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(54) **Heat engine**

(57) A heat engine comprising a plurality of cylinders (2) provided with one pair of inlet valves (5) and a pair of exhaust valves (4) and a valve control assembly (7) comprising, in turn, a camshaft (8) and, for each pair of corresponding valves, a rocker arm (9) controlled by a respective cam (10) of camshaft (8) and actuating said pair of valves by means of a cross-member (16), and a means (17) for adjusting the play in the kinematic chain present between each cam (10) and the associated pair of valves (4,5); the cross-member (16) comprises a control part (20) of the valves (4) and an arm (21) extending transversely from the control part (20) towards the outside of the associated cylinder (2), the valve control assembly (7) is accommodated in the cylinder head (6) in the vicinity of a free end (23) of the arm (21) of the cross-member (16) and is connected to this latter by an articulated coupling.

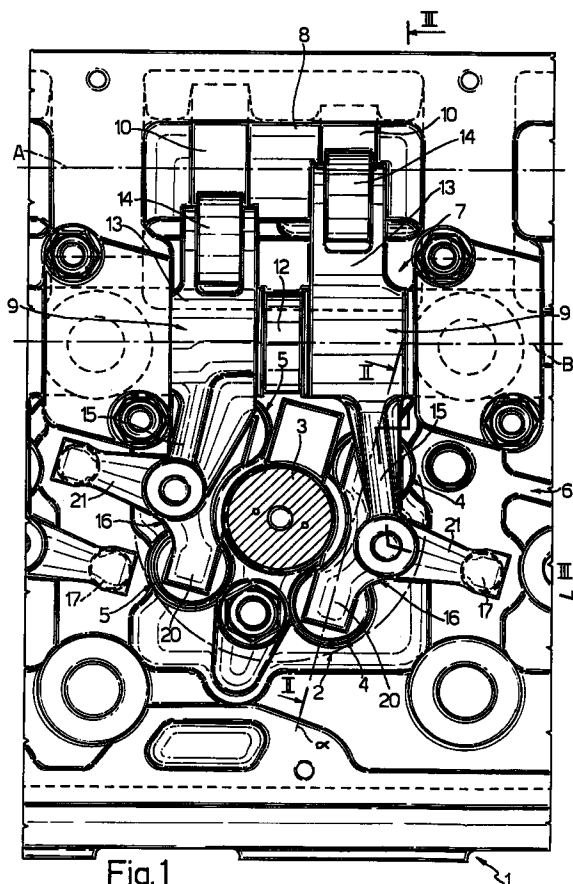
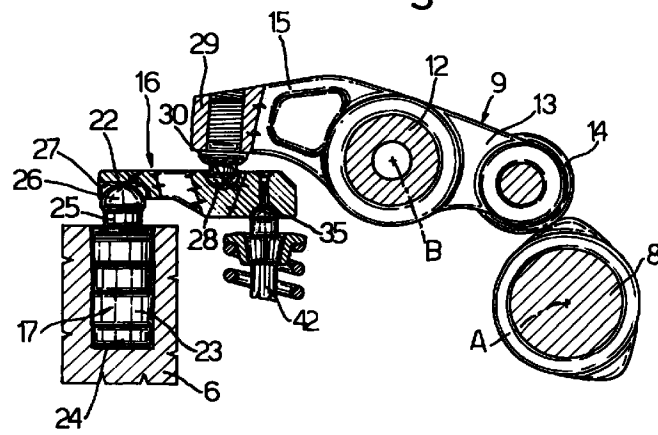


Fig.1

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Fig.3



Description

The present invention relates to a heat engine comprising at least one cylinder provided with at least one pair of corresponding valves and a valve control assembly.

Valve control assemblies are known which comprise a camshaft and a plurality of rocker arms oscillating about an intermediate axis of rotation; the rocker arms are controlled by respective cams of the camshaft and they each actuate a pair of corresponding valves of a cylinder via a control cross-member. With a view to balancing the forces being exerted, the action of the rocker arm on the cross-member is applied in the plane of the axes of the valves, in an intermediate position with respect to the valves themselves.

To take up the play which inevitably occurs during assembly and in the course of time there is normally provided a means for adjusting valve play, which is interposed between each rocker arm and the associated cross-member. This means may either be of manual adjustment type, for example, an adjusting screw provided with a lock nut, or of automatic take-up type, for example a hydraulic tappet.

The known arrangement of the type briefly described is not readily applicable to all engine types, since the cross-member and the means for adjusting valve play have to be accommodated in a region of the engine which is already particularly critical with respect to space, as happens in fuel-injected engines, for example.

In particular, in the case of modern diesel engines the adoption of multivalve fuel supply systems generally requires a coaxial arrangement of the injector with respect to the cylinder so as to obtain the most uniform possible distribution of fuel in the combustion chamber. In the case in which the injection is effected with an accumulation-type system, the dimensions of the control part of the injector are greater than those of conventional injectors and to such an extent that they give rise to difficulties in the design of the means for adjusting valve play.

The object of the present invention is to devise a heat engine for a vehicle, which does not have the aforementioned drawbacks associated with the known engines described above.

This object is achieved by the present invention in that it relates to a heat engine comprising at least one cylinder provided with at least one pair of corresponding valves, and a valve control assembly comprising, in turn, a camshaft, at least one rocker arm associated with said pair of corresponding valves and controlled by a respective cam of said camshaft, a cross-member provided with a control part interposed between said rocker arm and said pair of corresponding valves, and a means for adjusting the play in the kinematic chain present between the associated cam and the associated pair of corresponding valves, characterised in that

said cross-member comprises an arm extending transversely from said control part of the cross-member itself towards the outside of said cylinder, said valve control assembly comprising first articulated coupling means interposed between said arm of said cross-member and a fixed part of said engine, said rocker arm cooperating with a contact zone of said cross-member displaced towards the outside of the cylinder with respect to a plane containing the axes of said corresponding valves.

With a view to a better understanding of the present invention a preferred embodiment will be described non-restrictively by way of example below, with reference to the accompanying drawings, in which:

Figure 1 is a partial plan view of a heat engine designed in accordance with the present invention, with parts omitted for greater clarity,

Figure 2 is a partial section along the line II-II in Figure 1;

Figure 3 is a partial section along the line III-III in Figure 1;

Figure 4 is a plan view of from below of a detail of the engine in Figure 1;

Figure 5 is a view is side elevation and partly in section of the detail in Figure 4;

Figure 6 illustrates schematically a detail of Figure 2, on an enlarged scale and in a different operating condition, and

Figure 7 is an analogous partial section to that in Figure 3 of a second embodiment of the present invention.

Referring now to Figure 1, the reference numeral 1 generally denotes a heat engine 1, only part of which is shown.

The engine 1 comprises a plurality of cylinders 2 and, for each cylinder, an injector 3 coaxial to the cylinder itself, a pair of exhaust valves 4 and a pair of inlet valves 5. The injectors 3 and the valves 4,5 are mounted in conventional manner in a cylinder head 6 of the engine 1; the cylinder head also accommodates a valve control assembly 7 which will be described in greater detail below.

Figure 1 illustrates the above-mentioned components associated with a single cylinder 2 of the engine 1; it is evident that the engine comprises analogous components for each of the cylinders.

The valve control assembly 7 essentially comprises a camshaft 8 with an axis A and, for each cylinder, a pair of rocker arms 9 controlled by respective cams 10 of the shaft 8 and each actuating a pair of corresponding valves 4 or, respectively, 5 against the action of respective springs 11 of the valves themselves.

The rocker arms 9 are pivoted about a common pivot 12, whose axis B is parallel to the axis A, and they each comprise a first arm 13 cooperating with the respective cam 10 by means of an idle roller 14 and a second arm 15 actuating the associated pair of valves 4

and, respectively, 5 by means of a cross-member 16.

The assembly 1 also comprises, for each rocker arm 9, a means 17 for adjusting play in the kinematic chain present between the associated cam 10 or, respectively, 11 and the associated pair of valves 4 or, respectively, 5.

The following description refers specifically to the rocker arm 9 and to the cross-member 16 associated with the pair of valves 4 (Figures 2 and 3), it is also be apparent that the valve control assembly 7 comprises corresponding members for controlling the pair of valves 5 of the same cylinder 2, as well as for the other pairs of valves (not shown).

The valves 4 have respective parallel axes E, E' lying on a plane α .

According to the present invention the cross-member 16 comprises a control part 20 extending from one valve 4 to the other, and an arm 21 extending from one median zone of the part 20 in a transverse direction to the part 20 itself, towards the outside of the associated cylinder 2.

The part 20 advantageously has a recess 18 in an intermediate section of its side opposite the arm 21 and, therefore, opposite the injector 3 for reasons concerned with the space occupied by the injector itself. Therefore, overall the cross-member 16 is substantially of symmetrical Y-shape (Figure 4) with respect to a plane P defining the transverse centre line of the control part 20 and the longitudinal centre line of the arm 21.

The means 17 for adjusting play (Figure 3) is accommodated in the head 6 below a free end 22 of the arm 21 and advantageously comprises a hydraulic compensator, of a type known per se, having a fixed body 23 accommodated in a seating 24 provided in the head 6, and a piston 25 sliding unidirectionally relative to the body 23 so as to extend out of the latter if play is present.

The means 17 is supplied with an operating fluid, advantageously comprising engine lubricating oil, through passages (not shown) provided in the head.

The end 22 of the arm 21 is pivoted about the piston 25 of the device 12, which has a spherical head 26 co-operating with a substantially semicylindrical seating 27 extending longitudinally along the plane P on a lower surface of the arm 21 itself (Figures 4 and 5).

The rocker arm 9 actuates the cross-member 16 by means of a spherical head 28 inserted in an end portion 29 of the arm 15 and co-operating with a cavity 30 having a spherical bottom (with its geometrical centre on the plane P) provided in the cross-member 16 itself in the vicinity of the connecting zone between the control part 20 and the arm 21 (Figures 3 and 5) and displaced with respect to the plane α towards the outside of the cylinder 2.

The control part 20 of the cross-member 16 has at its lower end a substantially cylindrical longitudinal seating 34 extending along the entire length of the part 20 itself. A cylindrical bar 35 is accommodated in the seat-

ing 34 and is able to rotate about its own longitudinal axis D lying on the plane α and orthogonal to the axes E, E' of the valves 4.

The bar 35 is held in contact with the seating 34 by a spring 36. The latter comprises a C-shaped anchoring portion 37 which surrounds the arm 21 of the cross-member 16, and a flexible strip 38 extending from the portion 37 towards the bar 35 and provided with an arcuate end 39 partly surrounding the bar itself.

The bar 35 has respective semicircular ends 40 bounded at the bottom by respective flat surfaces 41 which are mutually coplanar. These surfaces co-operate axially with respective stems 42 of the valves 4.

The mode of operation of the valve control assembly 7 will be described below referring in all cases only to the valves 4 illustrated in Figures 2 and 3.

The operating load of the valves 4 is transmitted from the rocker arm 9 through the head 28 to the cross-member 16 and from the latter to the valves 4 through the bar 35. The means 17 ensures the contact between the head 28 and the cross-member 16. In the event that play develops, it is immediately and automatically taken up by the means 17, as a result of its piston 25 extending out therefrom under the pressure exerted by its internal members.

The operating load line is contained within the plane P and, therefore, under theoretical conditions, the movement of the cross-member 16 is that of a lever of the second kind about the fulcrum defined by the contact between the spherical head 26 of the piston 25 of the means 17 for adjusting play and the seating 27 of the cross-member 16.

The freedom of the bar 35 to rotate in the seating 34 during the rotation of the cross-member 16 enables the surfaces 41 to be always maintained orthogonal to the axes E, E' of the respective valves, thereby exerting a purely axial force on the valves themselves.

The load transmitted by the cross-member 16 is distributed equally to the valves 4, whose axes E, E' are equidistant from the plane P owing to the symmetrical design of the cross-member itself.

As a result of differing stiffness of the springs 11 of the valves 4, the same operating load could correspond to different degrees of lift of the springs 4, in which case the cross-member 16 would tend to be inclined, as illustrated schematically in Figure 6 in an exaggerated manner with respect to its proportions, and this for greater clarity.

In this case, the contact between the valves 4 and the surfaces 41 no longer occurs over the entire surface of the heads of the stems 42 but is displaced along an outer edge of the head surface. As a result, the distances from the plane P of the respective contact points H, H' of the stems 42 with the bar 35 become different (in particular smaller than that of the valve with which the stiffer spring is associated). Accordingly, the operating load is distributed unequally between the valves themselves (inversely proportional to the distance of the

points H, H' from the plane P) so that a greater proportion of the load is transmitted to the valve 4 with which the stiffer spring is associated. Therefore, a sort of mechanical feedback or self-correction is provided, which renders the difference in stiffness between the springs substantially without influence.

Figure 7 illustrates a second embodiment of the present invention, provided with a means 17' for manual adjustment of play.

The means 17' essentially comprises an adjusting screw 40 screwed into the end portion 29 of the arm 15 of the rocker arm 9 and carrying the spherical actuating head 28 of the cross-member 16, and a lock nut 41 engaged by the screw 40 and able to be tightened against said portion 29. The cross-member 16, which is entirely analogous to that described with reference to Figures 1 to 6, is pivoted about a spherical head 26' fixed to the cylinder head 6.

The advantages which can be achieved with the present invention are evident from a study of the features of the engine 1 designed in accordance therewith.

In particular, the provision of the arm 21 makes it possible to displace the contact zone between the rocker arm 9 and the cross-member 16 towards the outside of the cylinder, outside the plane α of the valve axes, thereby balancing the tilting torque on the cross-member 16 resulting therefrom: this makes it possible to obviate undesirable space requirement in the region of the injector 3 and to remove therefrom the means 17 for adjusting valve play.

In the embodiment of Figures 1 to 6, this means is automatic and is incorporated in the articulated coupling means for the arm 21 itself to the cylinder head 6. In the embodiment of Figure 7 the means is mechanical and is interposed between the rocker arm and the cross-member for reasons of accessibility but it is displaced towards the outside of the cylinder with respect to the plane of the valve axes.

Finally, it is evident that the engine 1 described can be subject to modifications and variants which do not depart from the scope of protection of the present invention.

Claims

1. A heat engine (1) comprising at least one cylinder (2) provided with at least one pair of corresponding valves (4,5), and a valve control assembly (7) comprising, in turn, a camshaft (8), at least one rocker arm (9) associated with said pair of corresponding valves (4,5) and controlled by a respective cam (10) of said camshaft (8), a cross-member (16) provided with a control part (20) interposed between said rocker arm (9) and said pair of corresponding valves (4,5), and a means (17) for adjusting the play in the kinematic chain present between the associated cam (10) and the associated pair of corresponding valves (4,5), characterized in that said

cross-member (16) comprises an arm (21) extending transversely from said control part (20) of the cross-member (16) itself towards the outside of said cylinder (2), said valve control assembly (7) comprising first articulated coupling means (26,27) interposed between said arm (21) of said cross-member (16) and a fixed part (6) of said engine (1), said rocker arm (9) co-operating with a contact zone (30) of said cross-member (16) displaced towards the outside of the cylinder (2) with respect to a plane (α) containing the axes (E,E') of said corresponding valves (4,5).

2. An engine according to claim 1, characterized by comprising second articulated coupling means (28,30) interposed between said rocker arm (9) and said cross-member (16).
3. An engine according to claim 2, characterized in that said second articulated coupling means comprise a spherical head (28) secured to said rocker arm (9) and a concave cavity (30) provided in said cross-member (16) in the vicinity of the connection between said arm (21) and said control part (20) of the cross-member (16) itself and defining said contact zone.
4. An engine according to any one of the preceding claims, characterised in that said first coupling means comprise a spherical head (26) carried by said fixed part (6) of said engine (1) and a concave seating (27) provided in said arm (21) of said cross-member (16).
5. An engine according to claim 4, characterised in that said concave seating (27) is of substantially semi-cylindrical concave shape elongated in the longitudinal direction with respect to said arm (21) of said cross-member (16).
6. An engine according to any one of the preceding claims, characterised in that said means (17) for adjusting play is interposed between said arm (21) of said cross-member (16) and said fixed part (6) of said engine (1).
7. An engine according to any one of the preceding claims, characterised in that said first articulated coupling means (26,27) are interposed between said arm (21) of said cross-member (16) and said means (17) for adjusting play, said spherical head (26) forming part of a movable member (25) of said means (17) for adjusting play.
8. An engine according to any one of the preceding claims, characterised in that said means (17) for adjusting play is a hydraulic compensator (17) using the lubricating oil of said engine (1) as the

operating fluid.

9. An engine according to any one of claims 1 to 5, characterised in that said means (17) for adjusting play is interposed between said rocker arm (9) and said contact zone (30) of said cross-member (16). 5
10. A heat engine according to claim 9, characterised in that said means (17) for adjusting play is of screw type, with manual adjustment. 10
11. A heat engine according to any one of claims 8 to 10, characterised in that said spherical head (26) of said first coupling means is secured to said fixed portion (6) of said engine (1). 15
12. An engine according to any one of the preceding claims, characterised by comprising third articulated coupling means (34,35) interposed between said control part (20) of said cross-member (16) and said pair of corresponding valves (4). 20
13. An engine according to claim 12, characterised in that said third articulated coupling means comprise a bar (35) accommodated in a longitudinal seating (34) of said control part of said cross-member (16) with the possibility of rotation about its own longitudinal axis (D) intersecting the axes (E,E') of said valves (4) and provided with a pair of thrust surfaces (41) with flat ends and which are mutually coplanar and co-operate with said respective valves (4). 25 30
14. An engine according to claim 13, characterised by comprising elastic means (36) connecting said bar (35) to said cross-member (16). 35
15. An engine according to claim 14, characterised in that said elastic connecting means comprise a spring (36) having an anchoring part (37) fixed to said arm (21) of said cross-member (16) and a flexible strip (38) co-operating with said bar (35) so as to retain it in said seating (34). 40
16. An engine according to any one of the preceding claims, characterised in that said control part (20) of said cross-member (16) has a recess (18) in an intermediate section of its side opposite said arm (21). 45 50
17. An engine according to claim 16, characterised in that said cross-member (16) is substantially Y-shaped. 55

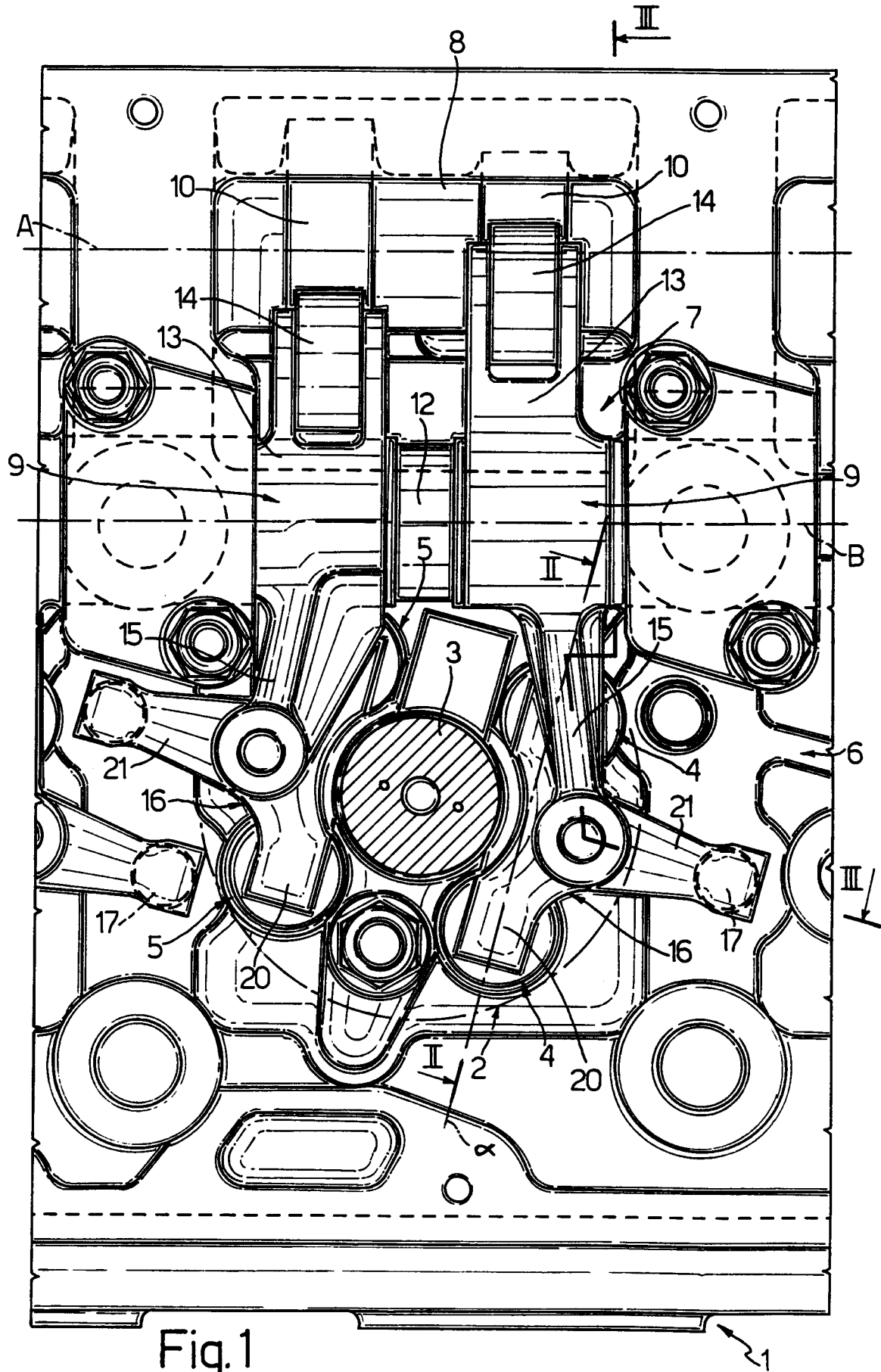


Fig.1

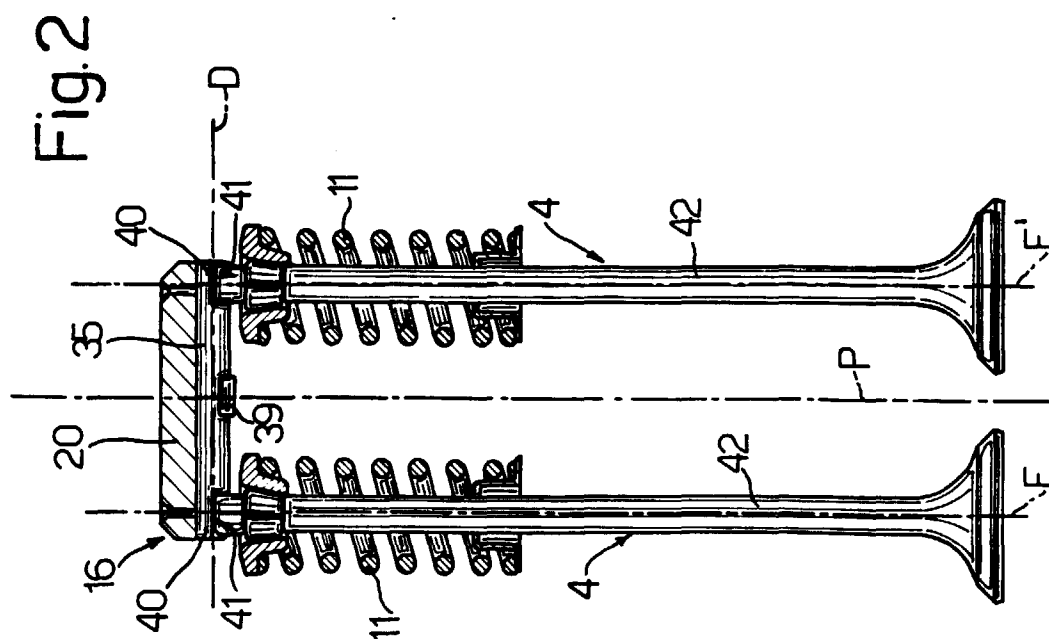


Fig. 2

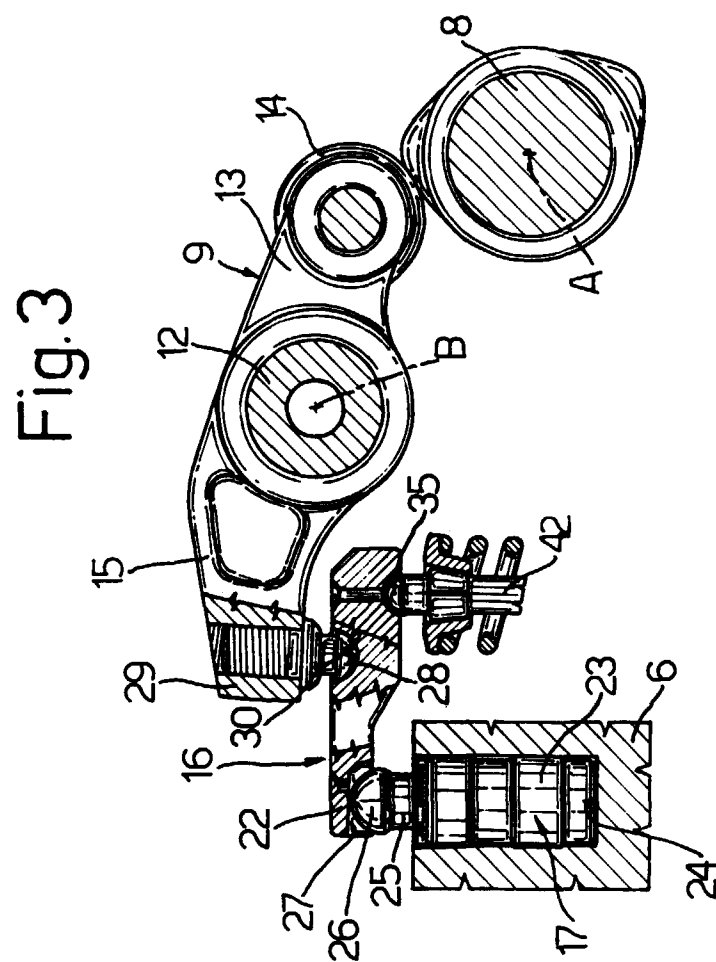


Fig. 3

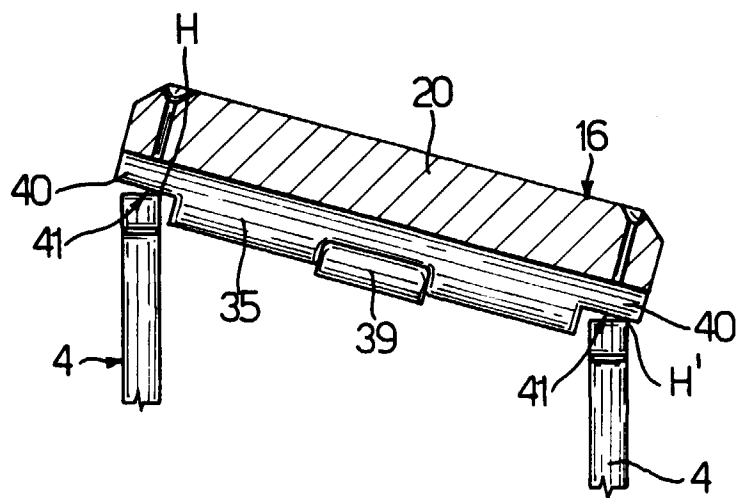
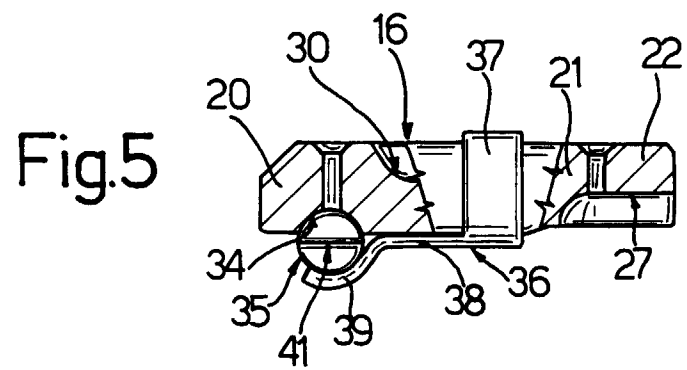
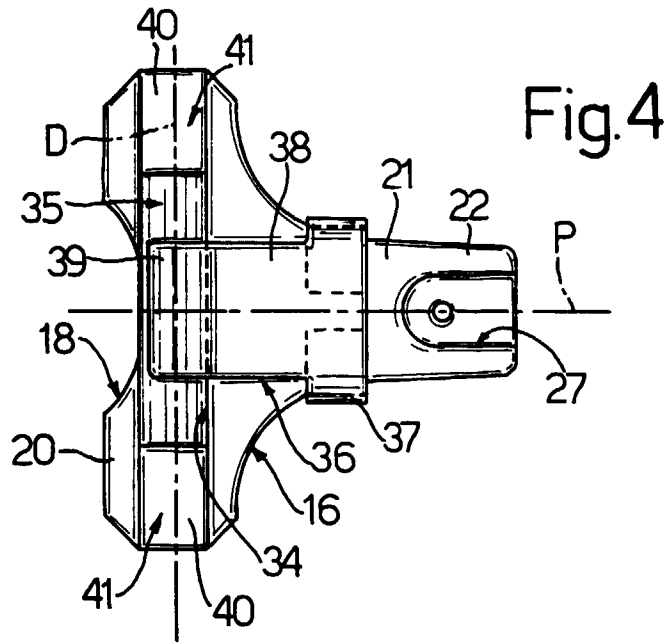
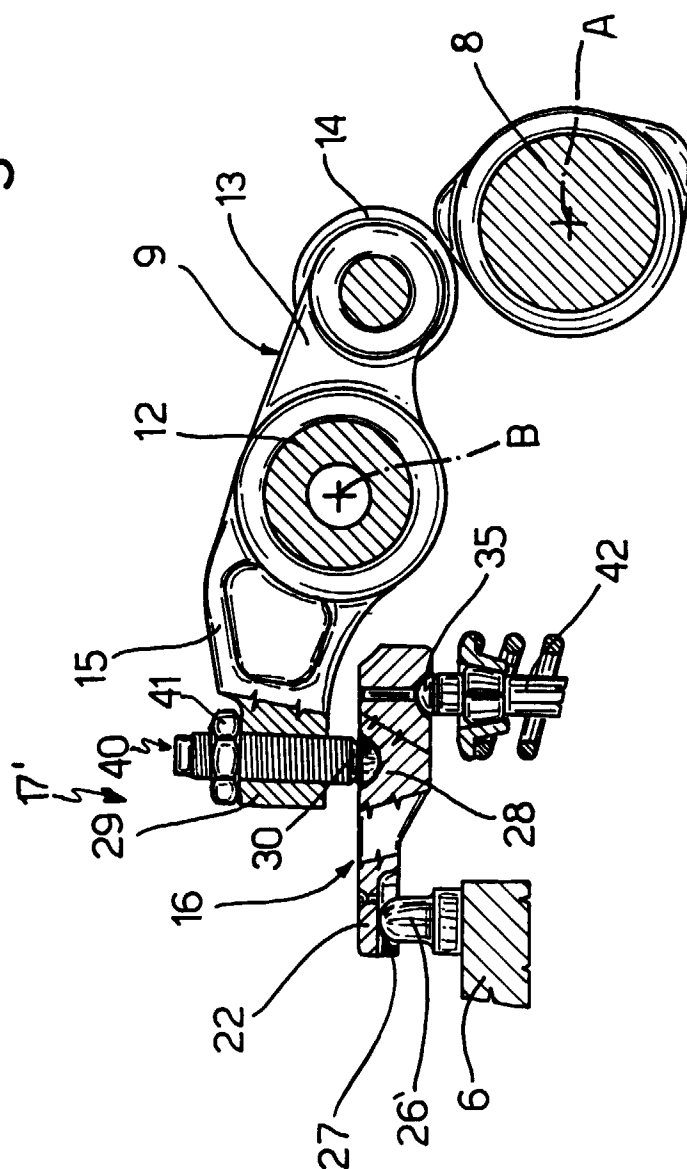


Fig. 7





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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 9104

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.6)
X	EP 0 764 769 A (NETHERLANDS CAR BV) 26 March 1997 * the whole document *	1,2,6-8, 12,16,17	F01L1/26 F01L1/18 F01L1/24
A	WO 97 16630 A (CUMMINS ENGINE COMPANY INC) 9 May 1997 * figures *	1-3	
A	US 5 303 680 A (EATON CORPORATION) 19 April 1994 * the whole document *	1	
A	EP 0 586 884 A (IVECO FIAT SPA) 16 March 1994		
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			F01L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 26 August 1998	Examiner Klinger, T
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