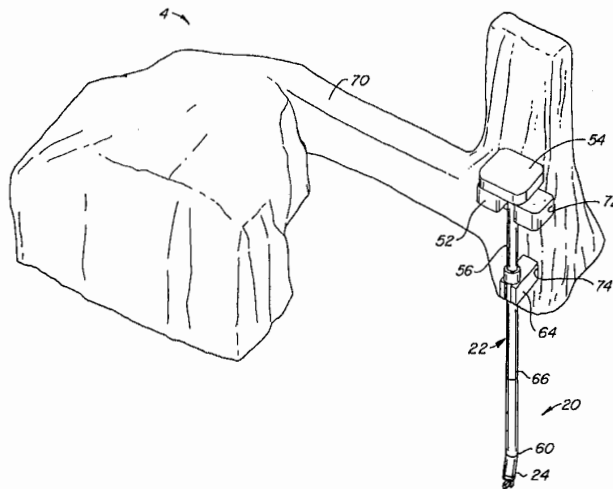




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : A61M 37/00</p>	<p>A1</p>	<p>(11) International Publication Number: WO 98/25666 (43) International Publication Date: 18 June 1998 (18.06.98)</p>
<p>(21) International Application Number: PCT/US97/22035 (22) International Filing Date: 12 December 1997 (12.12.97) (30) Priority Data: 60/033,321 12 December 1996 (12.12.96) US (71) Applicant: INTUITIVE SURGICAL, INC. [US/US]; 1340 West Middlefield Road, Mountain View, CA 94303 (US). (72) Inventors: COOPER, Thomas, G.; 304 Concord Drive, Menlo Park, CA 94025 (US). PARSONS, Rodney, Lawrence, Jr.; 1804 Thomas Road, Wilmington, DE 19803 (US). PATEL, Mona; 111 Scotts Way, Wilmington, DE 19810 (US). SEITZ, Steven, Paul; 333 Haverford Place, Swarthmore, PA 19081 (US). (74) Agents: BARRISH, Mark, D. et al.; Townsend and Townsend and Crew LLP, 8th floor, Two Embarcadero Center, San Francisco, CA 94111-3834 (US).</p>		<p>(81) Designated States: CA, JP, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>

(54) Title: MULTI-COMPONENT TELEPRESENCE SYSTEM AND METHOD



(57) Abstract

The present invention provides systems and methods for performing robotics assisted surgical procedures on a patient. In particular, a three component surgical system (2) is provided that includes a non-sterile drive and control component (40), a sterilized end effector or surgical tool (20), and an intermediate connector component (24) that includes mechanical elements for coupling the surgical tool (20) with the drive and control component (40), and for transferring motion and electrical signals therebetween. The drive and control component (40) is shielded from the sterile surgical site, the surgical tool (20) is sterilized and disposable and the intermediate connector (24) is sterilized and reusable. In this manner, the intermediate connector (24) can be sterilized after a surgical procedure without damaging the motors (170) or electrical connections within the drive and control component (40) of the robotics system.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

MULTI-COMPONENT TELEPRESENCE SYSTEM AND METHOD

5

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of, and claims
10 the benefit of priority from, U.S. Provisional Patent
Application Serial No. 60/033,321, filed December 12, 1996,
the full disclosure of which is hereby incorporated by
reference.

15

BACKGROUND OF THE INVENTION

This invention relates to robotically-assisted
surgical manipulators and more particularly to systems and
methods for performing telerobotic surgical procedures on a
20 patient while providing the surgeon with the sensation of
physical presence at the surgical site.

In robotically-assisted or telerobotic surgery, the
surgeon typically operates a master controller to remotely
control the motion of surgical instruments at the surgical
25 site from a location that may be remote from the patient
(e.g., across the operating room, in a different room or a
completely different building from the patient). The master
controller usually includes one or more hand input devices,
such as joysticks, exoskeletal gloves or the like, which are
30 coupled to the surgical instruments with servo motors for
articulating the instruments at the surgical site. The servo
motors are typically part of an electromechanical device or
surgical manipulator ("the slave") that supports and controls
the surgical instruments that have been introduced directly
35 into an open surgical site or through trocar sleeves into a
body cavity, such as the patient's abdomen. During the
operation, the surgical manipulator provides mechanical

such as tissue graspers, needle drivers, electrosurgical cautery probes, etc., that each perform various functions for the surgeon, e.g., holding or driving a needle, grasping a blood vessel, or dissecting, cauterizing or coagulating tissue.

This new method of performing telerobotic surgery through remote manipulation has, of course, created many new challenges. One such challenge results from the fact that a portion of the electromechanical surgical manipulator will be in direct contact with the surgical instruments, and will also be positioned adjacent the operation site. Accordingly, the surgical manipulator may become contaminated during surgery and is typically disposed of or sterilized between operations. Of course, from a cost perspective, it would be preferable to sterilize the device. However, the servo motors, sensors, encoders and electrical connections that are necessary to robotically control the motors typically cannot be sterilized using conventional methods, e.g., steam, heat and pressure or chemicals, because they would be damaged or destroyed in the sterilization process.

Yet another challenge with telerobotic surgery systems is that a surgeon will typically employ a large number of different surgical instruments during a procedure. Since the number of instrument holders are limited due to space constraints and cost, many of these surgical instruments will be attached and detached from the same instrument holder a number of times during an operation. In laparoscopic procedures, for example, the number of entry ports into the patient's abdomen is generally limited during the operation because of space constraints as well as a desire to avoid unnecessary incisions in the patient. Thus, a number of different surgical instruments will typically be introduced through the same trocar sleeve during the operation. Likewise, in open surgery, there is typically not enough room around the surgical site to position more than one or two surgical manipulators, and so the surgeon's assistant will be compelled to frequently remove instruments from the holder and exchange them with other surgical tools.

What is needed, therefore, are improved telerobotic systems and methods for remotely controlling surgical instruments at a surgical site on a patient. These systems and methods should be configured for easy sterilization so that they can be reused after the components have been contaminated during an operation. In addition, these systems and methods should be designed to minimize instrument exchange time during the surgical procedure.

10

SUMMARY OF THE INVENTION

The present invention provides systems and methods for performing remote, robotically-assisted surgical procedures on a patient while providing the surgeon with the sensation of physical presence at the surgical site (i.e., telepresence). In particular, a three-component surgical system is provided that includes a non-sterile drive and control component, a sterilizable end effector or surgical tool and an intermediate connector component that includes mechanical elements for coupling the surgical tool with the drive and control component, and for transferring motion from the drive component to the surgical tool. The drive and control component is shielded from the sterile surgical site, the surgical tool is sterilizable and disposable and the intermediate connector is sterilizable and reusable. In this manner, the intermediate connector can be sterilized after a surgical procedure without damaging the motors or electrical connections within the drive and control component of the robotic system.

The drive and control component of the present invention generally includes the drive actuators, e.g., motors, gears or pulleys, etc., and positioning devices that are necessary to articulate the surgical tool at the surgical site. In addition, the drive and control component will usually include the encoders and electrical connectors required to couple the component to a servomechanism to form a master/slave telerobotic surgical system. In a specific configuration of the invention this component comprises a

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.