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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, DJ, 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, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, 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,

(54) Title: METHOD FOR OPERATING A SURGICAL INSTRUMENT

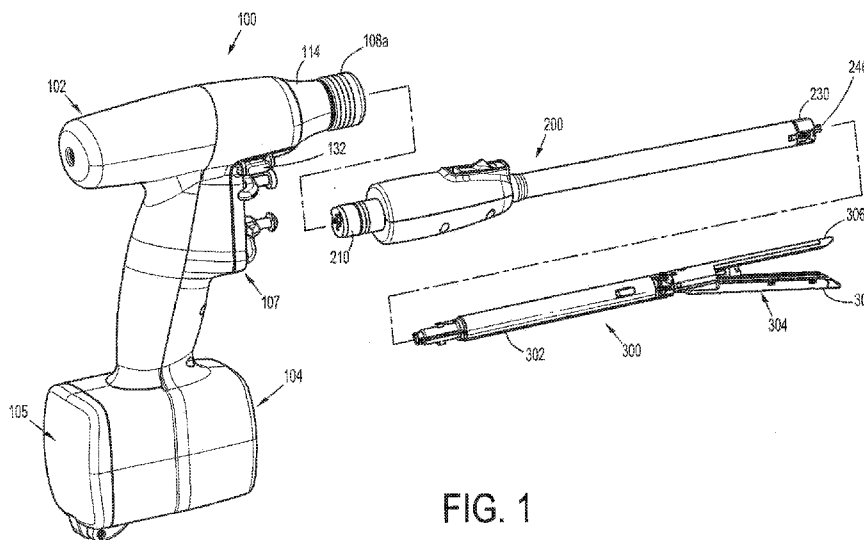


FIG. 1

(57) Abstract: A surgical instrument is configured to compensate for battery pack and drivetrain failures. One method includes generating a firing sequence, determining whether a subset of rechargeable battery cells is damaged during the firing sequence, and stepping-up an output voltage of the battery pack to complete the firing sequence in response to a determination that a subset of the rechargeable battery cells is damaged. Another method includes generating a mechanical output to motivate a drivetrain to transmit a motion to a jaw assembly of the surgical instrument, activating a safe mode in response to an acute failure of the drivetrain, and activating a bailout mode in response to a catastrophic failure of the drivetrain. Another method includes driving a drivetrain, sensing and recording vibration information from the drivetrain, generating an output signal based on the vibration information, and determining a status of the surgical instrument based on the output signal.



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.

- (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, ST, 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).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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:

01 March 2018 (01.03.2018)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/027929

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.:
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/US2017/027929

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/072 H02J7/00
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)
A61B H02J

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	EP 2 923 661 A2 (ETHICON ENDO SURGERY INC [US]) 30 September 2015 (2015-09-30)	1
Y	paragraphs [0063] - [0106]; figures 31-45	2-4
Y	US 2014/125284 A1 (QAHOUQ JABER ABU [US]) 8 May 2014 (2014-05-08)	2-4
	paragraphs [0002] - [0025]; figure 1	
L	EP 3 187 125 A1 (ETHICON ENDO-SURGERY LLC [PR]) 5 July 2017 (2017-07-05)	1-4
	paragraphs [0065] - [0080]; figures 1,20-24	
X	EP 2 724 674 A2 (COVIDIEN LP [US]) 30 April 2014 (2014-04-30)	5-13
	paragraphs [0072] - [0085]; figures 11-14	
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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	Date of mailing of the international search report
12 January 2018	23/01/2018

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 Bergler, Christian
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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/027929

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 939 607 A1 (COVIDIEN LP [US]) 4 November 2015 (2015-11-04) paragraphs [0006] - [0008], [0024] - [0035]; figures 2,3,5,6,8a -----	14
X	EP 3 000 409 A2 (ETHICON ENDO SURGERY INC [US]) 30 March 2016 (2016-03-30) paragraphs [0058] - [0077], [0237] - [0248]; figures 21a,25,87-89 -----	5
X	WO 2007/056763 A2 (YABLON JAY R [US]; ZACHARIAS JAIME [CL]) 18 May 2007 (2007-05-18) page 15, lines 12-23; figure 13 -----	14-20
X	US 2016/030119 A1 (DEVENGENZO ROMAN L [US] ET AL) 4 February 2016 (2016-02-04) paragraphs [0121] - [0145]; figures 20-22 -----	14
X	DE 10 2004 063606 A1 (ZEISS CARL AG [DE]) 6 July 2006 (2006-07-06) paragraphs [0069] - [0073]; figure 7 -----	14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2017/027929

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
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DE 102004063606	A1	06-07-2006	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-4

Battery health detection and compensation of converter output voltage drop

2. claims: 5-13

Reaction to drivetrain failures by providing two operation modes

3. claims: 14-20

Determine operation status of a drivetrain by monitoring vibrations during operation
