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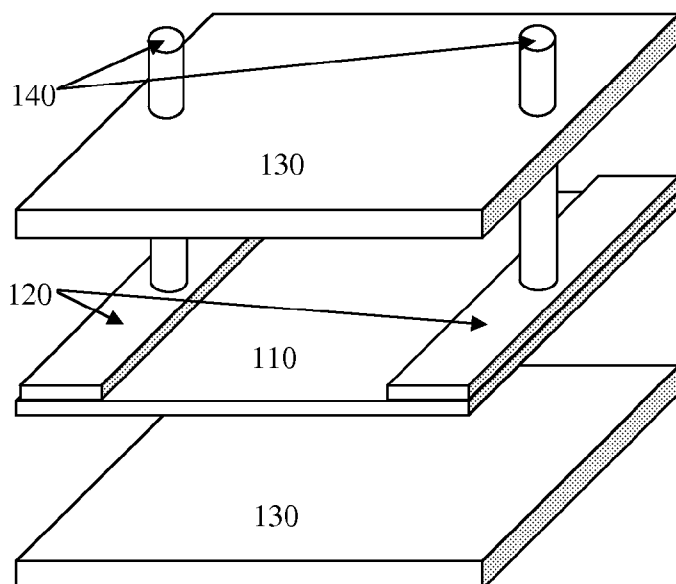
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[Continued on next page]

(54) Title: MULTIFUNCTIONAL ASSEMBLIES



100

Figure 1

(57) **Abstract:** A multifunctional assembly having a resistive element a conductive element in electrical communication with the resistive element, the conductive element defining at least one of a plurality of multifunctional zones of the resistive element, wherein the conductive element is configured to direct a flow of electricity across at least one of the plurality of multifunctional zones of the resistive element in a preselected manner.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/24262

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H05B 3/02, H01C 17/06, H05B 3/26, H05B 3/14 (2016.01)

CPC - H01L 51/5237, Y10T 29/49099, Y10T 29/49083, H05B 3/145

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): H05B 3/02, H01C 17/06, H05B 3/26, H05B 3/14 (2016.01)

CPC: H01L 51/5237, Y10T 29/49099, Y10T 29/49083, H05B 3/145

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

CPC: H05B 3/26, H01C 17/06, H05B 2214/04, H05B 2203/013; IPC(8): H05B 3/02, H01C 17/06, H05B 3/26, H05B 3/14 (2016.01)

USPC: 219/50, 219/162, 219/525, 219/543, 219/553, 29/611, 29/620

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

Patbase, Google Web/Scholar

Search terms used: Resistive dielectric layer sheet film conductive insulate glass plastic current breakout contact via bridge function use application heat section segment portion area carbon nanotube nano tube cnt cnts swcnt mwcnt chemical galvanic compatible suit match ohm square compare times wireless

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/0043342 A1 (NORDIN et al.) 21 February 2013 (21.02.2013), para [0016]-[0017], [0019], [0053], [0080]-[0086], [0090], [0099]	1, 4, 5, 7, 10, 13, 16-20, 25, 30-34, 36, 37, 48-52, 56, 57
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Y		2, 3, 6, 8, 9, 11, 12, 14, 15, 21-24, 35, 38-47, 53-55, 58
X	WO 2013/011306 A1 (SAJIC) 24 January 2013 (24.01.2013), pg. 3, ln 23-32; pg. 6, ln 31-pg. 7, ln 3; pg. 7, ln 18-26	26, 28
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Y		27, 29, 55
Y	US 2010/0126981 A1 (HEINTZ et al.) 27 May 2010 (27.05.2010), para [0007], [0015], [0052]	2, 3
Y	US 2009/0272731 A1 (OLDING et al.) 05 November 2009 (05.11.2009), para [0013], [0056]	6
Y	US 2013/0064587 A1 (JEONG et al.) 14 March 2013 (14.03.2013), para [0151]	8, 9
Y	US 5,698,316 A (KURAS et al.) 16 December 1997 (16.12.1997), col 1, ln 66-col 2, ln 13	11, 12
Y	US 4,868,899 A (BARD et al.) 19 September 1989 (19.09.1989), col 1, ln 62-col 2, ln 5; col 2, ln 37-50	14, 15
Y	US 2014/0070054 A1 (BURTON et al.) 13 March 2014 (13.03.2014) para [0067], [0083]	21-24, 27, 29, 35

☒ Further documents are listed in the continuation of Box C.

* 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

14 January 2016 (14.01.2016)

Date of mailing of the international search report

02 FEB 2016

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/24262

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/0240621 A1 (KESSLER et al.) 06 October 2011 (06.10.2011), para [0006], [0008], [0009], [0039]-[0042], [0050]	38-47
Y	US 2007/0210073 A1 (HUBERT et al.) 13 September 2007 (13.09.2007), para [0036], [0039], [0050]	53
Y	US 4,549,073 A (TAMURA et al.) 22 October 1985 (22.10.1985), col 1, ln 38-43; col 4, ln 54-col 5, ln 24	54
Y	WO 2013/172762 A1 (JKA KEMI AB) 21 November 2013 (21.11.2013), pg. 2, ln 20-pg. 3, ln 12; pg. 4, ln 9-pg. 5, ln 5	58
Y	US 2009/0278685 A1 (POTYRAILO et al.) 12 November 2009 (12.11.2009), para [0003], [0051], [0055]	23

INTERNATIONAL SEARCH REPORT

International application No.

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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:
This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-25 drawn to a multifunctional assembly comprising a layered structure with a plurality of electrical breakout points.
Group II: Claims 26-29, drawn to a method for manufacturing an object incorporating a multifunctional assembly and an assembled object comprising a multifunctional assembly.
Group III: Claims 30-47, drawn to a system comprising an object formed incorporating a multifunctional assembly
Group IV: Claims 48-55, drawn to a multifunctional assembly with a conductive element defining a plurality of multifunctional zones.
Group V: Claims 56-58, drawn to a carbon nanotube assembly.

--please see continuation on extra page--

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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/24262

Continuation of Box No. III -- Observations where unity of invention is lacking

The inventions listed as Groups I-V do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features

Group I includes the special technical feature of a first plurality of electrical breakout points, not included in the other groups.

Group II includes the special technical feature of using the generated heat to treat or cure an integral component of the object, not included in the other groups.

Group III includes the special technical feature of a control system operationally couplable to the resistive layer via the conductive layer and configurable or programmable to detect a change in a physical property or characteristic of the object, not included in the other groups.

Group IV includes the special technical feature of the conductive element defining at least one of a plurality of multifunctional zones of the resistive element, not included in the other groups.

Group V includes the special technical feature of a carbon nanotube assembly defining a first portion configured to perform a first operation of the assembly and defining a second portion configured to perform a second operation of the assembly not included in the other groups.

Common Technical Features:

The only technical features shared by Groups I-V that would otherwise unify the groups, are a multifunctional assembly comprising a layered structure including a first resistive layer, a first conductive layer adjacent the first resistive layer, a first pair of insulating layers including a first insulating layer disposed across the first resistive layer, a second insulating layer disposed across the first conductive layer on a side opposing the first resistive layer and an electrical current across the resistive layer. However, these shared technical features do not represent a contribution over prior art, because the shared technical features are disclosed by US 2009/0218320 A1 (Wang).

Wang discloses a multifunctional assembly comprising a layered structure (para [0001], [0006], [0007]; Fig 4, 10, hermetic sealing of a device having a chamber) including: a first resistive layer (para [0006], [0058], metal resistive heating element 103), a first conductive layer adjacent the first resistive layer (para [0012], resistive heating element comprises multiple layers of electrically-conductive material); a first pair of insulating layers including a first insulating layer disposed across the first resistive layer and a second insulating layer disposed across the first conductive layer on a side opposing the first resistive layer (para [0007], [0058], [0060]; Fig 4, 10 the first substrate and the second substrate are made of glass materials); and an electrical current across the resistive layer (para [0020], [0058]).

As the technical features were known in the art at the time of the invention, these cannot be considered special technical features that would otherwise unify the groups.

Therefore, Groups I-V lack unity under PCT Rule 13.

Note: Claim 47, as drafted, depends from claim 28 and reads "the system of claim 28..." however, claim 28 is drawn to "an assembled object..." Independent claim 37 is drawn to "a system" and therefore provides antecedent basis for claim 47. For purposes of this determination claim 47 is presumed to depend from claim 37.