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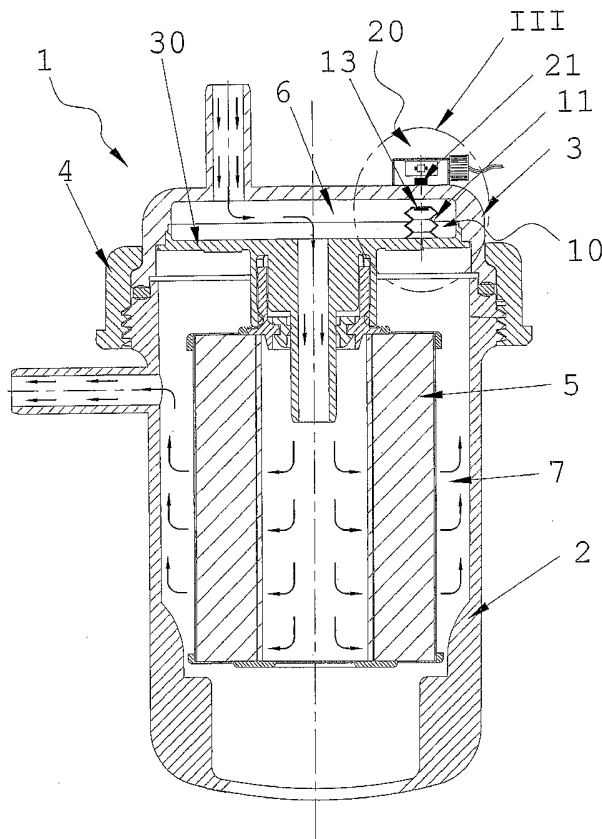
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(54) Title: DEVICE FOR INDICATING FUEL FILTER CLOGGING IN INTERNAL COMBUSTION ENGINES, PARTICULARLY DIESEL ENGINES



(57) Abstract: A device for indicating clogging of the fuel filter (1) of internal combustion engines, in particular diesel engines, the filter comprising an outer casing (2) closed by a cover (3) of amagnetic material, and a filter element (5) which, together with the disc (30) to which it is connected, defines two chambers (6 and 7) for fuel entry and exit respectively; said device comprises a pressure sensor means (10) sensing the difference between the entry and exit fuel pressure and housed inside the filter casing, and a means (20) for generating a signal proportional to said pressure difference which is located outside the filter casing and is not mechanically connected to the pressure sensor means.

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NA, 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, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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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.

DESCRIPTION

DEVICE FOR INDICATING FUEL FILTER CLOGGING IN INTERNAL
COMBUSTION ENGINES, PARTICULARLY DIESEL ENGINES

5 TECHNICAL FIELD

The present invention relates generally to a fuel filter for use in internal combustion engines, and more particularly in diesel engines.

PRIOR ART

10 Diesel fuel normally contains impurities, or more or less solid substances (especially paraffins) which separate at relatively low temperature.

For this reason the engine feed system must be provided with a suitable filter able to clean the fuel.

Modern diesel fuel filters generally consist of a cup-shaped outer casing
15 and a closure cover. Said casing contains a coaxial filter cartridge of toroidal form which, when fixed to a connection disc, separates the internal volume of the cup into an entry chamber and an exit chamber for the fuel.

In retaining said impurities, said cartridge progressively clogs and has
20 therefore to be periodically replaced.

However, said clogging does not always take place gradually, hence the clogging time is not constant and cannot be taken as a parameter for the regular replacement of the cartridge.

To determine the replacement interval such as to prevent the appearance
25 of dangerous external particulate inclusions in the fuel, automatic diagnostic devices are known.

Based on the observation that the fuel pressure difference between the filter inlet and outlet is a quantity related, to a sufficiently reliable and significant extent, to the degree of clogging of the filter, said devices activate indicator means when a limiting value of said pressure difference
5 is exceeded.

Said devices generally comprise a cylindrical chamber and a piston slidable in its interior to divide it into two half-chambers, of which one communicates with the fuel inlet and the other with the fuel outlet. Said chamber, which can be provided directly within the filter casing or within a
10 separate container, also houses a spring means acting on the piston against the action of the pressure difference, and an electromechanical or electromagnetic switch providing a signal as the result of a movement of said piston against the action of the spring.

The described device is mounted in suitable seats provided in the filter casing and fixed thereto by known means by way of suitable seal gaskets.
15 However this configuration presents certain drawbacks: firstly, problems in sealing the filter against the external environment inevitably arise at the fixing between the seat and the device; in addition, the provision of said seats considerably complicates construction, while the presence of the
20 gaskets makes it more difficult to mount and replace the device. Finally, these factors also produce a cost increase that cannot be ignored.

DISCLOSURE OF THE INVENTION

The object of the present invention is to overcome the stated drawbacks
25 within the context of a simple, rational and low-cost solution.

The invention attains said object by virtue of the characteristics indicated

in the claims.

In particular, the invention provides a device for indicating clogging of the fuel filter of internal combustion engines, comprising a pressure sensor means sensing the difference between the entry and exit fuel pressure and housed within the filter casing, and a means for generating a signal proportional to said pressure difference which is located outside the filter casing and is not mechanically connected to the pressure sensor means. By virtue of this solution, a device according to the invention does not induce sealing problems, is of simple installation and replacement, and is of low cost.

According to the preferred embodiment, the pressure sensor means comprises an elastically deformable element, for example a membrane or a bellows, mounted within the fuel entry chamber. When associated with the filter cartridge connection disc, said elastically deformable element defines a volume which communicates with the fuel exit chamber via a hole passing through the body of the disc. A magnet, associated with said elastically deformable element, is positioned such as to be able to move as a result of deformation of the sensor means.

Externally, the signal generating means is fixed, by a screw fixing, by insertion or by gluing, to the filter cover in a position corresponding with the underlying pressure sensor means.

According to the invention, said signal generating means comprises a Hall sensor, which emits a voltage signal proportional to the proximity of the magnet, and hence to the pressure difference, and a processor able to process it.

By this solution, the invention handles an analogue signal, hence allowing continuous monitoring of the state of the filter, and does not merely indicate when clogging has taken place, as in the case of known devices. Moreover, when necessary, the acceptable limiting value of the pressure difference can be easily and quickly adjusted by acting merely on the electronic parameters of the device.

BRIEF DESCRIPTION OF THE DRAWINGS

The characteristics and the constructional merits of the invention will be more apparent from the ensuing description given with reference to the figures of the accompanying drawings which illustrate a particular preferred embodiment by way of non-limiting example.

Figure 1 is a side section through a filter of the invention;

Figure 2 shows on an enlarged scale the detail III of Figure 1, in the configuration with a new filter cartridge

Figure 3 shows the same detail as Figure 2, but in the configuration with the cartridge clogged.

BEST MODE FOR CARRYING OUT THE INVENTION

Said figures, and in particular Figure 1, show a diesel fuel filter for installation on a diesel engine.

Said filter, indicated by the reference numeral 1, comprises a cup-shaped outer casing 2, and an upper cover 3 of amagnetic material sealedly fixed to the casing by a ring nut 4.

Inside the casing 2 a disc 30 supports a filter cartridge 5 which divides the inner volume of the filter into two chambers, one 6 for the diesel fuel to be

filtered, and the other 7 for the filtered diesel fuel, they being associated with an inlet conduit and an outlet conduit respectively.

In the chamber 6 (see Figures 2 and 3) there is inserted a pressure sensor means 10, composed of an extendable membrane 11, a hole 12
5 which connects the volume on the inside of the membrane to the filtered diesel oil chamber 7, and a magnet 13 mounted on said membrane 11.

The pressure sensor 10 is configured such that elongation or contraction of the membrane 11, and with it an axial movement of the magnet 13, takes place in response to variation in the pressure difference between
10 the filtered diesel oil chamber 7 and the chamber 6 for the diesel oil to be filtered.

On the cover 3, in proximity to the sensor means 10, a signal generating means 20 is mounted, comprising a Hall sensor 21, a processor 22 and an output cable 23.

15 During normal operation of the diesel oil filter 1, with the cartridge 5 unclogged (see Figure 2), the pressure in the chamber 6 upstream of the filter is virtually equal to the pressure in the downstream chamber 7.

In this state the membrane 11 is at its maximum elongation allowed by its shape, and the magnet 13 at the minimum distance from the Hall sensor
20 21 which hence indicates high magnetic field intensity. Said intensity, converted by the sensor 21 into a proportional voltage signal, is recognized by the processor 22 as indicative of a clean filter.

When the cartridge 5 begins to clog, the pressure in the chamber 6 containing diesel oil to be filtered increases relative to the pressure in the
25 filtered diesel oil chamber 7. The pressure difference, opposed only by the rigidity of the membrane 11, causes it to lower with corresponding

withdrawal of the magnet 13 from the Hall sensor 21.

As the distance varies, the intensity of the sensed magnetic field varies, as does the intensity of the voltage signal emitted by the Hall sensor.

An analogue quantity is therefore available which the processor is able to
5 evaluate at each moment in the life of the filter, and when this falls below a value corresponding to excessive clogging of the cartridge 1 it indicates the need for its replacement.

CLAIMS

1. A device for indicating clogging of the fuel filter of internal combustion engines, in particular diesel engines, the filter comprising an outer casing closed by a cover of amagnetic material, and a filter element
5 which, together with the disc to which it is connected, defines two chambers for fuel entry and exit respectively, characterised by comprising a pressure sensor means sensing the difference between the entry and exit fuel pressure and housed inside the filter casing, and a means for generating a signal proportional to said pressure difference which is not
10 mechanically connected to the pressure sensor means and is located outside the filter casing.
2. An indicator device as claimed in claim 1, characterised in that the pressure sensor means comprises:

an elastically deformable element which defines a variable volume inside
15 the fuel entry or exit chamber; a conduit which connects said volume to the other chamber; and a magnet which, associated with the flexible element, moves to follow its elongation or contraction.
3. An indicator device as claimed in claim 2, characterised in that said pressure sensor means is housed in the fuel entry chamber.
- 20 4. An indicator device as claimed in claim 2, characterised in that said elastically deformable element is fixed, by known means, to the filter cartridge connection disc.
5. An indicator device as claimed in claim 2, characterised in that said flexible element is a bellows.

6. An indicator device as claimed in claim 2, characterised in that said flexible element is a membrane.
7. An indicator device as claimed in claim 2, characterised in that said conduit is a through hole passing through the thickness of the filter cartridge connection disc, in correspondence with the flexible element.
8. An indicator device as claimed in claim 2, characterised in that said signal generating means comprise:
a Hall sensor sensitive to the magnetic field of the magnet of the pressure sensor means, and a processor for processing the voltage signal generated by the Hall sensor.
9. An indicator device as claimed in claim 7; characterised in that the signal generating means is positioned on the filter cover.

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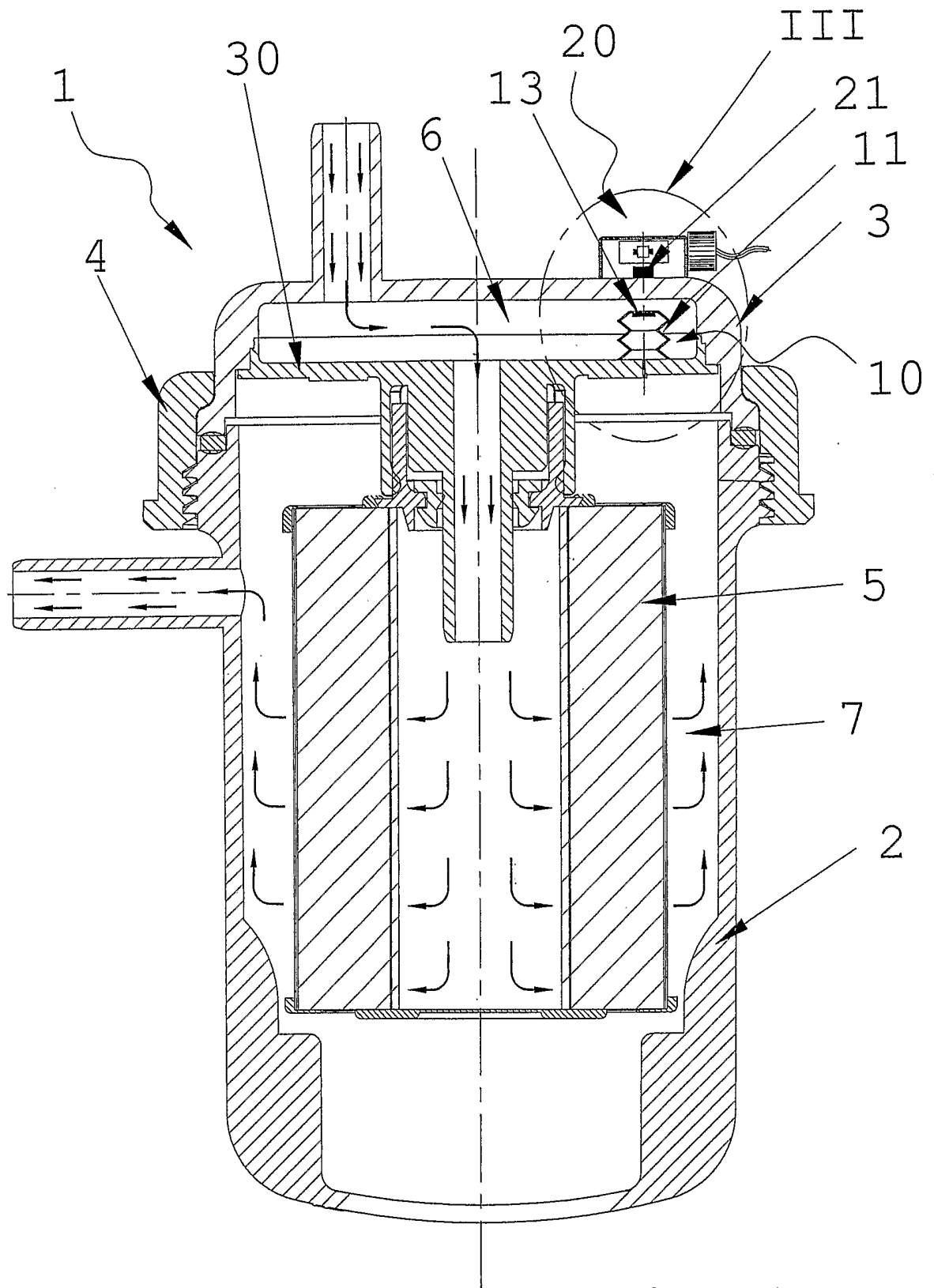


Fig. 1

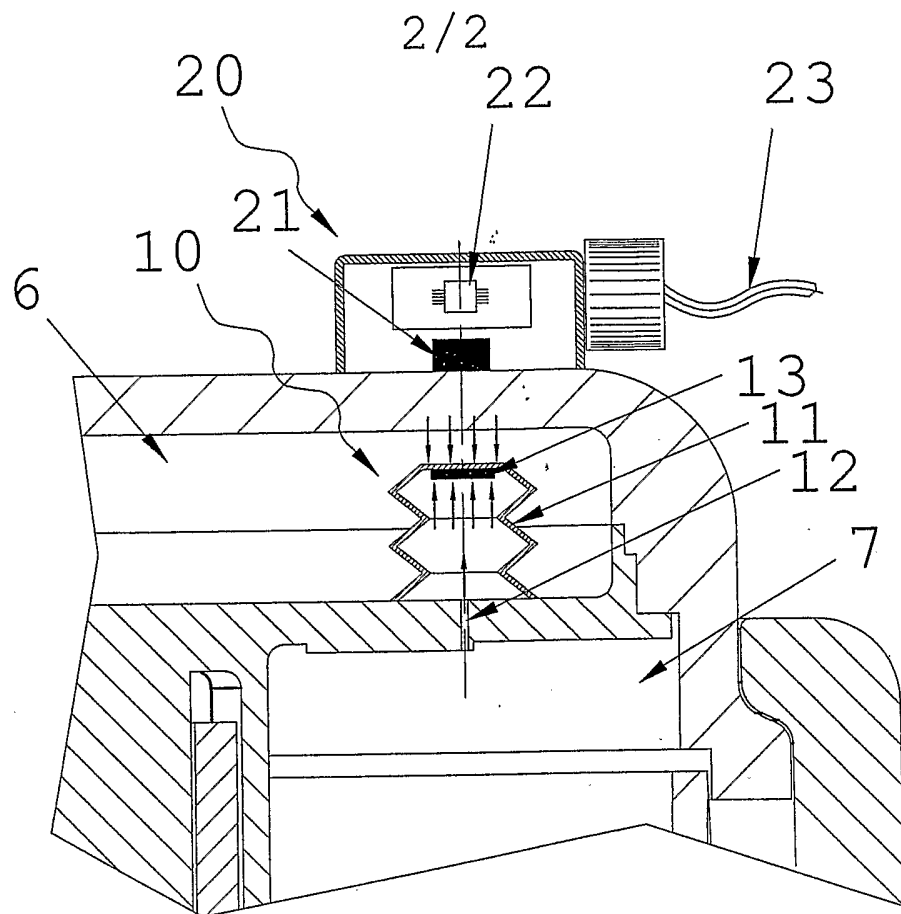


Fig. 2

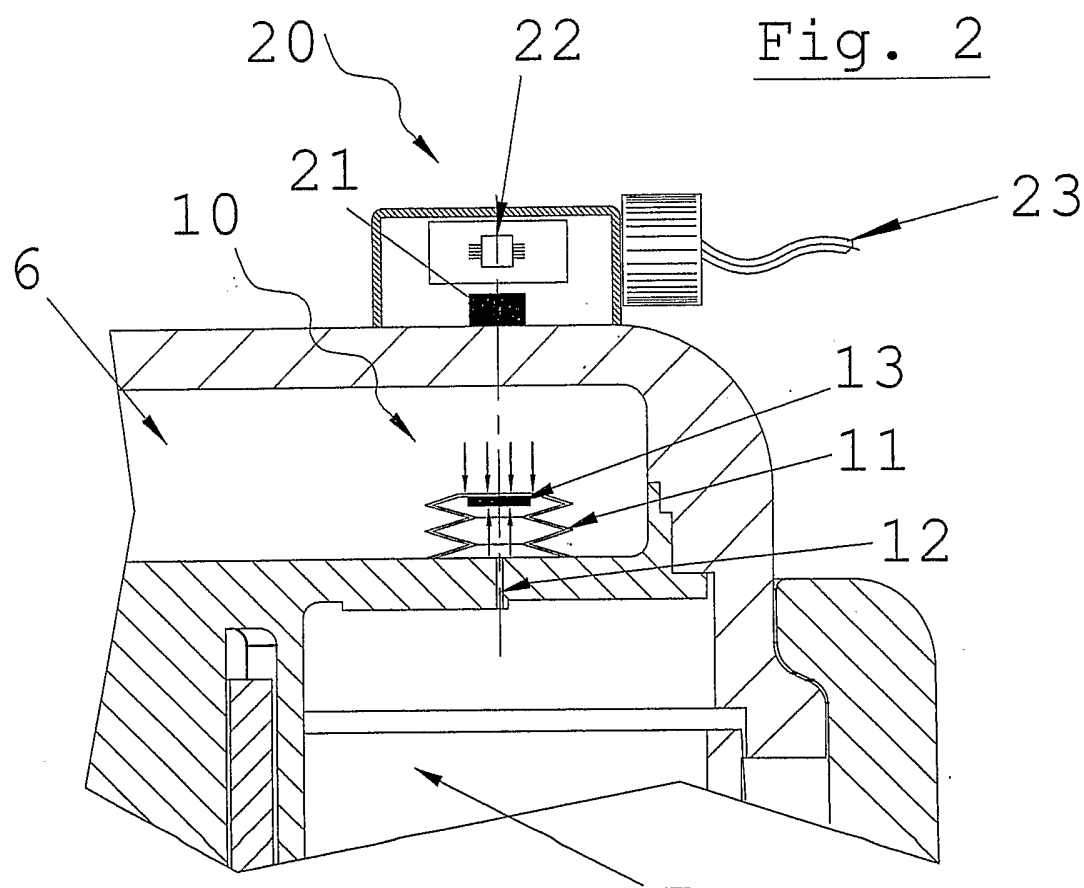


Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No
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A. CLASSIFICATION OF SUBJECT MATTER IPC 7 F02M37/22 B01D35/143				
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 B01D				
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, PAJ				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	GB 1 057 855 A (CENTRE DE RECHERCHES HYDRAULIQUES ET ELECTRIQUES) 8 February 1967 (1967-02-08)	1-4, 7, 9		
Y	the whole document	5, 6, 8		
Y	US 5 188 728 A (TRAONVOEZ ET AL) 23 February 1993 (1993-02-23) abstract column 8, line 62 - column 9, line 42; figure 9	5		
Y	DE 101 63 164 A1 (SIEMENS AG) 17 July 2003 (2003-07-17) the whole document	6, 8		
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<input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.				
<input checked="" type="checkbox"/> Patent family members are listed in annex.				
° Special categories of cited documents :				
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document 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 </td> <td style="width: 50%; border: none; vertical-align: top;"> "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 </td> </tr> </table>			"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document 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
"A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document 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 <p style="text-align: center; font-size: 1.2em;">16 June 2005</p>		Date of mailing of the international search report <p style="text-align: center; font-size: 1.2em;">23/06/2005</p>		
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 nt, Fax: (+31-70) 340-3016		Authorized officer <p style="text-align: center; font-size: 1.2em;">Van Zoest, A</p>		

INTERNATIONAL SEARCH REPORT

International Application No

PCT/EP2005/003249

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 702 592 A (SURI ET AL) 30 December 1997 (1997-12-30) abstract column 9, line 25 - column 11, line 6; figures 2,3 -----	1-4
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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