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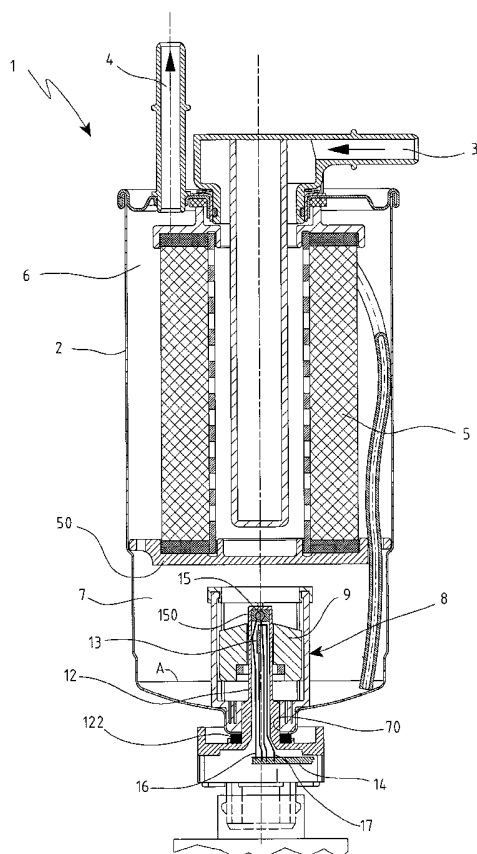
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- (71) Applicant (for all designated States except US): **UFI FIL-  
TERS S.P.A.** [IT/IT]; 26, Via Europa, I-46047 Porto Man-  
tovano (IT).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): **GIRONDI, Giorgio**  
[IT/IT]; 14, Vicolo Carbone, I-46100 Mantova (IT).
- (74) Agents: **CORRADINI, Corrado** et al.; 4, Via Dante  
Alighieri, I-42100 Reggio Emilia (IT).
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[Continued on next page]

(54) Title: FUEL FILTER FOR DIESEL ENGINES WITH HIGH PRESSURE DIRECT INJECTION OF COMMON RAIL TYPE AND THE LIKE



(57) Abstract: Fuel filter for diesel engines with high pressure direct injection of common rail type and the like, comprising an outer casing provided with a fuel inlet conduit (3) and an outlet conduit (4), and containing in its interior a filter means(5), a temperature sensor(15) being positioned in proximity to the bottom of said casing to measure the temperature of the fuel present in the casing.

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**Declarations under Rule 4.17:**

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, 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, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE,

DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations

**Published:**

— with international search report  
— with amended claims

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.

FUEL FILTER FOR DIESEL ENGINES WITH HIGH PRESSURE DIRECT  
INJECTION OF COMMON RAIL TYPE AND THE LIKE

This invention relates to a filter for vehicle fuel, in particular for diesel  
5 engines of common rail or high pressure direct injection type, and the like.  
In these types of engine the fuel feed rate to the engine feed pump is  
much greater than that required by the engine for its operation, as the fuel  
is used not only as engine feed fluid but also as the lubrication fluid and  
cooling fluid for the feed pump. That fuel not fed to the cylinders  
10 increases in temperature as it removes heat from the pump and is then  
returned to the vehicle fuel tank.

It has been found that because of the high temperature at which the feed  
pump operates, after a certain time of engine operation the fuel contained  
in the vehicle tank or in the engine feed circuit attains a high temperature,  
15 of the order of 100°C and beyond.

A requirement has therefore arisen to control the fuel temperature as too  
high a fuel temperature could damage components of the engine feed  
circuit. Moreover in these types of engine the fuel temperature has  
become an essential parameter in regulating the fuel feed rate to the  
20 engine. Measuring the fuel temperature has hence become necessary for  
correct engine operation. The value of the measured temperature is fed  
to the electronic control unit which controls fuel feed to the pump and  
hence to the cylinders.

The known art has solved this need to control the fuel temperature by  
25 temperature measurement devices positioned either inside the fuel tank or  
along the conduits through which the fuel is fed to the engine.

In both cases the devices used require suitable fixing flanges and electric cables for connecting the device to the vehicle electronic control unit. Moreover it is often difficult to install said temperature measurement devices as that engine region in which the conduits are present is

5 crowded with numerous components.

The object of the present invention is to overcome the drawbacks of the known art within the context of a simple and rational solution of low cost. The invention attains said object by virtue of the characteristics defined in the claims.

10 Specifically, the invention provides a temperature measurement device which is associated with the lower part of the fuel filter installed on the vehicle.

According to a preferred embodiment of the invention, said temperature measurement device is associated with the means for sensing the

15 presence of water accumulated in the bottom of the fuel filter.

In this respect it is known that the water present in the fuel tends to create oxidation damage to the metal parts with which it comes into contact, hence the latest generation of filters, in particular for diesel engine fuel, separate not only the impurities but also the water present in the fuel.

20 As water has a specific gravity greater than the fuel, it collects on the bottom of a collection chamber positioned in the lower part of the filter. This water must be bled off on reaching a maximum level, to avoid it interfering with correct filter operation, or it may be returned to the fuel flow leaving the filter.

The water is bled off by suitable means which are activated when a suitable sensor senses that the water in said collection chamber has reached its maximum level.

Said means for sensing the water level comprise a float positioned within  
5 the collection chamber and having a specific gravity between the specific gravity of water and the specific gravity of the fuel. The float is mounted on a guide stem, in the interior of which a magnetic field sensor is positioned connected electrically to an electronic card by two conductors. According to the invention, said stem also internally houses the  
10 temperature sensor which measures the fuel temperature. Specifically, said temperature sensor is housed in proximity to the free end of the stem, which projects into the water collection chamber. To facilitate heat conduction the sensor is embedded in a conductive resin which is poured into the stem.

15 The invention is described in detail hereinafter with the aid of the accompanying figures, which illustrate a non-exclusive embodiment thereof by way of example.

Figure 1 is a schematic illustration of the filter according to the invention;

Figure 2 is an enlarged view of the lower portion of Figure 1;

20 Figure 3 is an enlarged view of the lower portion of the filter, on which a variant of the invention is installed.

Figure 1 shows a filter 1, substantially of known type, comprising an outer casing 2 having a fuel inlet 3 and outlet 4. Said casing 2 houses internally a filter means 5 positioned within an upper chamber 6. The fuel enters the  
25 chamber 6 through the inlet 3 and after passing through the filter means 5 leaves through the outlet 4.

Below the chamber 6 and communicating therewith there is positioned a chamber 7 separated from the former by a perforated base 50, which also acts as a support element for the filter means 5.

The chamber 7 serves to collect the water which separates from the fuel and is therefore filled with fuel in its upper part, the separated water  
5 accumulating in the lower part.

On the base of the chamber 7 there is positioned a water level sensor 8 comprising a float 9, the specific gravity of which lies between the specific gravity of water and that of the fuel, and which is positioned in the  
10 collection chamber 7 under the influence of the level of the water A which collects on the bottom. The float 9 is slidable along a vertical guide stem 12, which projects into the chamber 7 by passing through a lower port 70 located at the lowest point of the chamber and closed by the stem 12 in collaboration with a seal gasket 122.

15 In the interior of the stem 12 there is positioned a magnetic field sensor element 13, for example of reed or Hall type, which is activated when the float, in moving upwards as the level of the accumulated water increases, reaches a position in correspondence with the element 13.

The sensor element 13 is electrically connected to an electronic card 14  
20 by two connection cables 130 and 131. Said card is connected to the engine control unit. When, by the effect of the water collected in the chamber 6, the float 10 reaches the level of the sensor 13, an electrical signal is generated and by way of the two conductor cables 130 and 131 is sensed by the electronic card 14, which makes it available to the engine  
25 electronic control unit, to warn the user by a warning lamp positioned on the vehicle dashboard or by a different warning signal.

When the water maximum level signal is generated, the control card 14 activates withdrawal means for the water collected in the chamber 7. Said water withdrawal means are associated with the lower end of the filter 1, but are not illustrated or described in detail as they are of known type.

- 5 In the interior of the stem 12, in proximity to its free end, there is also present a temperature sensor 15 embedded in a layer of conductive resin 150, to measure the temperature of the fuel present in the chamber 7, this being equal to or at least indicative of the temperature of the fuel passing through the filter 1.
- 10 The sensor 15, for example of NTC type, is connected to the electronic card by two conductors 16 and 17. The temperature value measured by the sensor 15 is fed to the engine electronic control unit via the card 14. Figure 3 shows a variant of the invention in which one of the conductor
- 15 cables connecting the sensor to the card 14 is also used as the conductor cable connecting the sensor 15 to the card itself. Hence in this case there is simplification of the electrical circuit connecting the sensors to the card as the cable 20 is used as a common conductor.

## CLAIMS

1. A fuel filter for diesel engines with high pressure direct injection of common rail type and the like, comprising an outer casing provided with a fuel inlet conduit (3) and an outlet conduit (4), and internally housing a filter means, characterised in that a temperature sensor (15) is positioned in the lower part of said casing to measure the temperature of the fuel present in the casing.
2. A filter as claimed in claim 1, characterised in that said casing presents an upper chamber (6) for containing said filter means, and a lower chamber (7) communicating with said upper chamber to collect the water which said filter means (5) separates from the fuel, means (8) for measuring the level of the water collected in the chamber (7) being associated with said lower chamber.
3. A filter as claimed in claim 2 characterised in that said temperature sensor is associated with said means for measuring the water in the chamber (7).
4. A filter as claimed in claim 2 characterised in that said water level measurement means comprise a sensor positioned in the collection chamber to generate an electrical signal when the water level reaches a predetermined maximum value, said signal being fed to an electronic card.
5. A filter as claimed in claim 4 characterised in that said sensor means comprises a float positioned in the collection chamber and having a specific gravity between the specific gravity of water and that of the fuel, and a float guide stem in the interior of which there is positioned a magnetic field sensor connected electrically to said electronic card by two conductors.



6 A filter as claimed in claim 5 characterised in that said temperature sensor is positioned in the interior of said stem in proximity to its free end, and is connected electrically to said card by two conductors.

7 A filter as claimed in claim 6 characterised in that one of the  
5 conductors connecting said temperature sensor to said card is also connected to said magnetic field sensor.

8 A filter as claimed in claim 1, characterised in that said temperature sensor is of NTC type.

9 A filter as claimed in claim 1, characterised in that said temperature  
10 sensor is embedded in a layer of conductive resin.

**AMENDED CLAIMS**

[received by the International Bureau on 21 April 2004 (21.04.04);  
original claims 1-5 replaced by new claims 1-5; original  
claims 6-9 cancelled; (2 pages)]

1. A fuel filter for diesel engines with high pressure direct injection of common rail type and the like, comprising an outer casing provided with a fuel inlet conduit (3) and an outlet conduit (4), and internally housing a filter means, said casing comprising an upper chamber (6) for containing said filter means, a lower chamber (7) communicating with said upper chamber to collect the water which said filter means (5) separates from the fuel, and means (8) for measuring the level of the water collected in the lower chamber (7), characterised in that said means for measuring the water level in the chamber (7) comprise a temperature sensor for generating an electrical signal, said signal being fed to an electronic card by two conductors.
- 2 A filter as claimed in claim 1 characterised in that said level sensor means comprises a float positioned in the collection chamber and having a specific gravity between the specific gravity of water and that of the fuel, and a float guide stem in the interior of which there is positioned a magnetic field sensor connected electrically to said electronic card by two conductors, said temperature sensor means being positioned in the interior of said stem in proximity to its upper free end.
- 3 A filter as claimed in claim 2 characterised in that one of the conductors connecting said temperature sensor means to said card is also connected to said magnetic field sensor.

- 4 A filter as claimed in claim 1, characterised in that said temperature sensor is of NTC type.
- 5 A filter as claimed in claim 1, characterised in that said temperature sensor is embedded in a layer of conductive resin.

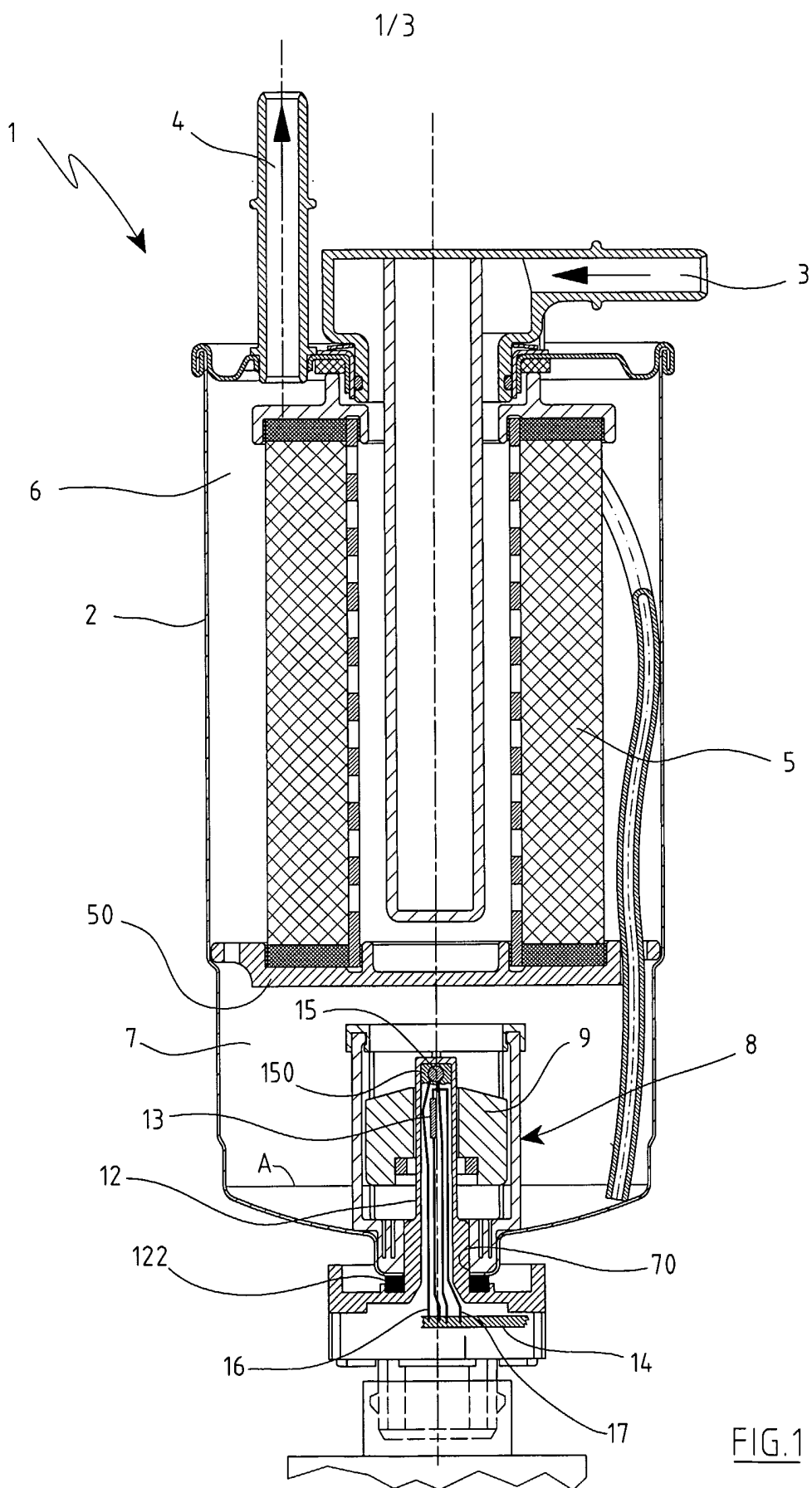


FIG. 1

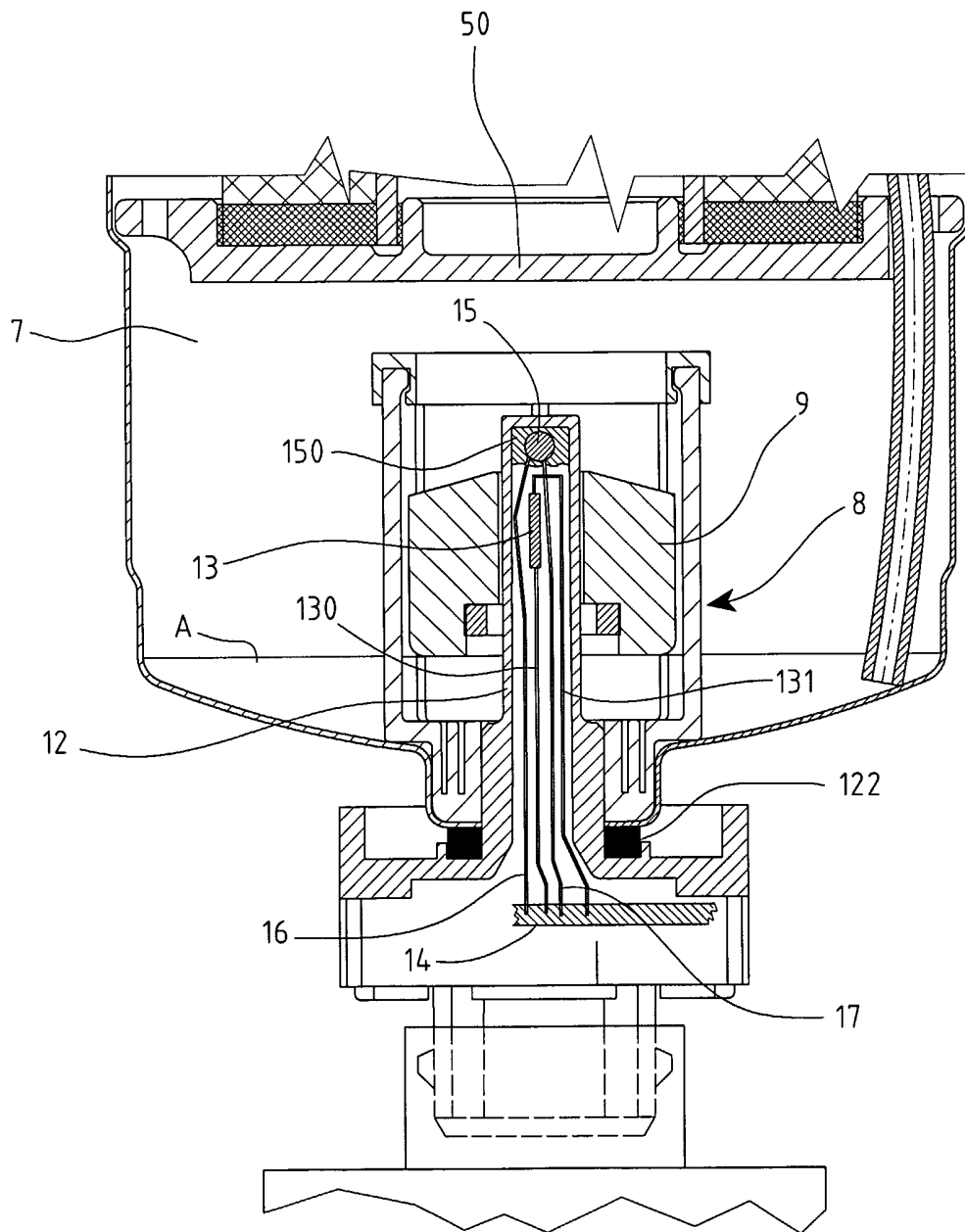


FIG. 2

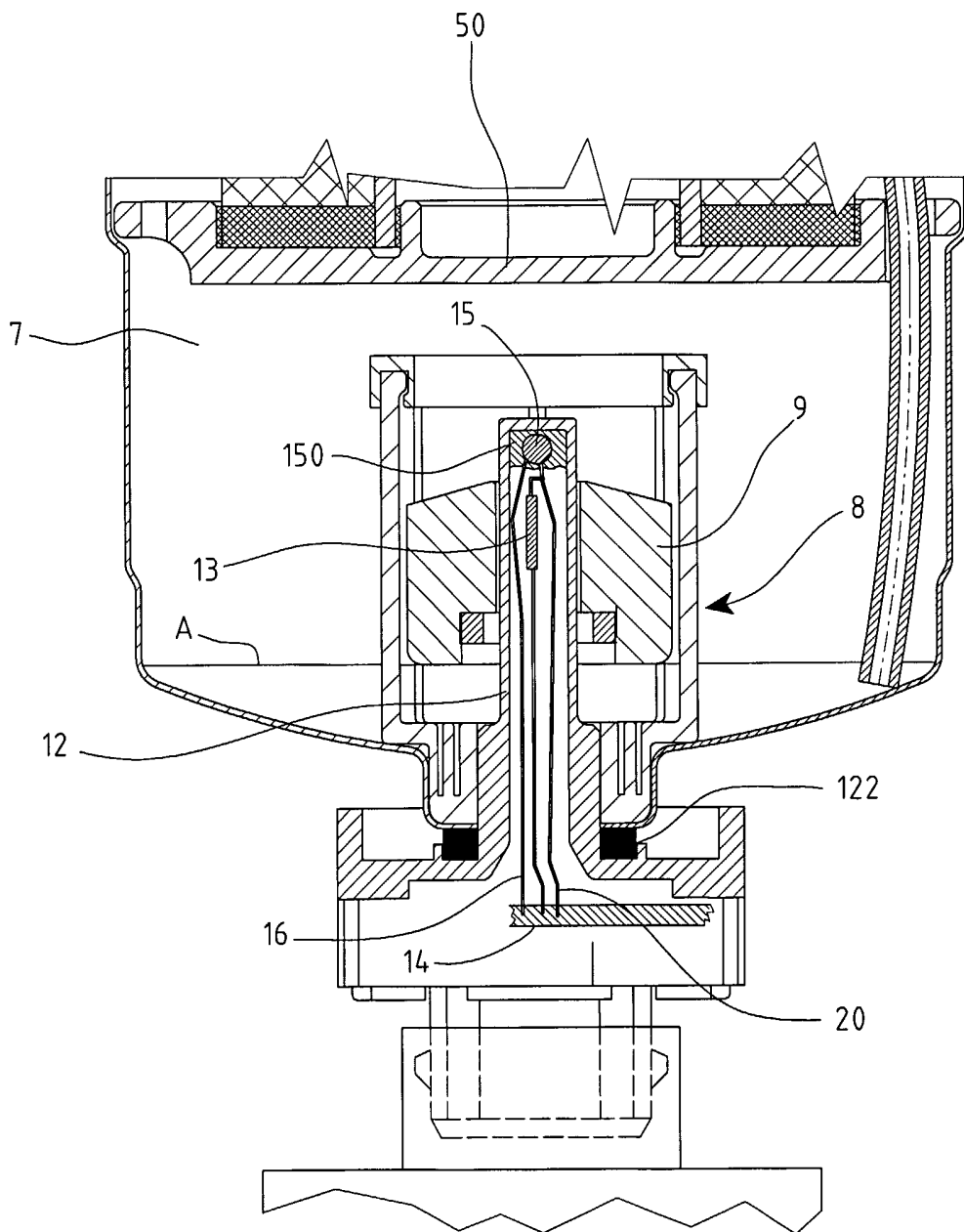


FIG. 3

# INTERNATIONAL SEARCH REPORT

International Application No

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**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 F02M37/22

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)  
 IPC 7 F02M

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 practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 580 542 A (KAWABATA) 8 April 1986 (1986-04-08) the whole document	1,2,4,5, 9
X	US 4 321 136 A (MATSUI ) 23 March 1982 (1982-03-23) the whole document	1-4
X	US 4 680 110 A (DAVIS ) 14 July 1987 (1987-07-14) column 4, line 24 -column 5, line 47; figures 3,4	1,2

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

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- \*E\* earlier document but published on or after the international filing date
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- \* & \* document member of the same patent family

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
 NL - 2280 HV Rijswijk  
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
 Fax: (+31-70) 340-3016

Authorized officer

Van Zoest, A

# INTERNATIONAL SEARCH REPORT

Information on patent family members

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