PUMP FOR VEHICLE SUSPENSION SYSTEM

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[Continued on next page]

(57) Abstract: A pump includes a housing defining an interior volume, and a diaphragm, where the diaphragm partitions the interior volume into a pumping chamber and an actuating chamber. The diaphragm is formed from a polymeric material, and the pump further includes a diaaphragm support configured to limit a stroke of the diaphragm. The diaaphragm support includes an array of apertures through which fluid passes to interface with the diaphragm during operation of the pump.

FIG. 1

Declared under Rule 4.17:
— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))
— as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Hi))

Published:
— with international search report (Art. 21(3))
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INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. F04B43/06  F04B43/073  F04B43/00

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)
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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>Y</td>
<td>paragraphs [0001] - [0020] ; claims 1,11; figure 1</td>
<td>7, 8</td>
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<td>columns 1, line 51 - column 2, line 56; claims 1,5,6; figure 1</td>
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<td>paragraphs [0161] - [0179] ; figures 2,3a, 3c, 4b, 4c</td>
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* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"B" 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

"A" document member of the same patent family

Date of the actual completion of the international search

7 February 2012

Date of mailing of the international search report

10/05/2012

Name and mailing address of the ISA/

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Authorized officer

Jurado Orenes, A
### INTERNATIONAL SEARCH REPORT

**Box No. II** Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.: because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 64(a).

**Box No. III** Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

"see additional sheet(s)"

**Remark on Protest**

- □ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

- □ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

- □ No protest accompanied the payment of additional search fees.

Form PCT/ISA/21 0 (continuation of first sheet (2)) (April 2005)
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8

A pump, comprising:
- a housing defining an interior volume;
- a diaphragm formed from a polymeric material, wherein the diaphragm partitions the interior volume into a pumping chamber and an actuating chamber;
- a diaphragm support configured to limit a stroke of the diaphragm, wherein the diaphragm support comprises an array of apertures through which fluid passes to interface with the diaphragm during operation of the pump.

2. claims: 9-16

A pump, comprising:
- a housing defining an interior volume;
- a diaphragm partitioning the interior volume into a pumping chamber and an actuating chamber;
- a diaphragm support located in the actuating chamber, and configured to limit movement of the diaphragm; and
- a dispersion element integrated with the diaphragm support and configured to laterally distribute hydraulic fluid within the pump.

3. claims: 17-20

A vehicle suspension system, comprising:
- a gas spring, wherein adding or removing gas from the gas spring changes the length of the gas spring;
- a gas storage container; and
- a diaphragm pump coupled to the gas spring and the gas storage container, wherein the pump is bi-directional such that the pump receives gas from the gas storage container and provides the gas to the gas spring to facilitate increasing a ride height of the vehicle suspension system when the pump is operating in a first direction, and wherein the pump receives gas from the gas spring and provides the gas to the gas storage container when the pump is operating in a second direction.
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