

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 June 2001 (07.06.2001)

PCT

(10) International Publication Number
WO 01/40645 A2

(51) International Patent Classification⁷: F02M 59/00

(21) International Application Number: PCT/IT00/00489

(22) International Filing Date:
29 November 2000 (29.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
TO99U000213 30 November 1999 (30.11.1999) IT

(71) Applicant (for all designated States except US): **ROBERT BOSCH GMBH** [DE/DE]; Postfach 30 02 20, 70442 Stuttgart (DE).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **DE MATTHAEIS, Sisto, Luigi** [IT/IT]; Via Siracusa, 4, I-70026 Modugno (IT).

(74) Agents: **JORIO, Paolo** et al.; Studio Torta S.r.l., Via Viotti, 9, I-10121 Torino (IT).

(81) Designated States (*national*): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

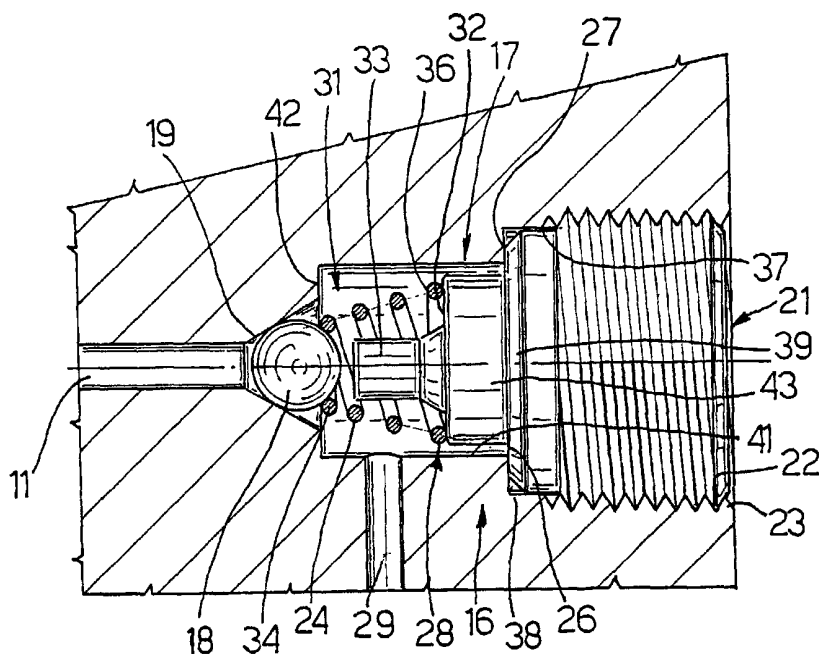
(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— Without international search report and to be republished upon receipt of that report.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: INTERNAL COMBUSTION ENGINE HIGH-PRESSURE FUEL DELIVERY VALVE



(57) Abstract: The valve (16) has a ball shutter (18) normally pushed by a helical compression spring (24) to close a delivery conduit (11) of the pump (5). A first end (28) of the spring (24) rests against a shoulder (26) of a fastening member (21) fitted in fluidtight manner to the pump (5); a second end (31) of the spring (24) acts directly on the ball (18); the fastening member (21) has a pin (33) coaxial with the conduit (11) and of such a length as to limit the travel of the ball (18) to a predetermined value; and the second end (31) of the spring (24) has at least one small-diameter turn (34) by which to engage the ball (18).

5 INTERNAL COMBUSTION ENGINE HIGH-PRESSURE FUEL DELIVERY
VALVE

TECHNICAL FIELD

The present invention relates to a delivery valve of
10 an internal combustion engine, e.g. diesel engine, high-
pressure fuel pump.

BACKGROUND ART

The high-pressure fuel pumps of modern diesel
engines operate at high pressures of up to 1,600 bars,
15 and the delivery valves must ensure constant delivery
pressure with no fall in pressure or pressure peaks over
and above the desired pressure.

Various types of delivery valves are known, each of
which comprises a shutter pushed elastically to close a
20 delivery conduit. In one known valve, the shutter is
defined by a ball, which is pushed against its seat by a
cylindrical helical spring having a first end resting on
a fastening member on the pump. The other end of the
spring acts on the ball by means of a cap, which slides
25 axially inside a cylindrical hole on the pump and,
together with the ball, defines the movable part of the
valve.

The cap of the above known valve has a wall engaging

the ball; a shoulder on which said first end of the spring rests; a cylindrical surface enclosing the turns of the spring; and axial cap guiding members in the hole and/or on the fastening member. The cap is therefore
5 complicated and expensive to produce and makes the movable part of the valve relatively heavy, thus resulting in a certain amount of inertia in turn resulting in severe oscillations in the delivery pressure of the pump.

10 DISCLOSURE OF INVENTION

It is an object of the invention to provide a delivery valve of the above type, which is highly straightforward and cheap to produce, and has a lightweight movable part to eliminate the aforementioned
15 drawbacks typically associated with known valves.

According to the present invention, there is provided a delivery valve of an internal combustion engine high-pressure fuel pump, comprising a shutter normally pushed by a helical compression spring to close
20 a delivery conduit of the pump communicating with a compression chamber; said spring having a first end resting against a surface of a fastening member fitted in fluidtight manner to the pump; characterized in that a second end of said spring acts directly on said shutter;
25 said fastening member having a pin coaxial with said conduit and for guiding said spring; and said pin being of such a length as to limit the travel of said shutter to a predetermined value.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred, non-limiting embodiment of the invention will be described by way of example with reference to the accompanying drawings, in which:

5 Figure 1 shows a partial section of an internal combustion engine high-pressure fuel pump comprising a delivery valve in accordance with the invention;

Figure 2 shows a larger-scale section of the Figure 1 valve.

10 BEST MODE FOR CARRYING OUT THE INVENTION

Number 5 in Figure 1 indicates as a whole a diesel engine high-pressure fuel pump. Pump 5 comprises a pump body 6 having at least one cylinder 7, in which slides in known manner a piston 8 defining, in cylinder 7, a
15 compression chamber 9 in which terminates a delivery conduit 11 communicating with a drain conduit 29.

Cylinder 7 has a known intake valve 12 by which the fuel to be compressed, from an intake conduit 13, is fed into cylinder 7. Pump 5 also comprises a delivery valve
20 indicated as a whole by 16 and housed inside a hole 17 formed in pump body 6 and coaxial with delivery conduit 11 of cylinder 7.

Delivery valve 16 comprises a shutter defined by a ball 18 engaging a truncated-cone-shaped seat 19 (Figure
25 2) at which delivery conduit 11 terminates towards hole 17. Delivery valve 16 also comprises a fastening member in the form of a cap 21 having a threaded portion 22 which screws onto a threaded portion 23 of hole 17.

Delivery valve 16 also comprises a helical compression spring 24 located between ball 18 and cap 21. Cap 21 has a first shoulder 26 contacting in fluidtight manner a shoulder 27 of hole 17; compression spring 24
5 has a first end 28 resting on a surface of cap 21; and hole 17 communicates with fuel drain conduit 29. It should be pointed out that the in-seat load produced by the pressure exerted by helical spring 24 on ball 18 is absolutely negligible with respect to the loads exerted
10 on opposite sides of ball 18 by the in-service pressures in compression chamber 9 and drain conduit 29.

According to the invention, compression spring 24 has a second end 31 which acts directly on ball 18, so that the movable part of the valve is defined solely by
15 ball 18; and cap 21 has a second shoulder 32 on which end 28 of spring 24 rests.

Cap 21 also has a pin 33 coaxial with hole 17 and therefore with delivery conduit 11. Pin 33 provides for guiding or transversely securing spring 24, and is of
20 such a length as to limit the travel of ball 18 to a predetermined value when delivery valve 16 opens.

End 31 of spring 24 has at least one small-diameter turn 34 by which spring 24 engages ball 18 to prevent the ball from moving transversely. More specifically, spring
25 24 is truncated-cone-shaped, with the smallest-diameter turn being turn 34 resting on ball 18, and the largest-diameter turn 36 resting on shoulder 32.

Cap 21 comprises a cylindrical surface 37 adjacent

to threaded portion 22 and facing shoulder 26, and which engages in fluidtight manner a corresponding cylindrical surface 38 of hole 17. Cap 21 also comprises a truncated-cone-shaped surface 39 located between cylindrical surface 37 and shoulder 26 to assist shoulder 26 in engaging shoulder 27 of hole 17.

Finally, hole 17 comprises a cylindrical portion 41 extending between shoulder 27 and an end wall 42 at which seat 19 terminates. Ample clearance exists between cylindrical portion 41 and the lateral surface of a cylindrical portion 43 of cap 21 extending between the two shoulders 26 and 32. Drain conduit 29 terminates at cylindrical portion 41 of hole 17.

When the fuel pressure in compression chamber 9 (and therefore in delivery conduit 11) is greater than the pressure in drain conduit 29, ball 18 moves towards pin 33 to open valve 16 so that fuel flows along drain conduit 29. When the fuel pressure in compression chamber 9 is once more lower than the pressure in drain conduit 29, spring 24 pushes ball 18 rapidly back into seat 19 to close delivery valve 16.

The advantages, as compared with known valves, of delivery valve 16 according to the invention will be clear from the foregoing description. Being defined solely by ball 18, the movable part of valve 16 is extremely lightweight, involves very little inertia, and ensures extremely rapid opening and closing of valve 16. Moreover, any oscillation in pressure within pump body 6

is eliminated, and the valve itself is much cheaper to produce by eliminating the usual cap interposed between ball 18 and spring 24.

Clearly, changes may be made to the delivery valve
5 as described herein without, however, departing from the scope of the accompanying Claims. For example, the shutter may be a plate type cooperating with a flat, as opposed to truncated-cone-shaped, seat.

Also, spring 24 may be cylindrical with a small-
10 diameter end turn 34; pin 33 may also have a curved end surface for arresting ball 18 and keeping it aligned with the axis of seat 19; and the fastening member of the delivery valve may be formed differently and fixed in any known manner inside a seat in body 6.

15 Finally, delivery valve 16 may be fitted to the delivery conduit of a pump having radial pistons 8 engaging respective cylinders 7 arranged radially in pump body 6, and defining respective compression chambers 9. In which case, hole 17 in body 6 may be located at a
20 common delivery conduit communicating in known manner with all the compression chambers 9 via intermediate conduits.

CLAIMS

1) A delivery valve of an internal combustion engine high-pressure fuel pump, comprising a shutter (18) normally pushed by a helical compression spring (24) to close a delivery conduit (11) of the pump (5) communicating with a compression chamber (9); said spring (24) having a first end (28) resting against a surface (26) of a fastening member (21) fitted in fluidtight manner to the pump (5); characterized in that a second end (31) of said spring (24) acts directly on said shutter (18); said fastening member (21) having a pin (33) coaxial with said conduit (11) and for securing said spring (24); and said pin (33) being of such a length as to limit the travel of said shutter (18) to a predetermined value.

2) A valve as claimed in Claim 1, wherein said shutter is defined by a ball (18) engaging a truncated-cone-shaped seat (19) in which said conduit (11) terminates; characterized in that said second end (31) of said spring (24) comprises at least one small-diameter turn (34) by which to engage said ball (18).

3) A valve as claimed in Claim 2, wherein said fastening member (21) comprises a threaded portion (22) which screws inside a threaded portion (23) of a hole (17) on the pump (5); said hole (17) being coaxial with said conduit (11); characterized in that said fastening member (21) has a first shoulder (26) contacting a

shoulder (27) of said hole (17) in fluidtight manner; and a second shoulder (32) on which rests said first end (28) of said spring (24).

4) A valve as claimed in Claim 3, characterized in
5 that said fastening member (21) has a cylindrical surface (37) adjacent to said first shoulder (26) of said fastening member (21); said cylindrical surface (37) engaging in fluidtight manner a corresponding cylindrical surface (38) of said hole (17).

10 5) A valve as claimed in Claim 4, characterized in that said fastening member (21) has a truncated-cone-shaped surface (39) located between said cylindrical surface (37) of said fastening member (21) and said first shoulder (26) of said fastening member (21).

15 6) A valve as claimed in one of the foregoing Claims, characterized in that said spring (24) is truncated-cone-shaped; said turn (34) being the smallest-diameter turn.

7) A valve as claimed in one of the foregoing
20 Claims, for a pump having radial pistons (8) engaging respective cylinders (7) in which the pistons define respective compression chambers (9); characterized in that said delivery conduit communicates with said compression chambers (9) via intermediate conduits.

1 / 1

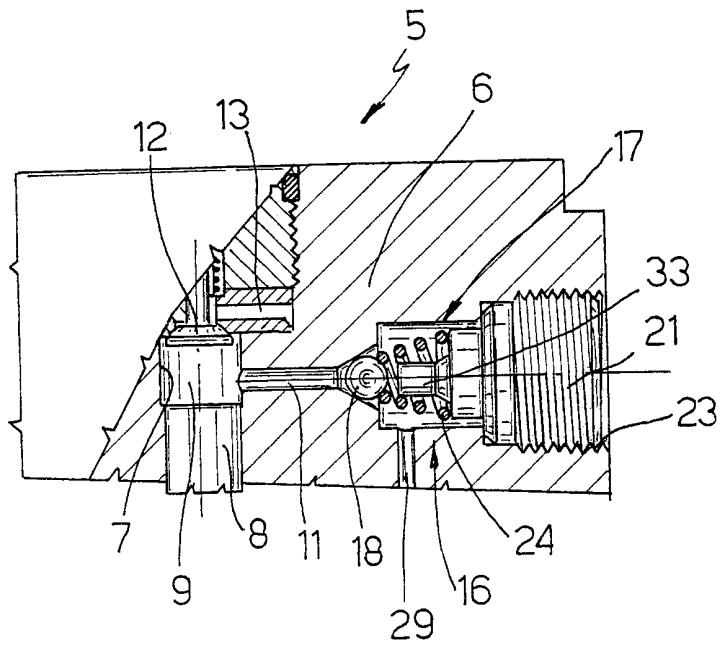


Fig.1

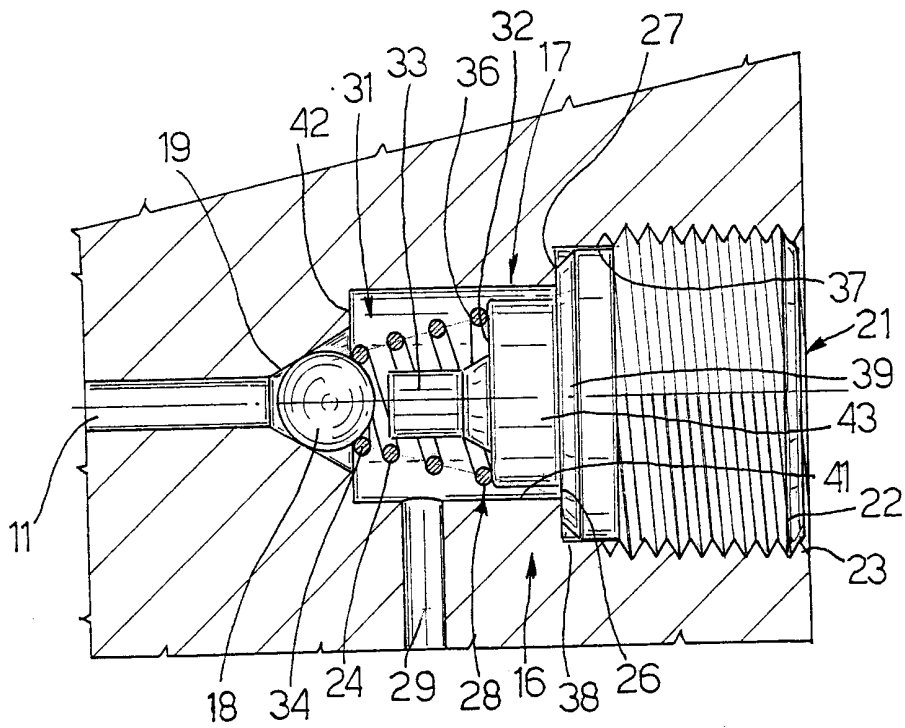


Fig.2