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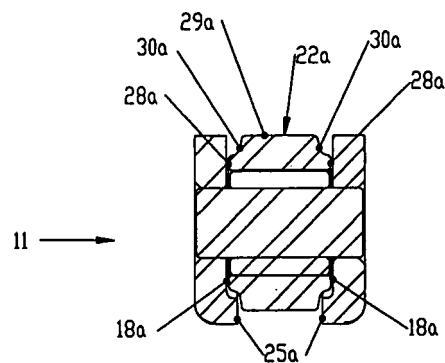
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(54) **Cam follower rocker arm**

(57) A cam follower rocker arm (11) is provided comprising a body with a U-shape cross section with an intermediate opening at the top of the inverted U-shape and having an outside width less then the inside width of the opening, creating a ledge perpendicular to the body

side walls. A roller (22a) having a peripheral step on both sides to allow the smaller width at the roller periphery to extend into the body opening with the larger width of the roller maintaining a close running clearance of the roller (22a) sides to the inside walls of the body when the roller (22a) is assembled in the body.



**FIG 5**

## Description

### BACKGROUND OF THE INVENTION

**[0001]** The invention relates to a cam follower rocker arm having a U-shaped body which, when inverted, has an intermediate opening at the top, a roller positioned inside the body and accessible through the opening, and is mounted on an axle that is secured to the side of the U-shaped body.

**[0002]** A conventional cam follower rocker arm of the kind described in U.S. Patent No. 4,825,717 the disclosure of which is incorporated herein by reference and over which the present invention is an improvement. U.S. Patent No. 4,825,717 includes a U-shaped cross section body with an intermediate opening, the width of which is, the same width as the body inside walls. A cam follower roller is positioned between the body side walls and opening. The roller when positioned in the body is captured between the side walls and extends into the intermediate opening and rotates within. The body of U.S. Patent No. 4,799,464 describes the use of rectangular opening for a boat style rocker arm of a U-shaped cross section. This type of rocker arm differs from the cam follower type in that in the boat style rocker arm is supported in the center by a pedestal having a shank that extends through the window. The perpendicular ledge in the side walls of the boat style arm is used to carry loads when operating.

### SUMMARY OF THE INVENTION

**[0003]** The invention is distinguishable from the prior art having a body that has a ledge opening with a width at the outside that is less than the inside width at the body opening creating a ledge perpendicular to the body side walls. A cylindrical roller has a transition step on both ends of its periphery to allow the smaller width of the roller, when extended, to extend into the outside window and the larger width to maintain a close running clearance to the inside walls of the body when assembled. The ledged opening or window in the portion joining the two vertical sides of the U-shaped body may be formed at top or at the bottom of the U-shaped body. This ledge functions to provide a structure that improves the rocker arm stiffness as verifiable by using analytical tools and actual static testing. It would not be desirable to have the ledge below the roller outer surface diameter. This would increase rocker arm stiffness but would greatly increase the overall mass and moment of inertia (rotating mass about a pivot) over conventional cam follower rocker arms. Optimization of stiffness and moment of inertia are key features that contribute to overall engine performance.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0004]** FIG. 1 is a typical end pivot over head cam valve train with a cam follower rocker arm, valve stem and hy-

draulic lash adjuster.

**[0005]** FIG. 2 is a cross section of prior art that shows the components for a cam follower rocker arm.

**[0006]** FIG 3 is a cross section of FIG 2 taken about the roller center.

**[0007]** FIG. 4 is a cross section of the invention that shows the components for a cam follower rocker arm.

**[0008]** FIG. 5 is a cross section of FIG 4 taken about the roller center.

### DETAIL DESCRIPTION OF THE INVENTION

**[0009]** The rocker arm in accordance with the invention is of the cam-follower type and is made preferably by cold-forming operation and comprises, a one-piece metal body generally convex body having a U-shaped cross section throughout most of its length with two structurally-integral side walls joined by a perpendicularly positioned wall. The rocker arm body includes a recess formed at one end to receive the upper part of a lifter post upon which the rocker arm can pivot and a second recess at the opposite end of the body adapted to receive the end of a valve stem. A central part of the wall joining the sides of the U-shape body has a generally rectangular opening. The width or transverse dimension of the rectangular opening is less than the width of the top wall so that the opening extends substantially, but not entirely, from one side of the rocker arm body to the other.

**[0010]** A cam-contacting roller with a stepped periphery is mounted in the body and is rotatably carried by the rocker arm that permits the peripheral circumferential surface of the stepped roller to be exposed through the rectangular body opening to engage a cam. The cam-contacting roller is rotatably mounted on an axle carried by the side walls of the body below the rectangular opening. The roller preferably has a multiplicity of needle bearings to provide minimal friction.

**[0011]** Referring to the drawing, as shown in FIG 1 a valve train 10 is comprised of a cam follower rocker arm 11, a hydraulic lash adjuster 12 which engages the cam follower rocker arm 11 at one end, a valve stem 13 which contacts the opposite end of the cam follower rocker arm 11 and a cam 14 located between the hydraulic lash adjuster 12 and valve stem 13 is also in contact with the cam follower rocker arm 11. The valve stem 13 extends upwardly from a cylinder head (not shown) through a coiled compression spring 15 which is conventionally seated against the cylinder head and a retaining ring 16 mounted on the valve stem 13. The cam 14 is able to rotate. The rotating motion of the cam 14 is transmitted through the cam follower rocker arm 11 which pivots about the hydraulic lash adjuster 12 and moves the valve stem 13 in a linear motion.

**[0012]** In FIG 2 the cam follower rocker arm 11 is comprised of a U-shape body 17 with a vertical surface 18 joined together by a first lower section 20 which contacts the valve stem 13 (FIG 1) and a second lower section 21 which engages the hydraulic lash adjuster 12 (FIG 1).

Both lower sections 20, 21 extend perpendicular to the vertical surface 18. A cylindrical roller 22 preferably provided within cylindrical needles 23 is mounted on a cylindrical axle 24. The roller 22 contacts the cam 14 (FIG 1) and is located between the vertical surface 18 and extends into an intermediate rectangular window surface 25. Surfaces 26, 27 extend through the lower sections 20, 21 respectively and are wide enough to allow clearance to the roller 22.

**[0013]** As shown in FIG 3 the window surface 25 is the same width as the vertical surface 18. The roller end surface 28 and the vertical surface 18 essentially have a total clearance throughout of about 0.2 - 0.8 when assembled. The roller outer periphery 29 and roller end (corner) surface 28 extend into the rectangular window surfaces 25, 26 (FIG 2) and 27 (FIG 2) with clearance.

**[0014]** In FIG 4 the invention for a cam follower rocker arm 11 is comprised of a U-shape body 17a with vertical side surfaces 18a joined together by a lower section 20a which has an end that contacts the valve stem 13 (FIG 1) and an opposite end which engages the hydraulic lash adjuster 12 (FIG 1). The lower section 20a is perpendicular to the vertical surface 18a. A cylindrical roller 22a and cylindrical needles 23 are mounted on a cylindrical axle 24. The roller 22a contacts the cam 14 in FIG 1 and is located between the vertical surface 18a and an intermediate rectangular window surface 25a. Surfaces 26a, 27a extend through the lower section 20a and are wide enough to allow clearance to the roller 22a.

**[0015]** In FIG 5 the window surface 25a is smaller than the vertical surface 18a creating a ledge that has a minimum distance of 30% material thickness. The roller 22a has a transition surface 30a on both ends that allows a total clearance of 0.2 - 0.8 between the vertical surface 18a and the roller end surface 28a. The roller outer surface 29a and roller transition surface 30a extend into the rectangular window surfaces 25a, 26a (FIG 4) and 27a (FIG 4) with clearance.

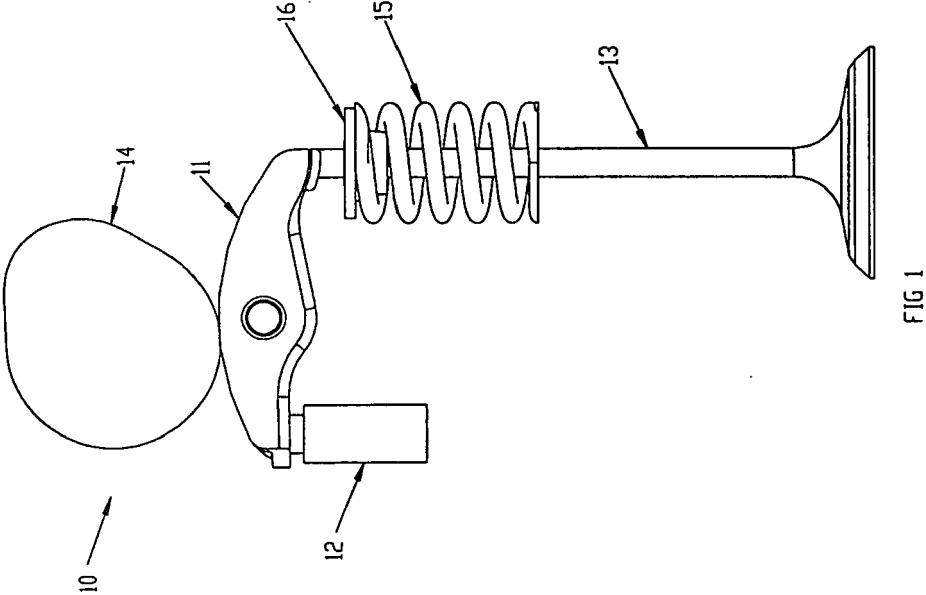
**[0016]** Although the present invention has been described in terms of specific embodiments, the invention is not meant to be so limited. For example, while the preferred body configuration comprises a generally U-shape cross section, the body also need not be so limited. Various additional changes can be made to the proportions and arrangement of the parts used while still obtaining the benefits of the invention. Thus the invention is only to be limited by the scope of the appended claims.

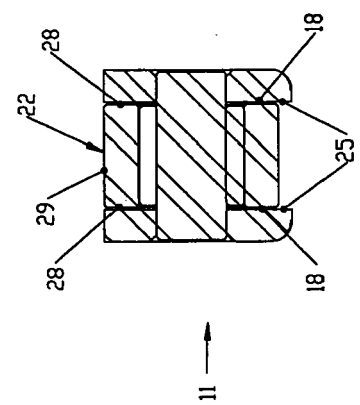
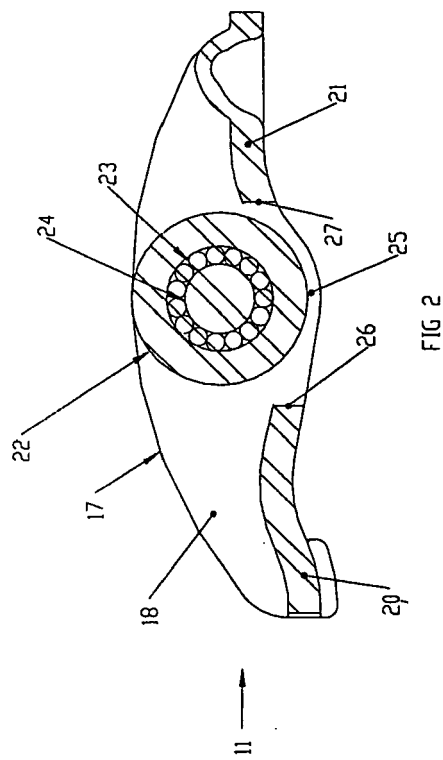
## Claims

1. A cam follower rocker arm comprised of a generally U-shaped body having sidewalls with a roller opening joining the sidewalls, a roller with an axle for mounting the roller in the sidewalls of the body at the opening and wherein the body opening is formed with a ledge having a narrower width and perpendicular to the body sidewall and the roller is formed with

steps providing a relative small peripheral width to conform with said ledge.

2. The cam follower of claim 1 wherein the ledge of the body permits access solely to the smaller width of said roller periphery.
3. A U-shaped cross section body of Claim 1 with an intermediate window opening that is less than the body inside width creating a ledge perpendicular to the body side walls.
4. A roller of Claim 1 with a transition on both sides to allow the smaller width to extend into the window of Claim 2 and the larger width to maintain a close clearance to the inside walls of the body of Claim 2.
5. An inverted U-shaped cross section body of Claim 1 with an intermediate window opening that is less than the body inside width creating a ledge perpendicular to the body side walls.
6. A roller of Claim 1 that uses spacers (not shown) on either side of the roller to allow the roller to extend into the window of Claim 2 and the stack-up of the roller and spacers maintain a close clearance to the inside walls of the body of Claim 2.





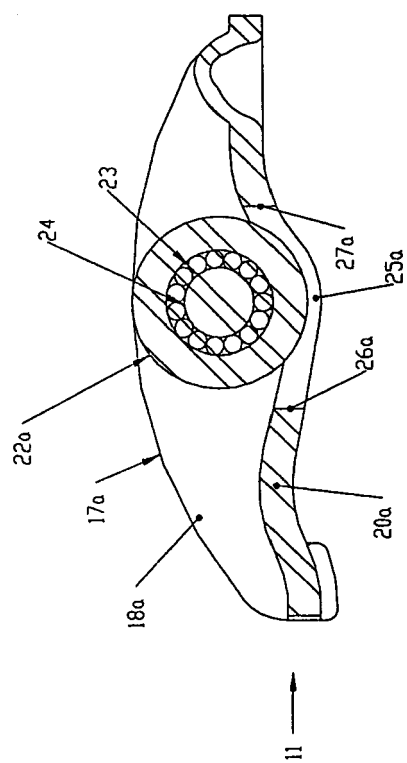


FIG 4

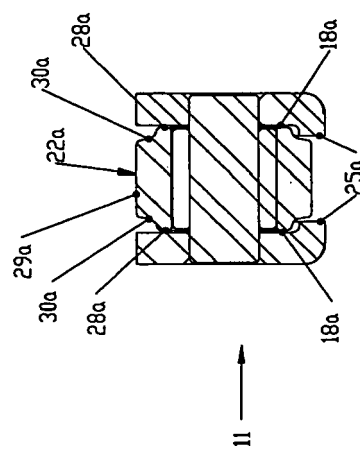


FIG 5



## EUROPEAN SEARCH REPORT

Application Number  
EP 08 01 7808

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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A	DE 101 21 798 A1 (AUDI NSU AUTO UNION AG [DE]) 7 November 2002 (2002-11-07) * paragraph [0001] * * figures *	1	
A	US 4 727 832 A (MIYAMURA NORIYUKI [JP] ET AL) 1 March 1988 (1988-03-01) * figures 4,6-8 * * column 1, line 5 - line 8 *	1	
A	GB 512 021 A (CLIFFORD TOWLER) 28 August 1939 (1939-08-28) * page 3, line 30 - line 105 * * figures *	1	
E	US 2009/078224 A1 (SMITH SCOTT PAUL [US]) 26 March 2009 (2009-03-26) * the whole document *	1-6	
			TECHNICAL FIELDS SEARCHED (IPC)
			F01L
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 9 March 2010	Examiner Paquay, Jeannot
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 08 01 7808

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The members are as contained in the European Patent Office EDP file on  
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09-03-2010

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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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