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[Continued on next page]

(54) Title: FLYWHEEL ENERGY STORAGE SYSTEMS

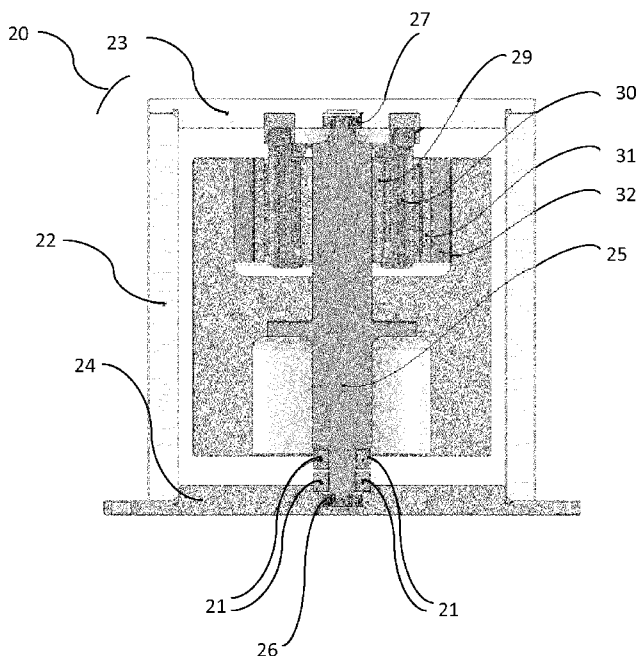


Figure 2

(57) Abstract: Flywheel for energy storage systems and energy storage systems comprising the same. The flywheel according to the present invention is characterised by a 5 vertical structure and a compact layout, optimized to reach maximum efficiency and to be lighter and less cumbersome when compared to state of the art systems.





SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,  
GW, KM, ML, MR, NE, SN, TD, TG).

— 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))

**Declarations under Rule 4.17:**

— of inventorship (Rule 4.17(iv))

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15 September 2016

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER  
 INV. H02K7/02 H02M3/24 H02M7/72 H02J9/06 H02K1/27  
 H02K5/173 H02K7/09 H02J1/16  
 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)  
 H02K H02M H02J F16C H02P

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 2012/126539 A1 (JACOB SAJAN JOSEPH [US]) 24 May 2012 (2012-05-24)	1,3,5
Y	paragraphs [0004] - [0006], [0087], [0094], [0096], [0098], [0099], [0101], [0102], [0104], [0107], [0109], [0113], [0124], [0130]; figures 23-26,32	1-10
X	US 5 932 935 A (CLIFTON DAVID B [US] ET AL) 3 August 1999 (1999-08-03)	1,5
Y	column 6, lines 9-11; figures 9,14 column 12, lines 3-7, 58-65 column 13, lines 26-35 column 15, lines 25-37,47-67	1,3-10
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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  22 July 2016	Date of mailing of the international search report  04/08/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Strasser, Thorsten
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2015/071133

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2010/074752 A1 (PROGRESSIVE FLYWHEEL ENERGY IN [US]; GABRYS CHRISTOPHER W [US]) 1 July 2010 (2010-07-01) page 8, lines 25-34; figures 1,4 page 10, line 3 page 9, lines 1-14 -----	3
Y	WO 2014/111651 A2 (LEVISYS [FR]) 24 July 2014 (2014-07-24) page 7; figures 3,4 -----	1,2,5
Y	EP 0 668 651 B1 (NIPPON OIL CO LTD [JP]) 23 August 1995 (1995-08-23) column 4, lines 15-26; figure 1 column 5, lines 12-13,24-33,44 -----	1,2,5
Y	US 2006/033393 A1 (RITCHEY JONATHAN G [CA]) 16 February 2006 (2006-02-16) paragraphs [0036], [0038] - [0040]; figures 1,1a,2 -----	4
Y	US 3 233 950 A (MAX BAERMANN) 8 February 1966 (1966-02-08) column 4, lines 53-63; figures 3,5 column 5, lines 8-23 -----	6,7
Y	CN 201 956 795 U (UNIV SOUTHEAST) 31 August 2011 (2011-08-31) figures 1,2 -----	8
Y	US 2012/326641 A1 (SAKAI KOUJIROU [JP] ET AL) 27 December 2012 (2012-12-27) paragraphs [0034] - [0036], [0038] - [0041]; figure 1 -----	9,10

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP2015/071133

## 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.: **1-4(partially)**  
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:  
**see FURTHER INFORMATION sheet PCT/ISA/210**
  
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.:
  
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: 1-5

An inner and outer rotating permanent magnet.  
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2. claims: 6-8

A magnetic bearing of support magnets in repelling mode.  
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3. claims: 9, 10

A combination of electronic power components.  
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**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

Continuation of Box II.2

Claims Nos.: 1-4(partially)

Claims 1 to 4 are unclear (Article 6 PCT) to such an extent that a meaningful search cannot be carried out on the whole respective claim.

1.1 Claim 1

"[...] said top and bottom cover (23,24) comprising means to house one end of said vertical shaft"

is unclear: According to this claim passage, the top cover houses one shaft end and the bottom cover houses the same shaft end. This is contradictory to the embodiments.

1.2

Claim 1

"[...] a coil section coupled with said shaft (25) and comprising an enclosure [...], said enclosure including at least one electrical coil (30,43)"

is unclear: According to this claim passage, the "electrical coil (30,43)" is coupled with said shaft (25). This is contradictory to the embodiments. According to the claim (implicit) and to the embodiments, the shaft is rotating. According to the embodiments, the coil is stationary and the "permanent magnets (29,31,42)" are coupled to the shaft (see also in claim 2). That is, the coil cannot be coupled to the shaft.

1.3 Claim 1

What is an "enclosure"?

On the one hand, according to claim 1, "said enclosure including [not only surrounding] at least one electrical coil (30)"; on the other hand claim 2 discloses that "said enclosure comprises an inner rotating permanent magnet". That is, on the one hand, the enclosure is stationary, on the other hand, it is rotating.

The claims do not give a reliable hint on what the enclosure may be. The term "enclosure" does not appear in the description.

1.4

Claim 1

This is what the examiner could interpret from claim 1 in combination with the description and the figures.

Flywheel device

comprising a container (22) provided with a top cover (23) and a bottom cover (24), a vertical shaft (25) made of ferromagnetic material and provided with bearings (26,27) at both ends, each of said top and bottom cover (23,24) comprising means to house one respective end of said vertical shaft (25) and engage with said bearings (26,27), at least one electrical coil (30,43) is placed between and in close proximity of at least a couple of permanent magnets (29,31,42).

The search for claim 1 has been limited to this combination of features.

2.1 Claim 2

What is the "enclosure"? See under 1.3.

2.2 Claim 2

"[...] an electrical coil

## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

(30) wound on said inner (29) [...] and outer rotating [permanent] magnet (31)"

is not disclosed in any embodiment. The coils are not wound on the magnets; magnets and coils are separate parts.

## 2.3 Claim 2

According to the embodiments there is no "outer rotating magnet (31) placed around said electrical coil".

Fig.3, 3bis disclose that the outer permanent magnet (31) is placed radially outside of the coil, wherein "radially" is interpreted with respect to the radius of the flywheel device.

## 2.4 Claim

2

What does "[...] an outer rotating magnet (31) [being] integral to said coil section (32)" mean?

## 2.5 Claim 2

This is what the examiner could interpret from claim 2 in combination with the description and the figures.

[...] characterised in that the flywheel device comprises an inner rotating permanent magnet (29) coupled with said shaft (25), and an outer rotating permanent magnet (31) placed radially outside of said electrical coil (30), wherein "radially" is interpreted with respect to the radius of the flywheel device.

The search for claim 2 has been limited to this combination of features.

## 3. Claims 3,4

What is the "enclosure"? See under 1.3.

According to the understanding of the examiner, the term "enclosure" must be replaced by "flywheel device".

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guidelines C-IV, 7.2), should the problems which led to the Article 17(2) declaration be overcome.

## INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2015/071133

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