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(71) Applicant: **IVECO FIAT S.p.A.**
Via Puglia 35
I-10156 Torino(IT)

(72) Inventor: **Carrara, Massimo**
Turmhalden Strasse 12
CH-8400 Winterthur(CH)

(74) Representative: **Boggio, Luigi et al**
STUDIO TORTA Società Semplice
Via Viotti, 9
I-10121 Torino (IT)

(54) An internal-combustion engine provided with an improved valve control assembly.

(57) An internal-combustion engine (1) having a pair of inlet valves (5, 6) and/or a pair of exhaust valves (5', 6') per cylinder (3), in which each pair of homologous valves (5, 6; 5' 6') is operated by a respective actuating member (9, 9') formed by a transverse member (17) adapted to co-operate with the valves themselves and by a stem (19) co-operating with respective guide means (45, 45') secured to the head (4) of the engine (1); the transverse member (17) is disposed at the lower end of the stem (19) and said guide means (45, 45') are disposed above the valves (5, 6; 5' 6').

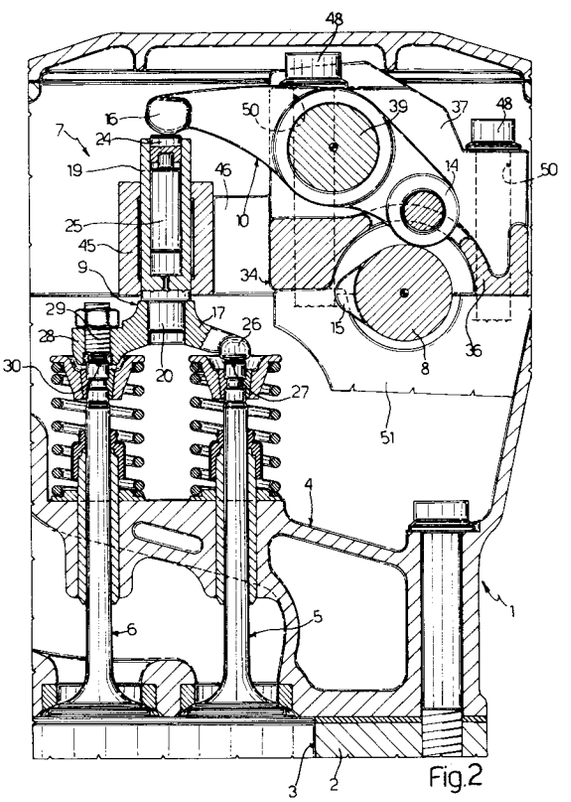

Fig.2

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The present invention relates to an internal-combustion engine and, in particular, to an internal-combustion engine of the type provided with at least one pair of homologous valves per cylinder.

Internal-combustion engines are known which comprise, for each cylinder, one pair of inlet valves and/or one pair of exhaust valves. The valves of each pair are operated by a common actuating member which, in turn, is operated by a camshaft, generally by means of a rocker arm. The aforementioned actuating member comprises an upper transverse member co-operating centrally with the rocker arm and adapted to act with its opposite ends on the stems of the respective valves, and a slide member sliding along guide means adapted to ensure movement of the transverse member in a direction parallel to the axes of the valves. These guide means are generally interposed between the valve stems.

Valve control assemblies of the type briefly described above have a number of drawbacks.

Above all, the use of three or more valves per cylinder creates considerable problems in respect of transverse dimensions; in addition to the space requirement of the valves there is that required for the guide means of the actuating members and, in the case of diesel engines, that required by the central injector. Certain types of injector are of such large transverse dimensions that it becomes substantially impossible to dispose all of said elements within a space equal to the cross-section of one cylinder. Other known design solutions resolve the problem of space requirement but, on the other hand, are not without disadvantages.

In particular, solutions are often provided having valves inclined towards the outside of the respective cylinders, which are operated by two camshafts disposed on opposite sides of the cylinders themselves. The inclined arrangement of the valves makes it possible for a central space to be provided which can accommodate the injector, even if it is of considerable size. This solution is very costly and, moreover, is disadvantageous with respect to emissions; finally, the two camshafts obstruct the upper zone of the cylinder head, thereby making it rather difficult to gain access to the screws connecting the head itself to the crankcase.

The object of the present invention is to devise an internal-combustion engine provided with an improved valve control assembly, which does not have the above-mentioned drawbacks associated with known engines.

This object is achieved by the present invention in that it relates to an internal-combustion engine comprising a crankcase defining a plurality of cylinders, a head provided with at least one pair of homologous valves for each cylinder, and a valve control assembly, said assembly comprising at least one camshaft, a plurality of actuating members adapted to be operated at least indirectly by said camshaft and to operate in turn, in each case, a respective pair of said homologous valves, said actuating members comprising a transverse member adapted to co-operate with said valves of one of said respective pairs, and a stem co-operating with respective guide means secured to said head, characterised in that said transverse member is disposed at the lower end of said stem, said guide means being disposed above said valves.

With a view to a better understanding of the invention, preferred embodiments thereof will now be described below, non-restrictively by way of example, with reference to the accompanying drawings, wherein:

Figure 1 is a plan view from above of part of a valve control assembly of an engine constructed in accordance with the present invention;

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

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

Figure 4 is a partial plan view from above of a detail of the valve control assembly in Figure 1;

Figure 5 is an analogous section to that in Figure 3 of a second embodiment of the present invention;

Figure 6 is a view in perspective of a detail of the valve control assembly in Figure 5, and

Figure 7 is a section taken along the line VII-VII in Figure 5.

Figures 2 and 3 illustrate part of a diesel engine for a commercial vehicle, which is generally designated by the reference numeral 1. The engine 1 comprises a crankcase 2 defining a plurality of cylinders 3 and a head 4, in which the respective valves are accommodated. In particular, two inlet valves 5, 6 and two exhaust valves 5', 6' are associated with each cylinder 3.

As is evident in Figure 1, the valves of each pair 5, 6 or 5', 6' are situated close to one another and the two pairs of valves are diametrically opposite each other with respect to the axis of the cylinder.

For greater clarity and ease of reference, in the following description the exhaust valves and their associated members are denoted by the same reference numerals as the inlet valves and their corresponding members but with the addition of an index mark (').

The valves 5, 6; 5', 6' are actuated by control assembly 7 comprising a single camshaft 8, a plurality of actuating members 9, 9' each associated with a respective pair of inlet valves 5, 6 or exhaust valves 5', 6', and a plurality of rocker arms 10, 10', each of which co-operates by means of an end roller 14 with a respective cam 15 of the shaft

7 [sic], and by means of its opposite end 16 with a respective actuating member 9, 9'.

According to the present invention, the actuating members 9, 9', which are illustrated respectively in Figures 2 and 3, are of a shape similar to an inverted T and comprise a lower transverse member 17 and a vertical stem 19 secured at one of its ends 20 in a central portion of the transverse member 17.

More particularly, the stem 19, which can slide axially along guide means to be described below, is provided with an upper head 24 which is acted upon by the end 16 of the respective rocker arm. The stem 19 is hollow and the head 24 is carried by a hydraulic device 25 accommodated inside the stem 19 and adapted to carry out the automatic take-up of the play caused by mechanical wear and machining and assembly tolerances. Said device, which uses engine oil as the operating fluid, will not be described in detail since it is known per se to persons skilled in the art.

At one of its ends 26, the transverse member 17 has a fixed lower contact surface 27 co-operating with the stem of the respective valve 5 or 5'; a threaded pin 29 is screwed to the opposite end 28 of the transverse member 17 and is provided at its bottom with a second contact surface 30 co-operating with the respective valve 6 or 6'. The pin 29 serves to adjust the position of the contact surface 30 with respect to that of the surface 27 so as to ensure perfect simultaneity of operation of the valves 5, 6 or 5', 6'.

According to another characteristic of the present invention, all the actuating members 9 are carried by a common support 34 which is shown in cross-section in Figures 2, 3 and which is illustrated more clearly in Figure 4.

The support 34 comprises a base 36 of semi-tubular elongate shape, which is disposed above the camshaft 7 [sic] and partly accommodating the latter, and a plurality of blocks 37 formed integrally and extending upwards from the base 6. The blocks 37, which are spaced equidistantly apart, are equal in number to the number of cylinders increased by one unit and are respectively disposed between each pair of adjacent cylinders and at the opposite sides of the outer cylinders.

Each of the blocks 37 has a transverse hole (i.e. having its axis parallel to that of the camshaft 79 [sic]) which is not shown and which accommodates a pivot pin 39 for the rocker arms 10, 10'.

Figure 1 illustrates a portion of the support 34 comprising two adjacent intermediate blocks 37 (i.e. not end blocks), and the associated cylinder 3 interposed between said blocks. Referring particularly to Figure 3, it is evident that each block 37 accommodates a respective pin 39 which projects axially from the block itself at both of its ends; on each of said ends there are pivoted respectively a rocker arm 10 for operating the inlet valves 5, 6 of a cylinder 3 and a rocker arm 10' for operating the exhaust valves 5', 6' of an adjacent cylinder. The rocker arms 10, 10' are locked axially on the pin 39 by retaining rings 40 co-operating axially with the rocker arms 10, 10' with the interposition of rings 38 with a low-coefficient of friction.

The base 36 of the support 34 has a plurality of openings 44 adapted to allow contact between the rollers 14 of the rocker arms 10, 10' and the associated cams 15 of the shaft 8. As already indicated, the rocker arms 10, 10' co-operate at their opposite ends 16 with the actuating members 9, 9', the stems 19 of which are guided inside respective bushes 45, 45' formed integrally with the support 34.

More particularly, extensions 46, 46' extend from the base 36 in alignment with the edges of each block and overhung with respect to the cylinders 3, said bushes 45, 45' being formed at the ends of said extensions 46, 46'. Said extensions 46, 46' extend from each intermediate block 37, in divergent directions, towards respective mutually adjacent cylinders 3 and are of different length. Moreover, the bushes 45, 45' are connected to one another by a stiffening rib 47. With regard to the end blocks 37, which are not interposed between two cylinders 3 but are adjacent to a single end cylinder, the above-described modifications are obvious. In particular, the end blocks 37 support the associated pin 39 for a single rocker arm 10 or 10'; additionally, one of the bushes 45 or 45' is omitted.

The support 34 is secured to the head 4 of the engine 1 by means of a plurality of screws 48 accommodated in respective pairs of through-holes 50 provided in the blocks 37 of the support itself and screwed into respective holes provided in a wall 51 of the head 4, part of which is shown, and also by means of screws 52 engaging in respective holes 53 provided in the ribs 47 and also screwed into a wall (not shown) of the head 4.

The mode of operation of the valve control assembly 7 is known per se and, therefore, will not be described in detail. The assembly 7 is installed in the following manner. Firstly, the rocker arms 10, 10' are mounted on the support member 34. Subsequently, before introducing the actuating members 9, 9' into the respective bushes 45, 45', the support member 34 is mounted on the head 4 and the screws 48 and 52 are tightened.

There will now be described, with reference to Figures 5 and 6, a second embodiment of a valve control assembly in accordance with the present invention, generally denoted by the reference numeral 55. For the sake of simplicity, the same reference numerals will be used in the following to identify like components or components corre-

sponding to those already described with reference to the assembly 7.

The assembly 55 has a plurality of support blocks 37 which are mutually independent (in this case, therefore, there is no common support base 36 for the various blocks 37). Each of the blocks 37, one of which is illustrated schematically in perspective in Figure 6, is secured separately to the head 4 and is provided with a respective pin 39 for two rocker arms 10, 10' (or a single rocker arm in the case of two end blocks 37). The bushes 45, 45' of each block 37 have a vertical slot 56 facing the block 37 itself, through which the end 16 of the associated rocker arm 10 or 10' can enter a diametral opening 57 provided in a central portion of the stem 19 (Figure 7). A lower portion of the stem 19 accommodates the device 25 for automatically taking up play, the head 24 of which is acted upon by the associated rocker arm 10 or 10'. The mode of operation of the assembly 55 is entirely analogous to that of the assembly 7, with the sole difference that the actuating members 9, 9' are not acted upon by the rocker arms 10, 10' at their upper end but in an intermediate portion, thereby reducing the vertical dimensions of the assembly and, consequently, of the engine.

The advantages which can obtained by the present invention are evident from the engine 1 and, in particular, from the valve control assemblies 7 and 55 designed in accordance with the invention.

In particular, the fact that the transverse member of the actuating members is disposed at the lower end of the associated stem and, therefore, that the guide means for the actuating members are disposed above the valve makes it possible to overcome the problems in respect of transverse dimensions associated with known valve control assemblies, and therefore to use two pairs of valves with mutually parallel axes and operated by a single camshaft, even if a central injector of large size is provided. The use of a single camshaft substantially reduces the production costs of the engine and facilitates access to the head screws. In addition, emissions are reduced to a minimum. Finally, compared to the assembly 7, the valve control assembly 55 makes it possible to reduce the vertical dimensions of the head. A further advantage of the assemblies 7 and 55 lies in the fact that the devices for automatically taking up play are incorporated in the stem 19 of the actuating members 9, 9'.

Finally, it is evident that modifications and variations can be made to the engine 1, without thereby departing from the scope of the present invention. For example, the head 4 can be provided with a single pair of homologous valves per cylinder, i.e. it may comprise two inlet valves and a single exhaust valve, or two exhaust valves and a single inlet valve per cylinder; in this case, for each cylinder the valve control assembly will comprise a single actuating member of the type described, adapted to operate simultaneously the pair of homologous valves. Furthermore, all the rocker arms 10, 10' can pivot about a single pin. Finally, instead of the roller 14, the rocker arms 10, 10' can be provided with an end slide member adapted to co-operate with a respective cam.

Claims

1. An internal-combustion engine (1) comprising a crankcase (2) defining a plurality of cylinders (3), a head (4) provided with at least one pair of homologous valves (5, 6; 5', 6') for each cylinder (3), and a valve control assembly (7, 55), said assembly (7, 55) comprising at least one camshaft (8), a plurality of actuating members (9, 9') adapted to be operated at least indirectly by said camshaft (8) and to operate in turn, in each case, a respective pair of said homologous valves (5, 6; 5', 6'), said actuating members (9, 9') comprising a transverse member (17) adapted to co-operate with said valves (5, 6; 5', 6') of one of said respective pairs, and a stem (19) co-operating with respective guide means (45, 45') secured to said head (4), characterised in that said transverse member (17) is disposed at the lower end of said stem (19), said guide means (45, 45') being disposed above said valves (5, 6; 5', 6').

2. An engine according to Claim 1, characterised in that said valve control assembly (7, 55) comprises means (24, 25) for automatically taking up the play between said actuating members (9, 9') and the respective pairs of valves (5, 6; 5', 6'), said means being incorporated in said stem (19) of each actuating member (9, 9').

3. An engine according to Claim 1 or 2, characterised in that said head is provided with one pair of inlet valves (5, 6) and one pair of outlet valves (5', 6') for each cylinder (3).

4. An engine according to any one of the preceding Claims, characterised in that said guide means (45, 45') comprise a plurality of support blocks (37) disposed between each pair of said adjacent cylinders (3) and at opposite sides of the end cylinders (3), said blocks integrally comprising at least one guide bush (45, 45') for said stem (19) of said actuating members (9, 9').

5. An engine according to Claim 4, characterised in that it comprises a plurality of rocker arms (10, 10') operated by said camshaft (8) and each co-operating with a respective actuating member (9, 9'), said rocker arms (10, 10') being pivoted about at least one pin (39) supported by said support blocks (37).

6. An engine according to Claim 5, characterised in that said means (24, 25) for automatically taking up play comprise a hydraulic device (25) accommodated in said stem (19) of each actuating member (9, 9') and provided with a head (24) adapted to receive an actuating load from a respective rocker arm (10, 10').

7. An engine according to Claim 5 or 6, characterised in that said support blocks (37) disposed between two adjacent cylinders (3) are formed integrally with a pair of said bushes (45, 45') extending towards the respective cylinders (3), said bushes (45, 45') co-operating respectively with said actuating member (9) for the intake valves (5, 6) of one cylinder (3) and an actuating member (9') for the exhaust valves (5', 6') of another cylinder (3).

8. An engine according to Claim 7, characterised in that said support blocks (37) disposed between said two adjacent cylinders (3) carry one of said pins (39), on the opposite ends of which are pivoted two rocker arms (10, 10') associated respectively with the inlet valves (5, 6) of one cylinder (3) and with the exhaust valves (5', 6') of another cylinder (3).

9. An engine according to any one of Claims 5 to 8, characterised in that said support blocks (37) extend from and are integral with a single support base (36) secured to said head (4).

10. An engine according to any one Claims 6 to 9, characterised in that said rocker arms (10, 10') co-operate with said actuating members (9, 9') at least in the vicinity of an upper end of the actuating members (9, 9') themselves.

11. An engine according to any one Claims 6 to 9, characterised in that said rocker arms (10, 10') co-operate with an intermediate portion of said actuating members (9, 9').

12. An engine according to Claim 11, characterised in that said bushes (45, 45') have a slot (56) through which said rocker arms (10, 10') pass.

13. An engine according to Claim 11 or 12, characterised in that said stems (19) of said actuating members (9, 9') have a diametral opening (57) accommodating one end of the respective rocker arms (10, 10'), said hydraulic means (24, 25) for automatically taking up play being accommodated in a lower end of said stems (19).

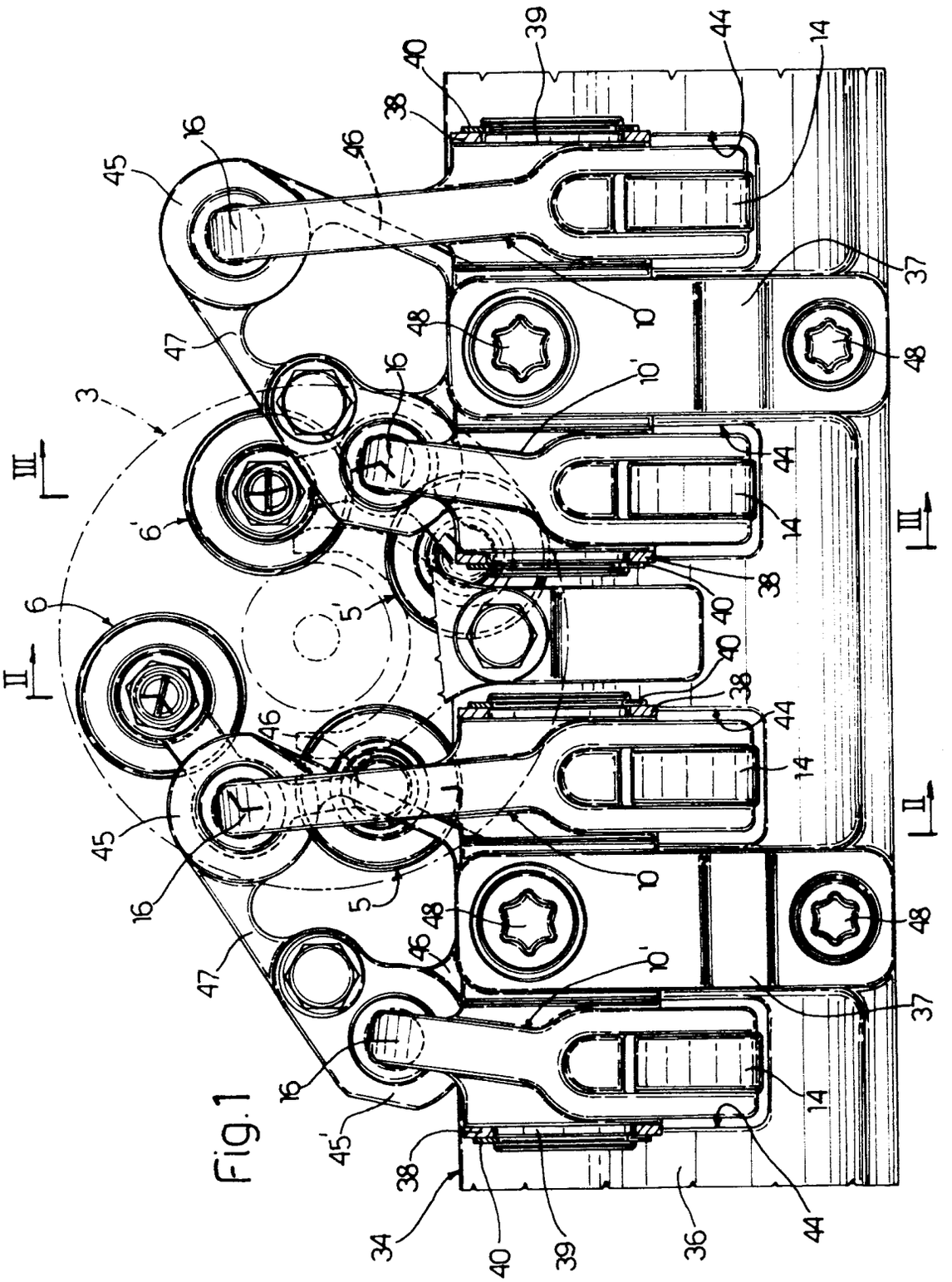

Fig.1

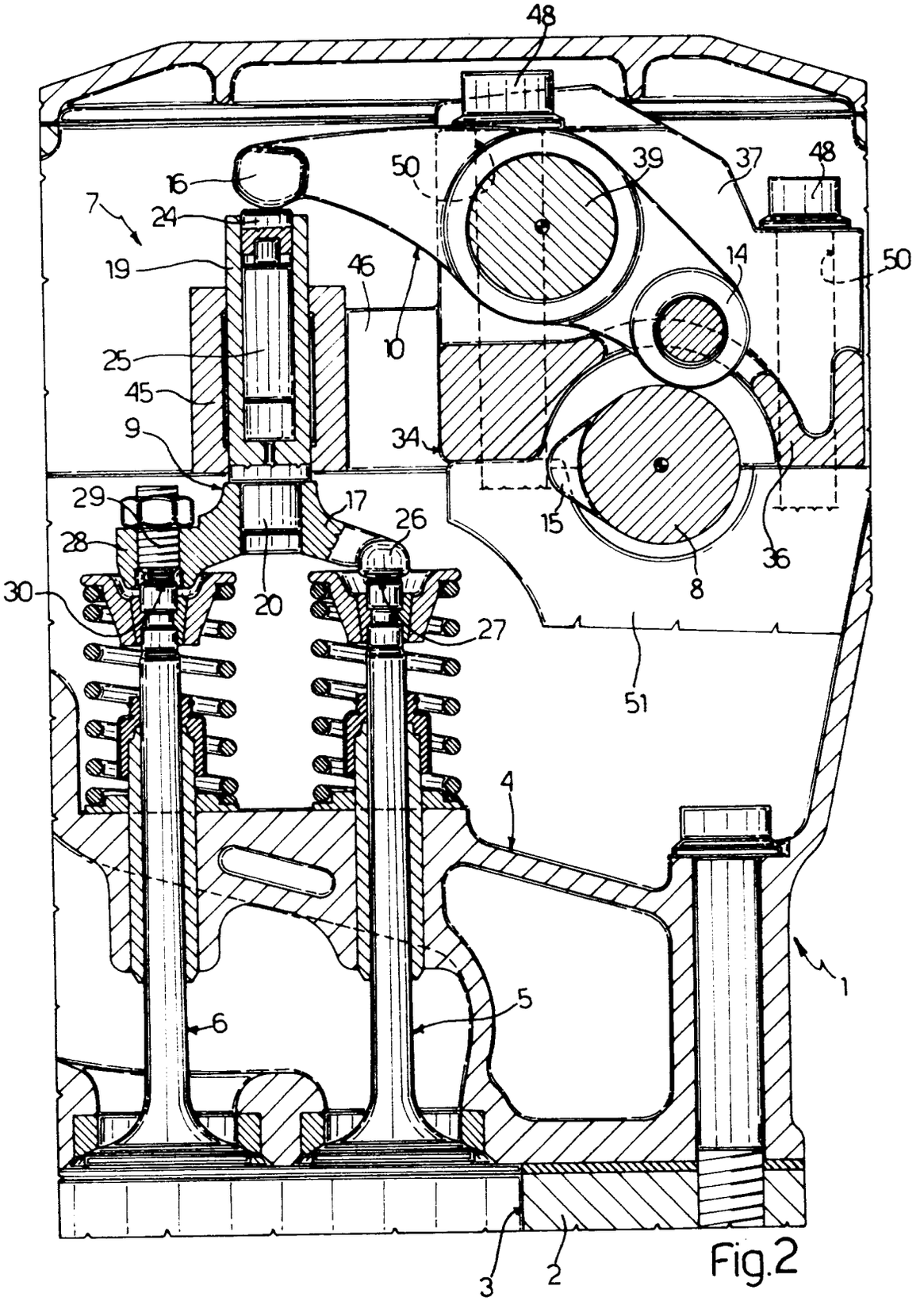
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Fig.2

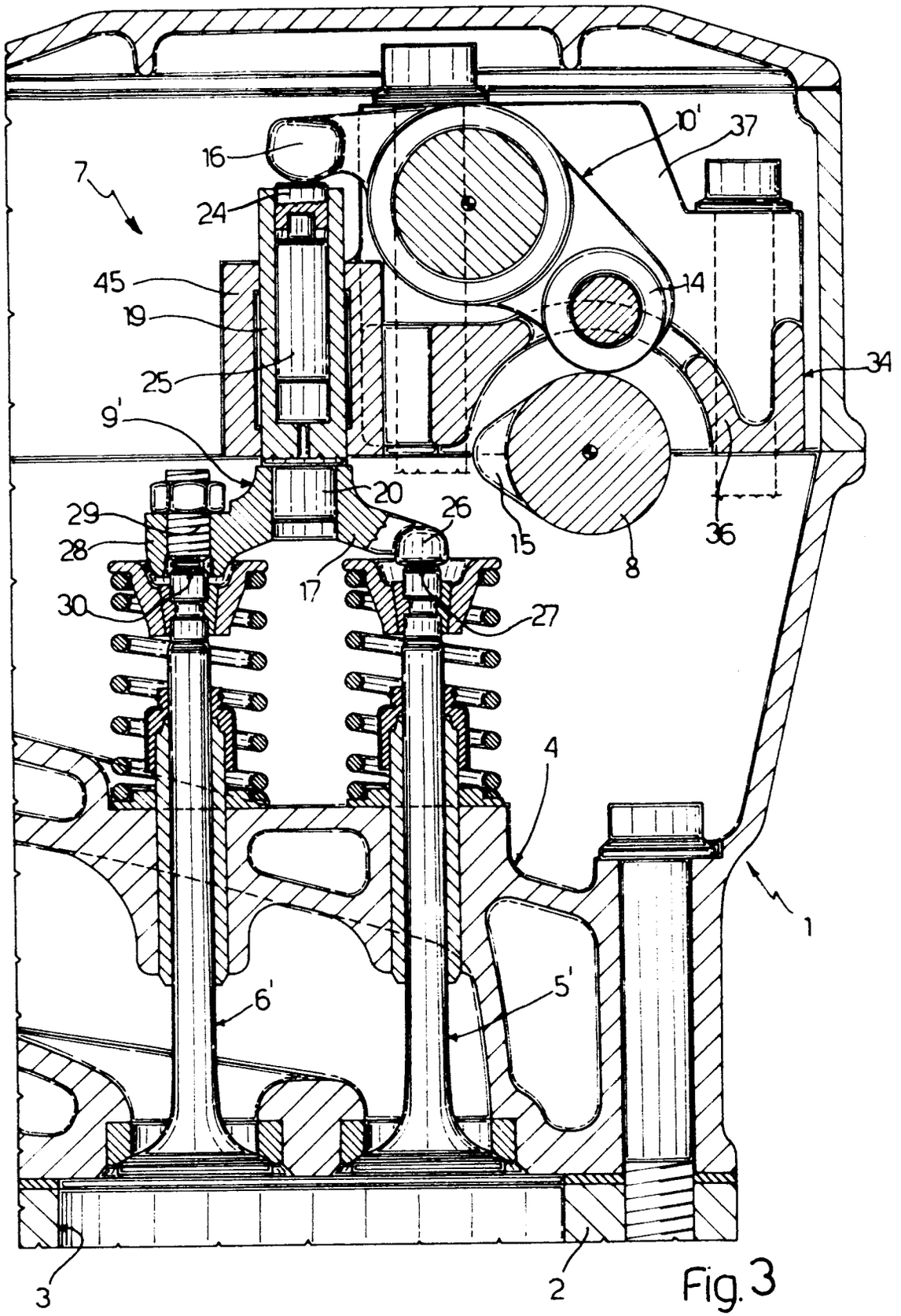

Fig. 3

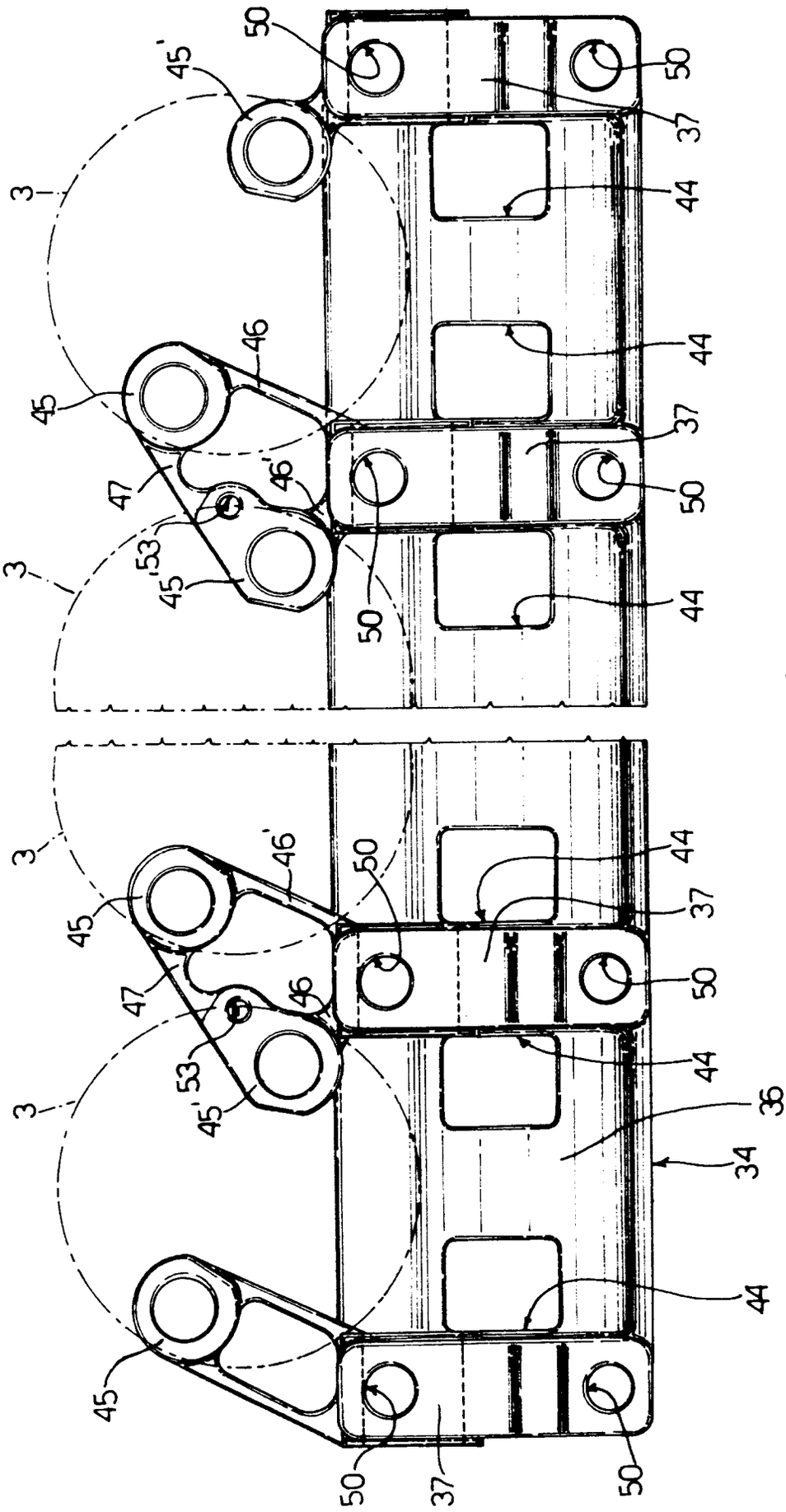
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Fig.4

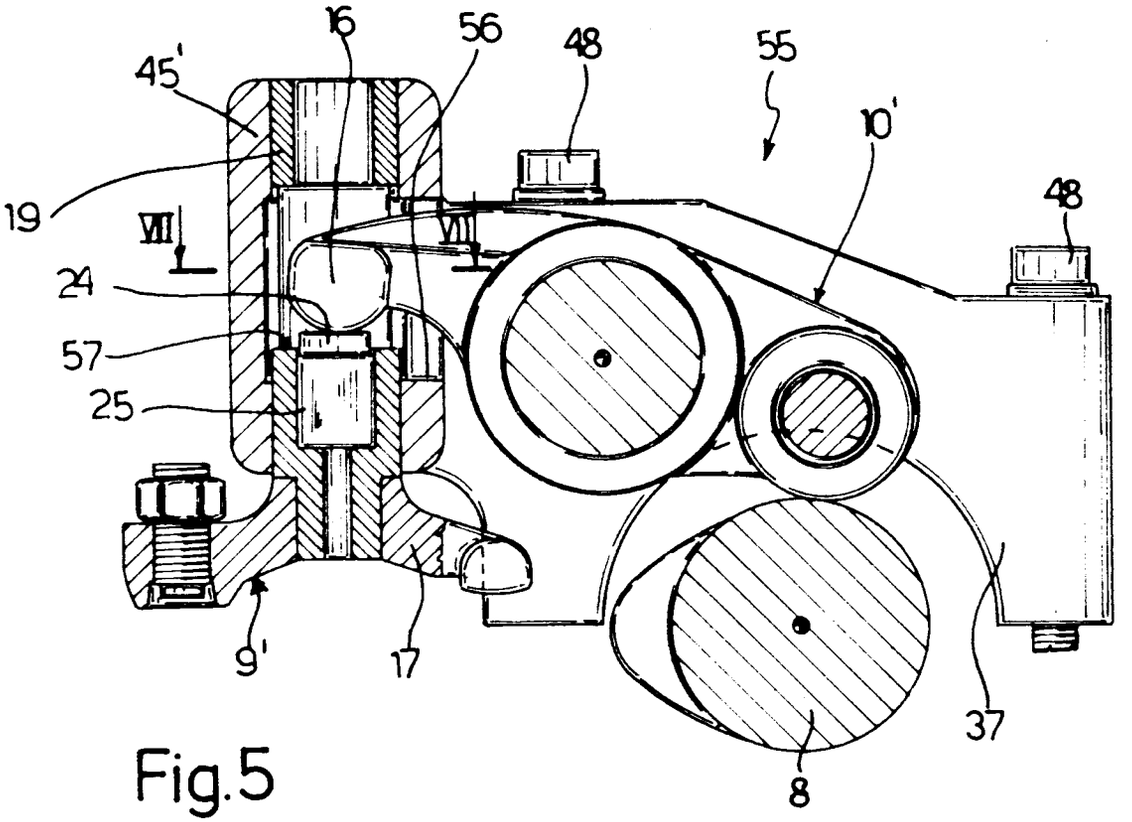

Fig.5

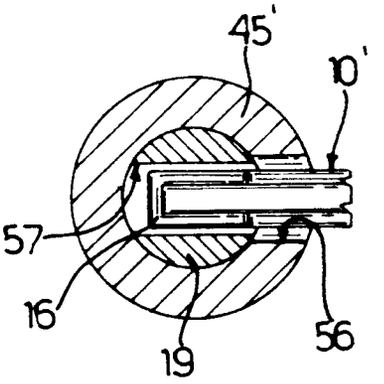

Fig.7

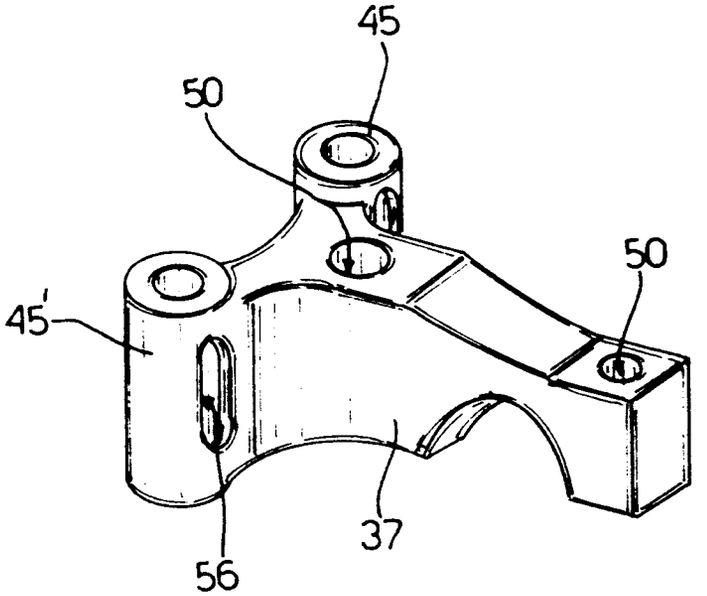

Fig.6

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EUROPEAN SEARCH REPORT

Application Number

EP 93 11 2573

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	FR-A-457 173 (BUGATTI) * the whole document *	1,3	F01L1/26 F01L1/14
X	DE-A-3 624 108 (OPEL) * column 4, line 27 - line 34 * * figure 3 *	1,2	
A		6	
P,X	EP-A-0 504 128 (AVL) * page 2, line 41 - line 54 * * figures 1-3 *	1,3-5	
A	GB-A-120 370 (SCHNEIDER & CIE) * page 1, line 30 - page 2, line 11 * * page 2, line 26 - line 28 * * figure 3 *	1,11-13	
A	EP-A-0 241 434 (FIAT)		

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

F01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02 NOVEMBER 1993	LEFEBVRE L.J.F.

CATEGORY OF CITED DOCUMENTS

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