



- (51) International Patent Classification:  
A61L 31/02 (2006.01) A61L 31/14 (2006.01)  
A61L 31/08 (2006.01)
- (21) International Application Number: PCT/IL2014/050466
- (22) International Filing Date: 23 May 2014 (23.05.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 61/826,505 23 May 2013 (23.05.2013) US
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: SHAPE CHANGE STRUCTURE

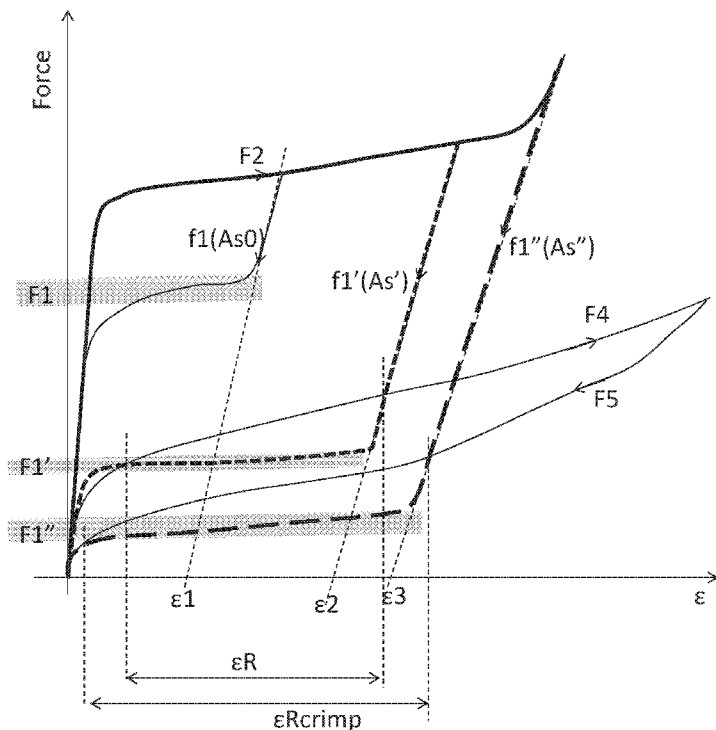


FIG. 6

(57) Abstract: An expandable structure comprising: a first shape memory (SM) portion which is in a strain-induced state; and a second portion which resists expansion of said structure due to said first portion, over a plurality of different expansion states of said first portion. Optionally, wherein said SM portion resists contraction of said structure due to forces applied by said second portion. Optionally or alternatively, said strain induced state is characterized by a SM portion expanding force decreasing as a function of strain of said SM portion, so as to have a difference of at least 10% in force between two strain states said structure is usable at.



**(84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Published:**

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

**(88) Date of publication of the international search report:**

19 March 2015

**Declarations under Rule 4.17:**

- *of inventorship (Rule 4.17(iv))*

INTERNATIONAL SEARCH REPORT

International application No  
PCT/IL2014/050466

A. CLASSIFICATION OF SUBJECT MATTER  
INV. A61L31/02 A61L31/08 A61L31/14  
ADD.  
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)  
A61L A61F

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, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/053946 A1 (STINSON JONATHAN S [US]) 28 February 2013 (2013-02-28) cited in the application claims -----	1-5
X	US 2003/036792 A1 (RICHTER JACOB [IL] ET AL) 20 February 2003 (2003-02-20) cited in the application claims; examples -----	1-38, 44-48, 53-57
X	US 5 964 770 A (FLOMENBLIT JOSEF [IL] ET AL) 12 October 1999 (1999-10-12)  column 1, line 5 - line 11 column 2, line 51 - column 3, line 7 column 4, line 61 - column 5, line 36 column 6, line 58 - line 67 column 10, line 13 - line 19 -----	1-38, 41-48, 53-57

Further documents are listed in the continuation of Box C.

See patent family annex.

\* 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
- "&" document member of the same patent family

Date of the actual completion of the international search

26 January 2015

Date of mailing of the international search report

03/02/2015

Name and mailing address of the ISA/

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# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IL2014/050466

## 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 6.4(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 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.:  
  
1-38, 41-43, 53-57(completely); 44-48(partially)
  
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.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-38, 53-57(completely); 44-48(partially)

An expandable structure comprising:  
a first shape memory (SM) portion which is in a strain-induced state; and  
a second portion which resists expansion of said structure due to said first portion, over a plurality of different expansion states of said first portion,  
wherein the structure is tubular and said SM portion and said second portion are tubular and wherein said SM portion defines an expanding force which decreases as a function of strain of said SM portion;  
wherein the expandable structure is stable in both a crimped state and a deployed state thereof, where a diameter of the structure in said deployed state is larger than a diameter of said structure in said crimped state; and  
wherein said structure is stable when a SM portion expanding force is less than a maximum resistive force of said second portion;  
and the associated method of manufacture.

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2. claims: 39, 40(completely); 44-48(partially)

An expandable axially oriented structure comprising:  
a plurality of circumferential segments;  
a plurality of connectors, each connector axially coupling two segments;  
wherein said connectors each comprise: two flexible struts, each flexible strut comprising vertex around which said strut bends axially to compress said connector;  
wherein said connectors are more axially compressible than said segments.

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3. claims: 41-43(completely); 44-48(partially)

A tubular expandable structure comprising:  
a plurality of rigid struts orientated axially along the structure and each having an initial length;  
a plurality of flexible members, made of nitinol;  
wherein each rigid strut is coupled to another two rigid struts;  
wherein coupling one rigid strut to another is by at least two flexibly bent members, such that rigid struts coupled by flexibly bent members form at least one circumferential segment of the tubular structure;  
wherein upon a radial expanding force said flexible members unbend to expand a diameter of each said circumferential segment;  
wherein upon a radial contracting force said flexible members bend to contract a diameter of each said

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

circumferential segment; and  
wherein said rigid struts substantially maintain said  
initial lengths thereof.

Remark: Claim 41, although not novel and thus having no  
special technical feature, is considered to define a  
different subject-matter than the invention 1 when grouped  
in part with claim 44, hence defining the third invention.

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4. claims: 49-52

A method of crimping an expandable structure

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No  
PCT/IL2014/050466

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