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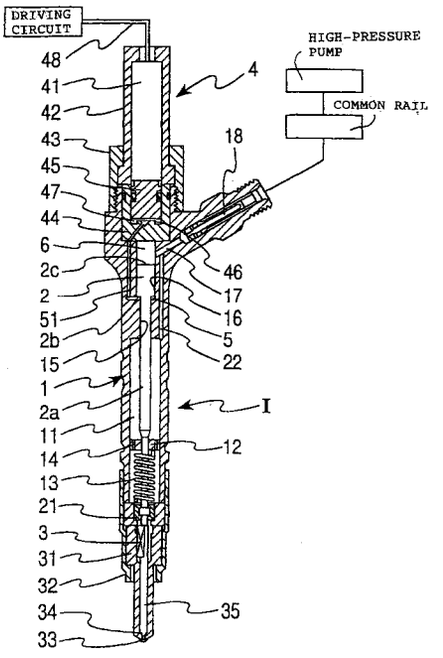
# (54) Fuel injection device

(57) A fuel injection device for internal combustion engines includes a needle valve (3) for opening and closing an injection port (33), a control chamber (5) for applying a fuel pressure to the needle valve (3) in a needle valve opening direction, a spring (13) for applying a biasing force to the needle valve (3) in a needle valve closing direction, a piezoelectric actuator (4) for increasing and decreasing a fuel pressure in the control chamber(5), a piston (2) which slides with the needle valve (3) so as to receive the fuel pressure in the control chamber (5) at a lower end face (2b) thereof, and a pressure storage chamber (11) for storing a fuel to be supplied to the injection port (33). The fuel injection device further includes another control chamber (6) which communicates with a fuel supply line (17) for applying a fuel pressure to an upper end face (2c) of the piston (2) in a needle valve closing direction. The another control chamber (6) communicates with the pressure storage chamber (11) via communication means (22).

FIG. 1

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# EUROPEAN SEARCH REPORT

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EP 01 11 5087

## 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) |
|---|---|---|---|
| E | DE 102 22 411 A (DENSO CORP)<br>28 November 2002 (2002-11-28)<br>* paragraph [0018] - paragraph [0026]; figure 1 * | 1,2,4,5 | F02M47/02<br>F02M47/04<br>F02M47/06 |
| D,A | PATENT ABSTRACTS OF JAPAN<br>vol. 1999, no. 12,<br>29 October 1999 (1999-10-29)<br>& JP 11 200981 A (NIPPON SOKEN INC),<br>27 July 1999 (1999-07-27)<br>* abstract; figure 1 * | 1 | |
| A | DE 198 43 535 A (BOSCH GMBH ROBERT)<br>30 March 2000 (2000-03-30)<br>* column 4, line 52 - column 5, line 60; figures 2,3 * | 1 | |
| A | EP 0 864 743 A (BOSCH GMBH ROBERT)<br>16 September 1998 (1998-09-16)<br>* column 3, line 9 - column 7, line 9; figure 3 * | 1 | |
| A | FR 2 214 823 A (CAV LTD)<br>19 August 1974 (1974-08-19)<br>* page 2, line 8 - line 23; figure * | 1 | TECHNICAL FIELDS SEARCHED (Int.Cl.7)<br>F02M |

The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| MUNICH | 16 October 2003 | Godrie, P |

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16-10-2003

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---|---|---|
| DE 10222411 A | 28-11-2002 | JP 2002349383 A | 04-12-2002 |
| | | DE 10222411 A1 | 28-11-2002 |
| JP 11200981 A | 27-07-1999 | NONE | |
| DE 19843535 A | 30-03-2000 | DE 19843535 A1 | 30-03-2000 |
| | | WO 0017509 A1 | 30-03-2000 |
| | | EP 1115971 A1 | 18-07-2001 |
| | | JP 2002525486 T | 13-08-2002 |
| | | US 6561436 B1 | 13-05-2003 |
| EP 0864743 A | 16-09-1998 | DE 19709795 A1 | 17-09-1998 |
| | | DE 59710265 D1 | 17-07-2003 |
| | | EP 0864743 A2 | 16-09-1998 |
| | | JP 10252598 A | 22-09-1998 |
| FR 2214823 A | 19-08-1974 | DE 2401874 A1 | 25-07-1974 |
| | | FR 2214823 A1 | 19-08-1974 |
| | | IT 1002715 B | 20-05-1976 |
| | | JP 49103018 A | 28-09-1974 |

EPO FORM P0459

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