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[Continued on next page]

(54) Title: CURVED CANNULA, ROBOTIC MANIPULATOR AND SURGICAL INSTRUMENT HAVING A PASSIVELY FLEXIBLE SHAFT

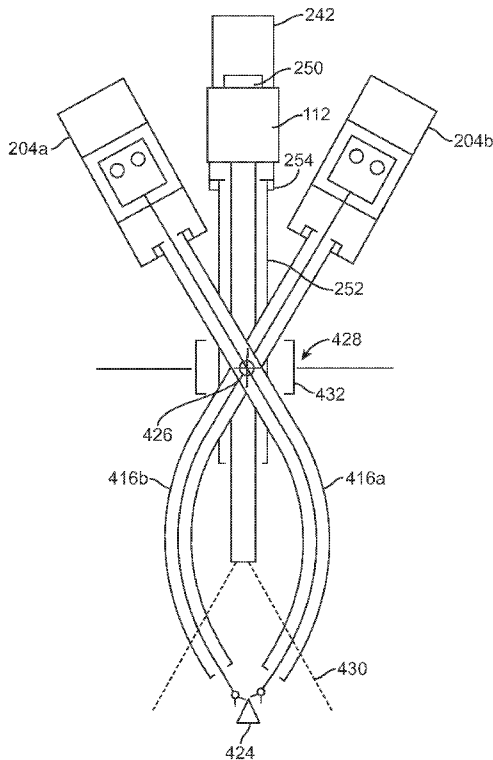
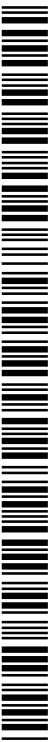


FIG. 4C

(57) Abstract: A robotic surgical system is configured with rigid, curved cannulas (416a) that extend through the same opening into a patient's body. Surgical instruments (500) with passively flexible shafts (506) extend through the curved cannulas. Force isolation elements (856) within the flexible shafts prevent shaft bending from affecting end effector actuation elements that extends through the shafts. The cannulas are oriented to direct the instruments towards a surgical site. Various port features (1402) that support the curved cannulas within the single opening are disclosed. Cannula support fixtures (1902) that support the cannulas during insertion into the single opening and mounting to robotic manipulators are disclosed. A teleoperation control system that moves the curved cannulas and their associated instruments in a manner that allows a surgeon to experience intuitive control is disclosed.



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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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INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
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 ADD. A61B17/29 A61B17/00 A61M25/00

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 A61M

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 practical, search terms used)
 EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/065105 A1 (LARKIN DAVID Q [US] ET AL) 13 March 2008 (2008-03-13) cited in the application	1-8, 10-12, 14-22
Y	paragraphs [0139], [0148], [0149], [0151], [0154], [0170], [0225], [0227], [0248], [0267], [0280]; figures 7,10,11,16d,16e,19d,19e,24a,31	3,4,6-8, 10-12, 14-17, 19-22
X	US 2008/177283 A1 (LEE WOOJIN [US] ET AL) LEE WOOJIN [US] ET AL 24 July 2008 (2008-07-24)	1-8, 10-12, 14-22
Y	paragraphs [0010], [0091] - [0093], [0101], [0105] - [0108], [0111], [0115] - [0117], [0200]; figures 1,2,3,4,8,9,10,13	3,4,6-8, 10-12, 14-17, 19-22
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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 document but published on or after the international filing date

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"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 23 May 2011	Date of mailing of the international search report 01/06/2011
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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 Assion, Jean-Charles
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/056193

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.: 23
because they relate to subject matter not required to be searched by this Authority, namely:
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by therapy
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.:
1-12, 14-22
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/US2010/056193

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 2001/021859 A1 (KAWAI TOSHIKAZU [JP] ET AL) 13 September 2001 (2001-09-13)	6,8
A	paragraphs [0072] - [0079]; figures 2,9,10 -----	1
Y	WO 2009/102102 A1 (MEERECOMPANY [KR]; CHOI SEUNG WOOK [KR]; WON JONG SEOK [KR]) 20 August 2009 (2009-08-20)	3,4,14
	paragraphs [0002], [0048], [0056], [0062]; figures 2,6,7 -----	
A	WO 2009/120944 A2 (ST JUDE MEDICAL ATRIAL FIBRILL [US]; KIRSCHENMAN MARK [US]) 1 October 2009 (2009-10-01)	1,3,6, 8-10,16, 17
	paragraphs [0045], [0053], [0064], [0065], [0070], [0071], [0076], [0098], [0099], [0116] - [0118]; figures 1,10b,10c,11c -----	
A	US 6 331 181 B1 (TIERNEY MICHAEL J [US] ET AL) 18 December 2001 (2001-12-18)	2,4
	cited in the application column 9, lines 30-44 -----	
X	EP 1 870 043 A2 (ETHICON ENDO SURGERY INC [US]) 26 December 2007 (2007-12-26)	1,5
Y	paragraph [0037]; figure 1 -----	6-8, 15-17
A	US 5 402 793 A (GRUNER GEORGE P [US] ET AL) 4 April 1995 (1995-04-04)	4
	column 3; figures 2a,2b,11 -----	
Y	US 2009/062602 A1 (ROSENBERG CRAIG R [US] ET AL) 5 March 2009 (2009-03-05)	6-8, 10-12, 15-17, 19-22
	paragraphs [0105], [0112], [0115], [0123]; figures 1,5A,12,31i-31L -----	
Y	WO 97/12558 A1 (KELLEHER BRIAN S [US]) 10 April 1997 (1997-04-10)	6-8
	columns 1,12; figures 1,5,8 -----	
Y	WO 97/12557 A1 (KELLEHER BRIAN S [US]) 10 April 1997 (1997-04-10)	6-8,10, 11
	abstract; figure 22A.30.33.34 -----	
A	US 2009/149936 A1 (LENTZ DAVID CHRISTIAN [US]) 11 June 2009 (2009-06-11)	9
	abstract; figures 1,5 -----	
A	US 2005/182386 A1 (AGGERHOLM STEEN [DK]) 18 August 2005 (2005-08-18)	9
	abstract; figures 1-3 -----	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/056193

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008065105	A1	13-03-2008	EP 2037794 A2 25-03-2009
			JP 2009539573 T 19-11-2009
			KR 20090019908 A 25-02-2009
			US 2010198232 A1 05-08-2010
			US 2008065097 A1 13-03-2008
			US 2008064931 A1 13-03-2008
			US 2008065098 A1 13-03-2008
			US 2008071288 A1 20-03-2008
			US 2008064927 A1 13-03-2008
			US 2008064921 A1 13-03-2008
			US 2008065099 A1 13-03-2008
			US 2008071289 A1 20-03-2008
			US 2008065100 A1 13-03-2008
			US 2008065101 A1 13-03-2008
			US 2008065102 A1 13-03-2008
			US 2008065103 A1 13-03-2008
			US 2008065104 A1 13-03-2008
			US 2008065106 A1 13-03-2008
			US 2008071290 A1 20-03-2008
			US 2008065107 A1 13-03-2008
			US 2008071291 A1 20-03-2008
			US 2008065108 A1 13-03-2008
			US 2008065109 A1 13-03-2008
			US 2008065110 A1 13-03-2008
			WO 2007146987 A2 21-12-2007

US 2008177283	A1	24-07-2008	US 2008177284 A1 24-07-2008

US 2001021859	A1	13-09-2001	NONE

WO 2009102102	A1	20-08-2009	CN 101945616 A 12-01-2011
			KR 20090088589 A 20-08-2009
			US 2010318101 A1 16-12-2010

WO 2009120944	A2	01-10-2009	EP 2254643 A2 01-12-2010
			US 2009247942 A1 01-10-2009

US 6331181	B1	18-12-2001	AT 464852 T 15-05-2010
			EP 2135577 A2 23-12-2009
			EP 2298216 A2 23-03-2011
			EP 2298217 A2 23-03-2011
			EP 2298218 A2 23-03-2011
			EP 2298219 A2 23-03-2011
			EP 1146830 A1 24-10-2001
			US 2005149003 A1 07-07-2005
			WO 0033755 A1 15-06-2000

US 6331181	B1		US 2003083673 A1 01-05-2003
			US 2009234371 A1 17-09-2009
			US 2009248043 A1 01-10-2009
			US 2007012135 A1 18-01-2007
			US 2002032451 A1 14-03-2002
			US 2002032452 A1 14-03-2002
			US 2002072736 A1 13-06-2002

EP 1870043	A2	26-12-2007	AU 2007202365 A1 17-01-2008
			CA 2590498 A1 21-12-2007
			CN 101172031 A 07-05-2008

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/056193

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		JP 2008018233 A	31-01-2008
		US 2009088603 A1	02-04-2009
		US 2007296365 A1	27-12-2007
		US 2010042141 A1	18-02-2010

US 5402793	A	04-04-1995	
		AT 250890 T	15-10-2003
		CA 2135692 A1	20-05-1995
		DE 69433198 D1	06-11-2003
		DE 69433198 T2	09-09-2004
		EP 0654245 A1	24-05-1995
		JP 7250836 A	03-10-1995
		JP 3923489 B2	30-05-2007
		JP 2005040619 A	17-02-2005
		US 5555887 A	17-09-1996
		US 5479930 A	02-01-1996

US 2009062602	A1	05-03-2009	NONE

WO 9712558	A1	10-04-1997	
		AU 7258396 A	28-04-1997
		US 5810876 A	22-09-1998

WO 9712557	A1	10-04-1997	
		AU 7255896 A	28-04-1997

US 2009149936	A1	11-06-2009	NONE

US 2005182386	A1	18-08-2005	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: 1-5, 14, 18

force transmission element

2. claims: 6-12, 15-17, 19-22

force isolation element and shaft stiffness

3. claim: 13

flushing system
