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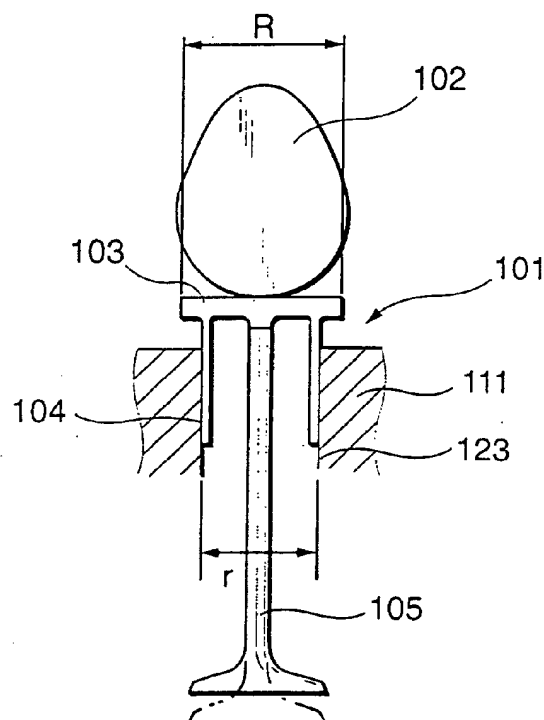
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(54) **Internal combustion engine**

(57) A valve driving apparatus using a direct driving type valve lifter is disposed between a cam (803) and a valve (105,117,118,217,317,417,517,617,717,807), said apparatus comprising: a guide hole (123,213,313,413,513,613,713,806) and a direct driving type valve lifter (101,214,314,414,514,614,714,811) including a tappet portion (103,216,316,416,516,616,716,813), and a guide portion (104,215,315,415,515,615,715,812) having one end portion coupled to said tappet portion and housed within said guide hole so as to slide freely therein to the axial direction of said poppet valve in an interlocked manner; wherein a diameter (r) of said guide portion is formed to be smaller than a diameter (R) of said tappet portion; characterized in that said valve lifter (101,214,314,414,514,614,714,811) is inclined in a direction perpendicular to a rotational axis of the cam relative to the head bolt (109) for securing the cylinder head; and said valve lifter is arranged so as to be adjacent to the head bolt in a planar view.

**FIG.1**





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# EUROPEAN SEARCH REPORT

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	FR 2 657 670 A (PEUGEOT ;CITROEN SA (FR)) 2 August 1991 (1991-08-02)	1,7,8	F01L1/14
A	* page 1, line 1-11 * * page 3, line 23-25 * * figures 1-4 *		
---			
Y	EP 0 436 779 A (PORSCHKE AG) 17 July 1991 (1991-07-17)	1,7,8	
A	* column 1, line 1-3 * * figures 1-5 *	2	
---			
Y	US 4 658 780 A (HOSOI YUKIHARU) 21 April 1987 (1987-04-21)	1,7,8	
	* column 1, line 8-13 * * column 14, line 30-37 * * column 15, line 56 - column 16, line 7 * * figures 8,17 *		
---			
Y	EP 0 454 518 A (PEUGEOT ;CITROEN SA (FR)) 30 October 1991 (1991-10-30)	1,7,8	
A	* column 1, line 1-12 * * column 3, line 51 - column 4, line 1 * * figures 1-4 *	2-5	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
---			
A	EP 0 312 216 A (HONDA MOTOR CO LTD) 19 April 1989 (1989-04-19)	1,7,8	F02F F01L
	* column 1, line 1-11 * * column 18, line 14-32 * * figures 22-26,28-30 *		
---			
A	FR 1 446 654 A (JOHNSON PRODUCTS INC) 22 July 1966 (1966-07-22)	1,7	
	* page 2, column 1 * * figure 1 *		
---			
	-/--		
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>22 September 2003</b>	Examiner <b>Paquay, J</b>
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	
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EPO FORM 1503.03.82 (P04/C01)



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 03 01 1023

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
D, A	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 03, 31 March 1999 (1999-03-31) & JP 10 331709 A (SUZUKI MOTOR CORP), 15 December 1998 (1998-12-15) * abstract * * figures 2,4 * -----	1, 6	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>22 September 2003</b>	Examiner <b>Paquay, J</b>
CATEGORY OF CITED DOCUMENTS 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 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			

EPO FORM 1503 03/82 (P04001)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 01 1023

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-09-2003

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 2657670	A	02-08-1991	FR	2657670 A1	02-08-1991
EP 0436779	A	17-07-1991	DE	3940845 C1	09-08-1990
			DE	3943727 A1	10-02-1994
			DE	3943728 A1	10-02-1994
			DE	3943729 A1	17-02-1994
			DE	59004034 D1	10-02-1994
			EP	0436779 A1	17-07-1991
			ES	2047785 T3	01-03-1994
			JP	4091351 A	24-03-1992
			US	5080057 A	14-01-1992
US 4658780	A	21-04-1987	JP	57183527 A	11-11-1982
			JP	1031035 B	22-06-1989
			JP	1546145 C	28-02-1990
			JP	57183553 A	11-11-1982
			JP	57186009 A	16-11-1982
			JP	57186010 A	16-11-1982
			JP	1432363 C	24-03-1988
			JP	58044229 A	15-03-1983
			JP	62042134 B	07-09-1987
EP 0454518	A	30-10-1991	FR	2661211 A1	25-10-1991
			EP	0454518 A1	30-10-1991
EP 0312216	A	19-04-1989	JP	1305114 A	08-12-1989
			JP	1929262 C	12-05-1995
			JP	6054085 B	20-07-1994
			JP	1991250 C	22-11-1995
			JP	2161114 A	21-06-1990
			JP	7006373 B	30-01-1995
			JP	1929265 C	12-05-1995
			JP	2009902 A	12-01-1990
			JP	6058048 B	03-08-1994
			JP	1929266 C	12-05-1995
			JP	2016314 A	19-01-1990
			JP	6058049 B	03-08-1994
			JP	1080710 A	27-03-1989
			JP	1748579 C	08-04-1993
			JP	4033962 B	04-06-1992
			DE	3877686 D1	04-03-1993
			DE	3877686 T2	06-05-1993
			EP	0312216 A2	19-04-1989
			US	4917056 A	17-04-1990
FR 1446654	A	22-07-1966	US	3286702 A	22-11-1966

EPO FORM P0489

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

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 01 1023

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-09-2003

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
FR 1446654	A		GB	1064338 A	05-04-1967
JP 10331709	A	15-12-1998	US	5957104 A	28-09-1999

EPO FORM P0459

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