



(51) International Patent Classification:

A61B 17/32 (2006.01) A61B 90/00 (2016.01)  
A61B 34/30 (2016.01) A61B 34/20 (2016.01)

Stephen J.; 5240 Saddle Club Drive, Kalamazoo, MI 49009 (US). **TIMMER, Jeffrey**; 7107 W. R. Ave, Kalamazoo, MI 49009 (US).

(21) International Application Number:

PCT/US2020/042128

(74) Agent: **WOOLBRIGHT, Jacob P.** et al.; Howard & Howard Attorneys PLLC, 450 West 4th St., Royal Oak, MI 48067 (US).

(22) International Filing Date:

15 July 2020 (15.07.2020)

(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, IT, JO, 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, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/874,107 15 July 2019 (15.07.2019) US  
63/015,184 24 April 2020 (24.04.2020) US

(71) Applicant: **STRYKER CORPORATION** [US/US]; 2825 Airview Boulevard, Kalamazoo, MI 49002 (US).

(72) Inventors: **BOZUNG, Timothy J.**; 5934 Clovermeadows Avenue, Scotts, MI 49088-7718 (US). **REASONER,**

(54) Title: ROBOTIC HAND-HELD SURGICAL INSTRUMENT SYSTEMS AND METHODS

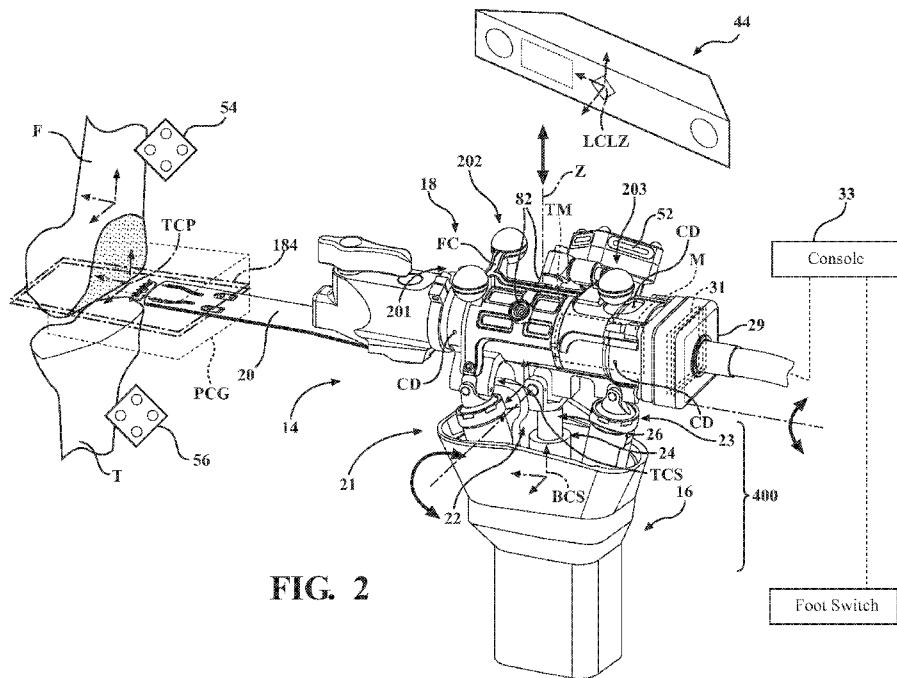


FIG. 2

(57) Abstract: A system is provided comprising a robotic instrument for use with a tool. In some versions, the robotic instrument comprises a hand-held portion to be held by a user and a tool support movably coupled to the hand-held portion to support the tool. A plurality of actuators operatively interconnect the tool support and the hand-held portion to move the tool support in three degrees of freedom relative to the hand-held portion. An optional constraint assembly may operatively interconnect the tool support and the hand-held portion to constrain movement of the tool support relative to the hand-held portion in three degrees of freedom. A guidance array assists users in positioning the tool and/or portions of the instrument.



**(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).

**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 April 2021 (01.04.2021)

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US2020/042128

## 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.: **134-143**  
because they relate to subject matter not required to be searched by this Authority, namely:  
**see FURTHER INFORMATION sheet PCT/ISA/210**
  
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.:  
**1-29, 100-119, 125-133, 148-150**
  
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/US2020/042128

A. CLASSIFICATION OF SUBJECT MATTER  
 INV. A61B17/32 A61B34/30 A61B90/00 A61B34/20  
 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

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 2013/096574 A1 (KANG HYOSIG [US] ET AL) 18 April 2013 (2013-04-18)	149,150
Y	paragraphs [0018], [0021] - [0022], [0032] - [0035]; claims 1, 3, 4; figures 3A-I	1-29
Y	----- WO 2018/104439 A1 (ORTHOTAXY [FR]) 14 June 2018 (2018-06-14) page 13, line 15 - page 14, line 10; figures 4, 5	1-29
A	----- US 2019/021937 A1 (SWIFT STEPHEN GLEN [CA] ET AL) 24 January 2019 (2019-01-24) paragraphs [0025], [0029] - [0030]; figures 1A-B, 2A-B	1-29
	----- -/--	

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  16 February 2021	Date of mailing of the international search report  24/02/2021
---	--

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  Rosander, Frida
--	---

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2020/042128

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 418 811 B1 (ROSHEIM MARK E [US]) 16 July 2002 (2002-07-16) column 3, line 15 - column 6, line 51; figures 1-4 -----	1-29
A	US 5 865 063 A (SHELDON PAUL C [US]) 2 February 1999 (1999-02-02) column 3, line 8 - column 4, line 54 column 6, lines 20-37 figures 1, 5, 6 -----	1-29
A	WO 2016/049180 A1 (THINK SURGICAL INC [US]) 31 March 2016 (2016-03-31) paragraphs [0029] - [0041]; figures 1-8 -----	1-29
A	WO 2011/021192 A1 (MAZOR SURGICAL TECHNOLOGIES LTD [IL]; SHOHAM MOSHE [IL]) 24 February 2011 (2011-02-24) page 7 - page 9; figures 1, 2 -----	1-29
X	US 2013/060278 A1 (BOZUNG TIMOTHY J [US] ET AL) 7 March 2013 (2013-03-07)  paragraphs [0135] - [0136], [0138], [0141] - [0147], [0151], [0155], [0161] - [0163], [0196], [0170] paragraphs [0258] - [0259], [0262] - [0263], [0267] - [0268], [0270] - [0271], [0275] - [0276], [0280] - [0284] paragraphs [0309], [0325], [0339], [0425] - [0429], [0443] - [0446]; figures 1, 2, 16, 18-23, 37-39, 56, 59, 62-64, 68, 107-111 -----	100-119, 125-133, 148-150
A	US 2004/106916 A1 (QUAID ARTHUR E [US] ET AL) 3 June 2004 (2004-06-03) paragraph [0052]; figure 2 -----	125-133, 148
A	EP 2 754 383 A2 (MST MEDICAL SURGERY TECHNOLOGIES LTD [IL]) 16 July 2014 (2014-07-16) paragraphs [0487] - [0491]; figure 16 -----	125-133, 148

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No

PCT/US2020/042128

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013096574 A1	18-04-2013	US 2013096574 A1	18-04-2013
		US 2015272686 A1	01-10-2015
		US 2017119403 A1	04-05-2017
		US 2018055517 A1	01-03-2018
		US 2018235718 A1	23-08-2018
		US 2020129254 A1	30-04-2020
-----			
WO 2018104439 A1	14-06-2018	EP 3551099 A1	16-10-2019
		WO 2018104439 A1	14-06-2018
-----			
US 2019021937 A1	24-01-2019	CA 2895123 A1	15-01-2016
		US 2016016309 A1	21-01-2016
		US 2019021937 A1	24-01-2019
-----			
US 6418811 B1	16-07-2002	AU 7496101 A	11-12-2001
		CA 2410473 A1	06-12-2001
		US 6418811 B1	16-07-2002
		US 2002166404 A1	14-11-2002
		WO 0192971 A2	06-12-2001
-----			
US 5865063 A	02-02-1999	NONE	
-----			
WO 2016049180 A1	31-03-2016	AU 2015320736 A1	09-03-2017
		AU 2020226980 A1	17-09-2020
		CN 107072674 A	18-08-2017
		EP 3197375 A1	02-08-2017
		JP 2017528255 A	28-09-2017
		JP 2021010745 A	04-02-2021
		KR 20170063610 A	08-06-2017
		US 2017258532 A1	14-09-2017
		US 2020046438 A1	13-02-2020
		WO 2016049180 A1	31-03-2016
-----			
WO 2011021192 A1	24-02-2011	CA 2770507 A1	24-02-2011
		EP 2467798 A1	27-06-2012
		US 2012143084 A1	07-06-2012
		US 2020406480 A1	31-12-2020
		WO 2011021192 A1	24-02-2011
-----			
US 2013060278 A1	07-03-2013	AU 2012301718 A1	13-03-2014
		AU 2017202635 A1	11-05-2017
		AU 2017225032 A1	28-09-2017
		AU 2019226263 A1	26-09-2019
		CA 2847182 A1	07-03-2013
		CA 3067299 A1	07-03-2013
		EP 2750620 A1	09-07-2014
		EP 3213697 A1	06-09-2017
		EP 3656317 A1	27-05-2020
		JP 6303033 B2	28-03-2018
		JP 6385275 B2	05-09-2018
		JP 6619850 B2	11-12-2019
		JP 6644822 B2	12-02-2020
		JP 2015502180 A	22-01-2015
		JP 2017099918 A	08-06-2017
		JP 2018108439 A	12-07-2018
		JP 2019022661 A	14-02-2019
		JP 2020072954 A	14-05-2020
		US 2013060278 A1	07-03-2013

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2020/042128

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 2014316412 A1	23-10-2014
		US 2015182295 A1	02-07-2015
		US 2017156799 A1	08-06-2017
		US 2017245947 A1	31-08-2017
		WO 2013033566 A1	07-03-2013
-----			
US 2004106916	A1	03-06-2004	CA 2532469 A1
			CN 101031236 A
			EP 1680007 A2
			JP 4833061 B2
			JP 2007534351 A
			US 2004106916 A1
			WO 2005009215 A2
-----			
EP 2754383	A2	16-07-2014	CN 203970548 U
			DE 202014010578 U1
			EP 2754383 A2
-----			

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

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

## 1. claims: 1-29

A hand-held robotic instrument having a constraint assembly and a passive linkage

---

## 2. claims: 30-43

A hand-held robotic instrument having a controller to control a plurality of actuators to maintain a saw blade along a plane

---

## 3. claims: 44-99, 144-147, 152-168

A hand-held robotic system having visual indicators and a controller to control visual indication of an instrument position

---

## 4. claims: 100-109, 125-133, 148-150

A hand-held robotic system having a localizer and a controller, the controller automatically controls a saw blade to maintain a pose or to move towards a desired plane

---

## 5. claims: 110-119

A hand-held robotic system having a saw blade, a saw drive motor, an input device, and a controller for controlling the saw drive motor according to the input device

---

## 6. claims: 120-124

A hand-held robotic system having an input device and a controller for automatic control to maintain or move the saw blade pose according to the input device

---

## 7. claim: 151

A hand-held robotic system having a controller to control an actuator assembly based on a desired pose of a saw blade

---

## 8. claims: 169-171

A robotic surgical instrument having a plurality of actuators to control elevation and pitch of a tool support

---

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

[Empty rectangular box for further information]

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

Continuation of Box II.1

Claims Nos.: 134-143

Claims 134-143 relate to methods for using a robotic instrument with a tool, methods of guiding movement of a robotic instrument, and methods of controlling movement of a hand-held robotic system which all include the step of adjusting a plurality of actuators or controlling a plurality of actuators. Such adjustment and control of a plurality of actuators of the robotic instrument implies a surgical step since movement or control of a surgical tool, e.g. a saw blade, during surgery falls in the scope of these claims (see also par. [00108]). Thus, claims 134-143 refer to a method for treatment of the human body by surgery. According to Rules 39.1(iv) and 67.1(iv) PCT, neither a search nor an international preliminary examination is required to be carried out on these claims.