



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) **EP 1 424 473 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.06.2004 Bulletin 2004/23

(51) Int Cl.7: **F02B 75/04**, F02D 15/04,
F02B 41/04

(21) Application number: **03006564.3**

(22) Date of filing: **24.03.2003**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT SE SI SK TR**
Designated Extension States:
AL LT LV MK RO

(72) Inventor: **Meyer, Siegfried**
86732 Oettingen (DE)

(74) Representative: **Casalonga, Axel et al**
BUREAU D.A. CASALONGA - JOSSE
Paul-Heyse-Strasse 33
80336 München (DE)

(71) Applicant: **Meyer, Siegfried**
86732 Oettingen (DE)

(54) **Dual-piston engine**

(57) A dual-piston engine is constructed to include a cylinder (1), a master piston (2) adapted to reciprocate in the cylinder (1), a supplementary piston (3) coaxially mounted in the master piston (2), a crank (6) a link (4) coupled between the crank (6) and the piston (2), the link having the top and bottom ends curved in reversed directions and respectively pivoted to the master piston (2) and the crank arm (4) of the crank (6) and a cam (42) formed integral with the top end and adapted to move the supplementary piston (3) in and out of the top side of the master piston (2) upon movement of the link (4).

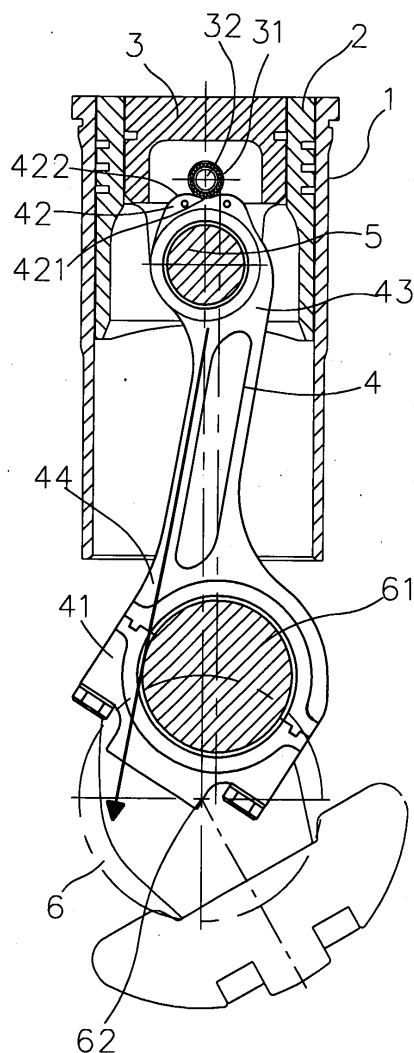


FIG. 3

EP 1 424 473 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

[0001] The present invention relates an engine and, more particularly, to a dual-piston engine, which comprises a master piston, and a supplementary piston, which is moved in and out of the master piston to increase the thrust force of the master piston during reciprocating motion of the master piston, enhancing the output of the engine.

2. Description of the Related Art:

[0002] FIGS. 1 and 2 show the structure and operation of an engine according to the prior art. As illustrated, the engine comprises a cylinder 1', a piston 2' reciprocating in the cylinder 1', a crank 6', and a link 4', which has one end pivoted to the piston 2' by a pivot pin 5' and the other end provided with a connector 41' pivoted to the crank arm 61' of the crank 6'. As illustrated, the link is a straight rod member coupled between the piston and the crank. During reciprocating motion of the piston, the link drives the crank to make a rotary motion. The maximum torque of the link is equal to the radius of the arm of rotation of the crank arm 61' (when the crank arm at 45°). The thrust force reaches the maximum when the engine ignited to explode. However, the torque is reduced to the minimum statue at this time. When the piston lowered, the thrust force is gradually reduced, and the torque is relatively increased. Due to the aforesaid problem, the performance of the aforesaid engine cannot be effectively improved.

[0003] Further, the engine is ignited to explode when the piston moved to the upper limited position, i.e., the dead line position where the center of the piston and the center of the link and the center of the crank are vertically aligned in a line). At this time, the volume of the chamber of the cylinder is minimized, providing the best compression ratio. Therefore, this time is the best time for explosion. When passed over the dead line, the piston starts to move downwards, and the best compression ratio and the best explosion time cannot be maintained. The maximum output of the engine is when the crank moved from 0° toward 90° (the moving distance "f" of the piston). After this angle, the output of the engine is gradually reduced. The output power of the engine has a great concern with the variation of the volume of the cylinder air chamber 11'. When the volume of the cylinder air chamber 11' relatively increased, the explosion pressure is relatively reduced, resulting in a reduction of output power of the engine. On the contrary, when the volume of the cylinder air chamber is relatively reduced during this stage and same explosion pressure is maintained, the fuel mixture can be completely burned to relatively increase the output power of the engine.

[0004] Further, in order to obtain the optimum compression ratio, the engine igniting time must be before the dead line. The engine provides no power output or a negative power before the dead line after the explosion. This drawback results in low engine performance, a waste of fuel energy, and a big amount of exhaust gas. Further, because the piston is reciprocated at a high speed when the combustion chamber of the engine is ignited to explode, fuel gas is not completely burned before a next cycle. This problem reduces the efficiency of the engine and, causes the engine to produce much waste gas.

[0005] Therefore, it is desirable to have a dual-piston engine that eliminates the aforesaid drawbacks.

SUMMARY OF THE INVENTION

[0006] The present invention has been accomplished under the circumstances in view. It is the main object of the present invention to provide a dual-piston engine, which enhances the output, saves fuel gas, and reduces the production of waste gas. According to the invention, the dual-piston engine comprises a cylinder, a master piston adapted to reciprocate in the cylinder, the master piston being provided with a transversely extended pivot pin, a crank, a link, the link having a first end pivoted to the pivot pin of the master piston and a second end pivoted to the crank arm of the crank, and a supplementary piston coaxially coupled to the inside of the master piston and axially movable in and out of the top side of the master piston, the supplementary piston comprising a transversely extended pivot pin and a bearing member fastened pivotally with the transversely extended pivot pin of the supplementary piston and disposed in contact with the periphery of a push member at the first end of the link for enabling the supplementary piston to be moved in and out of the top side of the master piston during reciprocating motion of the master piston. The push member can be a cam formed integral with the first end of the link, and the bearing member can be an axle bearing disposed in contact with the periphery of the cam.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

FIG. 1 is a sectional view of an engine according to the prior art.

FIG. 2 is similar to FIG. 1 but showing the link moved to 90°.

FIG. 3 is a sectional view of showing the basic principle of the present invention.

FIG. 3a is a sectional view of a dual-piston engine according to the first embodiment of the present invention.

FIG. 4 is a schematic drawing showing the action of the dual-piston engine according to the first em-

bodiment of the present invention.

FIG. 5 illustrates the status of the first embodiment of the present invention and the status of the prior art design when the crank moved to 0°.

FIG. 6 illustrates the status of the first embodiment of the present invention and the status of the prior art design when the crank moved to 45°.

FIG. 7 illustrates the status of the first embodiment of the present invention and the status of the prior art design when the crank moved to 90°.

FIG. 8 illustrates the status of the first embodiment of the present invention and the status of the prior art design when the crank moved to 180°.

FIG. 9 illustrates the status of the first embodiment of the present invention and the status of the prior art design when the crank moved to 270°.

FIG. 10 illustrates the status of the first embodiment of the present invention and the status of the prior art design when the crank moved to 315°.

FIG. 11 illustrates the status of the second embodiment of the present invention and the status of the prior art design when the crank moved to 0°.

FIG. 12 illustrates the status of the second embodiment of the present invention and the status of the prior art design when the crank moved to 45°.

[0008] FIG. 13 illustrates the status of the second embodiment of the present invention and the status of the prior art design when the crank moved to 90°.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0009] Referring to FIGS. 3 and 3A, a dual-piston engine in accordance with the first embodiment of the present invention is shown comprising a cylinder 1, a master piston 2 adapted to reciprocate in the cylinder 1, a supplementary piston 3 coaxially arranged in the master piston 2 and axially movable in and out of one end of the master piston 2, and a link 4. The link 4 has a top end 43 pivoted to a transversely extended pivot pin 5 in one end of the piston 2 remote from the supplementary piston 3 and a bottom end 44 fixed mounted with a connector 41, which is pivoted to the crank arm 61 of a crank 6. A push member 42 is formed integral with the top end 43 of the link 4. According to this embodiment, the push member 42 is a cam. The supplementary piston 3 has a pivot pin 32 transversely disposed on the inside and a bearing member (for example, a barrel or axle bearing) 31 fastened pivotally with the pivot pin 32 and disposed in contact with the periphery of the cam 42 of the link 4. Alternatively, the bearing member 31 can be an eccentric axle bearing or eccentric barrel formed of two symmetrical halves and eccentrically mounted on the pivot pin 32. During reciprocating motion of the master piston 2, the cam 42 is moved with the link 4 to reciprocate the supplementary piston 3 axially relative to the master piston 2. The top and bottom ends 43 and 44 of the link 4

are curved in reversed directions, therefore the link 4 has a substantially Z-shaped profile. This Z-shaped design greatly increases the angle of oscillation of the link 4 without changing the design of the crank arm 61 of the crank 6.

[0010] Referring to FIG. 4 and FIGS. 3 and 3a, when the link 4 does no work, the bearing member 31 is disposed in contact with the lowest point 421 of the cam 42, and the top side of the supplementary piston 3 is disposed in flush with the top side of the master piston 2. During movement of the link 4, the cam 42 is alternatively oscillated back and forth relative to the bearing member 31. When the highest point 422 of the cam 42 touches the periphery of the bearing member 31, the supplementary piston 3 is forced out of the top side of the master piston 3. The protruding distance *a* of the supplementary piston 3 over the top side of the master piston 2 is subject to the distance between the highest point 422 and lowest point 411. When the link 4 returned, the supplementary piston 3 is moved downwards to the inside of the master piston 2.

[0011] FIGS. 5~10 show a comparison between the invention and the prior art design in which A'~F' show the actions of the prior art design; A~F show the actions of the present invention. With reference to FIG. 5, when the crank arm moved to 0°, the lowest point 421 of the cam 42 touches the bearing member 32, the master piston 2 is moved to the upper limit position, and the supplementary piston 3 is disposed in flush with the master piston 2. Because the two ends 43 and 44 of the link 4 of the present invention are curved in reversed directions, the line of applied force *b* is biased to one side of the crank center 62 over the upper deadline *d* to work on the crank's arm of force *c* when the lowest point 421 of the cam 42 touches the bearing member 32. At this time, the torque of the prior art design is on the dead line and zeroed. When the crank arm 61 moved leftwards as shown in FIGS. 6 and 7, the link 4 is tilted leftwards. At this time, the cam 42 starts to push the bearing member 31, thereby causing the supplementary piston 3 to be forced upwardly out of the top side of the master piston 3. When the crank arm 61 moved to 90°, the supplementary piston 3 reaches the upper limit position to reduce the volume of the cylinder air chamber 11, so as to further increase the thrust force of the master piston 2 upon the explosive stroke. The maximum range of the thrust force of the master piston 2 is when the crank arm 61 moved to 0°~90°. Because the two ends 43 and 44 of the link 4 of the present invention are curved in reversed directions, the angle of oscillation of the link 4 is relatively increased, and the distance of the down stroke of the master piston 2 is relatively reduced, and therefore the crank working arm of force *c* is relatively prolonged. Because the distance of the down stroke of the master piston 2 is relatively reduced, the relatively smaller volume of the cylinder air chamber enhances the working of the explosive stroke, resulting in a high output of thrust force. The down stroke difference be-

tween the present invention and the prior art design is apparent in **B** and **C** and **B'** and **C'** as shown FIGS 6 and 7. When the crank arm **61** moved to 45°, it is the best point where the piston works on the crank. At this time, the master piston **2** is moved downwards to a short distance only, and the supplementary piston **3** is extended out of the master piston **2** to reduce the volume of the cylinder air chamber. The volume of the cylinder air chamber in the present invention is about one half of the volume of the cylinder air chamber in the prior art design at this time. Further, the crank working arm of force **c** of the present invention is relatively longer than the prior art design. In general, the thrust force of the present invention is greatly increased and much higher than the prior art design. When continuously working as shown in FIGS. 8~10, the crank arm **61** is returned to 0°. Because the distance between the pivot pin **5** and the center of the crank arm **61** of the present invention is equal to the prior art design, the working time of the engine through one full cycle of the present invention is equal to the prior art design. During the working of the engine of the present invention, the angle of oscillation of the link compensates the distance reduction of the master piston during the down stroke.

[0012] FIGS. 11~13 show a comparison between the second embodiment of the present invention and the prior art design in which **G'~I'** show the actions of the prior art design; **G~I** show the actions of the present invention. When the crank arm **61** moved to 0°, the master piston **2** reaches the upper limit position, the lowest point **421** of the cam **42** touches the bearing member **32**, the elevation of the top side of the supplementary piston **3** is lower than the elevation of the top side of the master piston **2**, thus a combustion chamber **12** is formed between the top side of the master piston **2** and the top side of the supplementary piston **3**. When the engine ignited to explode as shown in FIGS. 12 and 13, the master piston **2** and the supplementary piston **3** are lowering, and the link **4** starts to tilt leftwards, thereby causing the cam **42** to push the bearing member **31** and to further force the supplementary piston **3** out of the master piston **2**. When the supplementary piston **3** extended out of the master piston **2**, the aforesaid combustion chamber **12** is disappeared, and the volume of the cylinder air chamber **11** is reduced. Because the combustion chamber **12'** of the prior art design is fixedly provided in the piston **2'**, the cylinder air chamber **11'** is increased with the downward displacement of the piston **2'**, lowering the thrust force of the piston **2'**. The piston best working range is when the crank arm moved to 45~90°. At this time, the crank working arm of force **c** reaches the longest status. Because the combustion chamber **12** of the present invention is disappeared during down stroke of the master piston **2**, the expansion of the cylinder air chamber **11** is slow, the thrust force produced during the explosive stroke is fully applied to the crank **6**. According to the prior art design, the cylinder air chamber is greatly expanded during down stroke

of the piston, thereby causing the thrust force to be rapidly reduced. In consequence, less force is applied to the crank according to the prior art design. The volume of the aforesaid combustion chamber **12** is determined subject to the distance of the movement of the supplementary piston **3** by the cam **42**.

[0013] A prototype of dual-piston engine has been constructed with the features of the annexed drawings of FIGS. 3~13. The dual-piston engine functions smoothly to provide all of the features discussed earlier.

[0014] Although particular embodiment of the invention have been described in detail for purposes of illustration, various modifications and enhancements may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.

Claims

1. A dual-piston engine comprising a cylinder, a master piston adapted to reciprocate in said cylinder, said master piston being provided with a transversely extended pivot pin, a crank, and a link, said link having a first end pivoted to the pivot pin of said master piston and a second end pivoted to a crank arm of said crank, wherein said master piston has a supplementary piston coaxially coupled thereof and axially movable in and out of a top side thereof, said supplementary piston comprising a transversely extended pivot pin and a bearing member fastened pivotally with the transversely extended pivot pin of said supplementary piston; said link has a push member provided at the first end thereof and adapted to move said supplementary piston in and out of the top side of said master piston when moved by said master piston.
2. The dual-piston engine as claimed in claim 1, wherein said push member is a cam formed integral with the first end of said link; said bearing member is disposed in contact with the periphery of said cam.
3. The dual-piston engine as claimed in claim 1, wherein said bearing member is an axle bearing mounted on the transversely extended pivot pin of said supplementary piston.
4. The dual-piston engine as claimed in claim 1, wherein said bearing member is a barrel mounted on the transversely extended pivot pin of said supplementary piston for free rotation.
5. The dual-piston engine as claimed in claim 1, wherein the first end and second end of said link are curved in reversed directions, forming a Z-shaped profile so that the applied line of force of said link is

biased to one side relative to the center of the crank arm of said crank when said master piston is moved to an upper limit position.

6. The dual-piston engine as claimed in claim 5, wherein said push member is a cam formed integral with the first end of said link, and said bearing member is disposed in contact with the periphery of said cam. 5
- 10
7. The dual-piston engine as claimed in claim 5, wherein said bearing member is an axle bearing mounted on the transversely extended pivot pin of said supplementary piston. 15
8. The dual-piston engine as claimed in claim 5, wherein said axle bearing is an eccentric axle bearing eccentrically mounted on the transversely extended pivot pin of said supplementary piston. 20
9. The dual-piston engine as claimed in claim 5, wherein said bearing member is a barrel mounted on the transversely extended pivot pin of said supplementary piston for free rotation. 25
10. The dual-piston engine as claimed in claim 5, wherein said barrel is an eccentric barrel eccentrically mounted on the transversely extended pivot pin of said supplementary piston for free rotation. 30
11. The dual-piston engine as claimed in claim 5, wherein said bearing member is an eccentric axle bearing eccentrically mounted on the transversely extended pivot pin of said supplementary piston and installed in the push member of said link. 35
12. The dual-piston engine as claimed in claim 5, wherein said bearing member is an eccentric barrel formed of two symmetrical halves and eccentrically on the transversely extended pivot pin of said supplementary piston and installed in the push member of said link. 40
- 45
- 50
- 55

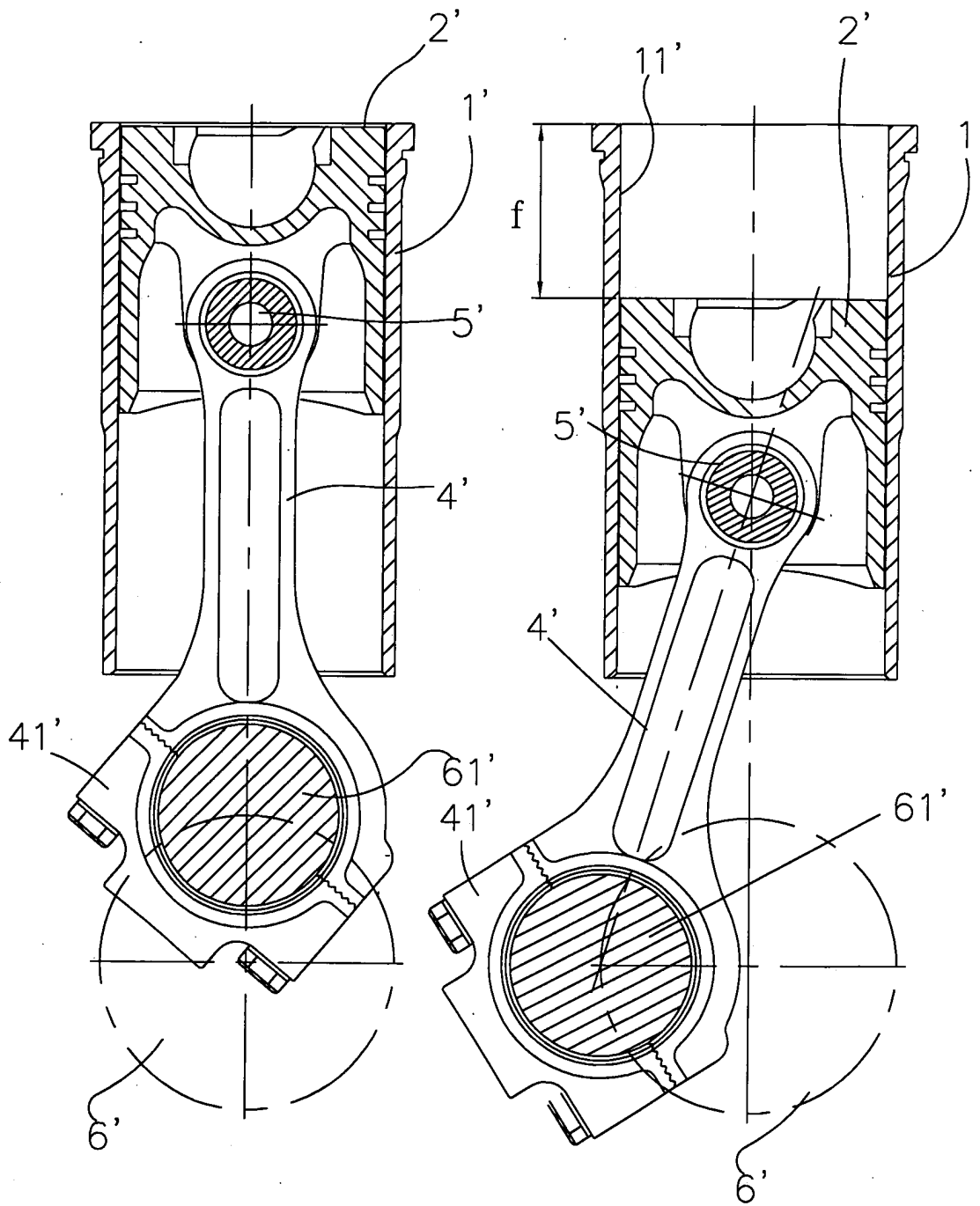


FIG. 1

FIG. 2

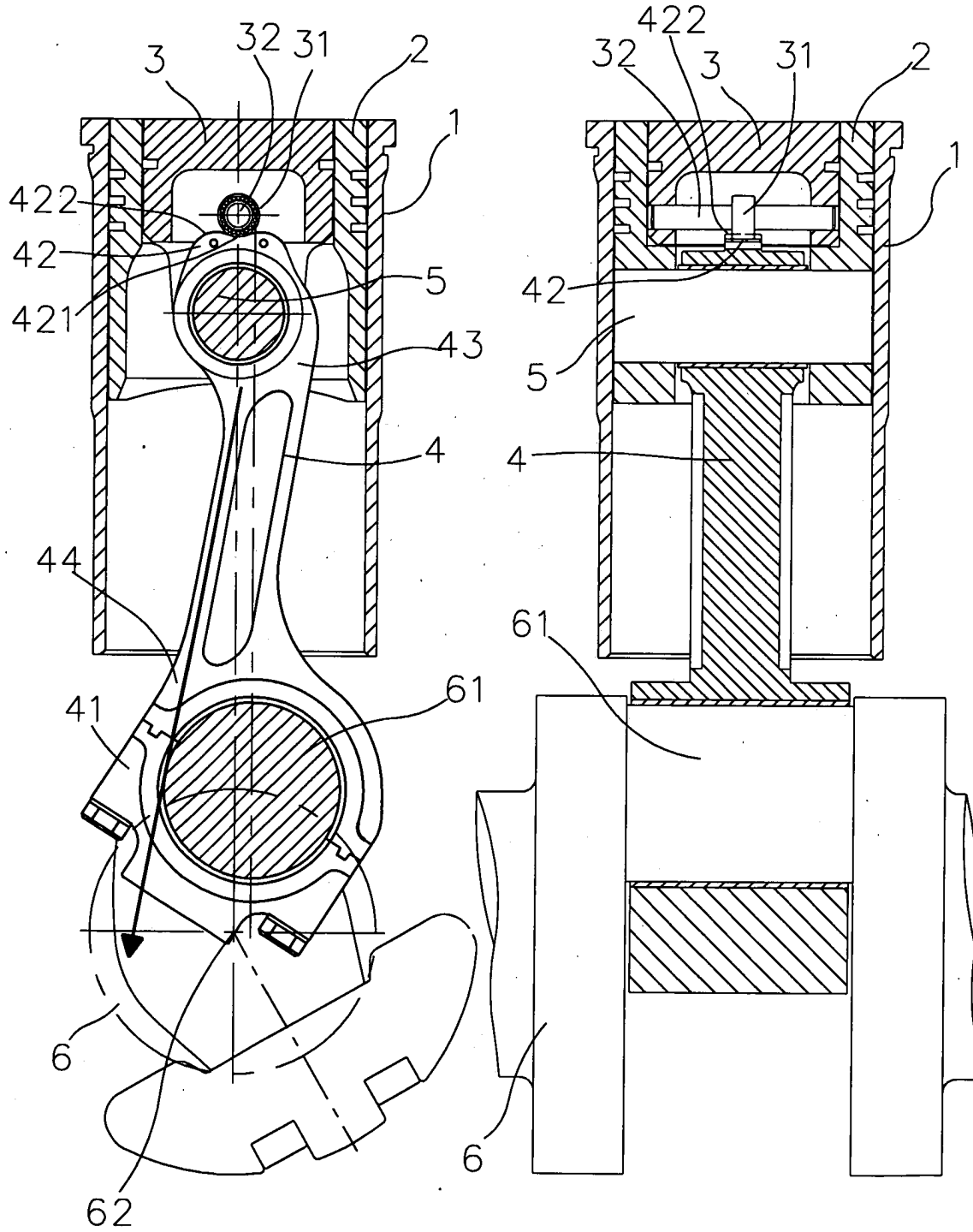


FIG. 3

FIG. 3a

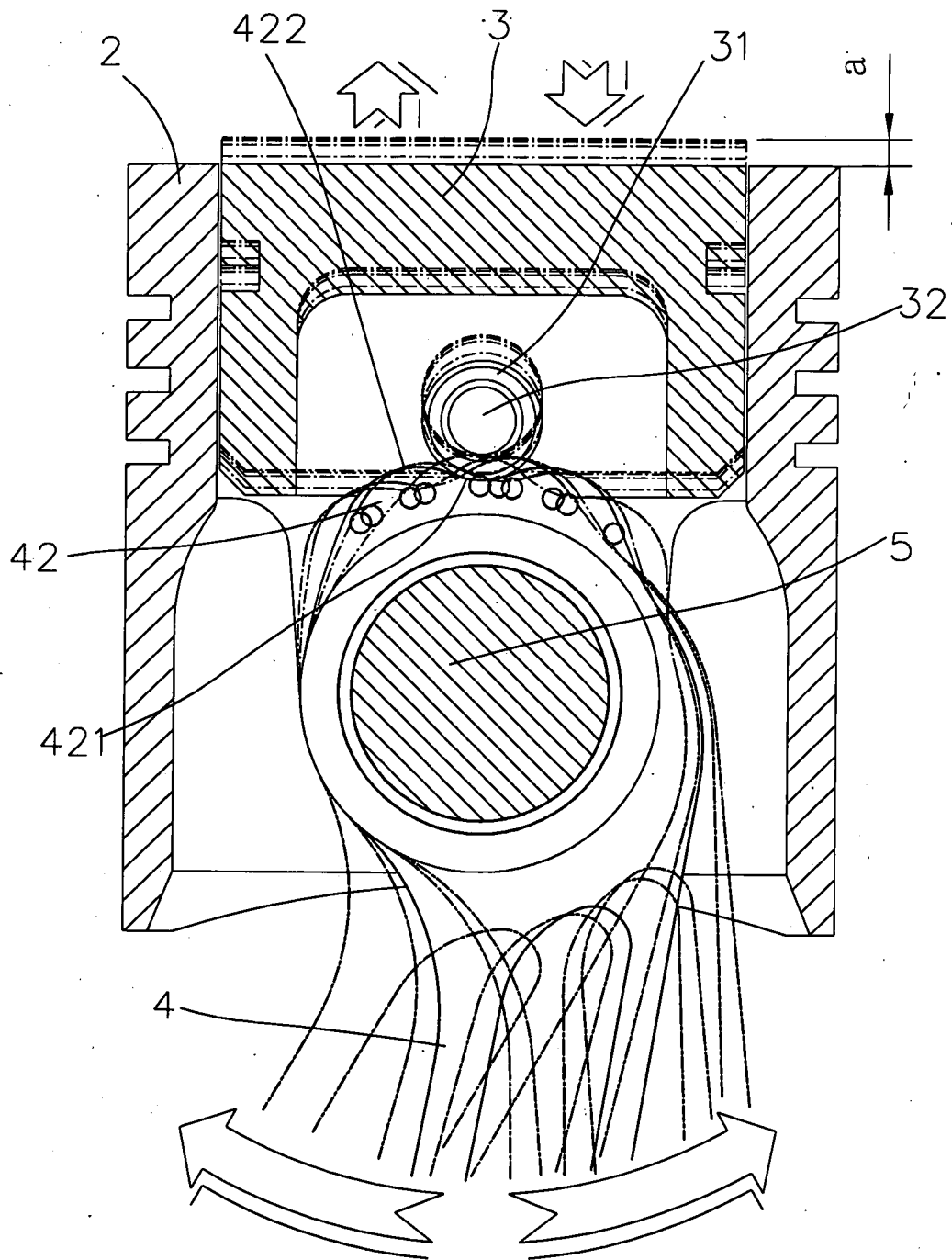


FIG. 4

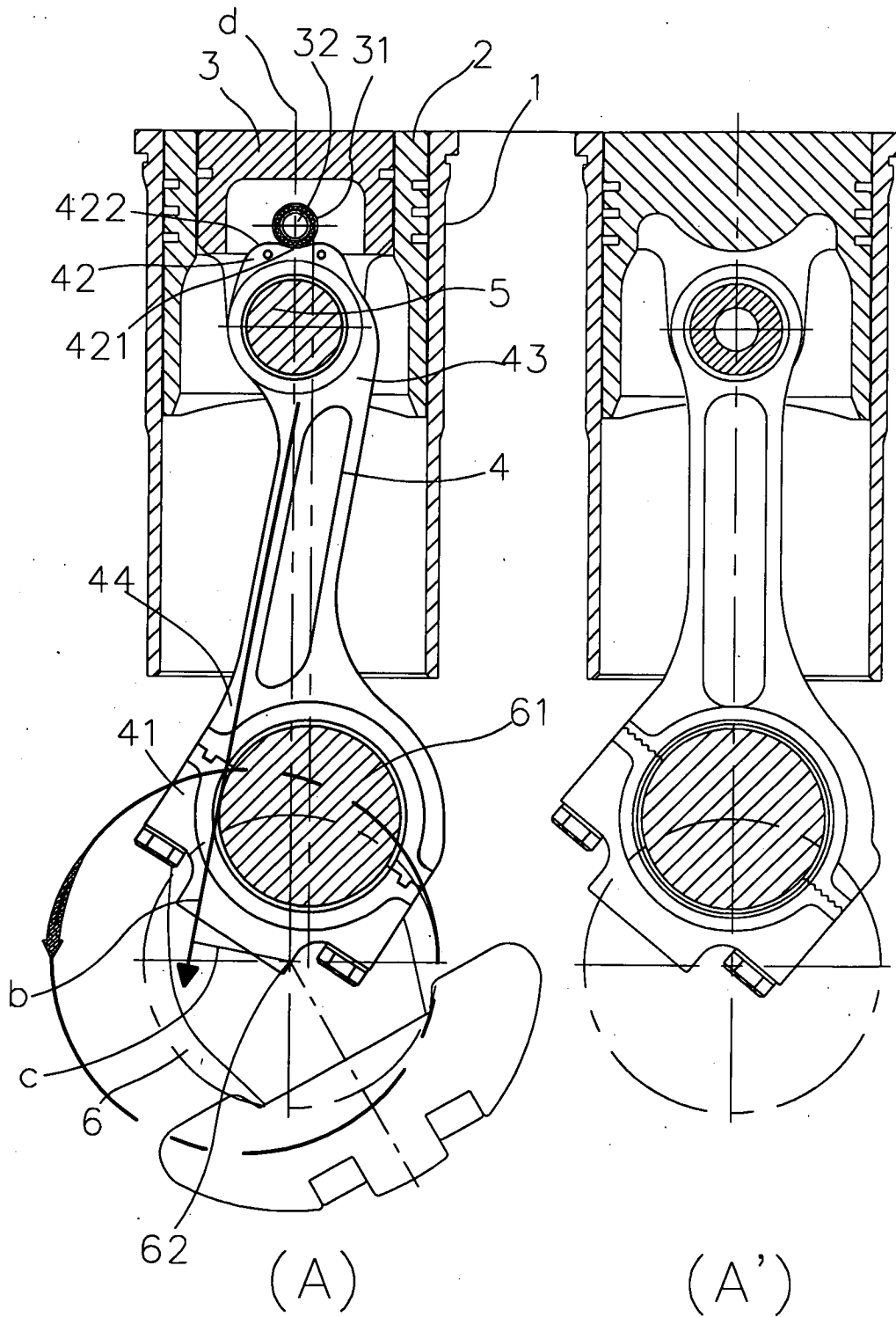


FIG. 5

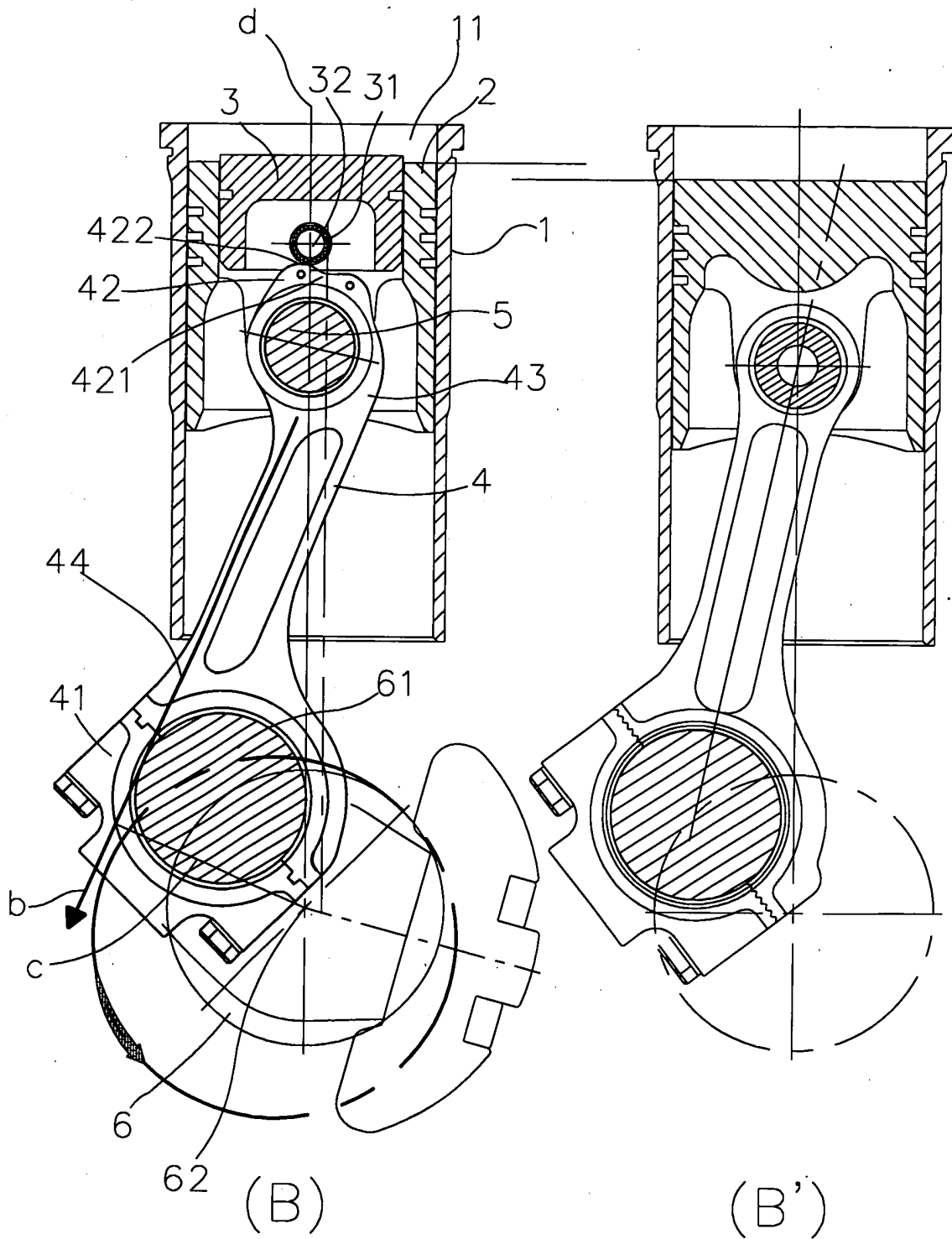


FIG. 6

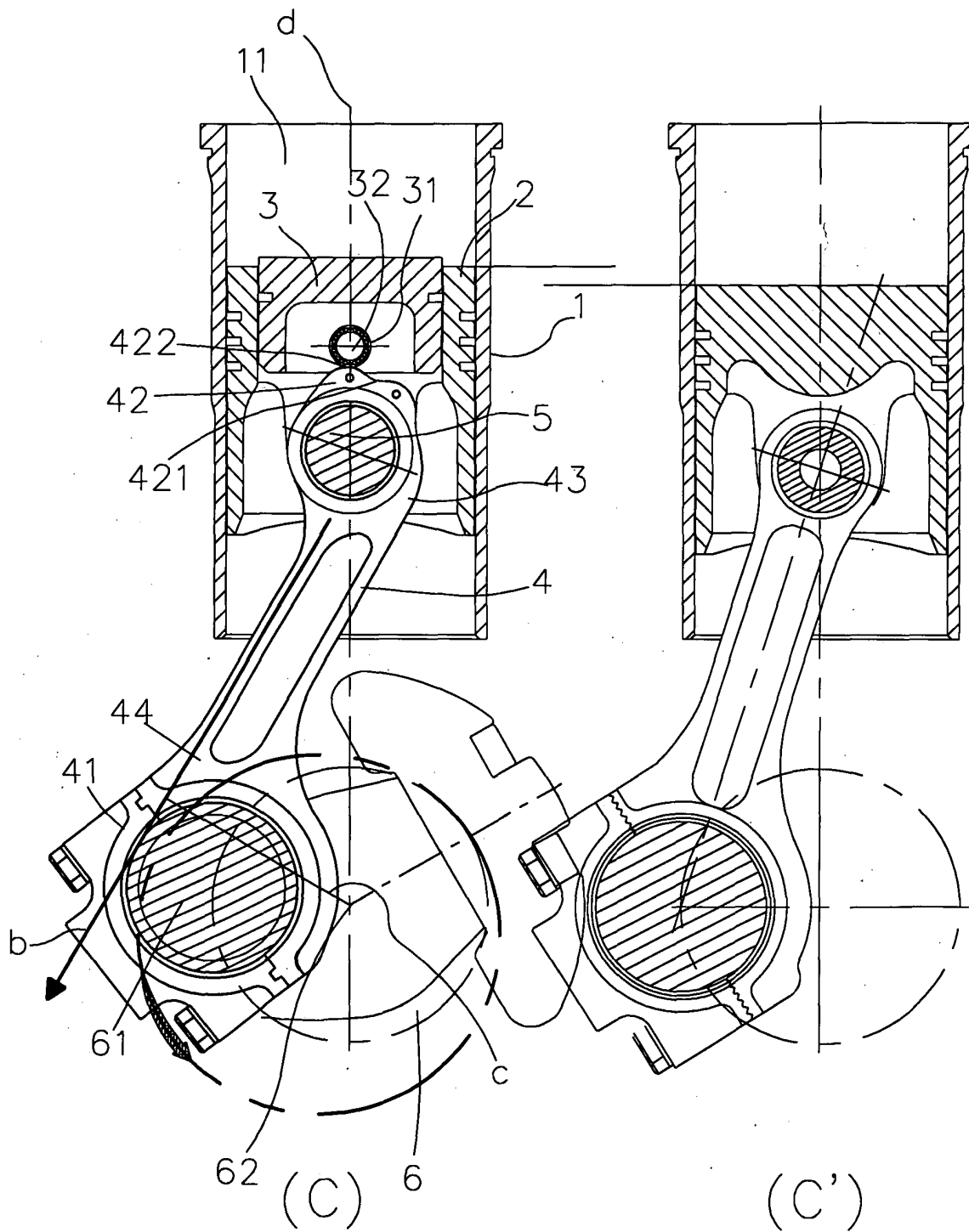


FIG. 7

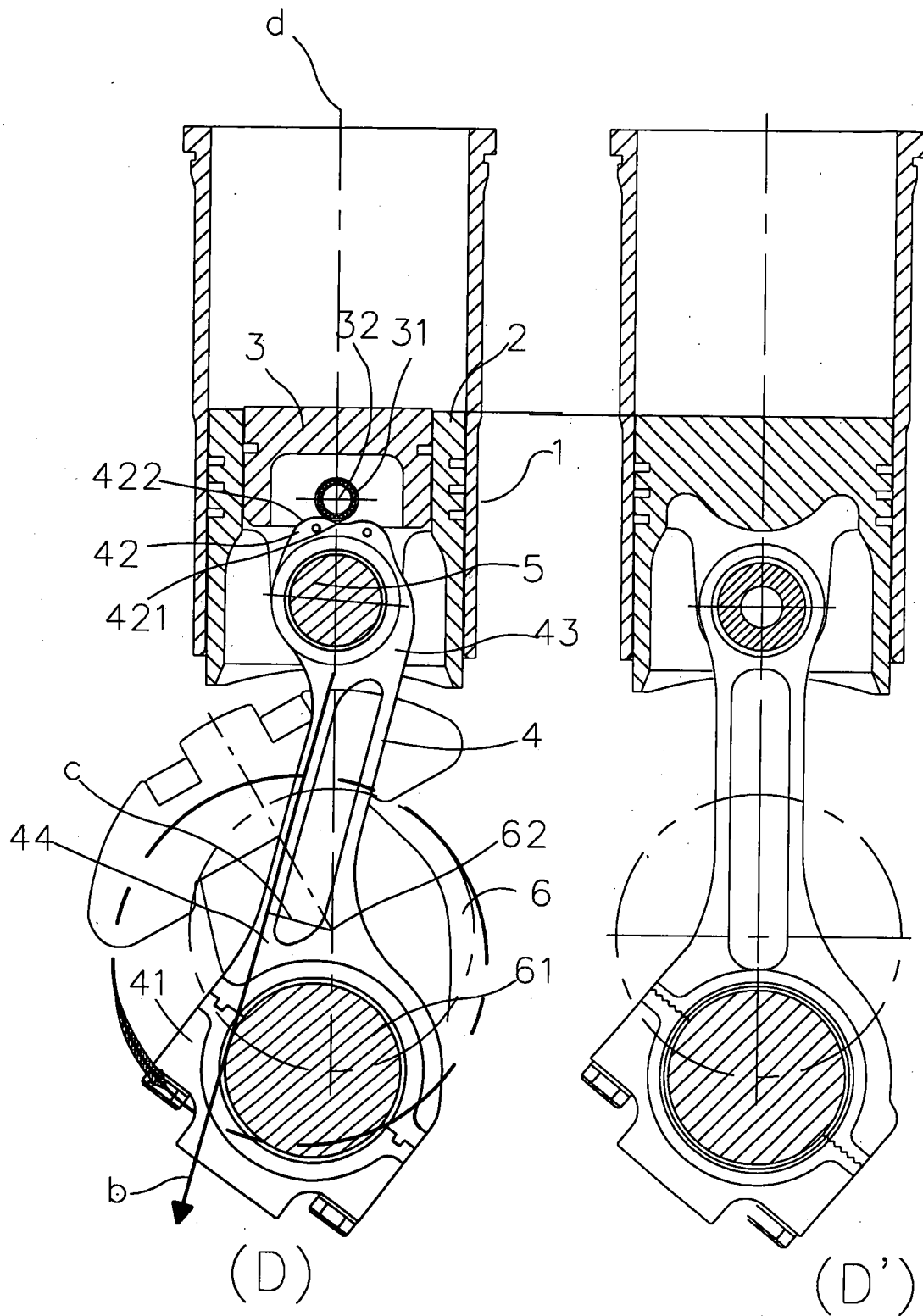


FIG. 8

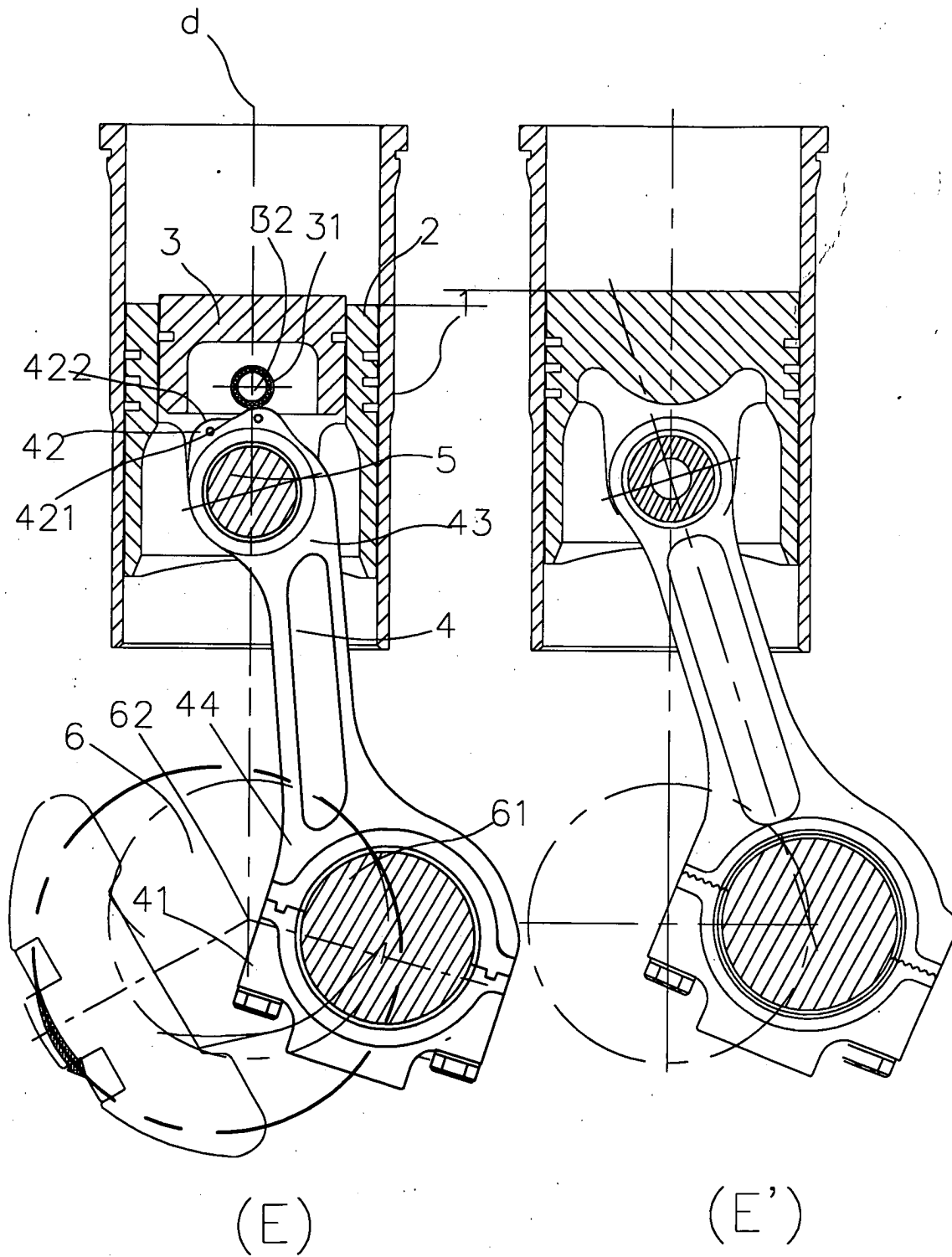


FIG. 9

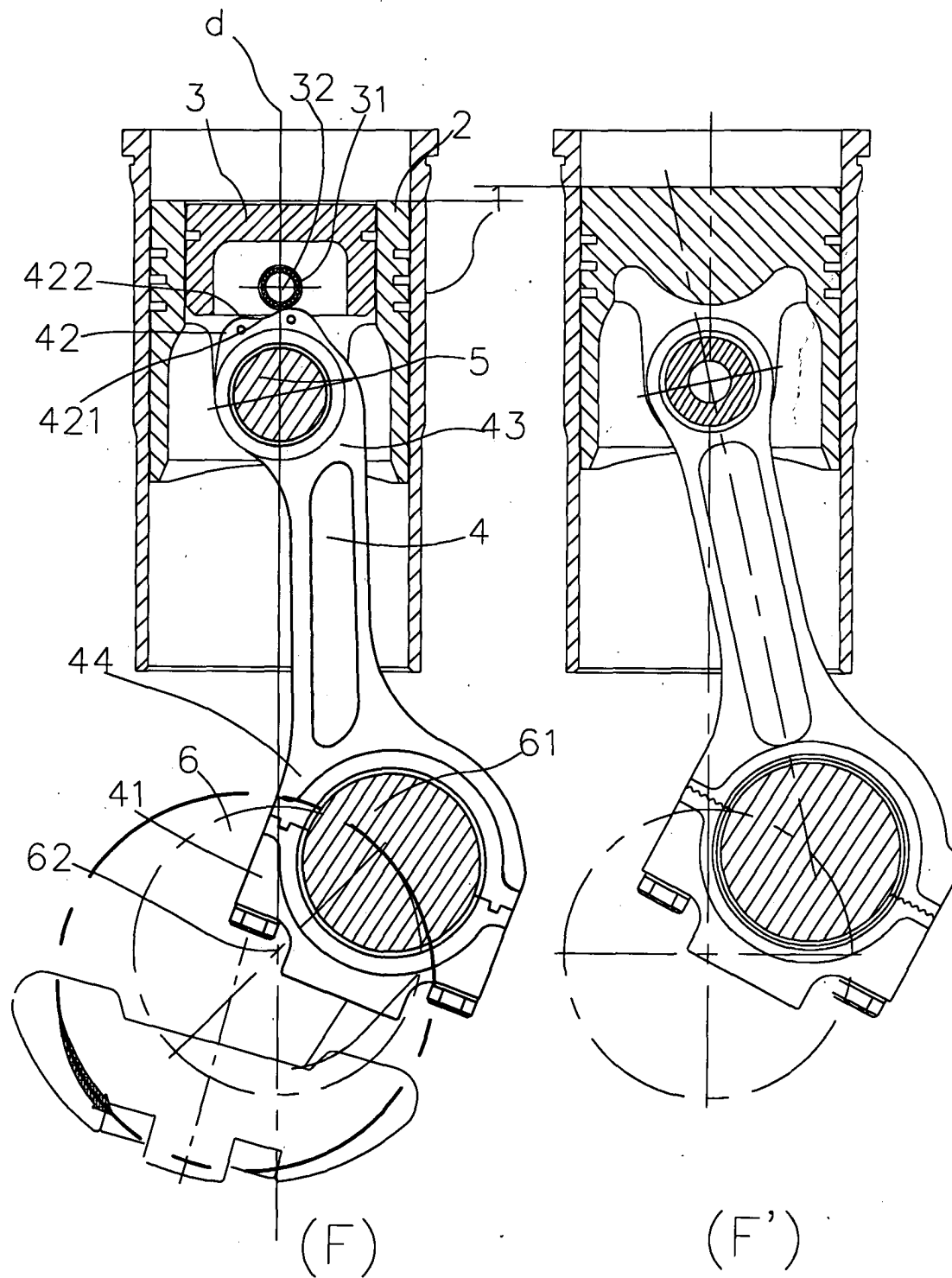


FIG. 10

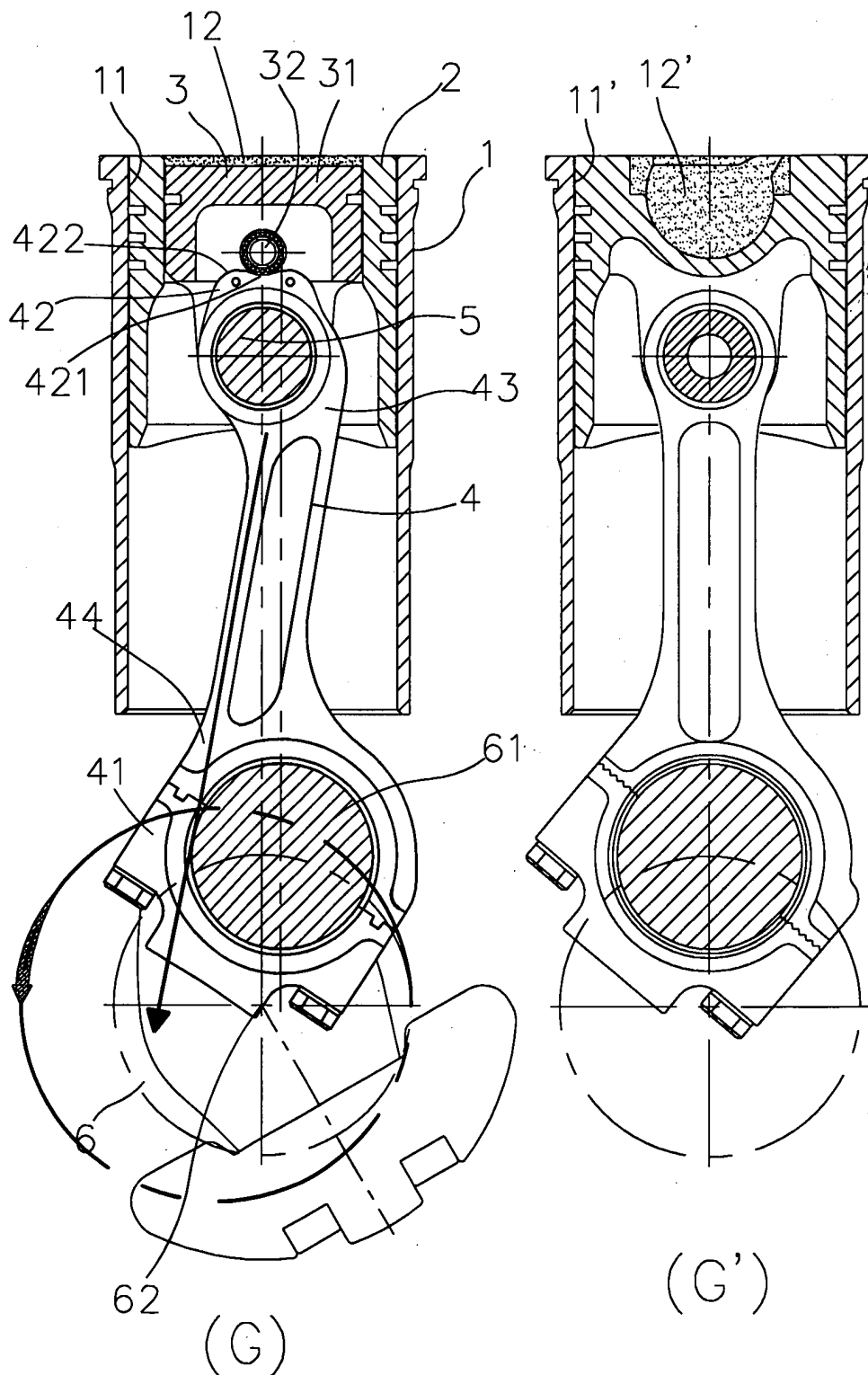


FIG. 11

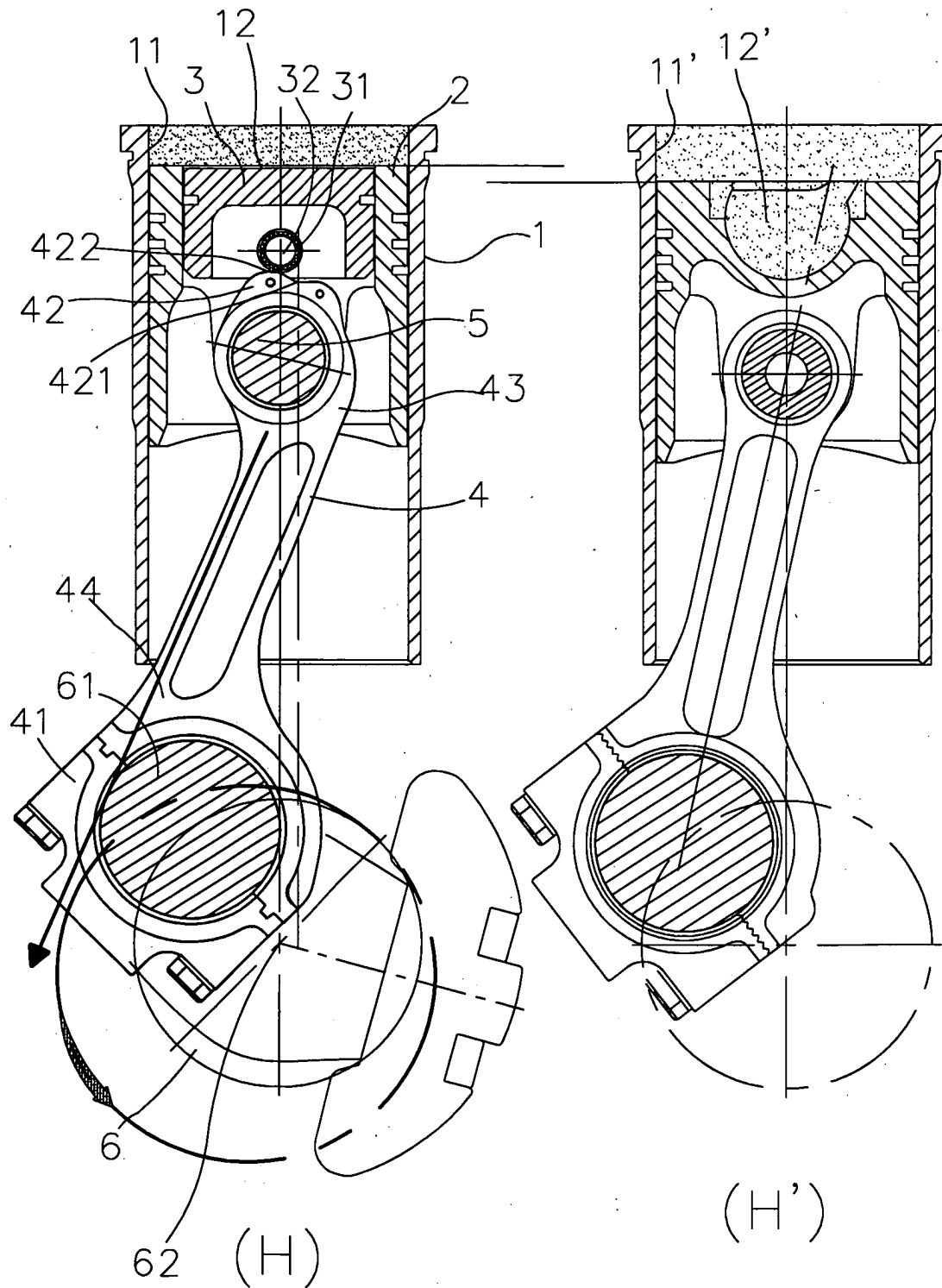


FIG. 12

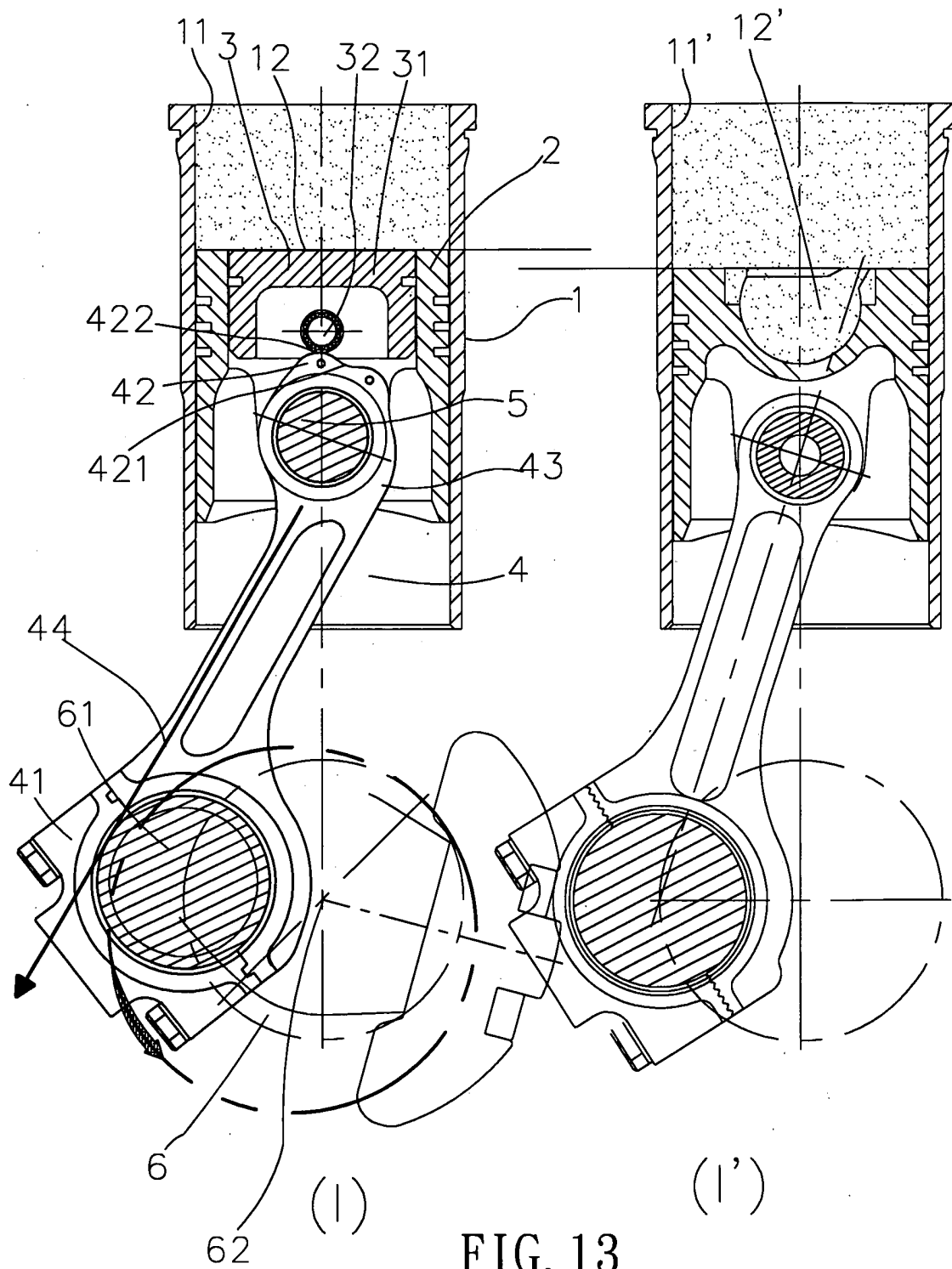


FIG. 13



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 00 6564

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.7)
A	US 4 515 114 A (DANG) 7 May 1985 (1985-05-07) * abstract * * column 3, line 44 - column 4, line 46; figures 6-12 *	1,2	F02B75/04 F02D15/04 F02B41/04
A	US 2 369 792 A (NOTTURNO) 20 February 1945 (1945-02-20) * page 1, column 1, line 1 - line 10 * * page 1, column 1, line 35 - page 2, column 2, line 35; figures 1-7 *	1	
A	US 2 394 269 A (SVETE) 5 February 1946 (1946-02-05) * page 1, column 1, line 5 - line 13 * * page 1, column 2, line 14 - line 45; figures 1,2 *	1	
A	US 5 908 012 A (ENDOH) 1 June 1999 (1999-06-01) * abstract * * column 5, line 4 - column 6, line 50; figures 1-4 *	1	
A	WO 02 081886 A (KNUTSEN) 17 October 2002 (2002-10-17) * abstract; figure 1A *	1	
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22 July 2003	Examiner Van Zoest, A
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			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 00 6564

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-07-2003

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
US 4515114	A	07-05-1985	NONE		

US 2369792	A	20-02-1945	NONE		

US 2394269	A	05-02-1946	NONE		

US 5908012	A	01-06-1999	JP	8338274 A	24-12-1996
			WO	9641939 A1	27-12-1996

WO 02081886	A	17-10-2002	SE	519307 C2	11-02-2003
			SE	0101180 A	04-10-2002
			WO	02081886 A1	17-10-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82