameter of the smaller diameter portion **158** is not constrained by such bearings or bushings but only by the diameter of the cam roller axle **150**.

At one extreme end of the invention, the two larger diameter portions **154** can be separate components without an intermediate smaller diameter portion **158** so that the diameter of the valve stem roller **160** is only constrained by the diameter of the cam roller axle **150**, which may itself be stepped or notched to provide additional clearance. In such an embodiment, the larger diameter portions **154** would be laterally constrained by a separate component, such as an extension of the beam **12**, another roller mounted toward the first end, steps on the axle **150**, etc. The width of the smaller diameter portion **158** is also set to accommodate the width of the valve stem roller **160** with the desired clearance between the two components. The shape and dimensions of the stepped outer surface **152** can be altered as desired.

To summarize in a different manner, the distance between the axis **26** and the axis **164** is less than the sum of one half of the outer diameter **166** and one half of the diameter of the larger diameter portions **154**, or stated differently, the sum of the outer diameter **166** and the diameter of the larger diameter portions **154** is more than twice the distance between the axis **26** and the axis **164**.

For example, given dimensions for a typical application (though not to be limited to such dimensions), the diameter of larger diameter portions **154** of cam roller **124** is 0.700 inch, the diameter of smaller diameter portion **158** is 0.580 inch and the outer diameter **166** of valve stem roller **160** is 0.520 inch. The distance between axis **26** and axis **164** is 0.557 inch. Thus, the distance between the axis **26** and the axis **164** (0.557 inch) is less than the sum of one half of the outer diameter **166** and one half of the diameter of the larger diameter portions **154** (0.5×(0.520+0.700)=0.5×(1.220)=0.610 inch). In fact, using the given dimensions, the distance between the axis **26** and the axis **164** is approximately only 91% of the sum of one half of the outer diameter **166** and one half of the diameter of the larger diameter portions **154** (0.557/0.610=91.31%). This percentage can theoretically be in the range of greater than 50% and less than 100% but in practice is set in a smaller range, preferably in the range of 75–99%.

Stated differently, the sum of the outer diameter **166** and the diameter of the larger diameter portions **154** (0.520+0.0700=1.220 inch) is more than twice the distance between the axis **26** and the axis **164** (2×0.557=1.114 inch). In fact, using the given dimensions, the sum of the outer diameter **166** and the diameter of the larger diameter portions **154** is approximately 219% the distance between the axis **26** and the axis **164** (1.220/0.557=219%). This percentage can theoretically be in the range of greater than 200% and less than 400% but in practice is set in a smaller range, preferably in the range of 201–300%.

The ratio of the diameters of the smaller diameter portion **158** to the larger diameter portions **154**, given the above dimensions, is approximately 82.9%. While this percentage can theoretically be in the range of greater than 0% and less than 100%, in practice it is set in a smaller range, preferably in the range of 50% to 99%.

The present invention can be set within any specific range falling within, inclusively, the above given ranges.

With this construction, the diameters of the valve stem roller **160** and the larger diameter portions **154** of the cam roller **124** can be set as desired for proper operation of the follower **110** without the sum of such diameters having to be less than twice the distance between the axis **26** and the axis **164**. Otherwise, the rollers would have to be made too small to operate properly and to bear the loads that they will experience. Although the contact area between the cam roller **124** and the cam lobe **28** is reduced by the present invention, it is still maintained within appropriate parameters to bear the loads experienced in the system.

The double roller cam follower **110** also includes a seat **168** positioned on the longitudinal beam **112** for engaging the static hydraulic lash adjuster **18**. See FIGS. **4**–**6** and **8**. The axles **150** and **162** are mounted to the beam **112** in a known manner, such as by a staking process or by use of retainers, etc. The double roller cam follower **110** also include fingers **170** positioned on the second end **116** and extending downward to straddle a portion of the valve stem **20** to maintain lateral positioning of the follower **110** with respect to the cam lobe **28** and valve stem **20**. See FIGS. **4**–**8**.

FIG. **7** is a perspective view comparing the double roller cam follower **110** of the present invention with a conventional roller cam follower **10**. The double roller cam follower **110** is on the right in FIG. **7**. As can be seen in FIG. **7**, the cam roller **124** of the present invention is preferably wider than the cam roller **24** of the prior art. This allows for a greater width of the smaller diameter portion to accommodate a wider valve stem roller **160**. The wider cam roller **124** does not create problems in engaging the cam lobe **28**, since, as seen in FIG. **8**, the cam lobe **28** is actually wider than the prior art cam roller **24**. Preferably, the valve stem roller **160** is as wide as the valve stem **20**, though this need not be the case. In an alternative embodiment, the cam roller **124** can have only one larger diameter portion **154** for engaging the cam lobe, with the one larger diameter portion being offset to one side of the valve stem roller **160**, although this is not currently preferred because of the tilting forces that will be applied to the cam follower. In such an embodiment, the tilting forces can be accommodated by further structure supporting the cam follower.

FIG. **8** is a perspective view comparing the double roller cam follower of the present invention on the bottom with a conventional roller cam follower on the top. Portions of the cylinder head assembly to which the present invention cam operated mechanism is mounted are shown in FIGS. **1**, **6** and **7**.

In an alternative embodiment, the engagement between the cam follower **110** and lash adjuster **118** can be via an axle and bearing arrangement, similar to what is used to mount the rollers to the cam follower.

In a preferred embodiment, the longitudinal beam **112** is machined from a solid piece of metal, usually steel or aluminum, but can also be made with different methods and materials. The follower **110** can be configured and altered as desired to be used in different models of engines. Likewise, the present invention can be applied to other components, including but not limited to rocker arms, where a double roller system is desired but space for two appropriately sized rollers is limited. In such a situation, one of the rollers may be for the pivoting of the rocker arm, as opposed to engaging the camshaft but the same principles as discussed above would otherwise apply to the double roller mechanism. The different features described herein can be combined in various manners to create new embodiments.

What is claimed is:

1. A cam operated mechanism, comprising:

a longitudinal beam having a first end and a second end;

a cam roller rotationally mounted on the beam for engaging a cam lobe, the cam roller including an outer circumference having at least one larger diameter portion for engaging the cam lobe;

a valve stem roller rotationally mounted on the second end of the beam and having an outer circumference portion for engaging a valve stem to actuate the valve stem;

wherein, a distance between an axis of the cam roller and an axis of the valve stem roller is less than the sum of one half of a diameter of the cam roller larger diameter portion and one half of a diameter of the valve stem roller outer circumference portion.

2. A cam operated mechanism as in claim **1**, wherein the cam roller includes a stepped outer circumference having the at least one larger diameter portion and at least one smaller diameter portion, the smaller diameter portion providing a clearance between the cam roller and the valve stem roller.

3. A cam operated mechanism as in claim **2**, wherein the cam roller includes two larger diameter portions flanking the smaller diameter portion which is positioned between the two larger diameter portions, with the outer circumference portion of the valve stem roller being positioned adjacent the smaller diameter portion and between the two larger diameter portions.

4. A cam operated mechanism as in claim **3**, wherein the cam roller is rotationally mounted on at least one axle mounted to the longitudinal beam and the valve stem roller is rotationally mounted on at least one axle mounted to the longitudinal beam.

5. A cam operated mechanism as in claim **4**, wherein the cam operated mechanism is a cam follower.

6. A cam operated mechanism as in claim **5**, and including a cylinder head assembly, with the cam follower and valve stem being mounted to the cylinder head.

7. A cam operated mechanism as in claim **4**, wherein the cam operated mechanism is a rocker arm.

8. A cam operated mechanism as in claim **7**, and including a cylinder head assembly, with the rocker arm and valve stem being mounted to the cylinder head.

9. A cam operated mechanism as in claim **1**, wherein the cam operated mechanism is a rocker arm.

10. A cam operated mechanism as in claim **1**, wherein the cam roller includes two separate larger diameter portions, with the outer circumference portion of the valve stem roller being positioned between the two larger diameter portions.

11. A cam operated mechanism as in claim **4**, wherein the at least one cam roller axle is notched to provide additional clearance for the valve stem roller.

12. A cam operated mechanism as in claim **5**, wherein the first end of the longitudinal beam includes a portion for engaging a lash adjustment mechanism.

13. A cam operated mechanism as in claim **5**, wherein the distance between the cam roller axis and the valve stem axis is in the range of 75–99% of the sum of one half of the diameter of the cam roller larger diameter portion and one half of the diameter of the valve stem roller outer circumference portion.

14. A cam operated mechanism as in claim **13**, wherein the distance between the cam roller axis and the valve stem axis is in the range of 90–93% of the sum of one halt of the diameter of the cam roller larger diameter portion and one half of the diameter of the valve stem roller outer circumference portion.

15. A cam operated mechanism as in claim **1**, wherein the distance between the cam roller axis and the valve stem axis is in the range of 75–99% of the sum of one half of the diameter of the cam roller larger diameter portion and one half of the diameter of the valve stem roller outer circumference portion.

16. A cam operated mechanism as in claim **15**, wherein the distance between the cam roller axis and the valve stem axis is in the range of 90–93% of the sum of one half of the diameter of the cam roller larger diameter portion and one half of the diameter of the valve stem roller outer circumference portion.

17. A cam operated mechanism as in claim **1**, wherein the first end of the longitudinal beam includes a portion for engaging a lash adjustment mechanism.

18. A cam operated mechanism, comprising:

a longitudinal beam having a first end and a second end, the first end including a portion for engaging a generally static support mechanism;

a cam roller axle mounted on the longitudinal beam;

a cam roller rotationally mounted on cam roller axle the beam for engaging a cam lobe, the cam roller including a stepped outer circumference having two larger diameter portions flanking a smaller diameter portion positioned between the two larger diameter portions, the larger diameter portions for engaging the cam lobe;

a valve stem roller axle mounted on the second end of the beam;

a valve stem roller rotationally mounted on the valve stem roller axle and having an outer circumference portion for engaging a valve stem to actuate the valve stem, the outer circumference portion of the valve stem roller being positioned adjacent the smaller diameter portion and between the two larger diameter portions, with a clearance being provided between the smaller diameter portion and the adjacent outer circumference portion of the valve stem roller;

wherein, a distance between an axis of the cam roller and an axis of the valve stem roller is less than the sum of one half of a diameter of the cam roller larger diameter portion and one half of a diameter of the valve stem roller outer circumference portion.

19. A cam operated mechanism as in claim **18**, wherein the cam operated mechanism is a cam follower.

20. A cam operated mechanism as in claim **19**, and including a cylinder head assembly, with the cam follower and valve stem being mounted to the cylinder head.

21. A cam operated mechanism as in claim **20**, wherein the distance between the cam roller axis and the valve stem axis is in the range of 75–99% of the sum of one half of the diameter of the cam roller larger diameter portion and one half of the diameter of the valve stem roller outer circumference portion.

22. A cam operated mechanism as in claim **21**, wherein the distance between the cam roller axis and the valve stem axis is in the range of 90–93% of the sum of one half of the diameter of the cam roller larger diameter portion and one half of the diameter of the valve stem roller outer circumference portion.

23. A cam operated mechanism as in claim **18**, and including a cylinder head assembly, with the cam follower and valve stem being mounted to the cylinder head.

* * * * *