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(54) **An internal combustion engine with an improved distribution control device**

Brennkraftmaschine mit verbessertem Steuertrieb

Moteur à combustion interne avec une distribution améliorée

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Description

[0001] The present invention relates to an internal combustion engine provided with at least one overhead camshaft and in particular, but not exclusively, to a diesel engine for a vehicle.

[0002] Internal combustion engines of the above-mentioned type are known in which the camshaft is synchronously driven by means of a first transmission, for instance a chain transmission, connecting the drive shaft to an intermediate return shaft, for instance the shaft of the fuel pump, and a second chain or toothed belt transmission connecting the intermediate shaft to the axle or the camshafts. An embodiment of this arrangement is disclosed in EP-A-1 046 790.

[0003] According to US 5.154.144, a drive arrangement for engine is disclosed comprising a block, a drive shaft, one overhead camshaft and a distribution control device for the rotational connection of the camshaft to the drive shaft in a phased manner; the distribution control device comprises a first transmission unit connecting the drive shaft to an intermediate shaft and provided with a first flexible transmission member, and a second transmission unit connecting the intermediate shaft to the camshaft and provided with a second flexible transmission member.

[0004] The first transmission unit of the abovecited US Patent solution comprises an auxiliary shaft having an axis parallel to and alongside an axis of the drive shaft and adapted to drive an oil pump of the engine and geared transmission means connecting the drive shaft to the auxiliary shaft, the first flexible transmission member being interposed between the auxiliary shaft and the intermediate shaft.

[0005] A problem raised by known engines of the type described briefly above relates to the bulk of the first and second transmissions at the front end of the engine, facing the radiator, and the resultant problems that this raises 'from the point of view of installing the water pump and the relative ducts for connection to the engine cooling circuit which should advantageously be installed in this area.

[0006] The object of the present invention is to provide an internal combustion engine with an improved distribution control unit which makes it possible to remedy the problems described above.

[0007] According to the present invention, this object is achieved by an internal combustion engine comprising a block, a drive shaft, at least one overhead camshaft and a distribution control device for the rotational connection of the camshaft to the drive shaft in a phased manner, the distribution control device comprising a first transmission unit connecting the drive shaft to an intermediate shaft and provided with a first flexible transmission member, and a second transmission unit connecting the intermediate shaft to the camshaft and provided with a second flexible transmission member, the first transmission unit comprising an auxiliary shaft having an axis parallel to and alongside an axis of the drive shaft and adapted to drive an auxiliary member of the engine, and geared transmission means connecting the drive shaft to the auxiliary shaft, the first flexible transmission member being interposed between the auxiliary shaft and the intermediate shaft; **characterized in that** said oil pump (24) is housed in a lateral recess (27) of said block (3), behind a housing (23) for said geared transmission means (20,21), and comprises an input shaft (25) coaxial with said auxiliary shaft (19); said axes (E,A) lying on a horizontal plane (α).

[0008] The present invention is described in further detail below with reference to an embodiment thereof, given by way of non-limiting example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective, diagrammatic and partial view of a distribution control unit of an internal combustion engine in accordance with the present invention;
Fig. 2 is a perspective and partial view of the engine, with some parts removed for clarity;
Fig. 3 is a section along the line III-III of Fig. 1;
Fig. 4 is a section along the line IV-IV of Fig. 3;
Fig. 5 is a section along the line V-V of Fig. 4;
Fig. 6 is a top view, partly in section, of the block of the engine of Fig. 1.

[0009] In Figs. 1 to 3, a transmission device for controlling the distribution in an internal combustion engine 2, in particular a diesel engine, is shown overall by 1.

[0010] The engine 2 comprises a block 3 formed by a cylinder block 4 defining a plurality of cylinders 5 and a sub-block 6 secured below the block 4 with which it meshes along a plane α.

[0011] The engine 2 comprises a drive shaft 7 having an axis A contained in the plane α and supported between the cylinder block 4 and the sub-block 6, and a pair of overhead camshafts 10 (Figs. 1 and 3), having axes B and C parallel with one another and with the axis A.

[0012] The engine 2 further comprises an intermediate shaft 11 for driving a high pressure fuel pump 12 forming part of an injection unit (not shown) of the common rail type. The pump 12 is disposed on a flank 14 of the engine 2, in the vicinity of a front wall 13 of the block 3; the shaft 11 has an axis D parallel with the axes A, B and C.

[0013] The device 1 (Fig. 1) comprises a first transmission unit 17 connecting the drive shaft 7 to the intermediate shaft 11 and a second chain transmission unit 18 interposed between the intermediate shaft 11 and the two camshafts 10.

[0014] According to the present invention, the first transmission unit 17 comprises an auxiliary shaft 19 having an axis E parallel to the axis A of the drive shaft 7 and adjacent thereto, on the same side of the pump 12; the axis E preferably lies in the horizontal plane α passing through the axis A of the drive shaft 7.

[0015] The first transmission unit 17 further comprises a pair of gears 20, 21 keyed on the drive shaft 7 and the

auxiliary shaft 19 respectively, and connected together in order rotationally to connect the two shafts 7, 19, and a chain transmission 22 interposed between the auxiliary shaft 19 and the intermediate shaft 11.

[0016] In particular, the gears 20, 21 (Figs. 3 and 5) are disposed in a box housing 23 provided immediately outside the front wall 13 of the engine 2, substantially symmetrical with respect to the plane α and formed in part by the cylinder block 4 and in part by the sub-block 6.

[0017] Advantageously, the auxiliary shaft 19 moves an auxiliary member of the engine, in particular an oil pump 24 (Figs. 3 and 4). The pump 24, of the geared type, has an input shaft 25 of axis E on which a drive gear 26 is keyed.

[0018] The pump 24 is advantageously housed in a lateral recess 27 of the block 3, open laterally for access to the pump itself, and disposed behind the housing 23.

[0019] The auxiliary shaft 19 is advantageously formed in two parts, for technological and assembly reasons, and in particular comprises a tubular duct 30, mounted to pass through the housing 23 in an angularly free and axially fixed manner, and a spindle 31 which connects the duct 30 to the shaft 25 of the pump 24.

[0020] The gear 21 is keyed on the duct 30, for instance by means of force fitting under heating. The spindle 31 is coupled to the duct 30 and to the shaft 25 of the pump 24 in a rotationally rigid and axially sliding manner by means of respective splined couplings 36, 37. In this way, it is possible axially to disengage the spindle 31 from the pump 24 and enable the dismantling of the latter without dismantling the engine 2.

[0021] The position of the pump 24 is such as to enable an easy connection to the oil couple (not shown) and to the lubrication circuit of the engine 2 by means of channels 40 provided in the block 3.

[0022] A sprocket 41 is also keyed on the duct 30 and forms part of the chain transmission 22, which sprocket further comprises a chain 42 and a driven wheel 43 keyed on a duct 44 rigidly connected to the intermediate shaft 11 of the pump 12 (Fig. 3).

[0023] The chain 42 of the chain transmission 22 is advantageously housed within the block 3 in the vicinity of the front wall 13.

[0024] The second transmission unit 18 comprises, in a known manner, a drive sprocket 45 keyed on the intermediate shaft 11, a pair of wheels 46 keyed on the respective camshafts 10 and a single chain 47 in engagement with the sprocket 41 and both the wheels 46.

[0025] The chains 42 and 47 are guided, in a conventional manner, by respective pairs of shoes 48a, 48b and 49a, 49b; one of the shoes (48a, 49a) of each pair, cooperating with the taut branch of the relative chain 42, 47 is fixed; the other (48b, 49b) cooperating with the return branch faces the flank 14 of the engine 2 and can move, under the thrust of a hydraulic tensioning member 50 and 51 respectively, for the recovery of play.

[0026] The operation of the device 1, already partly evident from the above description, is as follows.

[0027] The auxiliary shaft 19 is driven in rotation by the drive shaft 7 by means of the pair of gears 20, 21 and actuates the oil pump 24. Motion is transmitted via the chain 42 to the intermediate shaft 11, which also actuates the fuel pump 12, and from there to the camshafts 10 by means of the chain 47. The overall transmission ratio formed by the first transmission unit 17 and by the second transmission unit 18 is ½.

[0028] According to the present invention, by means of the use of an auxiliary return shaft 19 in the first transmission unit, a large zone 52 (Fig. 6) is left free in a position adjacent to the front end of the cylinder block 4, in which auxiliary engine components may be readily installed, and in particular the cooling water pump (not shown) and the relative ducts for connection to the engine cooling circuit.

[0029] Since the return of motion by means of the auxiliary shaft 19 causes, with the same direction of rotation of the drive shaft 7 (anticlockwise with respect to Fig. 1), an inversion of the direction of rotation of the chains 42, 47, the latter have their return branch facing away from the flank 14 of the engine 2. In this way, the tensioning devices 50, 51 may be disposed towards the exterior of the engine 2 rather than on the side of the zone 52 as is conventionally the case. This provides the twofold advantage of avoiding the bulk of the tensioning devices 50, 51 in the zone 52 and improving their accessibility.

[0030] The use of an auxiliary shaft 19 mounted between the cylinder block 4 and the sub-block 6 makes it possible to assemble the shaft itself and the oil pump 24 in a rapid and efficient way. The provision of the auxiliary shaft 19 in two telescopically sliding parts makes it possible to remove the oil pump 24 without dismantling the block 3.

[0031] It will be appreciated that the engine 2, and in particular the distribution control device 1, may be modified and varied without departing from the scope of protection of the claims.

[0032] In particular, one or both of the chains 42, 47 may be replaced by toothed belts; in this case, the moving shoes and the relative hydraulic tensioning devices may be replaced by conventional mechanical idle pulley tensioning devices. The engine may be a controlled ignition rather than a diesel engine; the fuel pump may be an injection pump of conventional type; the auxiliary shaft 19 may directly control an auxiliary member at one of its front ends.

Claims

1. An internal combustion engine (2) comprising a block (3), a drive shaft (7), at least one overhead camshaft (10) and a distribution control device (1) for the rotational connection of the camshaft (10) to the drive shaft (7) in a phased manner, the distribution control device (1) comprising a first transmission unit (17) connecting the drive shaft (7) to an intermediate shaft

(11) and provided with a first flexible transmission member (42), and a second transmission unit (18) connecting the intermediate shaft (11) to the camshaft (10) and provided with a second flexible transmission member (47), the first transmission unit (17) comprising an auxiliary shaft (19) having an axis (E) parallel to and alongside an axis (A) of the drive shaft (7) and adapted to drive an oil pump (24) of the engine (2), and geared transmission means (20, 21) connecting the drive shaft (7) to the auxiliary shaft (19), the first flexible transmission member (42) being interposed between the auxiliary shaft (19) and the intermediate shaft (11), **characterized in that** said oil pump (24) is housed in a lateral recess (27) of said block (3), behind a housing (23) for said geared transmission means (20,21), and comprises an input shaft (25) coaxial with said auxiliary shaft (19); said axes (E,A) lying on a horizontal plane (α).

2. An engine as claimed in claim 1, **characterised in that** the block (3) comprises a cylinder block (4) and a sub-block (6) meshing together along said horizontal plane (α).

3. An engine as claimed in claim 1 or 2, **characterised in that** the intermediate shaft (11) and the auxiliary shaft (19) are disposed in the vicinity of a flank of the engine (2).

4. An engine as claimed in any one of the preceding claims, **characterised in that** it comprise a fuel pump (12) driven by the intermediate shaft (11).

Patentansprüche

1. Brennkraftmaschine (2) umfassend einen Block (3), eine Antriebswelle (7), wenigstens eine oben liegende Nockenwelle (10) und einen Steuertrieb (1) für die Drehverbindung der Nockenwelle (10) mit der Getriebewelle (7) in einem Phasenverhalten, wobei der Steuertrieb (1) eine erste Übertragungseinheit (17), die die Getriebewelle (7) mit einer Zwischenwelle (11) verbindet und die mit einem ersten flexiblen Übertragungsbauteil (42) versehen ist, und eine zweite Übertragungseinheit (18) umfasst, die die Zwischenwelle (11) mit der Nockenwelle (10) verbindet und die mit einem zweiten flexiblen Übertragungsbauteil (47) versehen ist, wobei die erste Übertragungseinheit (17) eine Hilfswelle (19), die eine Achse (E) aufweist, die parallel zu und längs zu einer Achse (A) der Getriebewelle (7) ist und die geeignet ist, um eine Ölpumpe (24) des Motors (2) anzutreiben, und Zahnübertragungsmittel (20, 21) umfasst, die die Getriebewelle (7) mit der Hilfswelle (19) verbinden, wobei das erste flexible Übertragungsbauteil (42) zwischen der Hilfswelle (19) und der Zwischenwelle (11) eingesetzt ist, **dadurch gekennzeichnet, dass** die Ölpumpe (24) in einer seitlichen Ausnehmung (27) des Blocks (3) hinter einem Gehäuse (23) für die Zahnübertragungsmittel (20, 21) eingebaut ist, und dass sie eine Antriebswelle (25) umfasst, die koaxial zu der Hilfswelle (19) ist; wobei die Achsen (E, A) in einer horizontalen Ebene (α) liegen.

2. Motor nach Anspruch 1, **dadurch gekennzeichnet, dass** der Block (3) einen Zylinderblock (4) und einen Unterblock (6) umfasst, die mit einander entlang der horizontalen Ebene (α) verzahnt sind.

3. Motor nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Zwischenwelle (11) und die Hilfswelle (19) in der Nähe einer Flanke des Motors (2) angeordnet sind.

4. Motor nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** er eine Kraftstoffpumpe (12) umfasst, die durch die Zwischenwelle (11) angetrieben wird.

Revendications

1. Moteur à combustion interne (2) comprenant un bloc (3), un arbre d'entraînement (7), au moins un arbre à cames en tête (10) et un dispositif de commande de distribution (1) pour la liaison rotative en phase de l'arbre à cames (10) à l'arbre d'entraînement (7), le dispositif de commande de distribution (1) comprenant une première unité de transmission (17) reliant l'arbre d'entraînement (7) à un arbre intermédiaire (11) et pourvue d'un premier élément de transmission flexible (42), et une seconde unité de transmission (18) reliant l'arbre intermédiaire (11) à l'arbre à cames (10) et pourvue d'un second élément de transmission flexible (47), la première unité de transmission (17) comprenant un arbre auxiliaire (19) possédant un axe (E) parallèle à et à côté d'un axe (A) de l'arbre d'entraînement (7) et adapté pour entraîner une pompe à huile (24) du moteur (2), et des moyens de transmission par engrenage (20, 21) reliant l'arbre d'entraînement (7) à l'arbre auxiliaire (19), le premier élément de transmission flexible (42) étant interposé entre l'arbre auxiliaire (19) et l'arbre intermédiaire (11), **caractérisé en ce que** ladite pompe à huile (24) est logée dans un évidement latéral (27) dudit bloc (3), derrière un carter (23) pour lesdits moyens de transmission par engrenage (20, 21), et comprend un arbre d'entrée (25) coaxial avec ledit arbre auxiliaire (19) ; lesdits axes (E, A) se trouvant sur un plan horizontal (α).

2. Moteur selon la revendication 1, **caractérisé en ce que** le bloc (3) comprend un bloc cylindres (4) et un sous-bloc (6) entrant en prise l'un avec l'autre le long dudit plan horizontal (α).

3. Moteur selon la revendication 1 ou 2, **caractérisé en ce que** l'arbre intermédiaire (11) et l'arbre auxiliaire (19) sont disposés dans le voisinage d'un flanc du moteur (2).

4. Moteur selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend une pompe à carburant (12) entraînée par l'arbre intermédiaire (11).

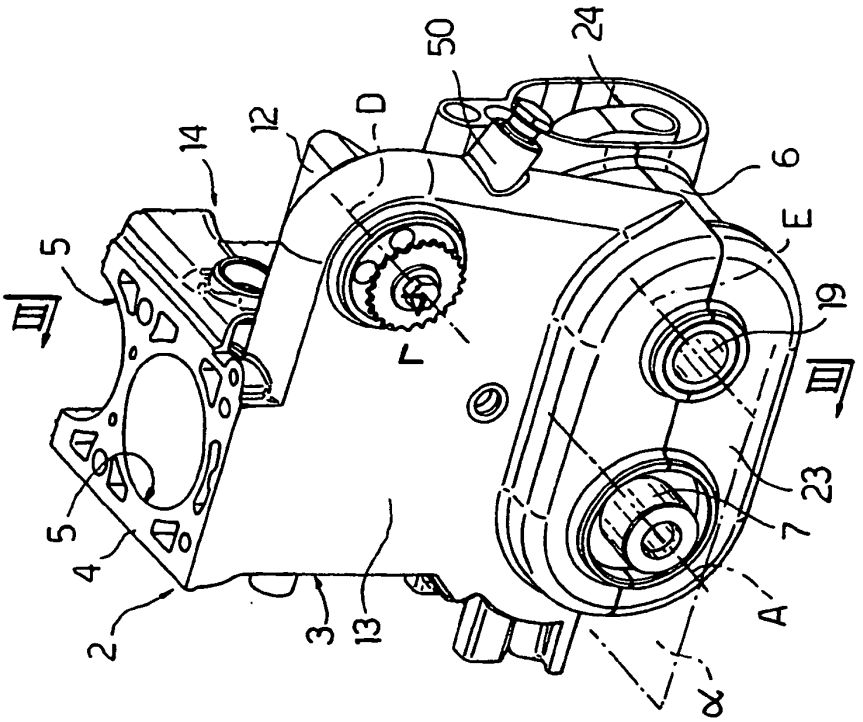
50
24
14
12
D
6
E
5
19
5
4
2
3
13
7
23
A
α

Fig.2

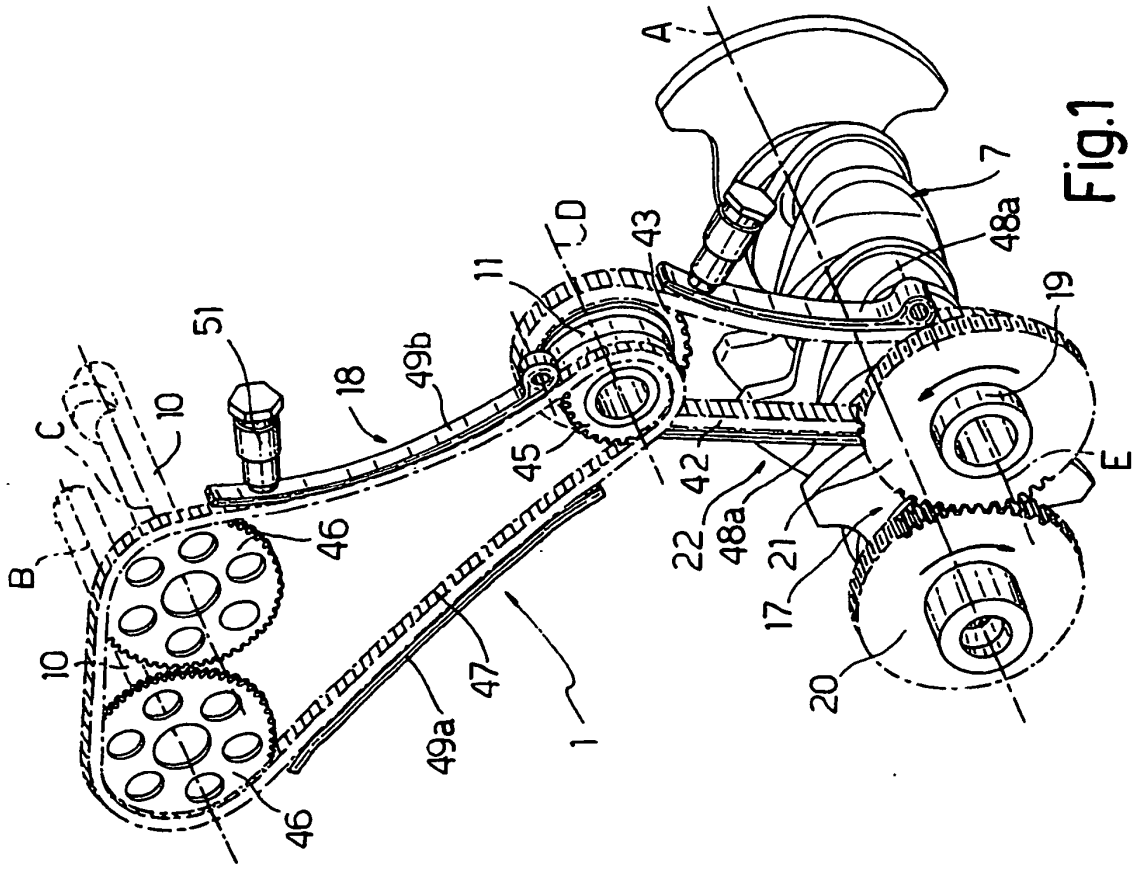
A
7
48a
43
11
D
19
51
18
49b
C
10
45
42
E
B
46
22
48a
21
17
10
47
49a
1
20
46

Fig.1

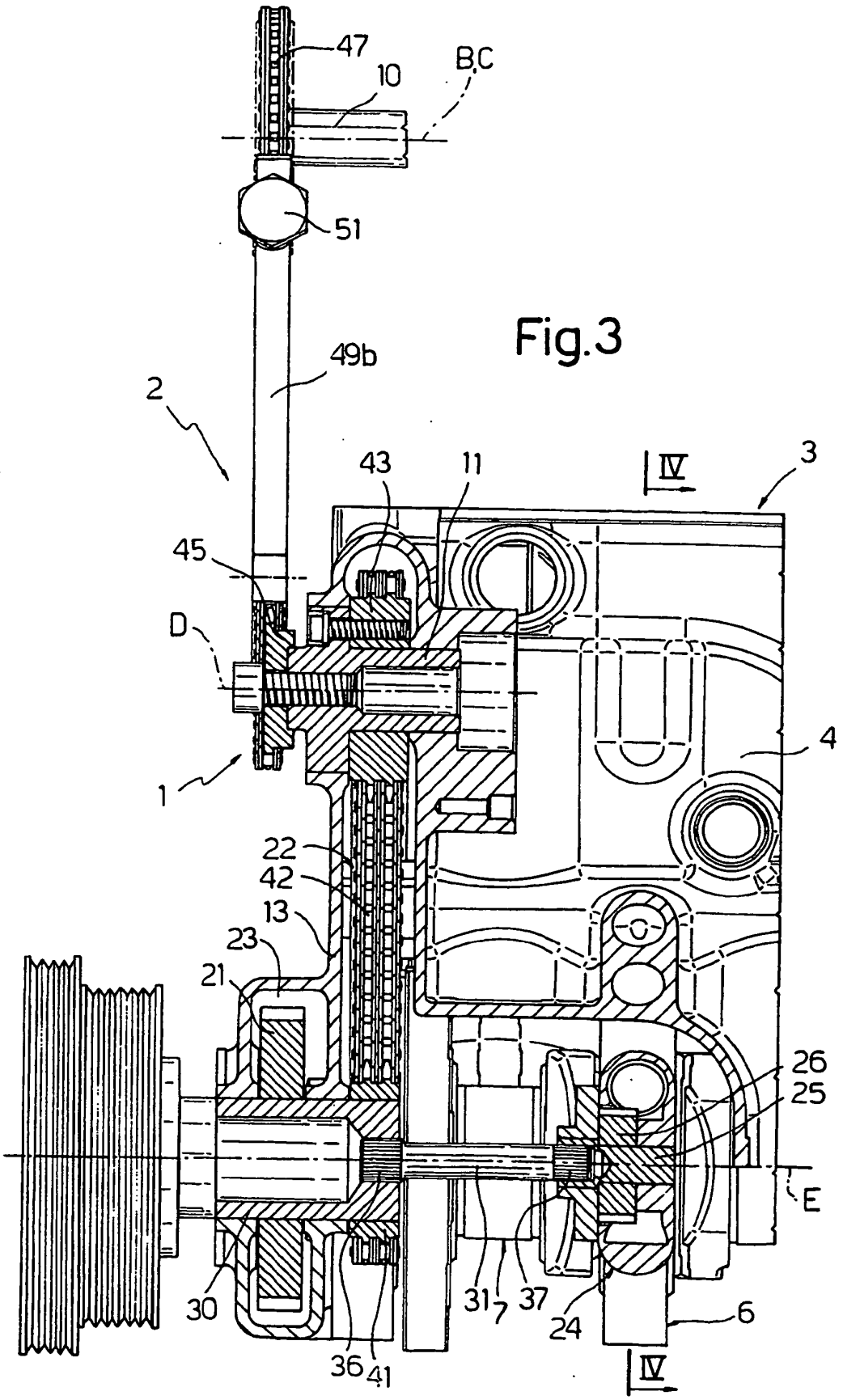
47
10
B.C
51
49b
2
43
11
IV
3
45
D
4
1
22
42
13
23
21
26
25
E
30
31
7
37
24
6
36
41
IV

Fig.3

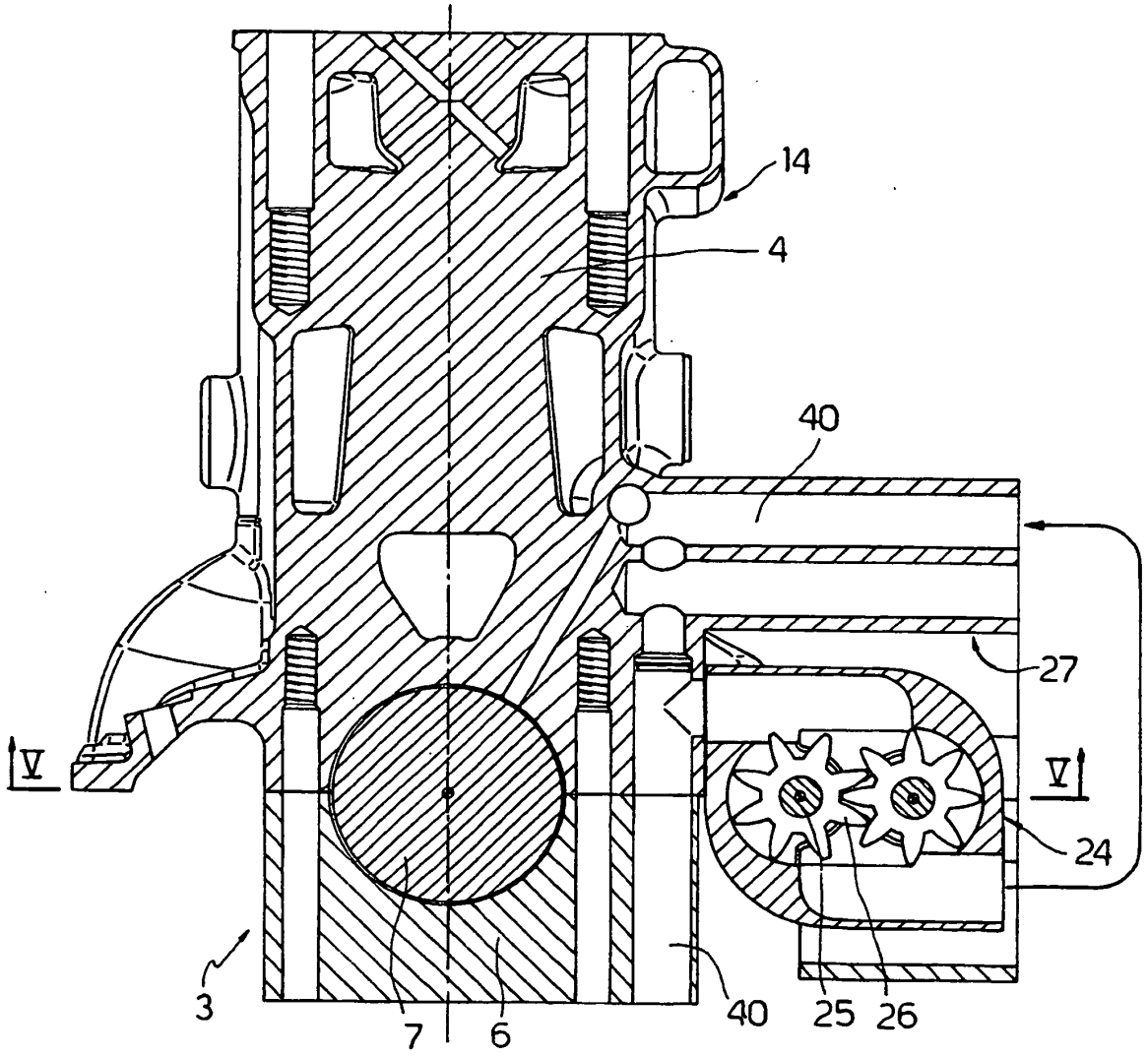

Fig.4

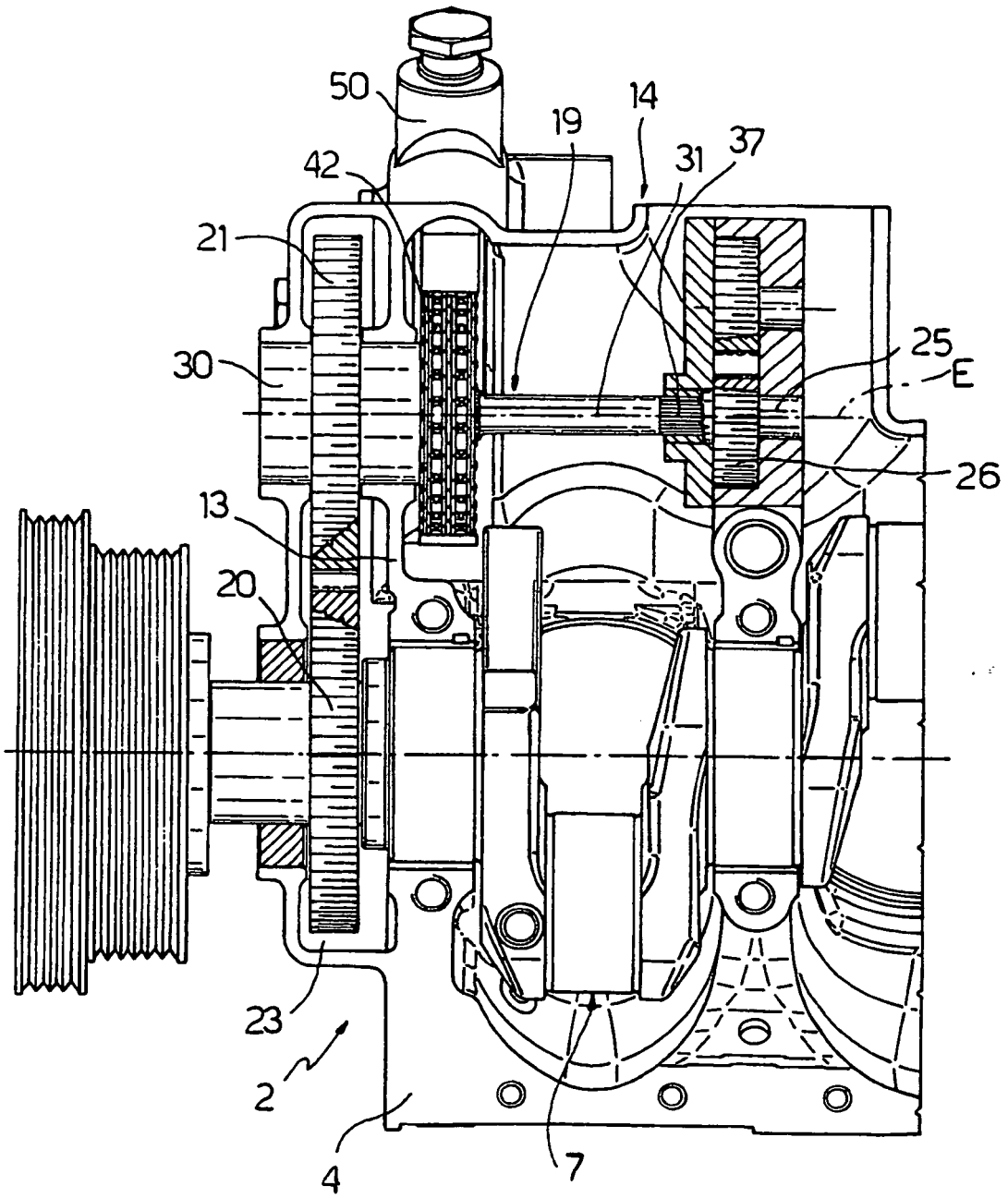

Fig.5

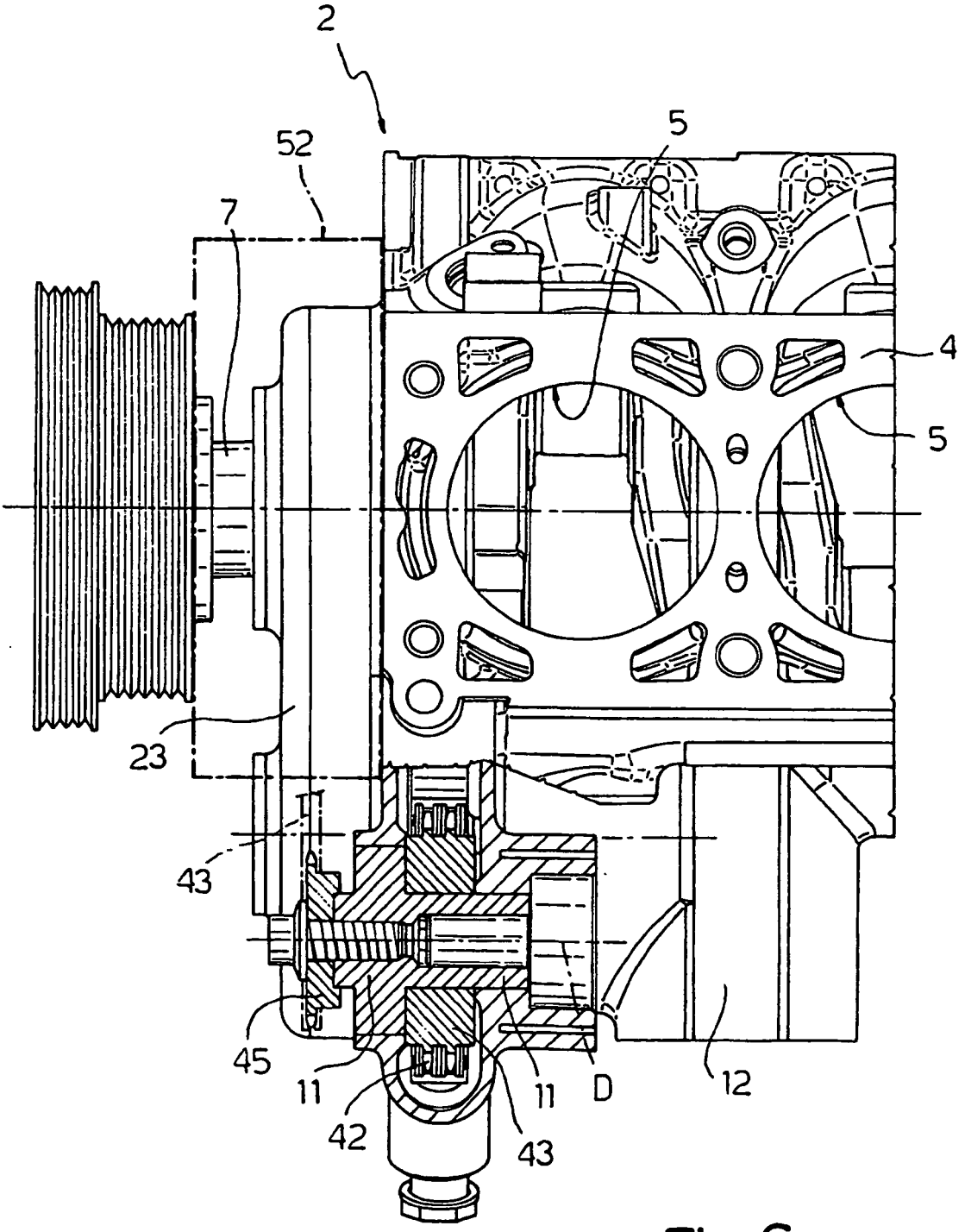

Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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