



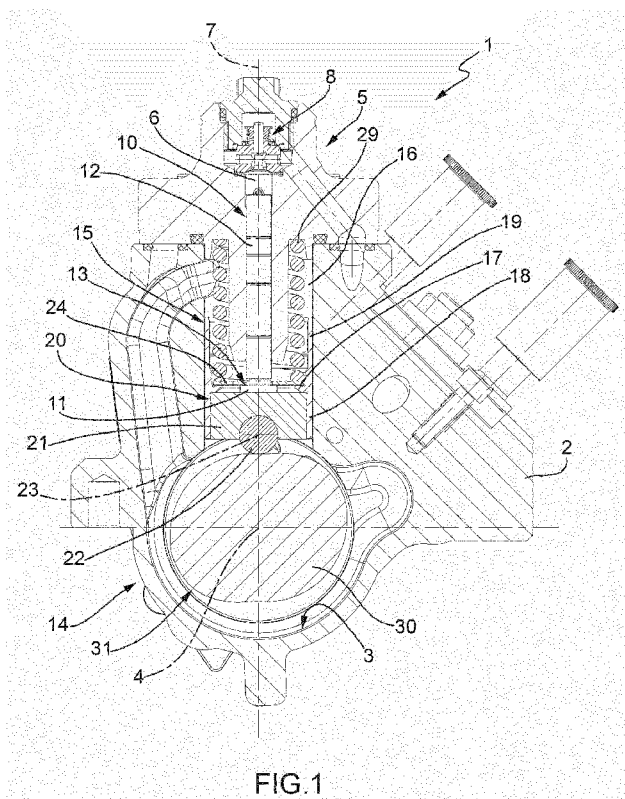
- (51) International Patent Classification:
F02M 59/10 (2006.01) *F04B 1/04* (2006.01)
F02M 59/44 (2006.01)
- (21) International Application Number:
PCT/EP2012/056068
- (22) International Filing Date:
3 April 2012 (03.04.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
MI2011A000976 30 May 2011 (30.05.2011) IT
- (71) Applicant (for all designated States except US): **ROBERT BOSCH GMBH** [DE/DE]; Postfach 30 02 20, 70442 Stuttgart (DE).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **RONCONE, Massimiliano** [IT/IT]; Via Madre Teresa di Calcutta 21, I-70020 Bitritto (IT). **RIGLIETTI, Gaetano** [IT/IT]; Via

Paolo Ricci 2/O, I-70051 Barletta (IT). **GORGONE, Giovanni** [IT/IT]; Via Taranto 9/b, I-75100 Matera (IT).

- (74) Common Representative: **ROBERT BOSCH GMBH**; Postfach 30 02 20, 70442 Stuttgart (DE).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,

[Continued on next page]

(54) Title: PUMP UNIT FOR SUPPLYING FUEL, PREFERABLY DIESEL OIL, TO AN INTERNAL COMBUSTION ENGINE



(57) Abstract: A pump unit for supplying fuel, preferably diesel oil, to an internal combustion engine has a piston (10), which is engaged slidably in a cylinder (6) formed in a pump housing (2), is moved through a stroke for the intake of fuel into the cylinder (6) by a first annular element (24) extending around a narrower portion (12) of the piston (10), and is positioned in contact with a shoulder (13) of the piston (10) by means of the interposition of a second annular element (27).



DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, **Published:**

LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE,
SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA,
GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— with international search report (Art. 21(3))

- 1 -

5 Description

Title

PUMP UNIT FOR SUPPLYING FUEL, PREFERABLY DIESEL OIL, TO AN
INTERNAL COMBUSTION ENGINE

10 The present invention relates to a pump unit for supplying fuel, preferably diesel oil, to an internal combustion engine.

15 More specifically, the present invention relates to a pump unit of the type comprising a pump housing, at least one cylinder formed in the pump housing; a piston which is engaged slidably in the cylinder and has a narrower portion and a wider portion interconnected at a shoulder which is positioned perpendicularly to a longitudinal axis of the cylinder; first actuator means for moving the piston through a stroke for the intake of fuel into the cylinder; and second actuator
20 means for moving the piston through a stroke for the compression of the fuel contained in the cylinder.

The second actuator means comprise a cam, formed on an outer surface of a transmission shaft extending through the pump housing transversely with respect
25 to the longitudinal axis of the cylinder, and a cam follower, which is positioned between the cam and the wider portion of the piston and which is provided with a cam follower roller positioned in contact with the cam.

The cam follower roller projects from a sleeve which extends around the cylinder,
30 is coupled slidably to the pump housing, and has a flange projecting radially inwards from the sleeve so as to separate a first portion of the sleeve, adapted to receive and retain the cam follower by a positive fit, from a second portion.

- 2 -

5 The first actuator means comprise an annular support element, which is fitted into the second portion of the sleeve, extends around the narrower portion of the piston, and axially faces the flange of the sleeve and the shoulder of the piston, and a cylindrical spring, which is mounted between the cylinder and the sleeve coaxially with the longitudinal axis of the cylinder, and is interposed between the pump housing and the annular support element so as to hold the annular support element axially against the flange and hold the cam follower against the cam.

10 Since the wider portion of the piston normally has an axial length which is smaller than the distance between the annular support element and the cam follower, the inertial forces acting on the piston cause the piston to move axially with respect to both the annular support element and the cam follower, and cause the piston to strike against the cam follower at the end of the intake stroke and against the annular support element at the end of the compression stroke.

15 The known pump units of the type described above have a number of drawbacks, mainly due to the fact that the striking of the piston against the annular support element and against the cam follower gives rise to troublesome noise and also causes the deformation of the annular support element, which is detrimental to its correct operation.

20 The object of the present invention is to provide a pump unit for supplying fuel, preferably diesel oil, to an internal combustion engine which is free of the drawbacks described above and which is simple and economical to produce.

25 According to the present invention, a pump unit is provided for supplying fuel, preferably diesel oil, to an internal combustion engine, as claimed in the appended claims.

30 The present invention will now be described with reference to the attached drawings, which show a non-limiting example of its embodiment, in which:

Figure 1 is a first schematic sectional view, with parts removed for clarity, of a preferred embodiment of the pump unit according to the present invention;

- 3 -

Figure 2 is a second schematic sectional view, with parts removed for clarity, of the pump unit of Figure 1; and

5 Figure 3 is a schematic sectional view of a detail of Figures 1 and 2.

With reference to Figures 1 and 2, the number 1 indicates, as a whole, a pump unit for supplying fuel, preferably diesel oil, to an internal combustion engine (not shown).

10 The pump unit 1 comprises a pump housing 2 provided with a central bore 3 having a specified longitudinal axis 4; a piston pump 5 for supplying the fuel to the aforesaid internal combustion engine (not shown); and a pre-feed pump of a known type (not shown) for supplying the fuel to the pump 5.

15 The pump 5 comprises at least one cylinder 6, which is formed in the pump housing 2, has a longitudinal axis 7 positioned substantially perpendicularly to the axis 4, faces the bore 3, and interacts with a valve 8 for the intake of fuel into the cylinder 6 and with a valve 9 for delivering the fuel to the internal combustion engine (not shown).

20 The cylinder 6 is engaged slidably by a piston 10, which is mounted inside the cylinder 6 coaxially with the axis 7, and comprises a wider end portion 11 and a narrower intermediate portion 12, these portions being interconnected at an annular shoulder 13 which is substantially perpendicular and coaxial with the axis 7.

25 The piston 10 is moved by an actuating device 14 along the cylinder 6 with a reciprocating rectilinear motion including a stroke for the intake of fuel into the cylinder 6 and a stroke for the compression of the fuel contained in the cylinder 6.

30 The device 14 comprises a tubular sleeve 15, which is engaged slidably in a cylinder 16 formed in the pump housing 2 coaxially with the axis 7, extends around the cylinder 6, and has an annular flange 17 which projects radially into the

- 4 -

sleeve 15 and divides the sleeve 15 into two cylindrical portions 18, 19, of which the portion 18 faces the bore 3.

5 The device 14 also has a cam follower 20 comprising a coupling block 21 of substantially cylindrical shape, which is fitted inside the portion 18, is positioned in contact with the flange 17, and is locked by interference in the portion 18, and a cam follower roller 22 which projects from the block 21 towards the bore 3 and is coupled rotatably to the block 21 so that it can rotate with respect to the block 21 about its own longitudinal axis 23 which is substantially perpendicular to the axis
10 7.

As illustrated in Figure 3, the flange 17 supports an annular element 24, which extends around the narrower portion 12 of the piston 10, is fitted into the portion 19 of the sleeve 15 coaxially with the axis 7, has an outer perimetric edge facing
15 the flange 17 axially, also has an inner perimetric edge facing the shoulder 13 axially, and is limited axially by two flat faces 25, 26 which are substantially parallel to each other and perpendicular to the axis 7, with the face 25 facing the cam follower 20.

20 Each face 25, 26 has, on its inner perimetric edge, an annular coating 27, 28, which is substantially coaxial with the axis 7 and which is preferably, but not necessarily, made from a resiliently deformable material, in the present case an elastomeric material deposited by curing on the face 25, 26.

25 Finally, the device 14 comprises a cylindrical spring 29, which is mounted between the cylinder 6 and the sleeve 15 coaxially with the axis 7, and is interposed between the pump housing 2 and the element 24 in such a way that it brings the element 24 into contact with the flange 17 and normally keeps it there, brings the coating 27 of the face 25 into contact with the shoulder 13 and normally keeps it
30 there, brings the piston 10 into contact with the block 21 and normally keeps it there, and brings the roller 22 into contact with a cam 30 and normally keeps it there, the cam 30 being formed on an outer surface of an intermediate portion of a transmission shaft 31 which is mounted through the bore 3 so as to rotate, with respect to the pump housing 2, about the axis 4.

- 5 -

5 Since the thickness of the coating 27, measured parallel to the axis 7, is at least equal to the difference between the distance of the face 25 from the block 21 and the thickness of the wider portion 11 of the piston 10, also measured parallel to the axis 7, the coating 27 prevents the portion 11 from striking the block 21 and the element 24, and from deforming the element 24 to the detriment of its correct operation.

10 The presence of the two coatings 27, 28 enables the personnel responsible for assembling the pump unit 1 to fit the element 24 correctly in the portion 19 of the sleeve 15, regardless of the position of the faces 25, 26.

15 Clearly, the coatings 27, 28 can extend continuously around the inner perimetric edges of the corresponding faces 25, 26, or can comprise a plurality of portions of elastomeric material distributed around the inner perimetric edges of the corresponding faces 25, 26 so as to form, in combination, an annular element for filling the space present between the shoulder 13 and the element 24.

20 In a variant which is not illustrated, the coatings 27, 28 are dispensed with and replaced with a ring, preferably a ring of elastomeric material, which is interposed between the shoulder 13 and the element 24, is made as a separate piece distinct from the element 24, and is axially locked between the shoulder 13 and the element 24 by the spring 29.

5 Claims

1. Pump unit for supplying fuel, preferably diesel oil, to an internal combustion engine, the pump unit comprising a pump housing (2); at least one cylinder (6), which is formed in the pump housing (2), and has a first longitudinal axis (7);
10 a piston (10), which is engaged slidably in the cylinder (6), and has a narrower portion (12), a wider portion (11), and a shoulder (13) for connecting the narrower portion (12) and the wider portion (11) to each other; first actuator means (24, 29) for moving the piston (10) through a stroke for the intake of fuel into the cylinder (6); and second actuator means (20, 30) for moving the piston (10) through a
15 stroke for the compression of the fuel contained in the cylinder (6), the first actuator means (24, 29) comprising a first annular element (24) extending around the narrower portion (12), the pump unit being characterized in that it further comprises a second annular element (27), which is interposed between the shoulder (13) and the first annular element (24), extends around the narrower portion (12),
20 and is positioned in axial contact with the shoulder (13) and with the first annular element (24).
2. Pump unit according to Claim 1, in which the second annular element (27) is fixed to the first annular element (24).
- 25 3. Pump unit according to Claim 1 or 2, in which the second annular element (27) is made from a resiliently deformable material.
4. Pump unit according to Claim 3, in which the second annular element (27) is made from an elastomeric material deposited by curing on the first annular
30 element (24).

- 7 -

5. Pump unit according to any one of the preceding claims and further comprising a third annular element (28) fixed to the first annular element (24) on the opposite side from the second annular element (27).

5 6. Pump unit according to Claim 5, in which the second and third annular elements (27, 28) are made from the same material.

7. Pump unit according to any one of the preceding claims, in which the first actuator means (24, 29) further comprise a spring (29) interposed between
10 the pump housing (2) and the first annular element (24) to keep the second annular element (27) in contact with the shoulder (13).

8. Pump unit according to Claim 7, further comprising a sleeve (15) which extends around the piston (10) coaxially with the first axis (7), is coupled slidably
15 to the pump housing (2), and is coupled in an axially fixed way to the first annular element (24).

9. Pump unit according to Claim 8, in which the sleeve (15) has a flange (17) projecting radially into the sleeve (15); the spring (29) being mounted inside
20 the sleeve (15) so as to bring the first annular element (24) into contact with the flange (17) and normally keep it there.

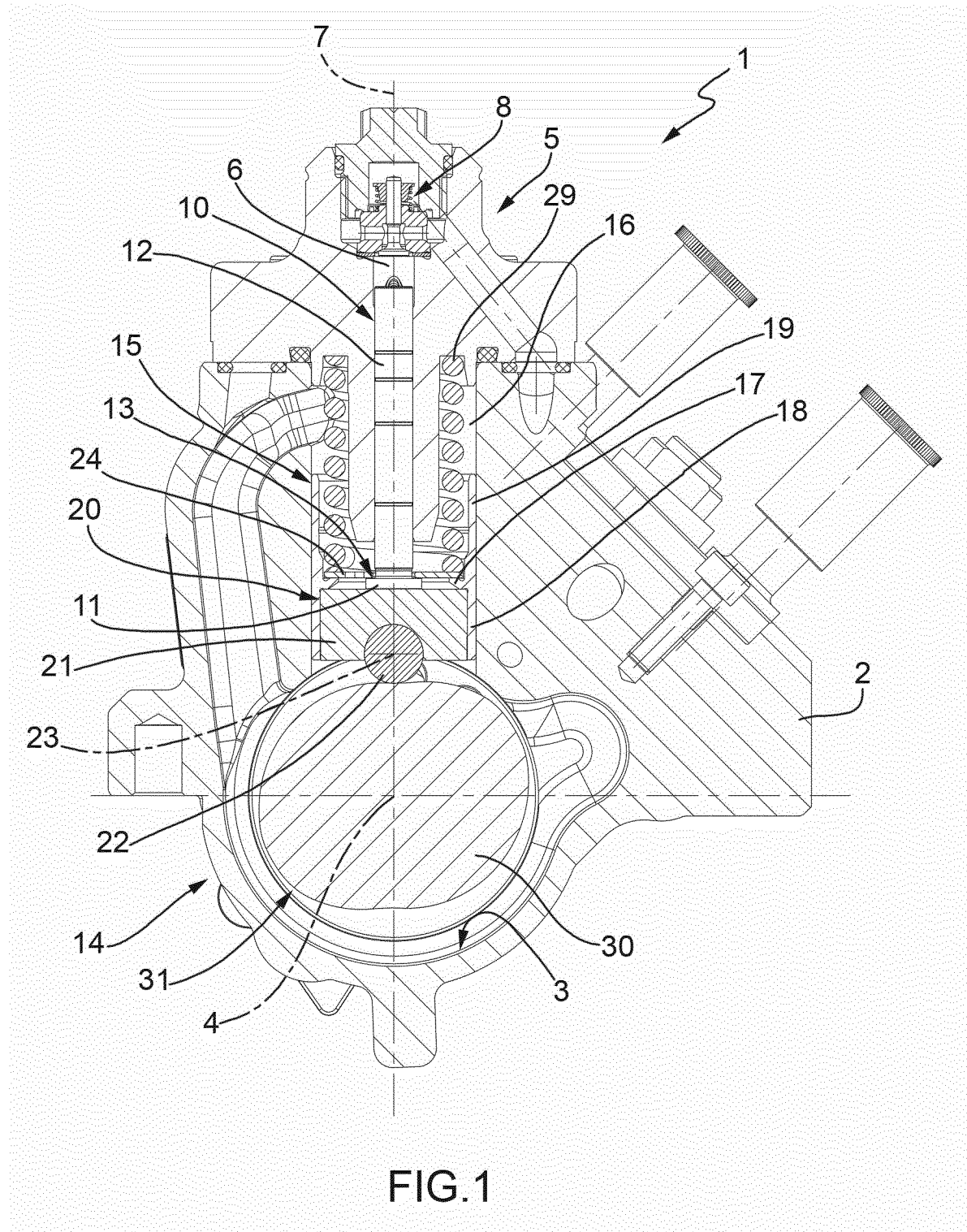
10. Pump unit according to any one of the preceding claims, in which the second actuator means (20, 30) comprise a cam (30), mounted so as to rotate
25 about a second axis (4) which is transverse with respect to the first axis (7), and a cam follower (20), which is engaged in the cam (30) and is positioned in contact with the piston (10).

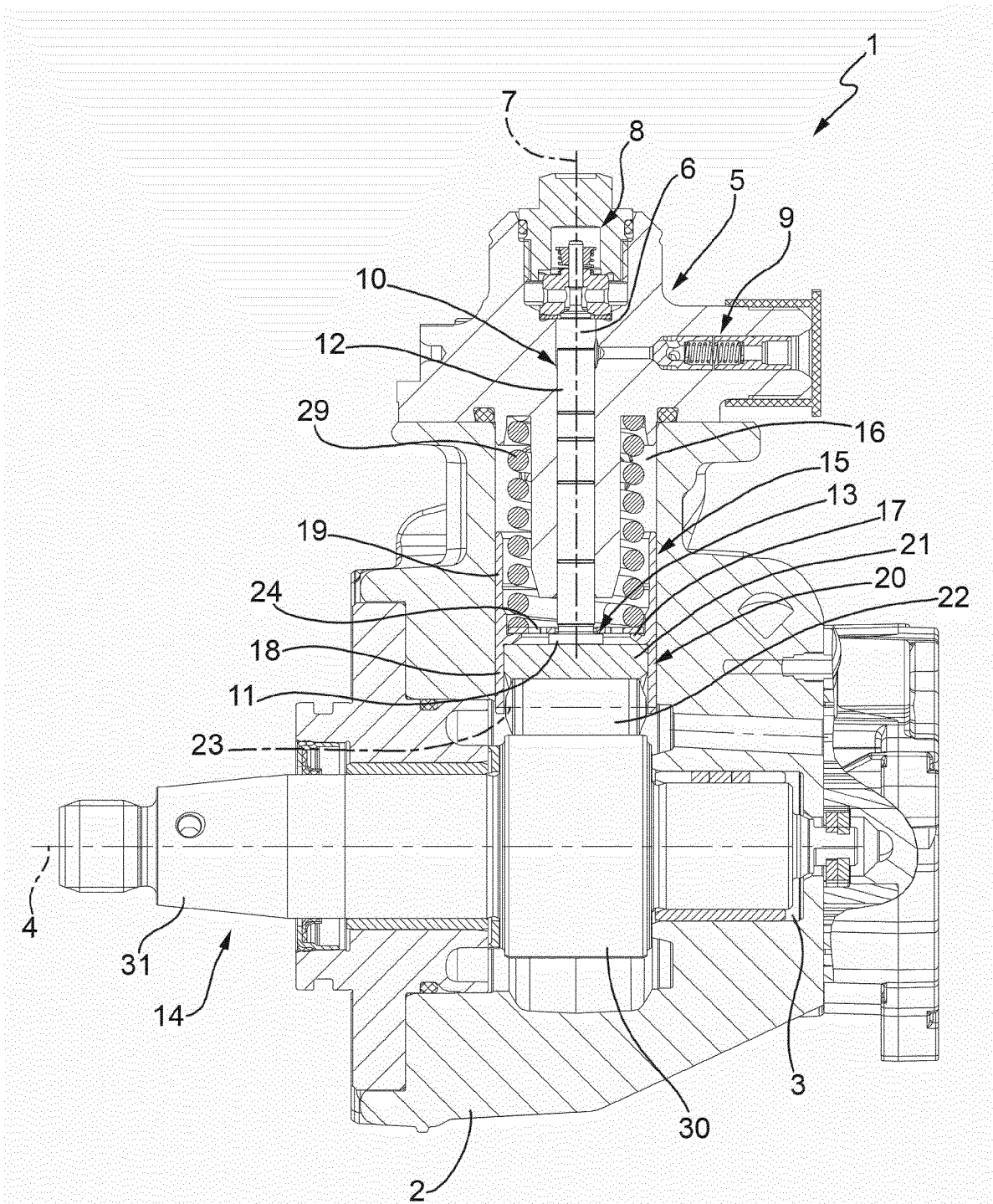
11. Pump unit according to Claim 10, when dependent on Claim 8 or 9, in
30 which the sleeve (15) and the cam follower (20) are coupled to each other in an axially fixed way.

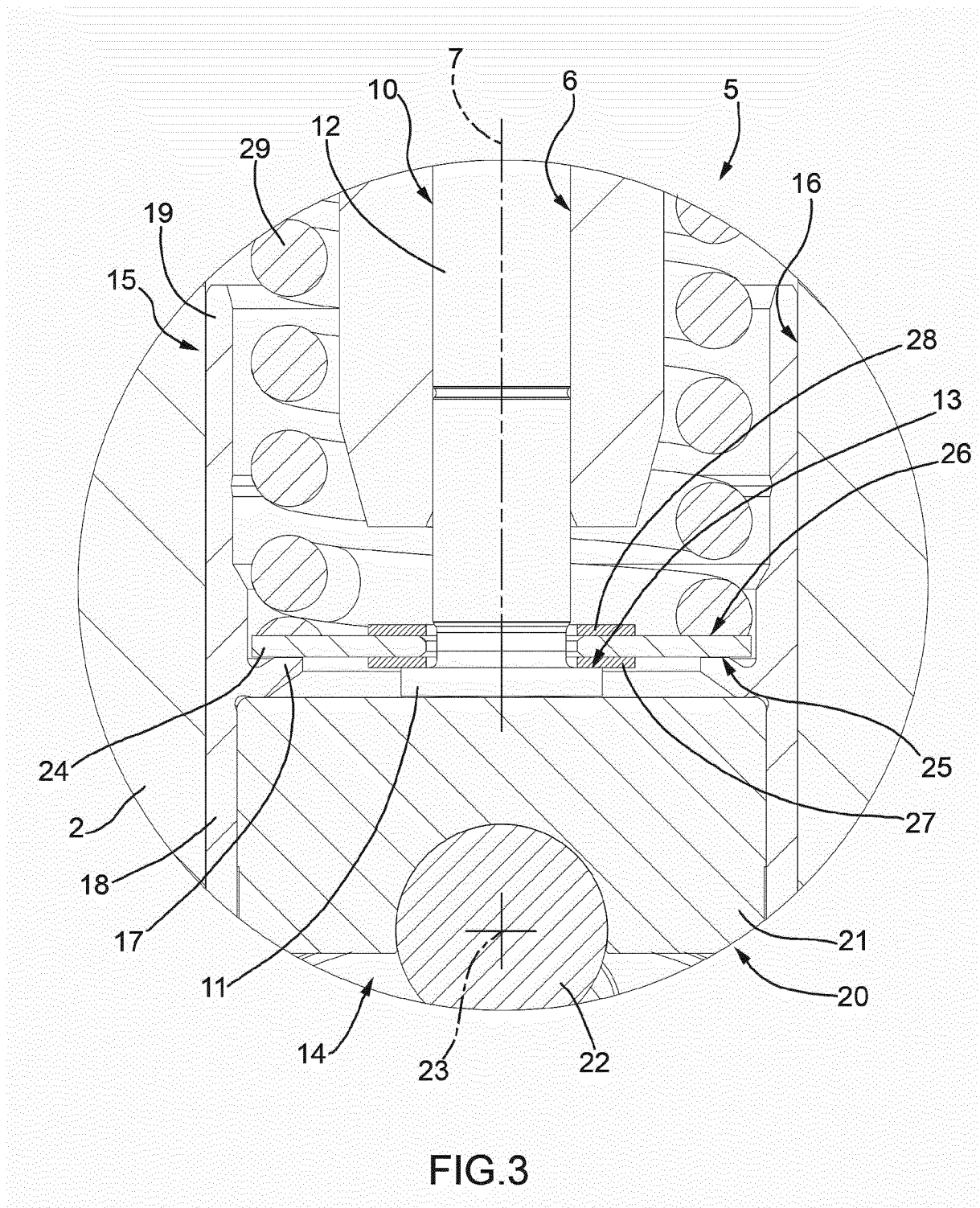
12. Pump unit according to Claim 10 or 11, in which the thickness of the second annular element (27), measured parallel to the first axis (7), is at least

- 8 -

equal to the difference between the distance of the cam follower (20) from the first annular element (24) and the thickness of the wider portion (11) of the piston (10), also measured parallel to the first axis (7).







INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/056068

A. CLASSIFICATION OF SUBJECT MATTER INV. F02M59/10 F02M59/44 F04B1/04 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F02M F04B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1 519 033 A2 (BOSCH GMBH ROBERT [DE]) 30 March 2005 (2005-03-30)	1-3,5-7, 12
Y	figures 1-4 -----	4,8-11
Y	EP 0 851 120 A2 (ELASIS SISTEMA RICERCA FIAT [IT] BOSCH GMBH ROBERT [DE]) 1 July 1998 (1998-07-01) figures 1,2 -----	4
Y	DE 10 2009 027689 A1 (BOSCH GMBH ROBERT [DE]) 20 January 2011 (2011-01-20) figures 1-3 -----	8-11
☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents :		
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 13 July 2012	Date of mailing of the international search report 19/07/2012	
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Morales Gonzalez, M	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2012/056068

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
EP 1519033	A2	30-03-2005	DE	10344459 A1		14-04-2005
			EP	1519033 A2		30-03-2005

EP 0851120	A2	01-07-1998	CN	1190699 A		19-08-1998
			DE	69723040 D1		31-07-2003
			DE	69723040 T2		06-05-2004
			EP	0851120 A2		01-07-1998
			IT	T0960264 U1		23-06-1998
			JP	4128253 B2		30-07-2008
			JP	10184492 A		14-07-1998
			RU	2196248 C2		10-01-2003
			US	5979297 A		09-11-1999

DE 102009027689	A1	20-01-2011	NONE			
