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(54) **Four-stroke internal combustion engines with overhead camshafts, and tappets therefor.**

(57) A tappet for a four-stroke internal combustion engine with an overhead camshaft comprises a tubular body (20) having an internal peripheral abutment (22, 23) against the top of which rests a shim (7) engaged by the cam (1). The cam movements are transmitted to the valve stem (9) by a disc spring (25), of which the periphery rests against the underside of the abutment, and a transfer member (26) which is slidable in the bore of the tubular body and has a convex part-spherical upper surface (27) in engagement with the underside of the disc spring (25).

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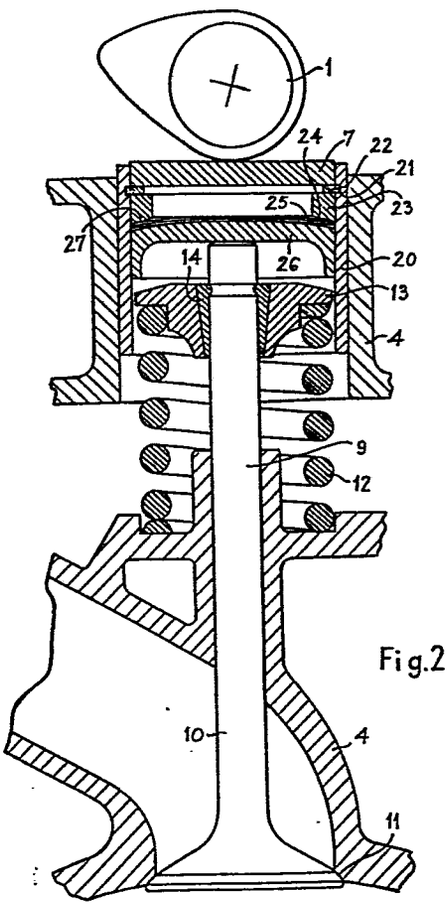

Fig.2

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FOUR-STROKE INTERNAL COMBUSTION ENGINES WITH OVERHEAD CAMSHAFTS, AND TAPPETS THEREFOR

This invention relates to tappets through the intermediary of which the poppet valves of a four-stroke internal combustion engine are actuated by the cams of an overhead camshaft. Such tappets are generally in the form of inverted cup-shaped cylindrical bodies which slide in guide apertures in a part of the cylinder head assembly, the upturned flat face of the base of a tappet being engaged by the associated cam of the camshaft, and the central region of the inside of the base of the tappet engaging the end of the stem of the associated spring-loaded valve of the engine. As the camshaft rotates, the cam moves across the flat face of the tappet base and moves the tappet axially to move the valve stem and the valve against the loading of the spring. The relatively large diameter tappet (compared with the diameter of a valve stem) ensures that, as it slides axially in its guide aperture, the flat face of its base is always presented normal to the cam, and the sideways thrust produced by the cam moving across that face is absorbed by the sliding surface of the tappet in its guide aperture and is not transmitted to the valve stem.

To adapt the tappets to provide the required clearance gap in the valve actuating system, which gap is provided to ensure that the valve can firmly close against its valve seat during the appropriate period of the engine cycle, irrespective of thermal expansion of the valve and engine associated parts and their wear under prolonged use, a shim is inserted either between the inside of the base of the tappet and the end of the valve stem or between the upturned base of the tappet and the cam.

A tappet with this latter arrangement of the shim (hereinafter called "a tappet of the kind referred to") has the advantage that the shim can be changed to adjust the clearance

gap without dismantling the camshaft. However the shim must be sufficiently large to be in contact with the cam in all its positions. To this end the outside of the base of the tappet is recessed to provide a base wall surrounded by a peripheral rim within which the shim is located and kept in position against the cam.

The cam transmits its thrust to the shim at locations which change continuously from near the periphery to the centre of the shim according to the different phases of cam rotation. It is therefore necessary for the smooth underside of the shim to rest firmly and without rocking on the base wall, to which end a peripheral zone of the shim rests on a ground annular land on the outer face of the base wall. From the underside of the shim the thrust is transmitted to this peripheral annular land and the efforts travel in the base wall from the periphery toward the axis of the tappet. The central region of the inside of the base wall applies the thrust against the end of the valve stem. Said central region is also usually ground flat.

Tappets of the kind referred to are thus expensive to fabricate and must be sufficiently sturdy to withstand the radial forces consequent upon the thrust forces having to travel radially through the integral base wall.

The present invention has for an object to simplify the fabrication of such tappets, to which end the tappet basically comprises a tubular body formed or provided around its internal surface with at least one abutment against which is supported the periphery of a disc spring (comprising a single spring disc or an assembly of several spring discs) facing one end of the tubular body, said at least one abutment or one of the abutments serving to support the periphery of a shim inserted into the other end of the tubular body.

Preferably a transfer member having a convex, e.g. part-spherical, surface is located between the disc spring and the end of the valve stem when the tappet is operatively installed

in an engine, whereby the disc spring progressively wraps itself around the convex surface, from its centre outwardly, as the tappet moves to open the valve. The transfer member is conveniently assembled as a piston slidable in the bore of the tappet so that it automatically locates against the end of the valve stem when the tappet is positioned in its guide aperture in the engine cylinder head. The disc spring and the convex surface of the transfer member, and the relative setting and initial pressure exerted by the disc spring, preferably conform with the teaching of European Patent Application No.79302975.2 (Publication No.0013135) in order to obtain the advantages of that invention and thereby also reduce the number of shims of different grade thicknesses by increasing the gradation step required to effect efficient valve setting.

In order that the invention may be more clearly understood, reference will now be made to the accompanying drawings, in which:-

Fig. 1 is a section through a part of the cylinder head of an internal combustion engine showing a valve operated by an overhead camshaft via a tappet of known construction,

Fig. 2 is a section similar to Fig. 1 but showing a tubular tappet construction and valve actuating system according to one embodiment of this invention,

Figs. 3 to 6 show alternative embodiments of tubular tappets the disc springs being omitted.

Fig.1 shows a known tappet-actuated valve system in which a cam 1 of an overhead camshaft actuates an inverted cup-shaped tappet 2 slidable in a guide aperture 3 in the cylinder head 4. The tappet 2 has a cylindrical recess in its upper end, defined by the base wall 5 and the surrounding rim 6, in which is located a shim 7 against which the cam 1 exerts its thrust. The central region 8 of the underside of the base wall 5 engages the end of the stem 9 of a poppet valve 10 which is normally urged against its seat 11 in the

cylinder head 4 by a strong helical spring 12 compressed between a spring retainer 13, secured to the valve stem 9 by split cotters 14, and the cylinder head. A peripheral zone of the underside of the shim rests on the ground annular land 15 on the upper surface of the base wall 5. The central region 8 of the underside of the base wall also comprises a raised land with a ground surface. The external cylindrical surface of the tappet and at least the internal surface of the rim 6 are also ground.

With the arrangement described the desired clearance gap is adjusted by inserting the appropriate selected one of a range of shims of graded thicknesses in the recess in the top of the tappet.

Fig. 2 shows one embodiment of the improved tappet and actuating system according to this invention, parts which are the same as those in Fig. 1 being indicated by the same references. In this embodiment the tappet comprises a tubular body 20 formed with an internal peripheral groove 21, normal to the tube axis, which receives a circlip 22 which serves to support the shim 7. Abutting the underside of the circlip 22 is an annular member 23 having an abutment surface 24 against which rests the periphery of a disc spring 25. Slidable in the bore of the tubular body 20 is a transfer member 26 having a convex, preferably part-spherical, upper surface 27 which abuts the underside of the disc spring 25. The underside of the member 26 abuts the end of the valve stem 9. The member 26 conveniently has a skirt portion to slidably guide the member 26 like a piston in the bore of the tubular body, although it is not necessary to prevent air leakage between the piston and the bore.

The disc spring 25, annular abutment member 23 and the convex surface of the member 26 are designed according to the disclosure and teaching in E.P.O. Publication No. 0013135 which is incorporated herein by reference. The shim 7 is selected so that the disc spring is partially deflected at initial adjustment as described in the

aforesaid publication.

Alternative embodiments of the tubular tappet are shown in Figs. 3 to 6.

In Fig. 3 the tubular body 30 has a ridge or rib 31 machined on its inside surface. The upper surface 32 of the ridge is square to the tube axis and serves to support a shim. The lower surface 33 of the ridge is shaped to form the annular abutment surface for the disc spring.

In Fig. 4 the tubular body 40 is machined internally to form a step 41 against which a ring 42 is pressed in from below to form an annular abutment of which the upper surface supports the shim and the lower surface form an abutment surface for the disc spring.

The embodiment of Fig. 5 is similar to Fig. 4 except that the step 51 in the tubular body 50 faces in the opposite direction and the abutment ring 52 is inserted from above.

The embodiment of Fig. 6 comprises a plain tubular body 60 into which an abutment ring 61 is pressed with considerable interference.

It is to be noted, in the embodiments of Figs. 2 and 4 to 6, that groove 21, steps 41 and 51, and the interference surface between 60 and 61 do not transmit the main thrust from the cam. In all embodiments this thrust is transmitted directly or via the circlip without involving the groove from the shim to the abutment ring. The tubular body simply acts as a guide to absorb the sideways thrust produced by the cam moving across the face of the shim. Virtually all grinding involved is limited to cylindrical surfaces.

FOUR-STROKE INTERNAL COMBUSTION ENGINES WITH OVERHEAD CAMSHAFTS, AND TAPPETS THEREFOR

CLAIMS

1. A four-stroke internal combustion engine of which the poppet valves are actuated by the cams of an overhead camshaft through the intermediary of tappets characterised in that at least one of the tappets comprises a tubular body (20,30,40,50,60) formed or provided around its internal surface with at least one abutment (22,23,31,42, 52,61) against which is supported the periphery of a disc spring (25) inserted into one end of the tubular body and of which the central region directly or indirectly engages the stem (9) of the associated poppet valve (10), said at least one abutment (22,31,42,52,61) or another of the abutments (23) serving to support the periphery of a shim (7) which is inserted into the other end of the tubular body and which is engaged by a cam (1) of the overhead camshaft.

2. An engine according to claim 1, characterised in that a transfer member (26) is located between the disc spring (25) and the valve stem (9), said transfer member having a convex, preferably part-spherical, surface (27) which abuts the disc spring (25).

3. An engine according to claim 2, characterised in that the transfer member (26) is slidable like a piston in the bore of the tubular body.

4. An engine according to claim 1, 2 or 3, characterised in that the internal surface of the tubular body (20) is formed with a peripheral groove (21) in which is fitted a circular spring clip (22) abutting one side of which is an annular member (23) having an abutment surface against which rests the periphery of the disc spring (25), the shim (7) abutting the other side of the circular

spring clip (22).

5. An engine according to claim 1, 2 or 3, characterised in that the internal surface of the tubular body (40,50) is formed with a step (41,51) against which rests a ring (42,52) forming an annular abutment one side of which supports the periphery of the disc spring (25) and the other side of which supports the shim (7).

6. An engine according to claim 1, 2 or 3, characterised in that said at least one abutment comprises an annular member (61) retained by an interference fit in the bore of the tubular body (60).

7. A tappet for a four-stroke internal combustion engine having an overhead camshaft, characterised in that it comprises a tubular body (20,30,40,50,60) formed or provided around its internal surface with at least one abutment (22,23,31,42,52,61) against which is supported the periphery of a disc spring (25) inserted into the tubular body through one of its open ends, said at least one abutment (22,31,42,52,61) or another of the abutments (23) serving to support a shim (7) inserted into the tubular body through its other open end.

8. A tappet according to claim 7, characterised in that it includes a transfer member (26) slidable like a piston in the bore of the tubular body and having a convex, preferably part-spherical, surface (27) facing the disc spring (25).

9. A tappet according to claim 7 or 8, characterised in that the internal surface of the tubular body (20) is formed with a peripheral groove (21) in which is fitted a circular spring clip (22) abutting one side of which is an annular member (23) having an abutment surface against which rests the periphery of the disc spring (25), the other side of the circular spring clip (22) serving to support a shim (7).

10. A tappet according to claim 7 or 8, characterised

in that said at least one abutment comprises an annular member (61) retained by an interference fit in the bore of the tubular body (60).

Fig.3

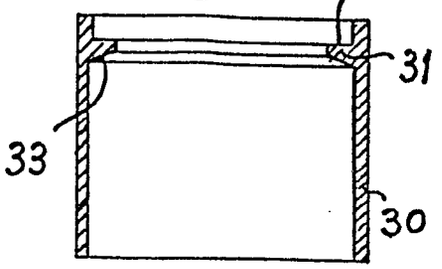


Fig.5

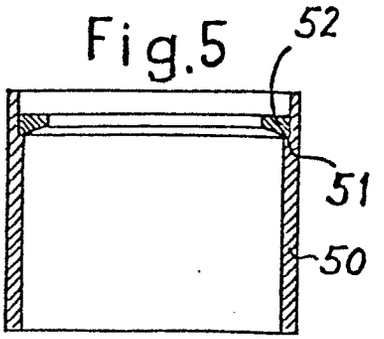


Fig.4

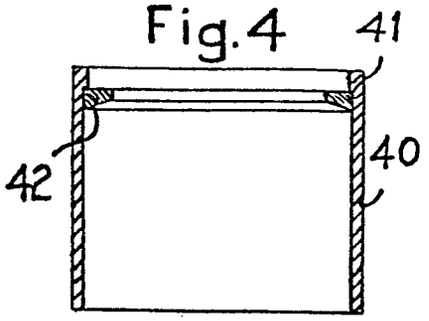


Fig.6

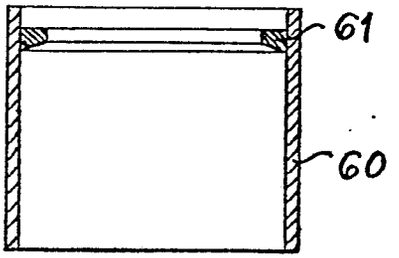
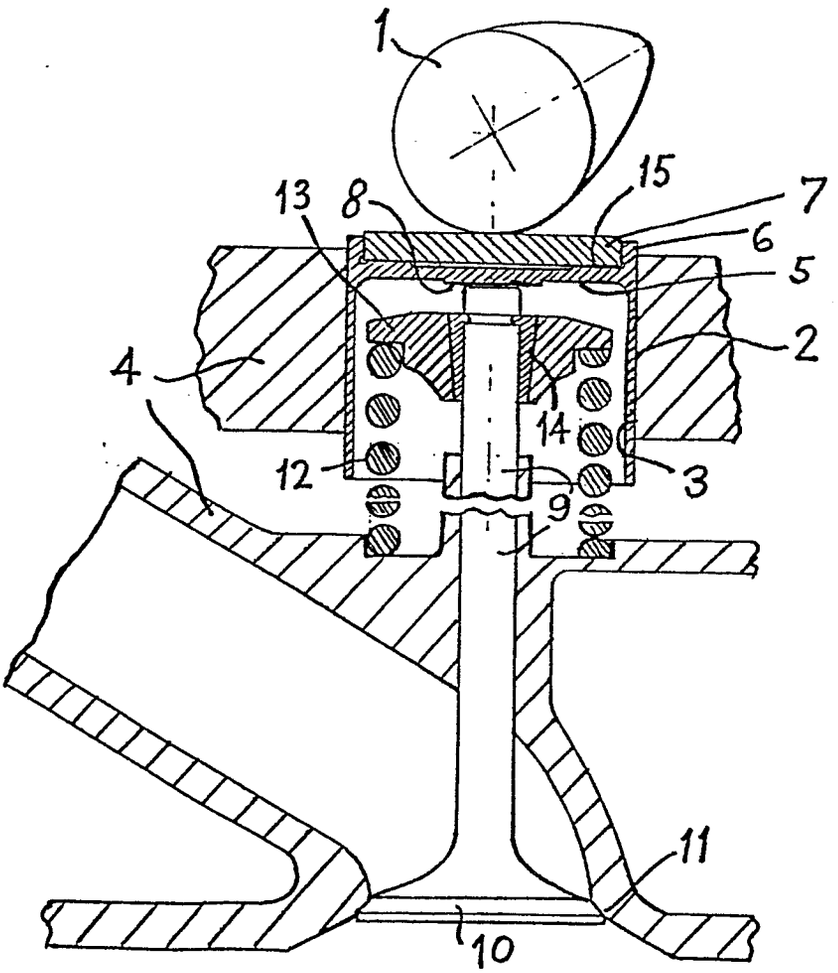


Fig.1



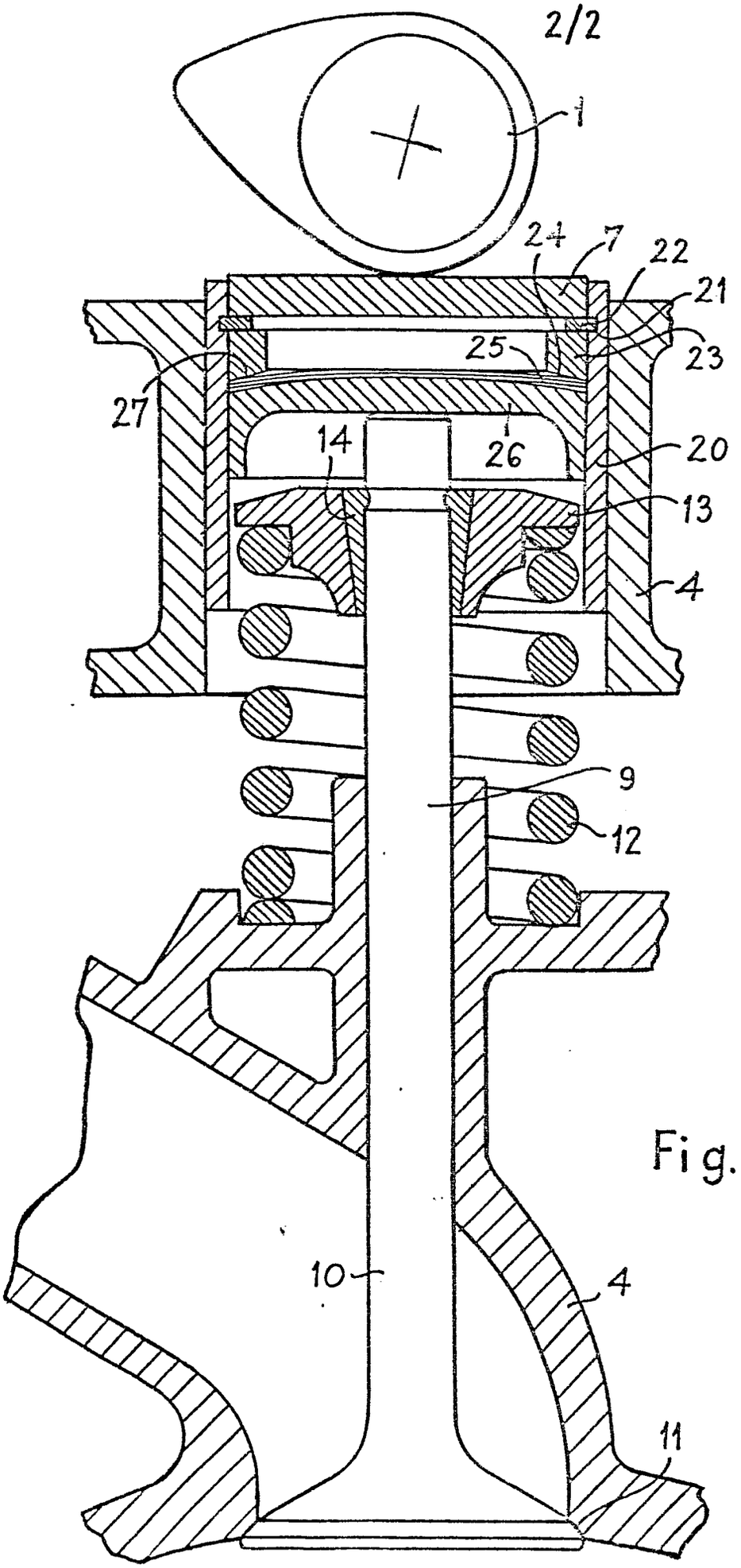


Fig.2

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EUROPEAN SEARCH REPORT

0084267
Application number

EP 82 30 7003

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. ³)
D,Y	EP-A-0 013 135 (VINCENZO) *Figures 1,2; page 5, line 19 to page 7, line 10; figure 4*	1,2,3, 8	F 01 L 1/14 F 01 L 1/16
Y	FR-A-2 129 420 (CIGALA) *Page 2, lines 3-28*	1,4,5, 9	
A	GB-A-1 165 446 (FIAT) *Page 1, lines 48-85*	1	
A	US-A-3 431 896 (GIULIETTI) *Figures 1,2; column 2, lines 24-60*	1	
A	US-A-3 183 901 (THUESEN)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-1 613 117 (MILLER)		F 01 L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30-03-1983	WASSENAAR G.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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