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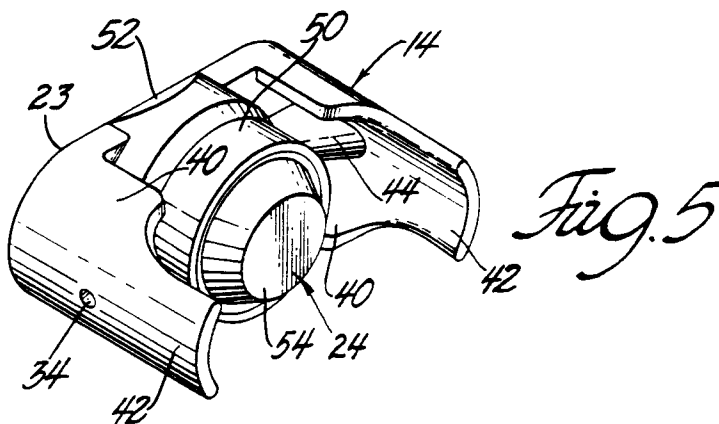
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(54) **Valve lifter.**

(57) A low mass hydraulic or mechanical valve lifter (14) has an oblong configuration for reduced mass, with straight or narrowed sides (23) connecting longitudinally spaced ends having depending semi-cylindrical end walls (42) that are received in similarly shaped end portions of lifter gallery openings to

absorb all longitudinal and lateral side loads. The lifter (14) is preferably made by investment casting of a steel alloy. The investment casting permits the use of thin semi-cylindrical walls at each end of the valve lifter (14) which also has internal reinforcing ribs (44) extending from its underside.

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This invention relates to valve lifters (also called tappets or cam followers) for use in engines having valve actuation. In preferred embodiments, the invention relates to so-called direct acting valve lifters.

Increased efficiency in modern engines has resulted from valve train mass reduction, (for lower friction losses and/or higher engine speeds), and from increasing the number of valves per cylinder. Direct acting valve arrangements, as in overhead cam engines are of particular interest since they can limit the reciprocating elements to the valves and their associated valve lifters.

Design efforts to reduce lifter mass have involved the use of ceramics, metal matrix composites and magnesium, as well as other materials. However, the cost of such materials, the special processing and the extensive development and testing required to use them can cause these designs to be prohibitive in terms of cost.

The present invention seeks to provide an improved valve lifter.

According to an aspect of the present invention, there is provided a valve lifter as specified in claim 1.

The term "oblong" used herein is intended to cover any suitable shape having its chief axis longer than its transverse diameter.

This invention can provide means to minimize valve lifter mass through changes in geometry not requiring special materials.

The valve lifter preferably has a cam lobe contact surface that is approximately the width of or slightly wider than the width of an associated cam lobe. The contact surface may be extended longitudinally (usually in the direction of the cam sliding motion) as desired to allow high velocity cam profiles to be used without requiring an increase in the width of the contact surface or the lifter. Semi-cylindrical end walls or skirts may depend from the longitudinal ends of the cam lobe contact surface to guide and stabilize the lifter in the lifter gallery. The walls may be ribbed for strength.

A circular recess in a mechanical version of the lifter is adapted to receive a valve shim. In a hydraulic version of the lifter, a cylindrical depending wall between the semi-cylindrical skirts defines a cylinder to receive a hydraulic lash adjuster.

In preferred embodiments, low mass and adequate strength characteristics can be provided by the use of thin walls and reinforcing ribs preferably formed by investment casting.

The ends of the cam lobe contacting surface and the depending walls are preferably semi-circular, and they may also be of any other suitable part-circular shape.

According to another aspect of the present

invention, there is provided apparatus for operating a valve in an internal combustion engine as specified in claim 12.

An embodiment of the present invention is described below, by way of illustration only, with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view of part of an engine cylinder head illustrating an embodiment of hydraulic valve lifter and associated cam;

Figure 2 is a bottom plan view of the hydraulic lifter taken along line 2-2 of Figure 1;

Figure 3 is a top plan view of part of a lifter gallery showing the surface of several hydraulic lifters, taken along the line 3-3 of Figure 1;

Figure 4 is a cross-sectional view of the hydraulic lifter of Figure 1 taken along the line of 4-4 of Figure 2;

Figure 5 is a perspective view of the hydraulic lifter of Figure 1;

Figure 6 is a partial cross-sectional view of a cylinder head and mechanical lifter;

Figure 7 is a longitudinal cross-sectional view of the mechanical lifter of Figure 6 taken along line 7-7 of Figure 8;

Figure 8 is a bottom plan view of the mechanical lifter of Figure 6; and

Figure 9 is a view corresponding to Figure 3 of an alternative form of hydraulic lifter.

Referring to Figures 1 to 5, an engine 10 with a lifter and cam gallery 12 comprises a camshaft 13 and a plurality of hydraulic valve lifters 14 operated by the camshaft through a plurality of cams 16 having lobes 18.

The lifter gallery 20 and cam cover 22 of the lifter and cam gallery 12 may be made of aluminium, cast iron or other suitable material; while the camshaft 13 and hydraulic lifters 14 are preferably made of alloy steel, although other materials may be used.

Each hydraulic lifter 14 includes a follower body 23 carrying a conventional hydraulic element assembly or lash adjuster 24 which receives a supply of hydraulic fluid via passages 34 from a passage 36 in one wall of the lifter gallery. The cam-engaging top 38 of the follower body 23 is oblong with semi-circular ends and generally parallel connecting sides. Semi-circular cylindrical end walls 40 depend from the semi-circular ends. The walls 40 are optionally reduced in circumference at their bottom portions 42 to reduce the mass of the lifters. Descending ribs 44 containing the hydraulic passages 34 connect the cylindrical walls 40 with the underside of the cam-engaging top 38.

A substantially circular cylindrical depending wall 50 extends from the centre of the follower body 23 to provide a closed-end cylinder for receiving the hydraulic lash adjuster 24. This wall 50, as shown, is slightly wider than the top 38 of the

follower body 23 and has tapered upper edges 52 (best seen in Figure 5).

The lash adjuster or hydraulic element assembly 24 includes a cup-shaped piston 54 which in use engages the top of a valve stem 56. The valve stem 56 is in use urged upwardly (that is, towards the lash adjuster 24) by a compression spring 57 which engages a washer 58 retained on the valve stem by split keepers 59 in the usual manner. If desired a smaller circular cylindrical lash adjuster or even a narrow oblong adjuster could be provided in place of the adjuster 24 so that the width of the cylinder formed by the wall 50 could be made so as to be no greater than the width of the top 38.

Also, as may be seen in Figure 9, the tapered edges 52 may be omitted, providing lifter 14' with an outwardly bulging oblong flat top 38'.

Turning now to Figures 6, 7 and 8, a mechanical lifter 60 is shown which shares some of the features of the hydraulic lifter 14. Lifter 60 comprises a follower body 61 reciprocally actuated in a lifter guide (not shown) by a lobe 62 of a cam-shaft 64. The body 61 is engaged at its bottom by an end 80 of a valve stem 65 which is urged upwardly (that is, towards the follower body 61) by a compression spring 66 retained between a washer 68 held by keepers 70 and a cylinder head wall 72. The upper end 80 of the valve stem 65 carries a lash cap acting as a shim 84 that is received in a recess in the bottom of the follower body 61. Other types of shims could also be used.

Semi-cylindrical depending walls 86 at the ends of the follower body 61 reduce in circumference at 88. Reinforcing ribs 90 provide increased rigidity of the body 61.

It should be understood that in some cases it might be desirable to extend the semi-cylindrical walls downwardly and eliminate the reduction in circumference. This would, of course, increase the mass of the lifter.

Oblong openings 92 in the lifter gallery 20 (Figure 3) or 20' (Figure 9), are provided to receive reciprocally the lifters 14, 61. These openings may be made by casting, or by drilling three overlapping holes in line and thereafter finishing to size.

The openings 92 preferably include small semi-circular ends 94 which are engaged by the end walls 40 of the lifters 14, 14' (or walls 86 of mechanical lifters 60) to carry both the lateral and longitudinal side forces imposed on the lifters in operation.

The ends 94 (Figure 9) are connected by arcs 96 of a larger centre circle. The arcs 96 are spaced with clearance outwardly from the sides of the valve lifters 14, 14' so that all bearing loads are carried by the semi-cylindrical end walls 40. This provides good control of lifter motion and mini-

mizes manufacturing tolerance problems since only the ends 94 of the openings are required to be closely dimensioned.

The enlarged portions shown as arcs 96 could be formed of any other suitable configuration or could be omitted from the lifter carrier structure if desired.

Other aspects of the invention are covered in our co-pending Japanese patent application no. (RJ/3583), the contents of which is incorporated herein by reference.

Claims

1. A valve lifter comprising an oblong cam lobe contacting surface (38,80) which includes longitudinally spaced ends; and a wall (40,86) depending from each end of the cam lobe contacting surface.
2. A valve lifter according to claim 1, wherein the ends of the cam lobe contacting surface are substantially semi-circular.
3. A valve lifter according to claim 1 or 2, wherein each end wall is substantially semi-cylindrical and semi-circular.
4. A valve lifter according to claim 3, wherein a portion of each depending wall is of a reduced circumference.
5. A valve lifter according to any preceding claim, comprising one or more ribs (44,90) depending from the cam lobe contacting surface and connected to the depending walls.
6. A valve lifter according to claim 5, wherein the rib or ribs comprise passages therein for receiving hydraulic fluid.
7. A valve lifter according to any preceding claim, comprising a substantially cylindrical member (50) depending from the cam lobe contacting surface and adapted to receive a hydraulic lash adjuster (24).
8. A valve lifter according to claim 7, comprising two or more ribs (44) depending from the cam lobe contacting surface and connecting the cylindrical member to the depending walls.
9. A valve lifter according to any preceding claim, wherein the depending walls are adapted to carry both longitudinal and lateral side loads applied to the lifter.
10. A valve lifter according to any preceding claim,

wherein the depending walls are formed by investment casting of an alloy steel.

11. A valve lifter according to any preceding claim, wherein the lifter is made by casting of an alloy. 5
12. Apparatus for operating a valve in an internal combustion engine comprising a lifter carrier (20,20') including an opening (92) with spaced semi-cylindrical end portions (94), and a valve lifter (14,61) slidably received in the opening and including an oblong cam engaging portion (23,61) which comprises spaced longitudinal ends each connected to a depending semi-cylindrical end wall (40,86), the end walls engaging the end portions of the opening so as to carry both longitudinal and lateral side loads applied to the lifter. 10 15 20
13. Apparatus according to claim 12, comprising a camshaft including at least one cam lobe (18,62) adapted to contact the cam engaging portion of the valve lifter in a sliding manner. 25
14. Apparatus according to claim 13, wherein the ends of the cam engaging portion of the lifter lie along a line substantially parallel to the motion of its associated cam lobe. 30

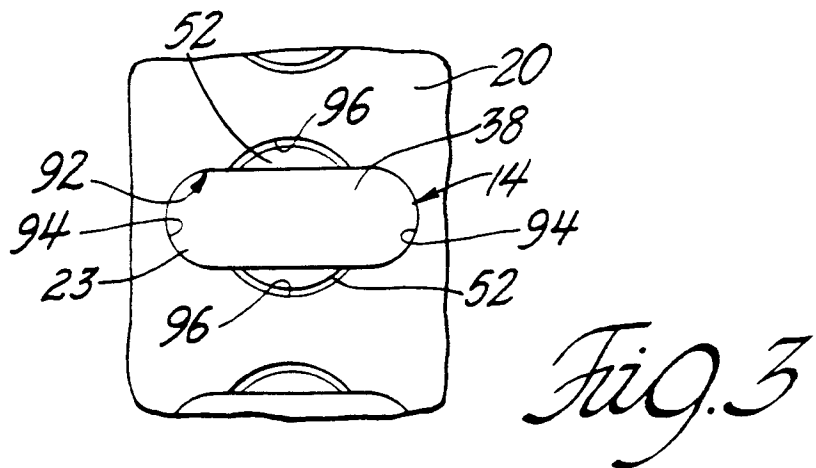
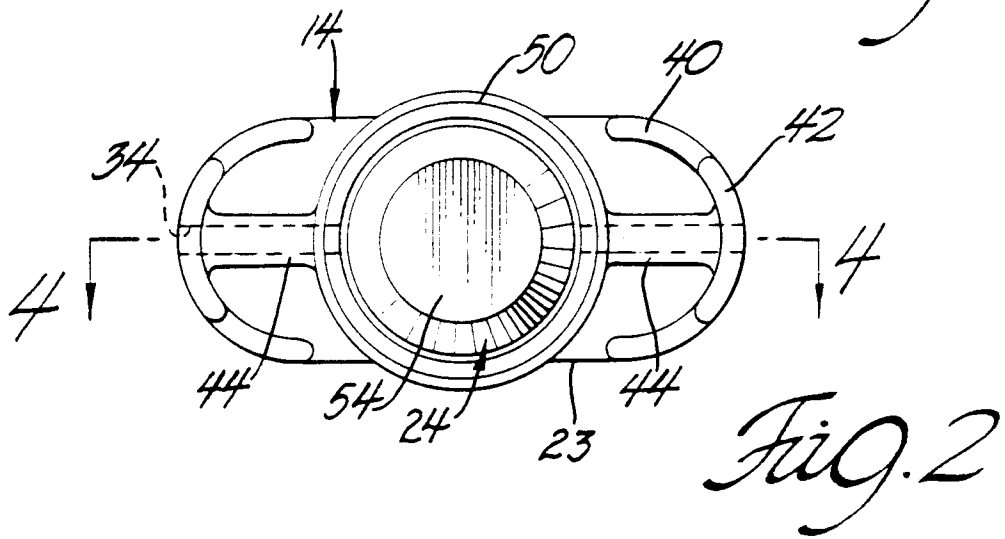
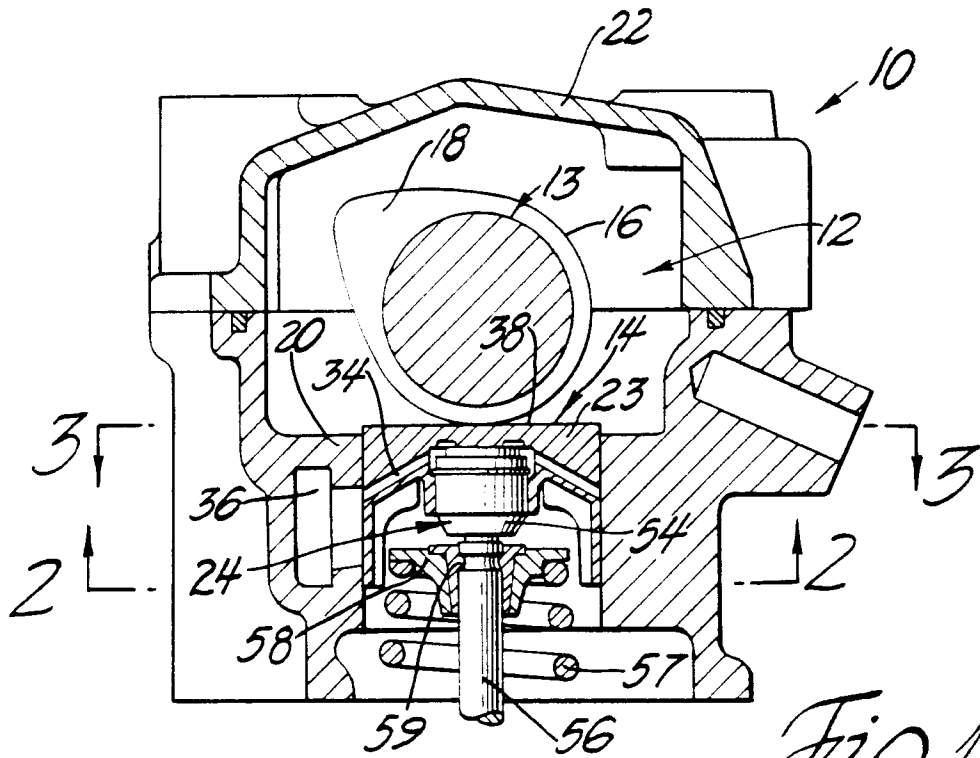
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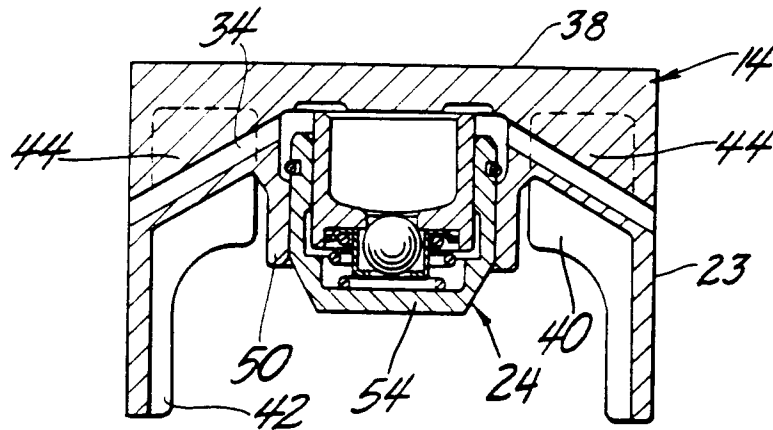


Fig. 4

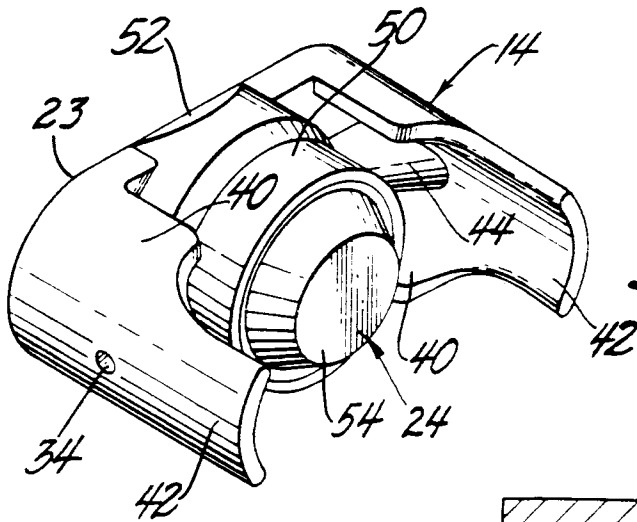


Fig. 5

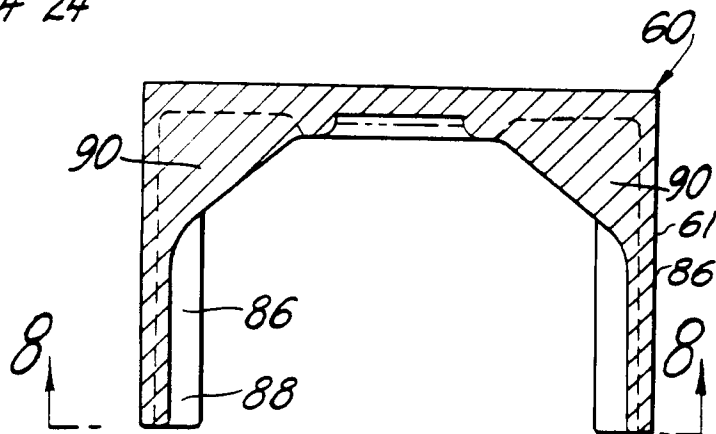


Fig. 7

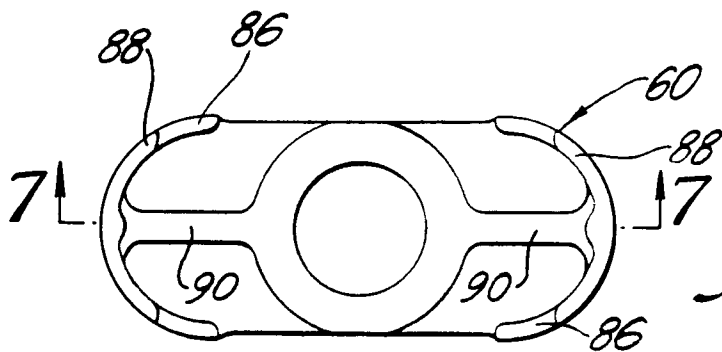


Fig. 8

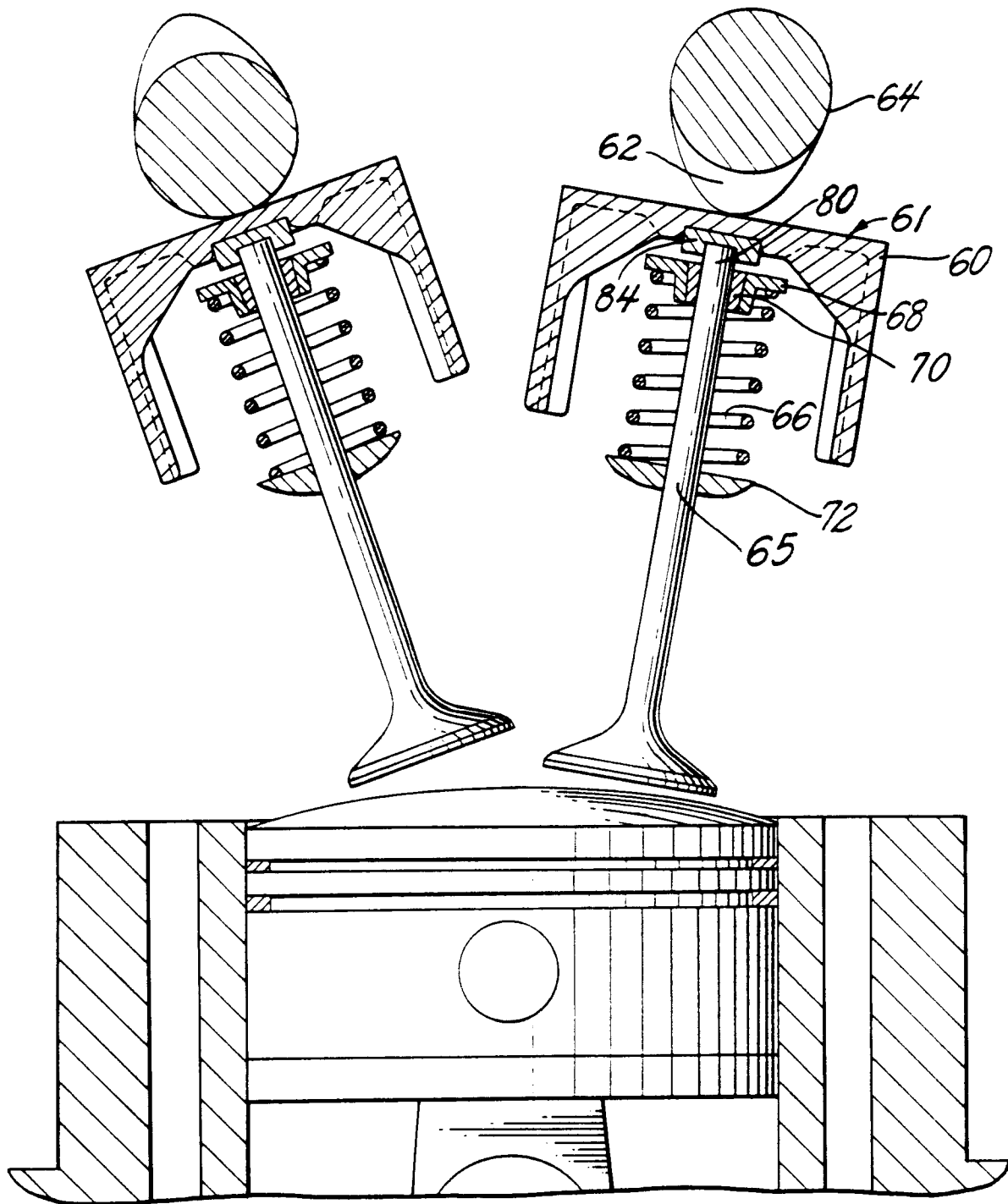


Fig. 6

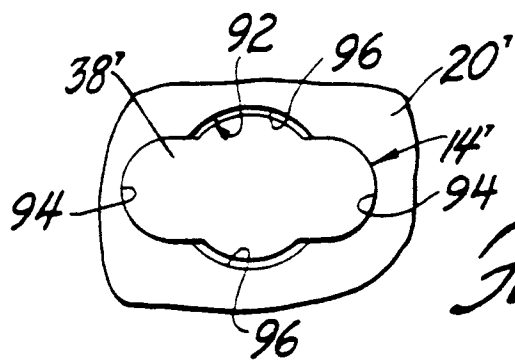


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number

EP 91 20 3144

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.5)
X	DE-A-3 806 839 (BAYERISCHE MOTOREN WERKE) * column 1, line 61 - column 2, line 30 * * figures 1-3 * ---	1-9, 12-14	F01L1/14 F01L1/24
X	US-A-4 637 357 (OHMI) * column 3, line 64 - column 4, line 5 * * column 4, line 27 - line 30 * * figures 3,4 * ---	1-3,9, 12-14	
A	EP-A-0 108 238 (FIAT) * page 3, column 10, line 4, paragraph 20 * * figure 1 * ---	1-4,7,9, 12-14	
A	EP-A-0 267 631 (EATON) * column 7, line 48 - column 8, line 1 * * figure 1 * -----	10,11	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F01L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 25 MARCH 1992	Examiner LEFEBVRE L. J. F.
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	