A hybrid robot containing integrated soft and rigid components includes at least one soft component, said soft component comprised of a first flexible material; at least one rigid component, said hard component comprised of a second rigid material; and an expandable chamber capable of actuation upon pressurization, wherein the hard component is integrally connected to the soft component by a functionally graded connector, wherein the functionally graded connector comprises a compositional gradient comprised of the first soft material and the second rigid material.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**IPC (8):** F16F 7/12 (2017.01)
**CPC:** F16F 7/12

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 (8):** F16F 7/12 (2017.01);
**CPC:** F16F 7/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

**IPC (8):** F15B 15/10, F16F 7/12 9/02 9/04 9/06 9/08, F16K 1/02 3/02 12/00, B25J 1/00 1/02 7/00 11/00 9/10 9/14 19/00 21/00, B32B 3/26 7/02 7/04, H05K 1/02 1/03, F03G 7/06, B62D 57/02 (2017.01); **CPC:** F15B 15/10, F16F 7/12 9/02 9/04 9/06 9/08, F16K 1/02 3/02 12/00

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Google Web, Google Patents; PatBase;
Search Terms Used: robot, hybrid, rigid, soft, expansion, chamber, hard, load, bearing, plate, nested, hemispheric, integrated, pressure, flexible, graded, gradient, connector, material, compositional, actuator, function, layer, stiff, gas, element, 3d, printed, Harvard

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>A jump for soft-bodied robots* (Wyss Institute) 9 July 2015 (09.07.2015) [online] retrieved from &lt;URL: <a href="https://wyss.harvard.edu/a-jump-for-soft-bodied-robots/%3E">https://wyss.harvard.edu/a-jump-for-soft-bodied-robots/&gt;</a> entire document, especially pg 1, paragraph 1-4, pg 2, paragraph 1; pg 3, paragraph 1; images on pages 2 and 4; demonstration 0:17-0:24, 0:39-0:47 and 1:20-1:30 of embedded video; snapshot 0:25 and 0:35 of embedded video</td>
<td>1-10, 13-16</td>
</tr>
<tr>
<td>A</td>
<td>WO 2013/148340 A2 (President And Fellows Of Harvard College) 3 October 2013 (03.10.2013), entire document</td>
<td>1-10, 13-16</td>
</tr>
<tr>
<td>A</td>
<td>us 2012/0216672 A1 (Menon et al.) 30 August 2012 (30.08.2012), entire document</td>
<td>1-10, 13-16</td>
</tr>
</tbody>
</table>

* Special categories of cited documents:
  *A* document defining the general state of the art which is not considered to be of particular relevance
  *E* 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
  *Z* document member of the same patent family

**Date of the actual completion of the international search**

15 February 2017

**Date of mailing of the international search report**

23 MAR 2017

**Name and mailing address of the ISA/US**

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
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**Authorized officer:** Lee W. Young

PCT Helpdesk: 571-272-4300
PCT GSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)
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.: 11-12 and 17-18
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

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

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 additional fees, 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.:

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.