IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Richard W. Timm, et al.		
U.S. Patent No.:	8,616,431	Attorney Docket No.:	11030-0049IP7
Issue Date:	December 31, 2013		
Appl. Serial No.:	13/369,578		
Filing Date:	February 9, 2012		
Title:	SHIFTABLE DRIVE INTERFACE FOR ROBOTICALLY-CONTROLLED SURGICAL TOOL		

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 8,616,431 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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IS1001	U.S. Patent No. 8,616,431 to Timm et al. ("the '431 Patent")
IS1002	Prosecution History of the '431 Patent
IS1003	Declaration of Dr. Knodel
IS1004	U.S. Pat. App. Pub. No. 2009/0101692 to Whitman et al. ("Whitman")
IS1005	U.S. Patent No. 7,524,320 to Tierney et al. ("Tierney")
IS1006	U.S. Pat. App. Pub. No. 2008/0251568 to Zemlok et al. ("Zemlok")
IS1007	U.S. Pat. App. Pub. No. 2008/0300613 to Shelton et al. ("Shelton Application")
IS1008	U.S. Patent No. 8,196,796 to Shelton et al. ("Shelton Patent")
IS1009	U.S. Patent No. 8,931,682 to Timm et al. ("Timm Patent")
IS1010	Morris, B., Robotic Surgery: Applications, Limitations, and Impact on Surgical Education, *Medscape General Medicine*, 2005;7(3):72 ("Morris")
IS1011	Levinson, K., Robotic Assisted Surgery, Electrical and Computer Engineering Design Handbook (2015) ("Levinson")
IS1012	Tonet, O. et al., Comparison of Control Modes of a Hand-Held Robot for Laparoscopic Surgery, MICCAI 2006, LNCS 4190, pp. 429-36 (2006) ("Tonet")
IS1013	Piccigallo, M. et al., Hand-held robotic instrument for dextrous laparoscopic interventions, The International Journal of Medical Robotics and Computer Assisted Surgery, Vol. 4, Issue 4, pp. 331-38 (2008) ("Piccigallo")

IS1014	Zahraee, A. et al., Toward the Development of a Hand-Held Surgical Robot for Laparoscopy, IEEE/ASME Transactions on Mechatronics, Vol. 15, No. 6, pp. 853-61 (Dec. 2010) (“Zahraee”)
IS1015	Pereira, R. et al., Hand-held robotic device for laparoscopic surgery and training, 2014 IEEE 3rd International Conference on Serious Games and Applications for Health (SeGAH), pp. 1-8 (2014) (“Pereira”)
IS1016	U.S. Pat. App. Pub. No. 2008/0308601 to Timm et al. (“Timm Application”)
IS1017	U.S. Patent No. 6,817,974 to Cooper et al. (“Cooper”)

I. Introduction

A. Background

Intuitive Surgical, Inc. ("Petitioner") petitions for *Inter Partes* Review ("IPR") of claims 1-7, 10-14, 16-20, 23-26 of U.S. Patent 8,616,431 ("the '431 Patent"). The '431 Patent concerns an alleged improvement to endoscopic surgical instruments, which conventionally have the following parts: (1) an end effector which performs some action, such as stapling and cutting; (2) an elongated shaft assembly; and (3) a transmission to transmit actuation motions (*e.g.*, from a trigger or motor) through the shaft assembly to the end effector. The following annotated figures illustrate a typical prior art surgical stapler:

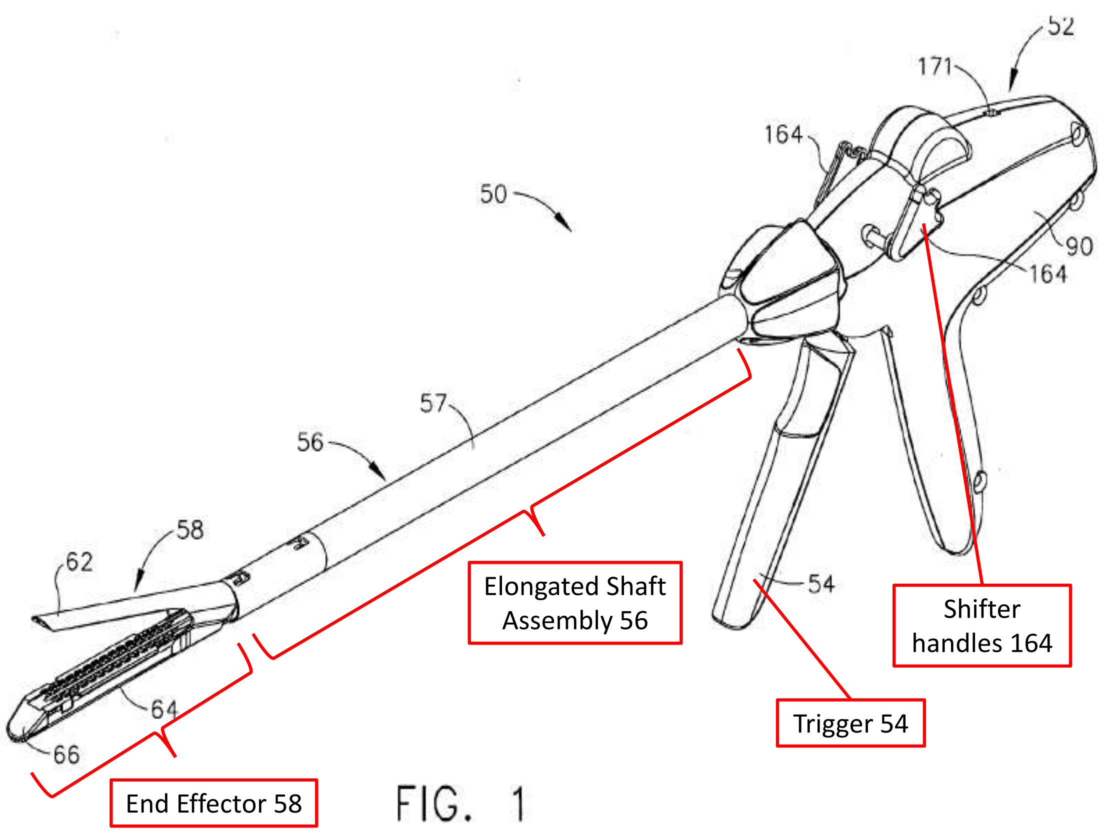


FIG. 1

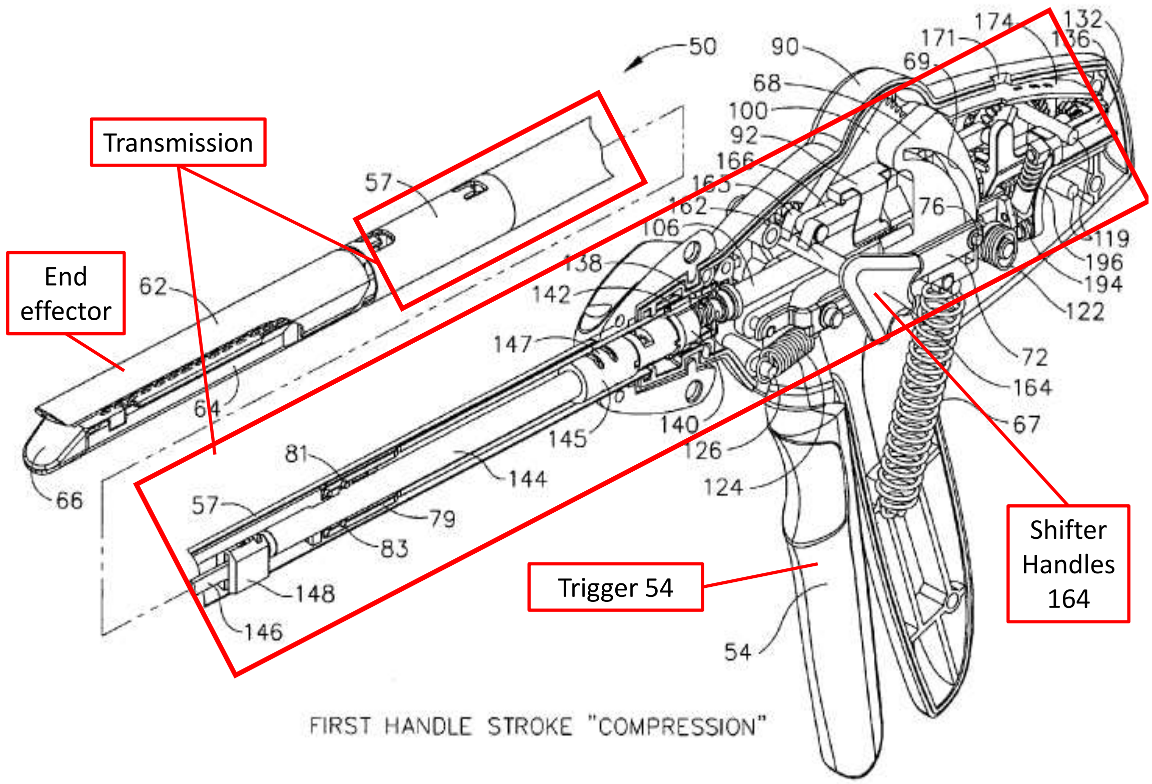
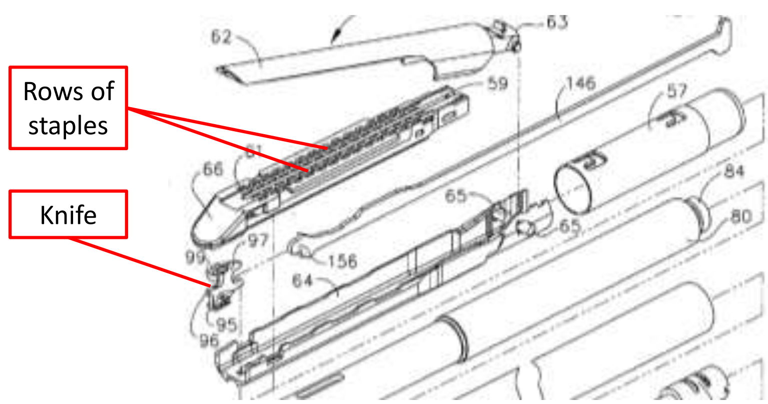


FIG. 8

IS1007 ("Shelton Application"), FIGs. 1, 8.[1] This prior art surgical stapler has a knife 99 that cuts the tissue between two rows of staples:



[1] These prior art figures are also found in the '431 Patent.

IS1007, FIG. 2. It also includes a shifting transmission (controlled by shifter handles 164) to selectively advance or retract the knife through the end effector. *Id.*, ¶¶56-57, 63-65, FIG. 5.

On May 27, 2011, the Applicant added FIGs. 34-151 and over 70 columns of text relating to surgical robots to the ’431 Patent’s parent application. However, the Applicant did not invent surgical robotics and admitted that Petitioner’s patents provide relevant prior art teachings of robotic surgical systems:

> For example, the tool arrangement [surgical instrument] described above may be ***well-suited for use with those robotic systems manufactured by Intuitive Surgical, Inc. . . . , many of which may be described in detail in various patents incorporated herein by reference***.[2]

IS1001, 34:50-62. The Applicant thereafter obtained the ’431 Patent which is directed exclusively to robotic embodiments of surgical instruments.

B. The Alleged Contributions of the ’431 Patent Were Not New

The ’431 Patent combines two prior art concepts: (1) a drive interface for a robotically-controlled surgical tool, and (2) a shiftable transmission that allows a single drive element of the surgical tool to perform multiple functions, such as jaw opening/closing and instrument articulation.

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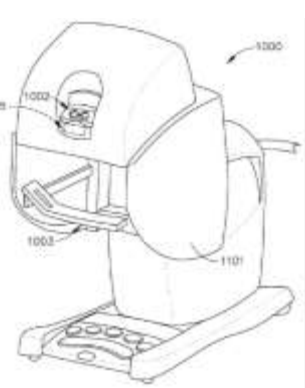
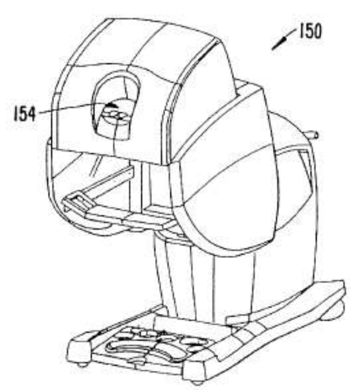
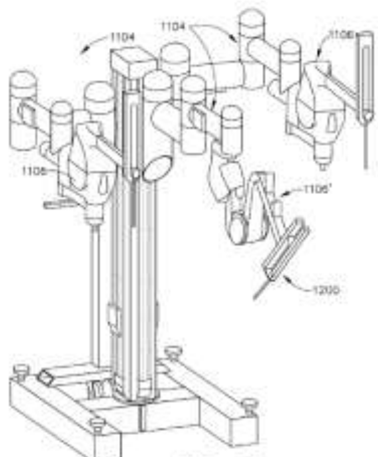
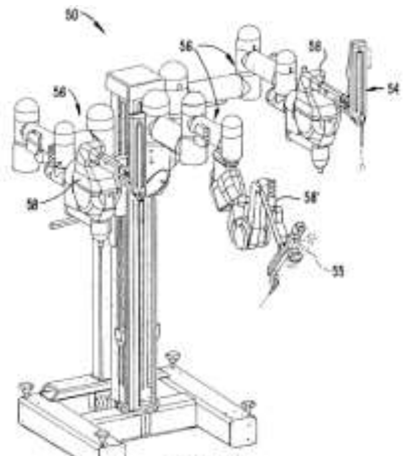
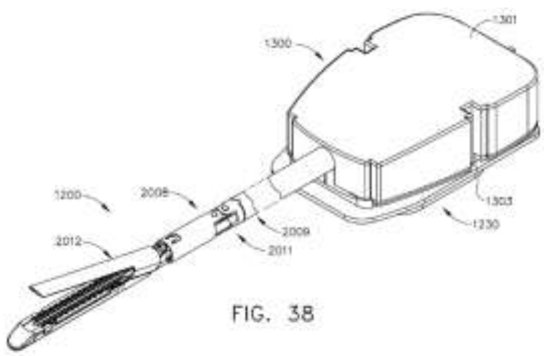
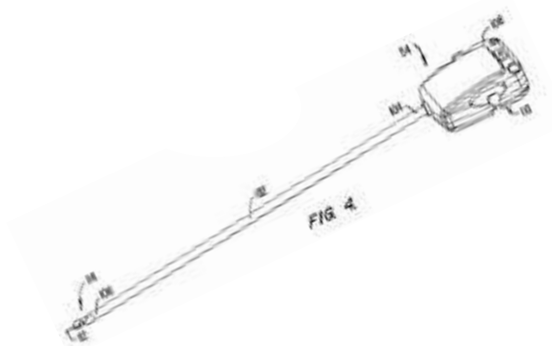
[2] Emphasis added to quotations throughout, unless otherwise stated.

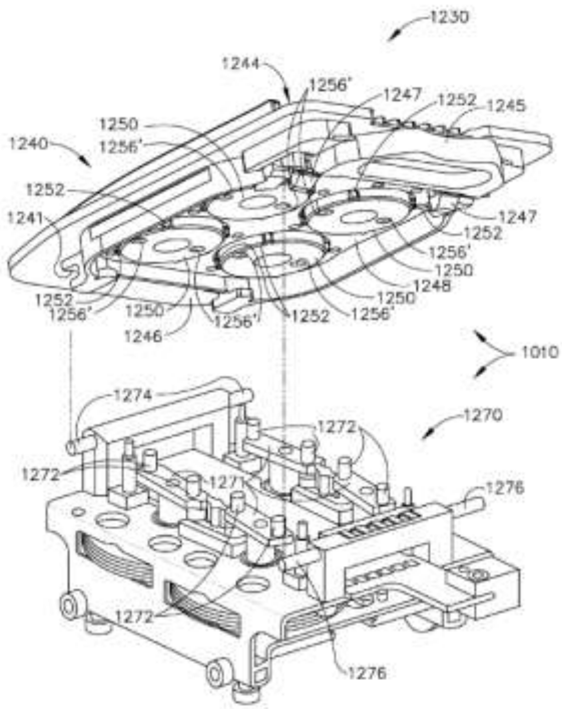
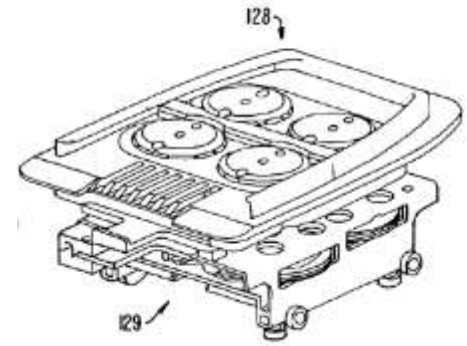
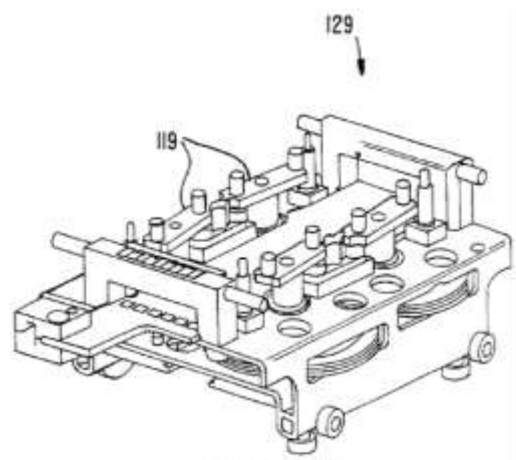
Drive interfaces for surgical robots were well-known in the prior art. In fact, the ’431 Patent incorporates by reference, and largely copies, the drive interfaces for surgical robots designed by Petitioner and disclosed by Petitioner in its prior art patents, including the Tierney reference used here. The ’431 Patent states:

> Over the years a variety of minimally invasive robotic (or “telesurgical”) systems have been developed to increase surgical dexterity as well as to permit a surgeon to operate on a patient in an intuitive manner. ***Many of such systems are disclosed in the following U.S. patents which are each herein incorporated by reference in their respective entirety: [such as]. . . U.S. Pat. No. 7,524,320, entitled “Mechanical Actuator Interface System For Robotic Surgical Tools” [(“Tierney”)] . . . .***

IS1001, 26:11-34. Not surprisingly, the ’431 Patent’s surgical robot bears a striking resemblance to Tierney’s (*i.e.*, Petitioner’s) surgical robot:

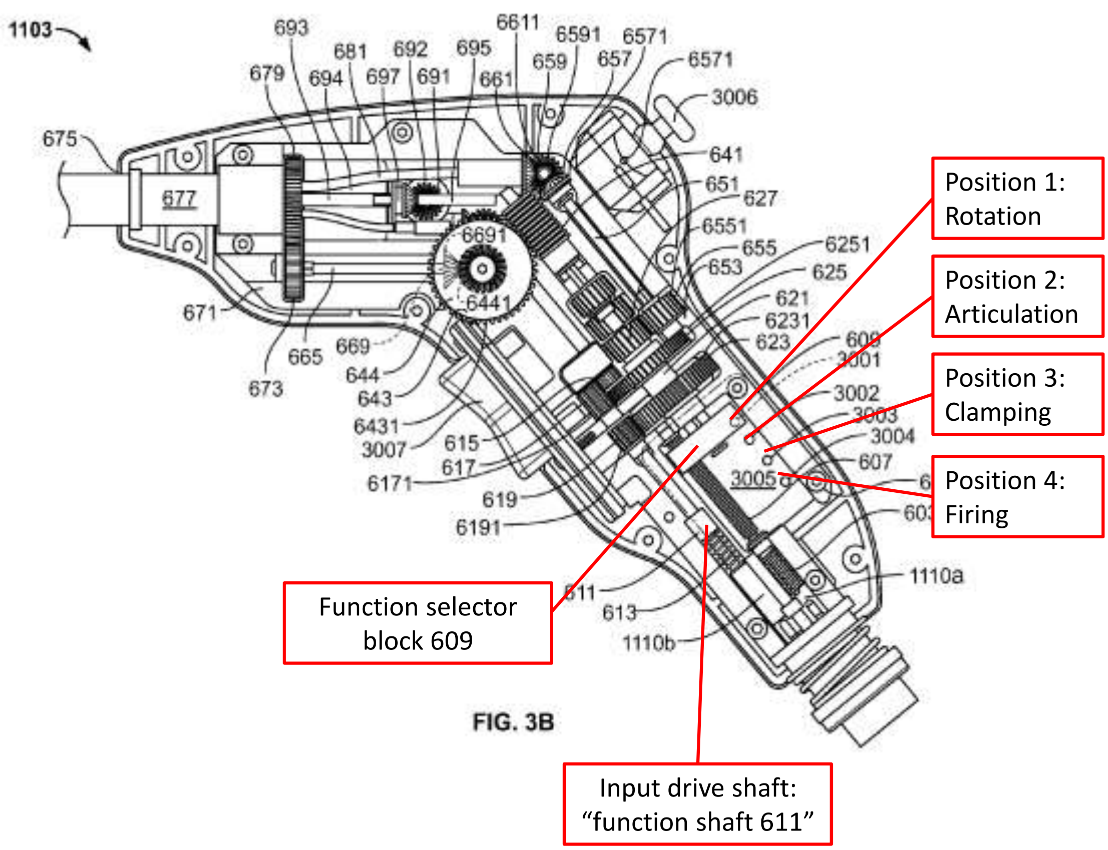
’431 Patent	**Tierney Prior Art**
Robotic Controller	
 FIG. 34	 FIG. 8B.

’431 Patent	**Tierney Prior Art**
Robotic Manipulator	
 FIG. 37	 FIG. 3A
Surgical Tool	
 FIG. 38	 FIG. 4

’431 Patent	**Tierney Prior Art**
Adapter and Tool Drive Assembly	
 FIG. 39	 FIG. 7F.  FIG. 7J.

Thus, the Applicant did not invent the first concept—namely, a drive interface for a robotically controlled surgical tool.

Likewise, the second concept—a shiftable transmission to choose among at least two functions of the surgical tool—was not new. Although the Shelton Application’s (*i.e.*, Patent Owner’s) prior art shiftable transmission merely changes the direction of a knife, other prior art shiftable transmissions selected among different functions. For example, Whitman disclosed a surgical instrument with a shiftable transmission that permits a single drive element to be selectively coupled using various shafts and gears to one of multiple drivers, to control four different functions of a surgical tool (rotation, articulation, clamping, and firing). IS1003, ¶¶38, 114, FIG. 3B. Each of these functions is selectively driven by "function shaft 611" depending on the placement of "function selector block 609." *Id.*, ¶¶92-94, 142-74, 241-44, FIG. 3B.



For the reasons explained more fully below, it would have been obvious to adapt Whitman's surgical instrument for use with Tierney's robotic surgical system. Whitman also anticipates certain claims of the '431 Patent.

Petitioner requests IPR of the challenged claims on Grounds 1-4 below.

II. MANDATORY NOTICES UNDER 37 C.F.R § 42.8

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Intuitive Surgical, Inc. is the real party-in-interest. No other party had access to the Petition, and no other party had any control over, or contributed to any funding of, the preparation or filing of the present Petition.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates, or petitions for *inter partes* review of the '431 Patent. The '431 Patent is the subject of Civil Action No. 1:17-cv-00871-LPS in the United States District Court for the District of Delaware. The '431 Patent was added to that action by an Amended Complaint filed on November 13, 2017. The Petitioner was served with the filed Amended Complaint the same day.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

LEAD COUNSEL	BACK-UP COUNSEL
Steven R. Katz, Reg. No. 43,706 3200 RBC Plaza 60 South Sixth Street Minneapolis, MN 55402 Tel: 617-542-5070 / Fax: 877-769-7945	John C. Phillips, Reg. No. 35,322 Tel: 858-678-5070 Ryan P. O'Connor, Reg. No. 60,254 Tel: 858-678-5070

D. Service Information

Please address all correspondence and service to the address listed above. Petitioner consents to electronic service by email at IPR11030-0049IP7@fr.com (referencing No. 11030-0049IP7 and cc'ing PTABInbound@fr.com, katz@fr.com, phillips@fr.com, and oconnor@fr.com).

III. PAYMENT OF FEES – 37 C.F.R. § 42.103

Petitioner authorizes the Office to charge Deposit Account No. 06-1050 for the petition fee set in 37 C.F.R. § 42.15(a) and for any other required fees.

IV. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

A. Grounds for Standing Under 37 C.F.R. § 42.104(a)

Petitioner certifies that the '431 Patent is available for IPR, and Petitioner is not barred or estopped from requesting IPR.

B. Challenge Under 37 C.F.R. § 42.104(b) and Relief Requested

Petitioner requests IPR of claims 1-7, 10-14, 16-20, 23-26 of the '431 Patent on the following grounds. An expert declaration by Dr. Knodel (IS1003) is included in support.

Ground	Claims	Basis for Rejection
Ground 1	1-6, 10-13	Obvious under 35 U.S.C. § 103 over Tierney (IS1005) in view of Whitman (IS1004)
Ground 2	7, 14, 16-20, 23-26	Obvious under 35 U.S.C. § 103 over Tierney (IS1005) in view of Whitman (IS1004) and further in view of Zemlok (IS1006)
Ground 3	1, 2, 6, 10-13	Anticipated under 35 U.S.C. § 102(b) by Whitman (IS1004)
Ground 4	11	Obvious under 35 U.S.C. § 103 over Tierney (IS1005) in view of Whitman (IS1004) and further in view of Timm (IS1009)

The ’431 Patent issued from U.S. App. No. 13/369,578, filed on Feb. 9, 2012, which is a continuation of U.S. App. No. 13/118,223, filed on May 27, 2011, now U.S. Pat. No. 8,931,682 (IS1009, “Timm Patent”), which is a continuation-in-part of U.S. App. No. 13/020,053, filed on Feb. 3, 2011, now U.S. Pat. No. 8,196,796 (IS1008, “Shelton Patent”), which is a continuation of U.S. App. No. 11/810,015, filed on June 4, 2007, now U.S. Pat. No. 7,905,380. Each claim recites new matter added by the May 27, 2011 CIP application, and thus the earliest possible date to which the claims of the ’431 Patent could claim priority is May 27, 2011 (“earliest possible effective filing date”). IS1003, Section VII; *compare* IS1008 (Shelton Patent) *with* IS1009 (Timm Patent) (adding the text at 3:25-4:2, 5:46-10:33, 10:43-11:17, 26:24-91:13, FIGs. 34-151 to the Timm Patent).

Whitman (IS1004) published on Apr. 23, 2009, which is more than one year before the earliest possible effective filing date, and thus qualifies as prior art under 35 U.S.C. § 102(b). Whitman was not made of record during prosecution of the ’431 Patent.

Tierney (IS1005) issued on Apr. 28, 2009, which is more than one year before the earliest possible effective filing date, and thus qualifies as prior art under 35 U.S.C. § 102(b). Tierney is incorporated by reference into the ’431 Patent, and its application served as a basis for rejection during prosecution.

Zemlok (IS1006) published on Oct. 16, 2008, which is more than one year before the earliest possible effective filing date, and thus qualifies as prior art under 35 U.S.C. § 102(b). Zemlok was made of record during prosecution of the ’431 Patent, but it never was discussed by the examiner or the applicant.

Timm Application (IS1016) published on Dec. 18, 2008, which is more than one year before the earliest possible effective filing date, and thus qualifies as prior art under 35 U.S.C. § 102(b). The patent that issued from the Timm Application was made of record during prosecution of the ’431 patent, but it never was discussed by the examiner or the applicant.

V. SUMMARY OF THE PROSECUTION HISTORY[3]

During prosecution of the ’431 Patent, the Examiner rejected many of the Applicant’s original claims as anticipated by U.S. App. No. 2002/0072736, which is assigned to Petitioner and discloses the same robotic surgical system as Tierney. IS1002, 374-77. The Examiner also rejected two of the Applicant’s original claims because they would have been obvious over the ’736 application in view of U.S. Patent No. 6,981,628. *Id.*, 377-79.

In response to this rejection, Patent Owner amended the rejected claims to

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[3] The chain of applications to which the ’431 Patent claims priority is provided above. *See* Section IV.B, *supra*.

require "application of separate control motions to different portions of an end effector from a single rotatable driven element of the tool drive assembly." *Id.*, 354-55 (emphasis in original). A notice of allowance subsequently issued. *Id.*, 168. In addition, a certificate of correction issued on July 25, 2017, making corrections to claims 1, 2, 6, and 7. *Id.*, 1. We apply the claims as amended by the certificate of correction. As explained below, however, application of separate control motions to different portions of an end effector from a single rotatable driven element of a tool drive assembly was not new.

VI. CLAIM CONSTRUCTION

For the purposes of this IPR only, Petitioner submits that the terms of the '431 Patent are to be given their broadest reasonable interpretation as understood by one of ordinary skill in the art at the time in view of the specification ("BRI").[4] 37 C.F.R. § 42.100(b).

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[4] Petitioner acknowledges that the Office has proposed to change from the BRI standard to the standard applied in District Courts. *See* 83 Fed. Reg. 21221 (proposed May 9, 2018). Petitioner submits that the prior art discussed herein invalidates the challenged claims under either standard. If the Office changes the rule after the filing of the Petition and applies the new standard to this proceeding, then

VII. THERE IS A REASONABLE LIKELIHOOD THAT AT LEAST ONE CLAIM OF THE '431 PATENT IS UNPATENTABLE

A. Ground 1: Claims 1-6 and 10-13 Are Obvious over Tierney in View of Whitman

[1.1] A tool mounting device for coupling a surgical end effector configured to selectively perform at least two actions in response to control motions applied thereto to a tool drive assembly of a robotic system that is operatively coupled to a control unit of the robotic system, said tool mounting device comprising

If this preamble is deemed to be a limitation, Tierney discloses it. IS1003, ¶43.

"<u>A tool mounting device for coupling a surgical end effector . . . to a tool drive assembly of a robotic system . . .</u>"

Tierney discloses a tool mounting device (the combination of rigid shaft 102, proximal housing 108, and adapter 128) for coupling a surgical end effector 112 to a tool drive assembly (the combination of tool holder 129, drive elements 119, and motors 70 of manipulator 58). *Id.*, ¶44; IS1005, FIGs. 1-7L, 14A-C.

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due process requires the Office afford Petitioner an opportunity to provide additional argument and evidence on that issue.

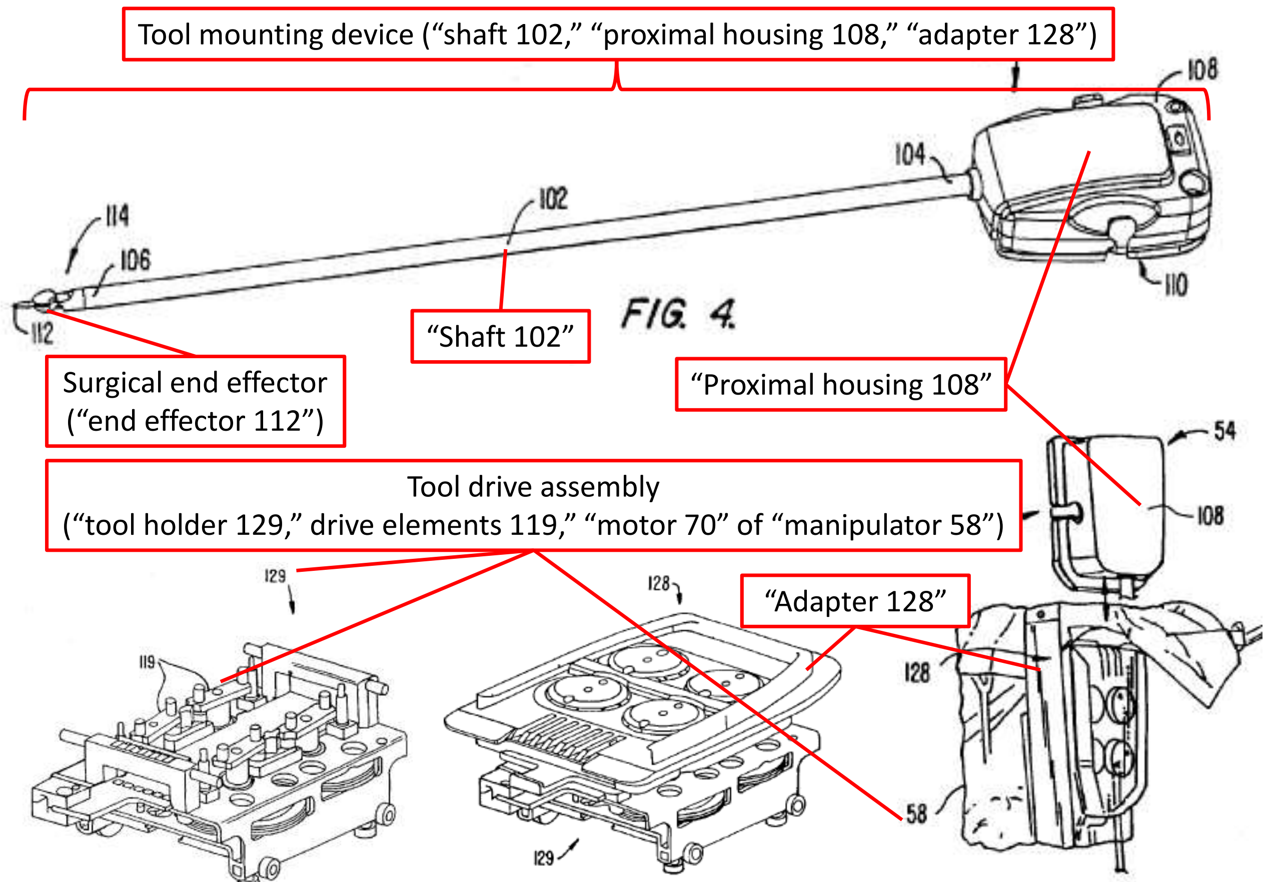

FIG. 4.

FIG. 7J.

FIG. 7F.

FIG. 14C.

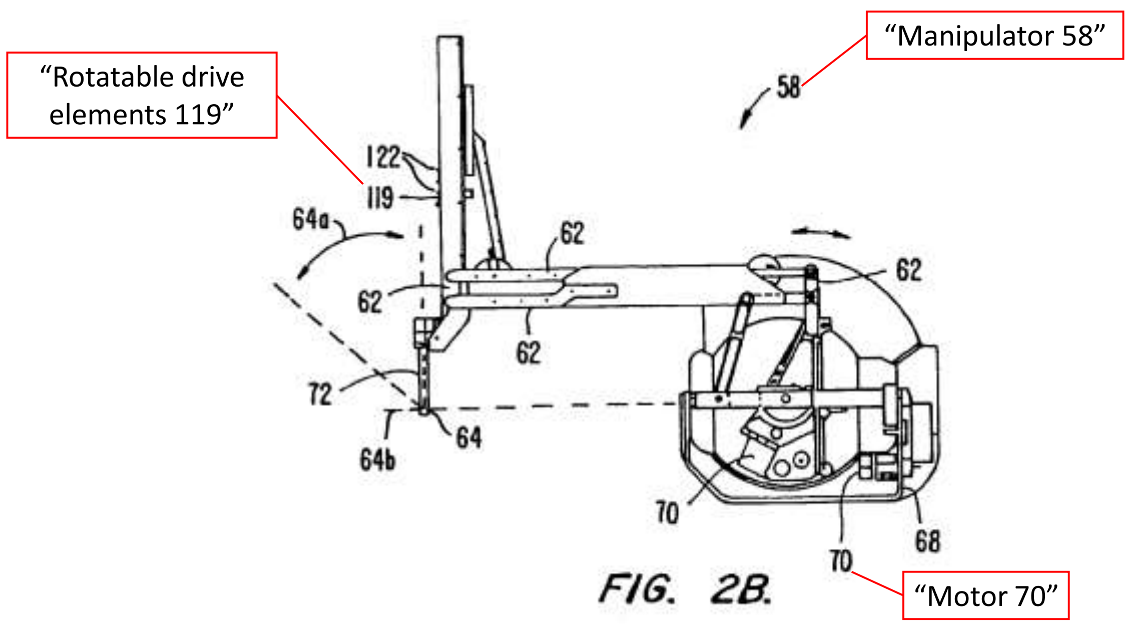

FIG. 2B.

As shown above in FIGs. 4 and 7F, rigid shaft 102 couples end effector 112 to proximal housing 108, and adapter 128 couples proximal housing 108 to the combination of tool holder 129, drive elements 119, and motor 70 of manipulator 58. *Id*.

The tool drive assembly is part of a "robotic surgical system 10[, which] generally includes master controller 150 and a robotic arm slave cart 50." *Id.*, 7:1-3, FIG. 1.

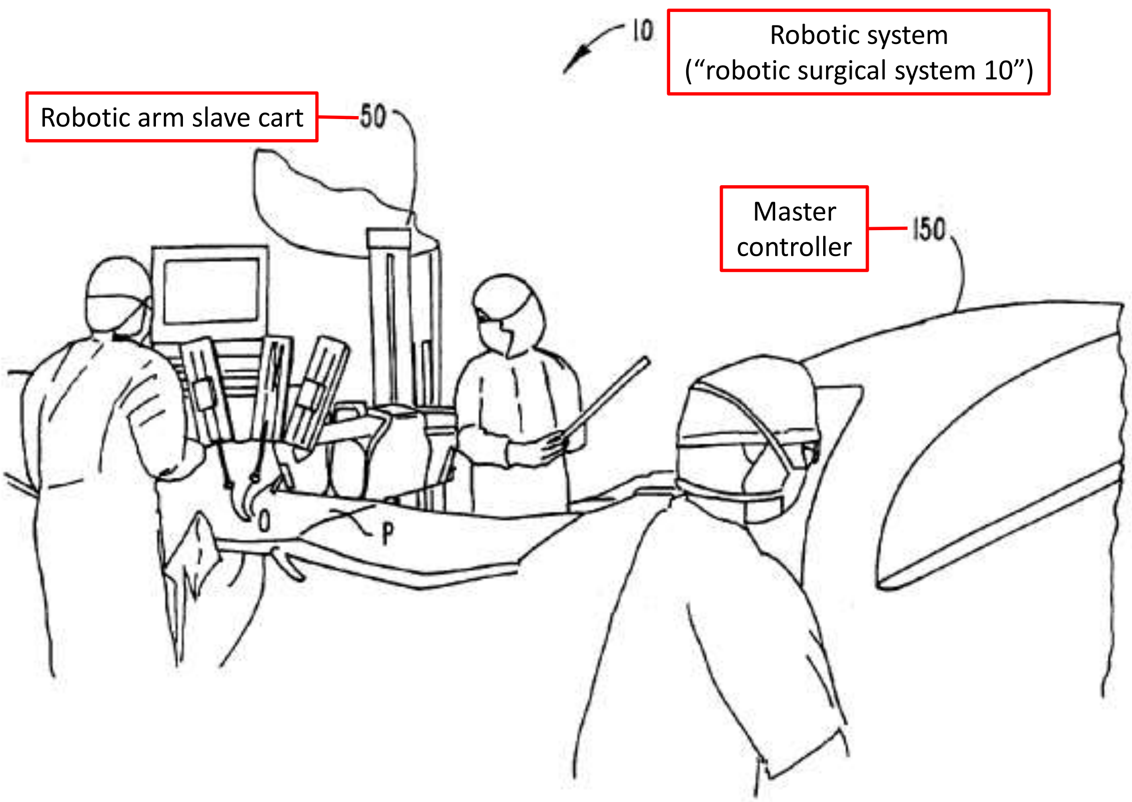

FIG. 1.

As shown in Section I.B. above, the Tierney surgical robot is incorporated by reference into the '431 Patent, and the '431 Patent figures are strikingly similar to Tierney's figures.

"Surgical end effector configured to selectively perform at least two actions in response to control motions applied thereto"

Tierney's end effector 112 is configured to selectively perform at least two actions (*e.g.*, at least two of rotation, opening, closing, cutting, and articulating) in response to control motions provided by "drive system 116." IS1005, 9:19-10:11, FIGs. 4A-5H. As explained in Tierney, "drive system 116 mechanically couples first and second end effector elements 112a, 112b to driven elements 118 of interface 110 [of proximal housing 108]. . . . Stated simply, the drive system [116] translates mechanical inputs from driven elements 118 into ***articulation*** of the wrist about first and second axes A1, A2, as well as into ***actuation*** of the two element end effector by relative movement of the end effector elements about axis A2." *Id.*, 9:19-28. Accordingly, "articulation of the wrist" and "actuation of the two element end effector" comprise the recited "at least two actions" that the surgical end effector can perform. IS1003, ¶46.

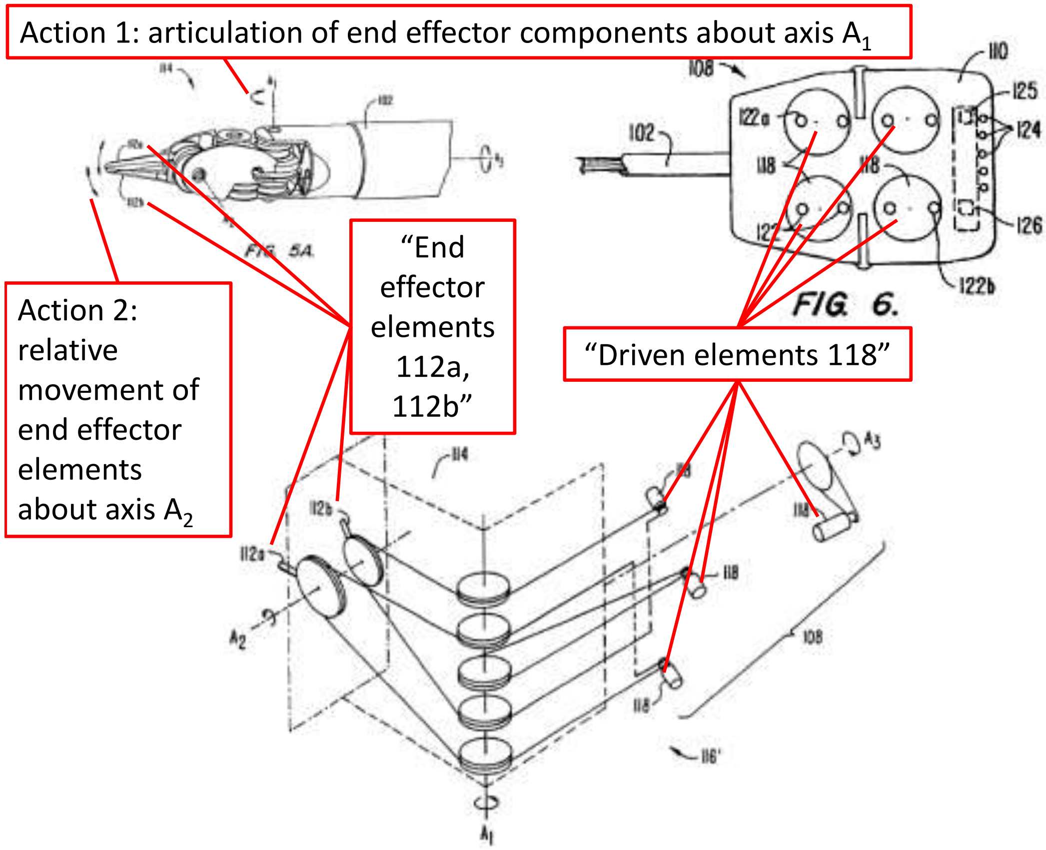

FIG. 4B.

IS1005, FIG. 4B.

“[<u>The tool drive assembly of a robotic system] is operatively coupled to a control unit of the robotic system</u>”

Tierney’s tool drive assembly (the combination of tool holder 129, drive elements 119, and motor 70 of manipulator 58) is operatively coupled to a control unit (master controller 150) of robotic surgical system 10. IS1003, ¶47. As shown below, drive elements 119 of tool holder 129 are part of manipulator 58, which is operatively coupled to processor 152 of master controller 150 by remote interface adapter (“RIA”) 56. IS1005, 7:1-3, 11:30-32, 12:45-58, FIGs. 1-2B, 8A-9.

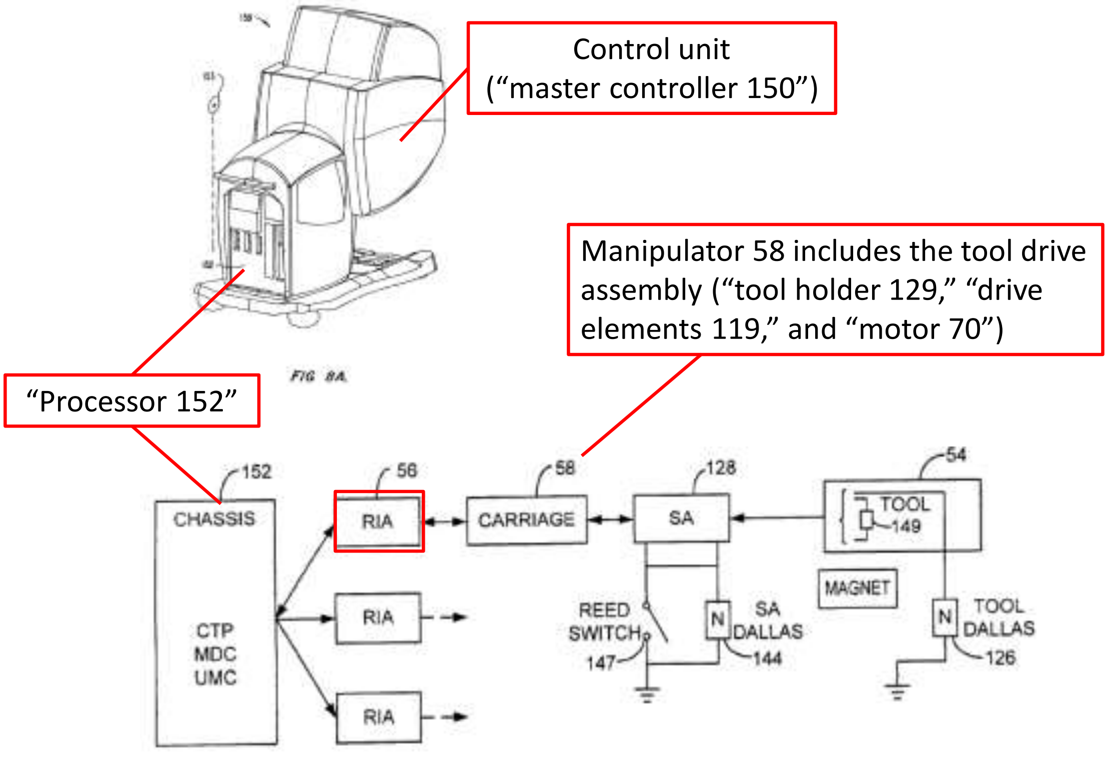

FIG. 9.

[1.2] a tool mounting portion configured for operable attachment to the tool drive assembly of the robotic system

Tierney discloses this limitation. IS1003, ¶48. As shown above in element [1.1], Tierney's tool mounting device includes a tool mounting portion (proximal housing 108) configured for releasable attachment to the tool drive assembly (the combination of tool holder 129, drive elements 119, and motor 70) of Tierney's robotic surgical system 10. *Id.*; IS1005, 10:44-11:32, FIG. 7F; *see also* FIG. 14B (mounting adapter[5] 128 to tool holder 129 of the tool drive assembly), FIG. 14C (mounting proximal housing 108 to adapter 128).

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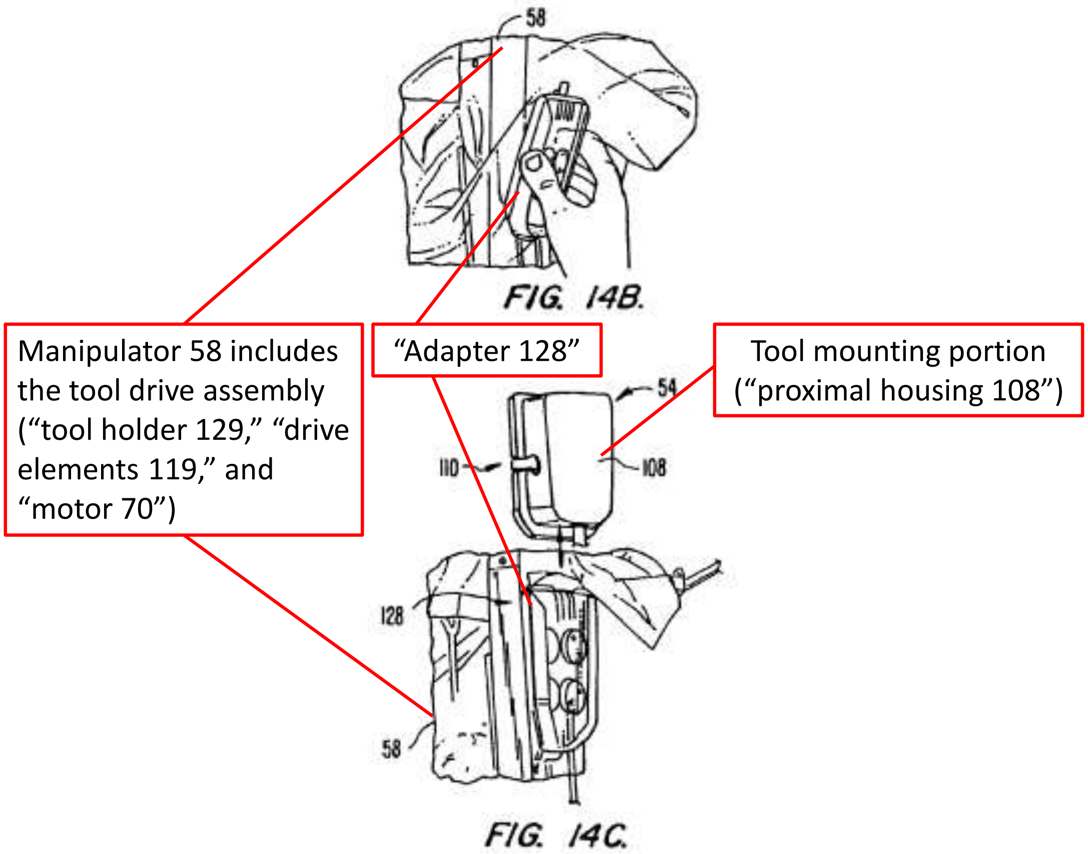
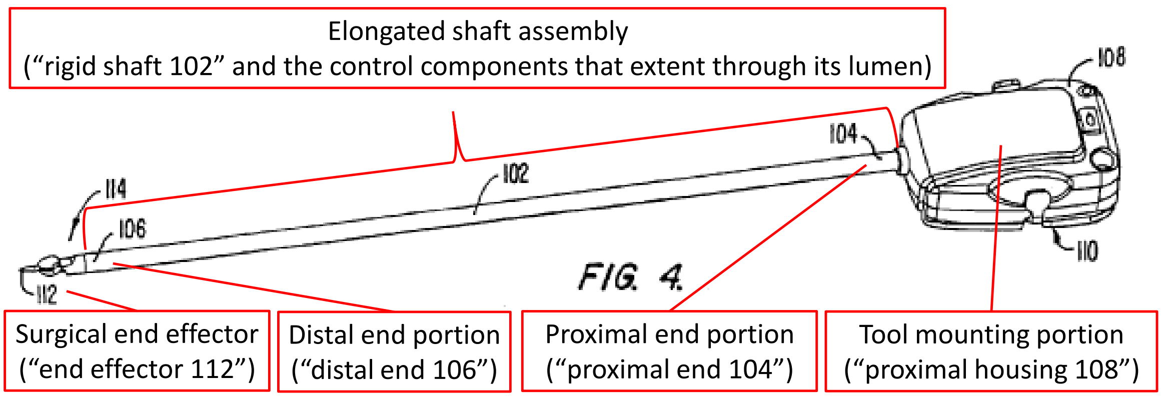
[5] Tierney uses interchangeably the spelling "adapter" and "adaptor."



As explained in Tierney, "[a] proximal housing 108 includes an interface 110 which mechanically and electrically couples tool 54 to the manipulator [58]." *Id.*, 9:12-14. The manipulator 58 holds the tool drive assembly including the motor 70 and tool holder 129. *Id.*, 4:42-54. Tierney's robotic system may also use an adapter to provide a sterile boundary between the tool drive assembly and the tool itself. Tierney explains that a "latch 145 releasably affixes the adaptor [128] to the holder [129]." *Id.*, 11:23-24, FIG. 7D. And "[o]penings 140 on the . . . [tool] holder side 132 of rotatable bodies 134 [of adapter 128] are configured to accurately align the driven elements 118 of the tool with the drive elements [119] of the [tool] holder [129]." *Id.*, 11:1-4, FIGs. 7A-M.

[1.3] an elongated shaft assembly having a proximal end portion operably supported on said tool mounting portion and a distal end portion operably interfacing with said surgical end effector to apply said control motions thereto

Tierney discloses this limitation. IS1003, ¶49. Tierney discloses an elongated shaft assembly (including rigid shaft 102 and the control components that extend through its central lumen) that has a proximal end 104 and a distal end 106. *Id.*; IS1005, 9:11-18, FIG. 4. The proximal end connects to the tool mounting portion (proximal housing 108, which may also include adapter 128) and the distal end connects to the end effector 112 to apply the control motions thereto.



[1.4] a transmission arrangement operably supported on said tool mounting portion

Tierney discloses this limitation. IS1003, ¶50. Tierney discloses a transmission arrangement (tool transmission system) operably supported on the tool mounting portion (proximal housing 108). *Id.*; IS1005, 9:19-21, 15:50-58, FIGs. 4A-B. Tierney's tool transmission system includes a "drive system 116 [that] mechanically couples first and second end effector elements 112a, 112b to driven elements 118 of interface 110" of proximal housing 108. *Id.* Like the transmission arrangement in the '431 Patent, Tierney's drive system transmits mechanical power from a source of rotary output motion to a driven component. *Id.* Furthermore, as shown in FIGs. 4A-B, portions of the drive system 116 are inside, and supported by, the tool mounting portion (proximal housing 108). *Id.* Other portions of drive system 116 extend through the rigid shaft 102, which is also supported by the proximal housing 108. *Id.* The shaft is physically connected to, and is held in place by, proximal housing 108. *Id.*, 9:11-46, FIGs. 4A-B.

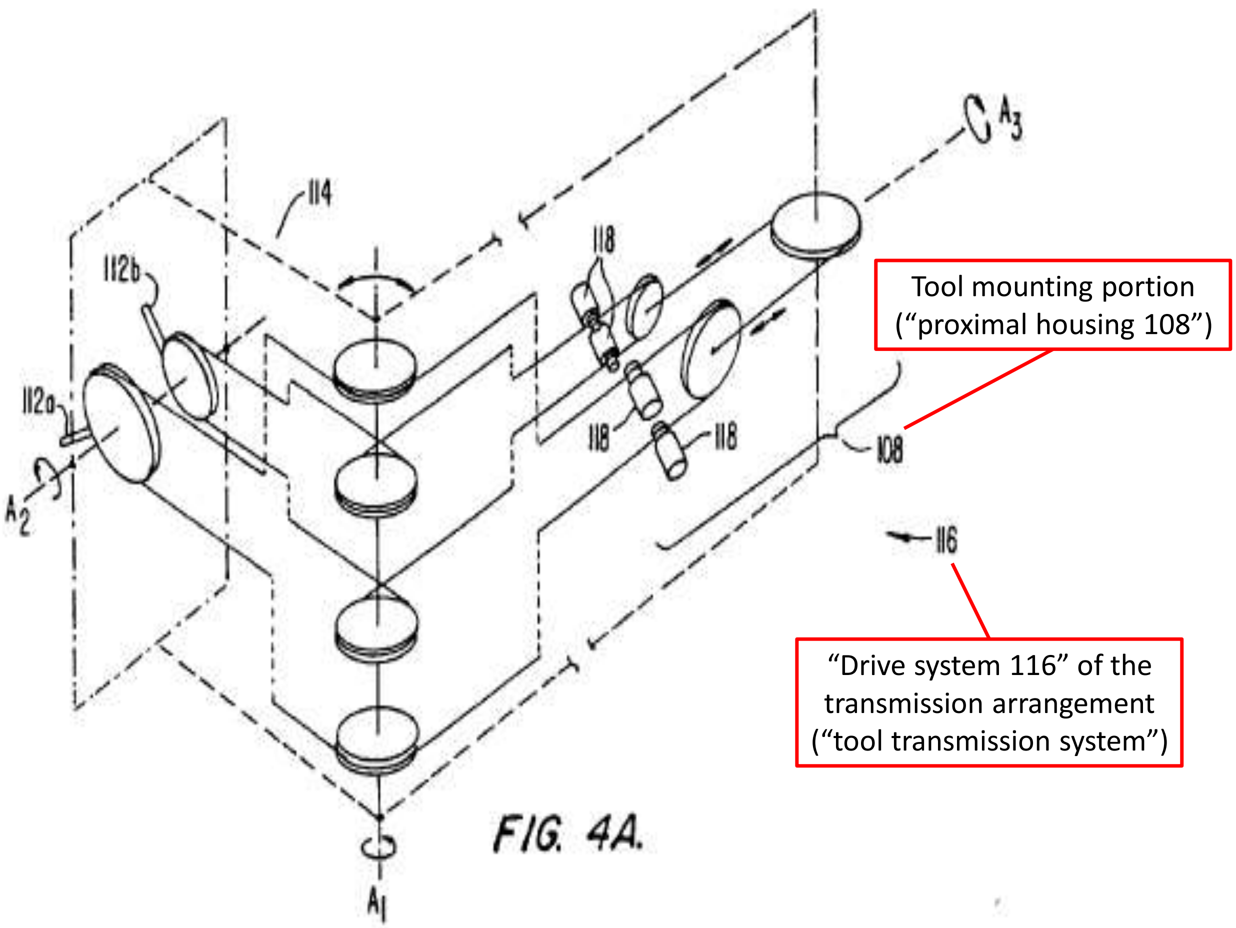
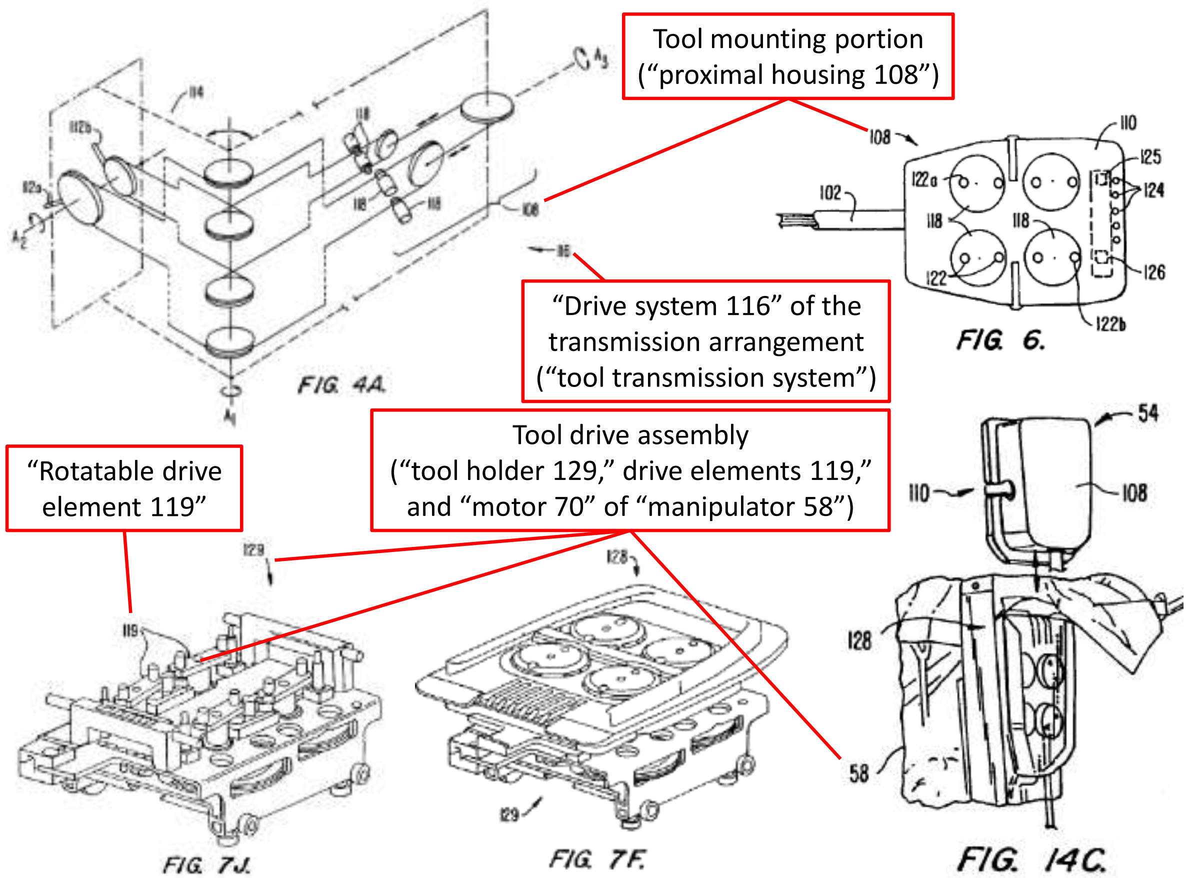


FIG. 4A.

Tierney's transmission arrangement does not move between first and second positions to couple drive motions from a single drive element to first and second end effector functions (*e.g.*, shift between cutting and articulating), as specified later in the claim. Nonetheless, Whitman discloses such a transmission arrangement, as will be described below. *See* Ground 1, elements [1.6]-[1.8].

[1.5] such that when said tool mounting portion is attached to the tool drive assembly said transmission arrangement is configured to operably interface with a rotatable drive element of the tool drive assembly to receive a rotary output motion therefrom

Tierney discloses this limitation. IS1003, ¶53. When Tierney's tool mounting portion (proximal housing 108) is attached to the tool drive assembly (the combination of tool holder 129, drive elements 119, and motor 70 of manipulator 58), Tierney's transmission arrangement (tool transmission system) is configured to operably interface with rotatable drive element 119 of the tool drive assembly to receive a rotary output motion therefrom. *Id*. Tierney, for example, discloses attaching the tool mounting portion to the tool drive assembly via an adapter. *Id.*; IS1005, 10:12-20, 10:44-11:32, FIGs. 4A-B, 6, 7A-M. In such an embodiment, driven elements 118 are coupled to, and receive rotary motion from, rotatable bodies 134 on adapter 128, which are coupled to, and receive rotary motion from, drive elements 119 of the tool drive assembly to receive rotary output motions therefrom. *Id*. Thus, drive elements 119 drive rotatable bodies 134 of adapter 128, which, in turn, drive driven elements 118 of the surgical instrument. The adapter, when used, may be part of the transmission arrangement interfacing with the rotatable drive elements of the tool drive assembly. IS1003, ¶53.



[1.6] said transmission arrangement communicating with the control unit of the robotic system and being responsive to actuation motions therefrom to move between first and second positions

Tierney in view of Whitman discloses this limitation. IS1003, ¶54.

Whitman discloses a transmission arrangement (including function selector module 1110[6]) communicating with a control unit (*e.g.*, controller 1122) of a robotic system. For example, function selector module 1110 reports its status back to

[6] Whitman describe component 1110 as a "selector module" and a "selection module." Except where quoting the specification, the former is used herein.

controller 1122: "Depending on the position of the function selector block 609 [of function selector module 1110], corresponding signals to and from various ones of the optical sensors 3001, 3002, 3003 and 3004 [of function selector module 1110] are blocked, thereby providing a suitable controller [1122] with an indication when the surgical device 11 is in one of the four above-described functional positions." IS1004, ¶226; *see also* ¶¶140, 147, 221, 231, 240-244, 220 ("controller 1122 . . . is configured to control all functions and operations of" the surgical device 11).

Whitman's transmission arrangement (including function selector module 1110) is also responsive to actuation motions (*e.g.*, actuation of first motor 96) from Whitman's control unit (controller 1122) to move between first and second positions (and in fact, it moves between four positions). IS1003, ¶55. "Generally, the function selector module 1110 is actuatable by a first rotatable drive shaft 1110a so as to move between a plurality of different functional positions." IS1004, ¶76, FIG. 3B. As shown below, function selector module 1110 includes a function selector block 609 and a selector shaft 601. *Id.*, FIG. 3B. "The threaded portion 607 of the selector shaft 601 extends through the threaded bore of the function selector block 609 . . . such that, . . . rotation of the selector shaft 601 . . . causes the function selector block 609 to move distally and proximally along the selector shaft 601." *Id.*, ¶93. "[R]otation of the first rotatable drive shaft 1110a causes rotation of the selector shaft 601." *Id.*, ¶92.

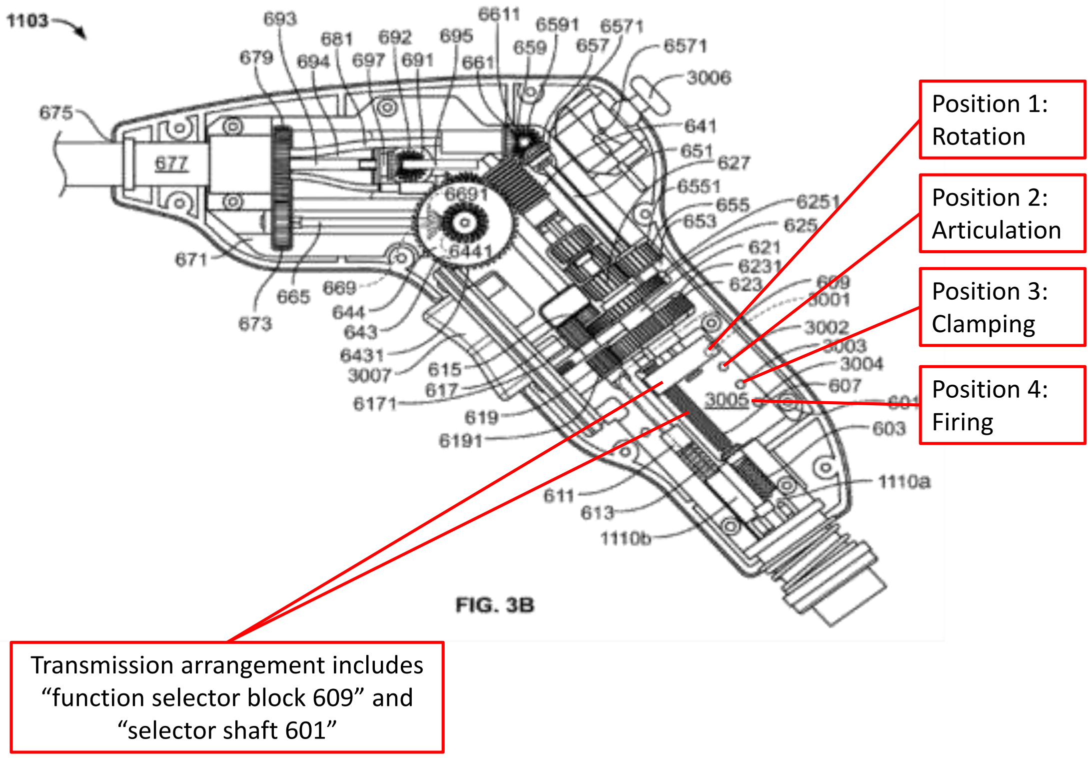


FIG. 3B

Whitman’s controller 1122 controls “first motor 96” via “line[] 1116” which “electrically and logically connect[s]” the controller to the first motor. *Id.*, ¶221. The first motor 96 drives a series of shafts, including first rotating drive shaft 1110a and selector shaft 601, which control the positioning of the function selector block 609 of function selector module 1110. *Id.*, ¶¶77, 92-93, 221, FIG. 12.

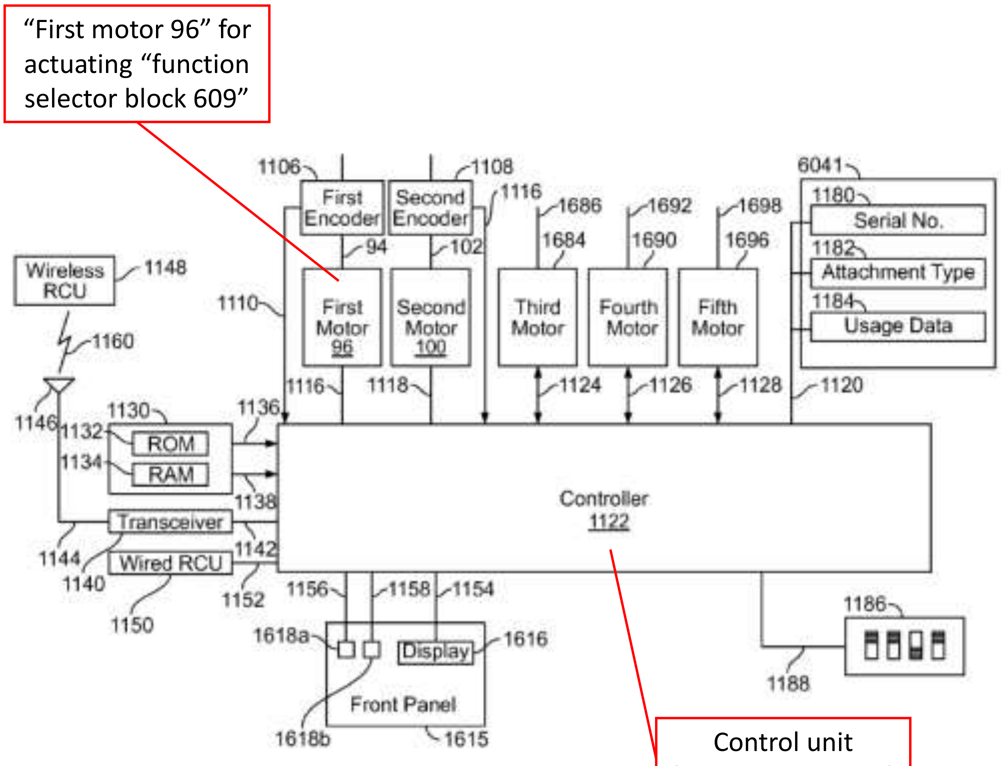
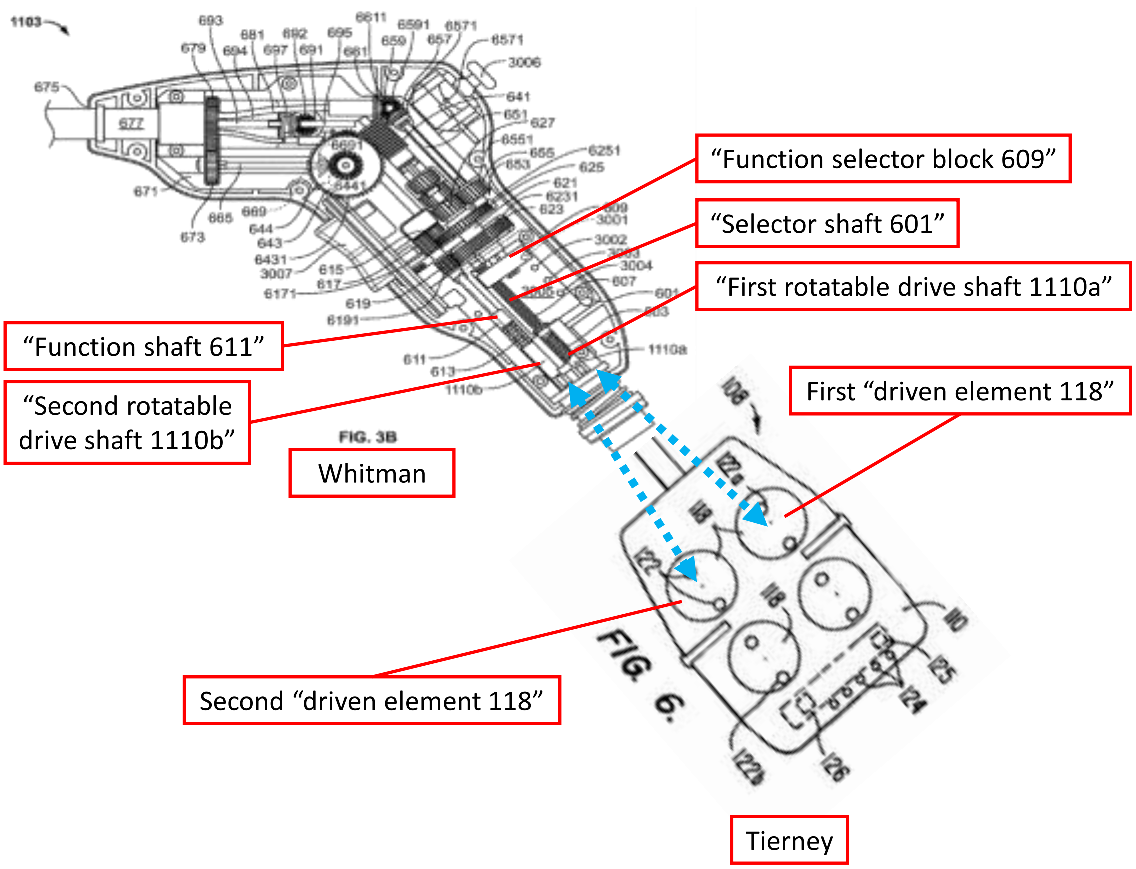


FIG. 12

It would have been obvious to adapt Whitman's surgical device 11 for use with Tierney's robotic system such that Whitman's transmission is responsive to actuation motions from the controller of Tierney's robotic system to move between at least first and second positions. IS1003, ¶57. In this combination, Whitman's elongated shaft assembly and end effector would be used, as would Whitman's transmission arrangement. However, Whitman's handle 1103 would be replaced with Tierney's proximal housing 108. To the extent the components of Whitman's transmission arrangement are located in Whitman's handle, these components would be moved to Tierney's proximal housing 108. A first one of Tierney's driven elements 118 would drive Whitman's first rotatable drive shaft 1110a (now in Tierney's proximal housing 108), which drives selector shaft 601 to shift the position of function selector block 609, which selects the desired end effector function to be driven (rotation, articulation, clamping, or firing). *Id*. A second one of Tierney's driven elements 118 would drive Whitman's "second rotatable drive shaft 1110b" (also, now located in Tierney's proximal housing 108) to rotate "function shaft 611," which provides the mechanical power to drive the selected end effector function (*i.e.*, rotation, articulation, clamping, or firing). *Id*.



Accordingly, in this combination, the surgical instrument would have a transmission arrangement (including the combination of Whitman's function selector module 1110 and drive shafts 1110a/1110b with two of Tierney's driven elements 118 and, if used, rotatable bodies 134 from Tierney's adapter 128) in communication with the robotic control unit (master controller 150) of Tierney's robotic surgical system 10. IS1003, ¶58. Tierney's control unit would direct Tierney's motors to actuate drive elements 119 (which drive corresponding driven elements 118) to shift Whitman's function selector module 1110 between first and second functions, and to provide the mechanical power to actuate these first and second functions. *Id.* In addition, in the combination, the signals from the function selector module 1110 that inform the controller of the position of function selector block 609 are transmitted back to Tierney's control unit via the "electrical connection pins 124" within proximal housing 108. *Id.*

A POSITA would have been motivated to modify Tierney to use the surgical instrument of Whitman for a number of reasons. **First**, a POSITA would have been motivated to use Whitman to increase the number of functions that can be performed on the end effector. *Id.*, ¶59. Tierney has four drive elements 119 and, without Whitman's modifications, Tierney can drive only four end effector functions with its four rotatable drive elements. With Whitman's transmission shifter, two rotary drive elements 119 can drive at least four different functions. One drive element shifts among the four possible functions and the other drive element provides the rotary power for the selected function. *Id.* Thus, in the Tierney/Whitman combination, the tool drive can power more functions than there are drive elements. For example, two drive elements could provide the four functions of Tierney, or four drive elements could provide at least 6 to 8 functions (depending on whether the combination would have one or two Whitman shifters).

Second, Whitman itself describes the benefit of using its shifter mechanism as enabling a drive shaft to drive multiple functions. *Id.*, ¶60. For example, Whitman describes a "surgical attachment" wherein a "first rotatable drive shaft is configured, upon actuation, to cause selective engagement of one of the first, second, third and fourth drivers with the second rotatable drive shaft, and wherein the second rotatable drive shaft is configured to drive the selectively engaged one of the first, second, third and fourth drivers." IS1004, ¶17.

Third, Tierney suggests its robotic surgical system may be combined with a variety of surgical instruments and thus a POSITA (who would be familiar with Whitman and Tierney) would be motivated by Tierney to adapt Whitman's surgical instrument for robotic use to improve the safety, accuracy, and speed of surgery using the Whitman device: "This invention relates to robotically assisted surgery, and more particularly provides surgical tools having improved mechanical and/or data interface capabilities to enhance the safety, accuracy, and speed of minimally invasive and other robotically enhanced surgical procedures." IS1005, 1:32-36. Tierney further states that "[o]ne or more of the robotic arms will often support a surgical tool which may be articulated (such as jaws, scissors, graspers, needle holders, microdissectors, ***staple appliers***, tackers, suction/irrigation tools clip appliers, or the like) or non-articulated (such as cutting blades, cautery probes, irrigators, catheters, suction orifices, or the like)." *Id.*, 6:31-37. Whitman is such a surgical instrument: "[T]he present invention relates to a powered, rotating and/or articulating device for clamping, cutting and stapling tissue." IS1004, ¶3. Tierney thus suggests adapting Whitman for use with its surgical robot. IS1003, ¶61.

Moreover, such a modification of Whitman's surgical instrument 11 would have been well within a POSITA's abilities for several reasons. First, it would have been merely the application of a known technique (*e.g.*, using a robotic arm and control unit) to manipulate a known system (*e.g*., Whitman's surgical instrument 11) in the same field of endeavor (motor-driven surgical devices). *Id.*, ¶62; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) ("[W]hen a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an arrangement, the combination is obvious."). Second, in combination, each element (Whitman's surgical instrument 11 and Tierney's robotic arm and control unit) merely performs the same function as it does separately. IS1003, ¶62. The combination of Whitman and Tierney proposed here would have yielded predictable results without significantly altering or hindering the functions performed by Whitman's or Tierney's device. *Id*.

Finally, adapting Whitman's surgical instrument for use with the Tierney robotic system was an obvious design choice. *Id.*, ¶63. As recognized by the '431 Patent, "[m]any [robotic] systems are disclosed in [the prior art]." IS1001, 26:11-31. Accordingly, a POSITA would have recognized that a robotic system, like Tierney's, is an effective and efficient mechanism for manipulating Whitman's surgical instrument 11. IS1003, ¶63. Moreover, well before the earliest possible effective filing date there was a general trend to modify known surgical instrument types for use with surgical robots like the Tierney surgical robot, and thus general knowledge in the art would have led a POSITA to combine any surgical instrument type, and certainly laparoscopic instruments (such as that disclosed by Whitman) for use with existing surgical robots, such as that disclosed in Tierney. *Id.* Indeed, the '431 Patent explicitly admits that there was a motivation to use Tierney's surgical robot because it "increase[s] surgical dexterity [and] permit[s] a surgeon to operate on a patient in an intuitive manner." IS1001, 26:11-31.

[1.7] such that when said transmission arrangement is in said first position, an application of said rotary output motion thereto by said rotatable drive element of the tool drive assembly causes a first one of said control motions to be applied to a portion of said surgical end effector through said elongated shaft assembly and when said transmission arrangement is in said second position, said application of said rotary output motion thereto by said rotatable drive element of the tool drive assembly causes a second one of said control motions to be applied to another portion of said surgical end effector through said elongated shaft assembly.

Tierney in view of Whitman discloses this limitation. *Id.*, ¶64. The recited "first position" corresponds, for example, to the first position of Whitman's function selector block 609, and the recited "second position" corresponds, for example, to the third position of Whitman's function selector block 609. *Id.*, ¶65.

In Whitman's transmission, when the function selector module 1110 is in the first position (rotation), an application of rotary output motion thereto by rotatable drive element 119 of Tierney's tool drive assembly (via rotatable driven element 118) causes a first control motion (rotary control motion of Whitman's transmission) to be applied to a portion (cartridge housing coupling 535) of the surgical end effector (jaw portion 11a) through the elongated shaft assembly (shaft portion 11b and hinge portion 11c). *Id.*, ¶66; IS1004, ¶¶79, 139-54, FIGs. 2B, 3A, 4B, 4D, 5A-B, 6A-B.

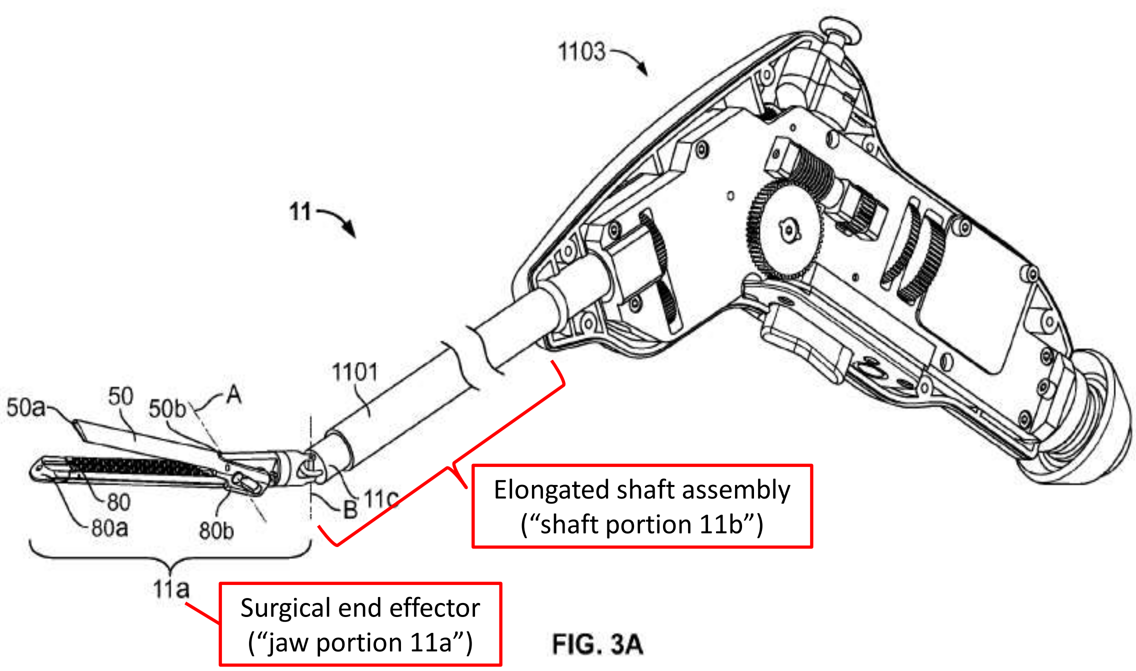
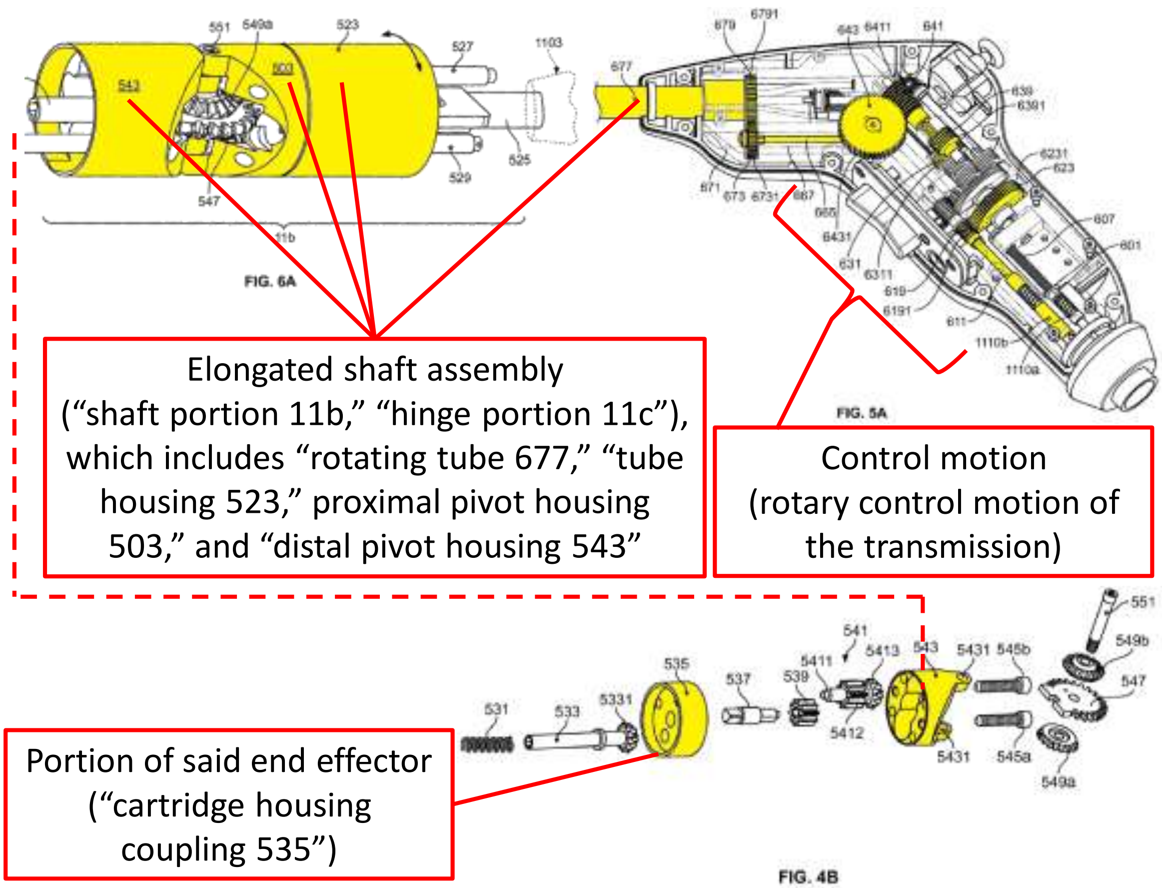
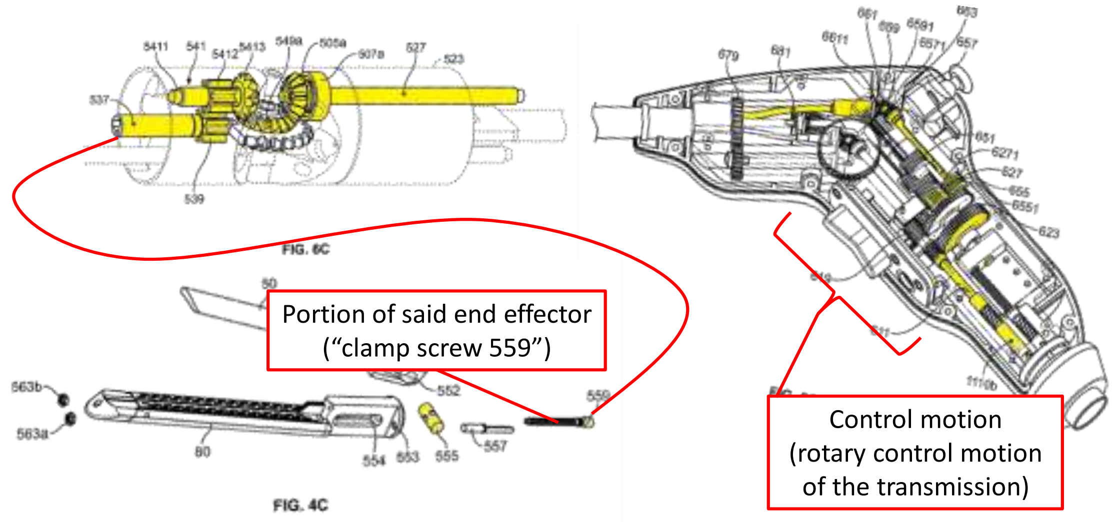


FIG. 3A

For rotation, the rotary control motion of the transmission is applied to cartridge housing coupling 535 through the rotating tube 677, tube housing 523, and distal pivot housing 543 components of the elongated shaft assembly. *Id.*

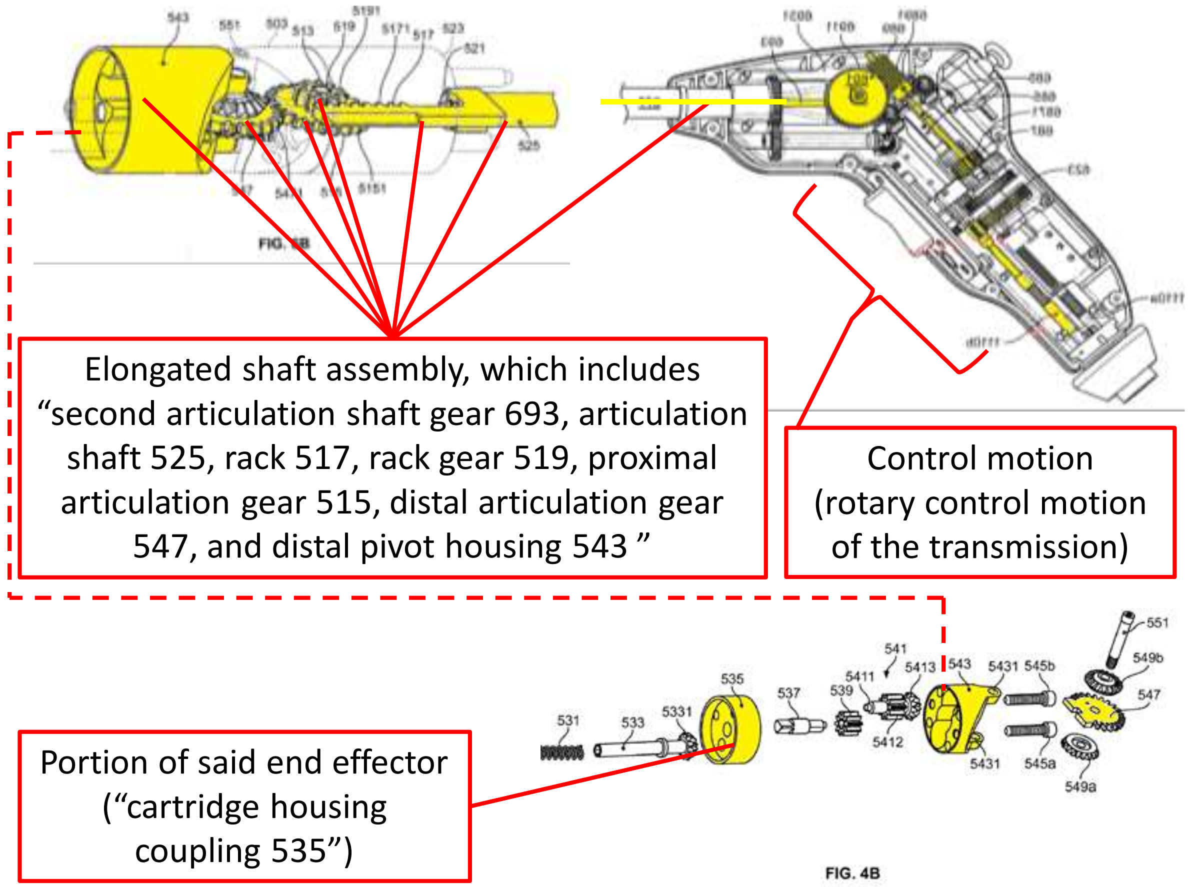


When the function selector module 1110 of Whitman’s transmission arrangement is in the third position (clamping), an application of rotary output motion thereto by rotatable drive element 119 of Tierney’s tool drive assembly (via rotatable driven element 118) causes a first control motion (rotary control motion of Whitman’s transmission) to be applied to another portion (clamp screw 559) of the surgical end effector (jaw portion 11a) through the elongated shaft assembly (shaft portion 11b and hinge portion 11c). IS1003, ¶69.



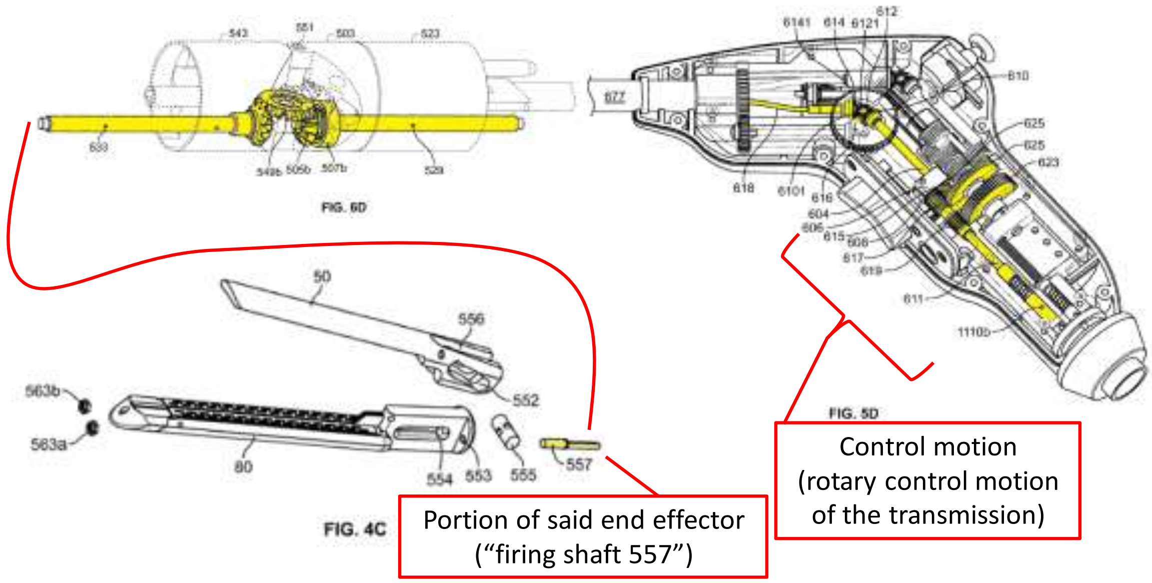
IS1004, FIGs. 4C, 5C, 6C (illustrating control path for clamping).

The recited first and second positions may be associated with other Whitman functions. For example, for articulation, the control motion is applied through the second articulation shaft gear 693, articulation shaft 525, rack 517, rack gear 519, proximal articulation gear 515, distal articulation gear 547, and distal pivot housing 543 components of the elongated shaft assembly. IS1003, ¶68.



IS1004, FIGs. 4B, 5B, 6B.

And when Whitman is in the fourth position, the first control motion is applied to another portion (firing shaft 557) of the surgical end effector (jaw portion 11a) through the elongated shaft assembly (shaft portion 11b and hinge portion 11c). IS1003, ¶69.



IS1004, FIGs. 4C, 5D, 6D (illustrating control path for firing).

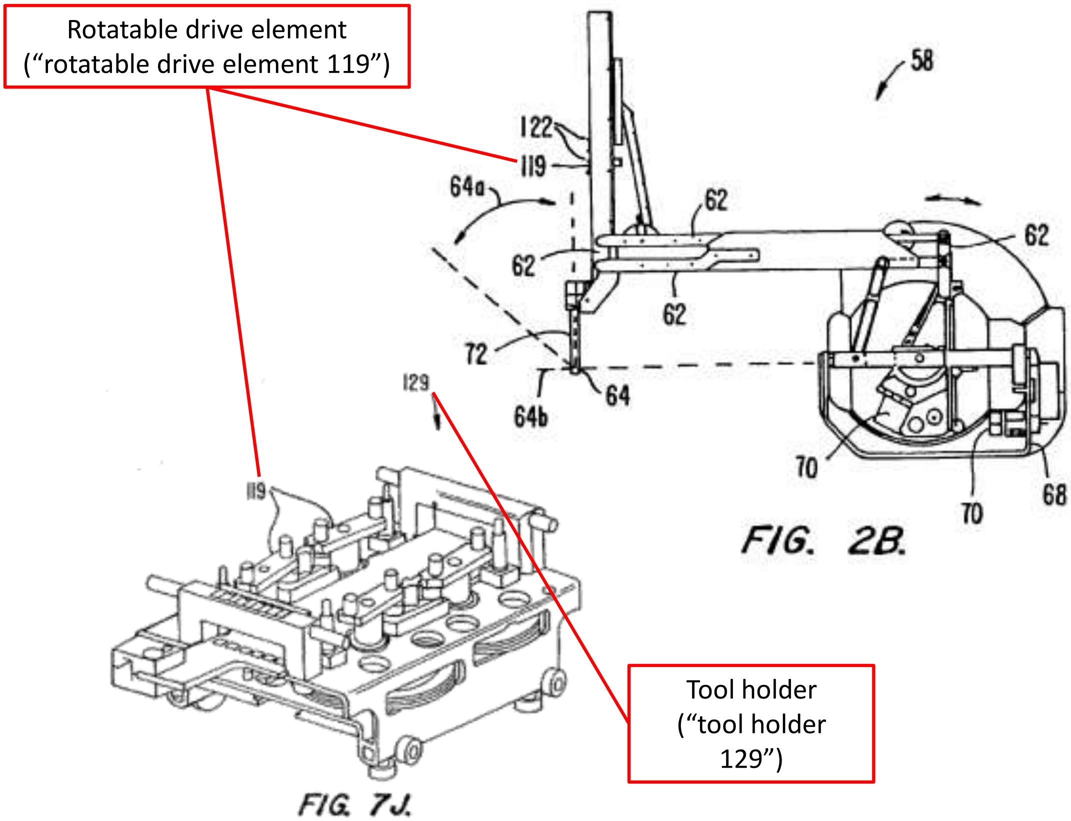
Thus, for example, the rotation or articulation position of Whitman's transmission arrangement can correspond to the "first position" and the clamping or firing position can correspond to the "second position" recited in the claim. IS1003, ¶71. Other combinations are also possible. *Id*.

[2.1] The tool mounting device of claim 1

See Ground 1, claim [1].

[2.2] wherein the tool drive assembly of the robotic system comprises at least one rotatable drive element operably supported on a tool holder and

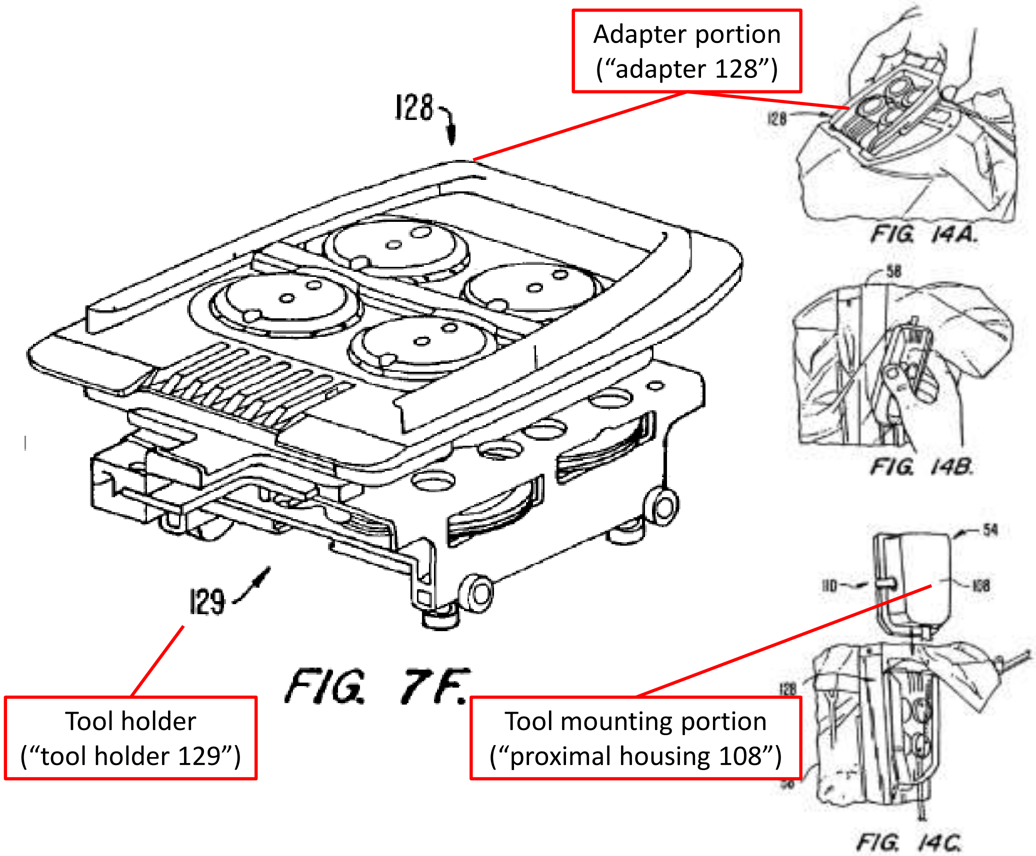
Tierney discloses this limitation. *See* IS1003, ¶73. Tierney discloses a tool drive assembly (the combination of tool holder 129, drive elements 119, and motor 70 of manipulator 58) that comprises at least one rotatable drive element (one of the four drive elements 119) operably supported on a tool holder 129. *Id.*; IS1005, 11:30-32, FIGs. 7F-M.



Id., FIGs. 7J and 2B.

[2.3] wherein said tool mounting device further comprises an adapter portion operably attachable to the tool holder and said tool mounting portion for establishing an interface there between,

Tierney discloses this limitation. IS1003, ¶74. Tierney discloses an adapter portion (adapter 128) that is operably attachable to the tool holder 129 and the tool mounting portion (proximal housing 108) to establish an interface there between. *Id.*; IS1005, 10:35-11:32, FIGs. 7F, 14A-C.



This is substantially the same adapter disclosed in FIG. 39 of the ’431 Patent:

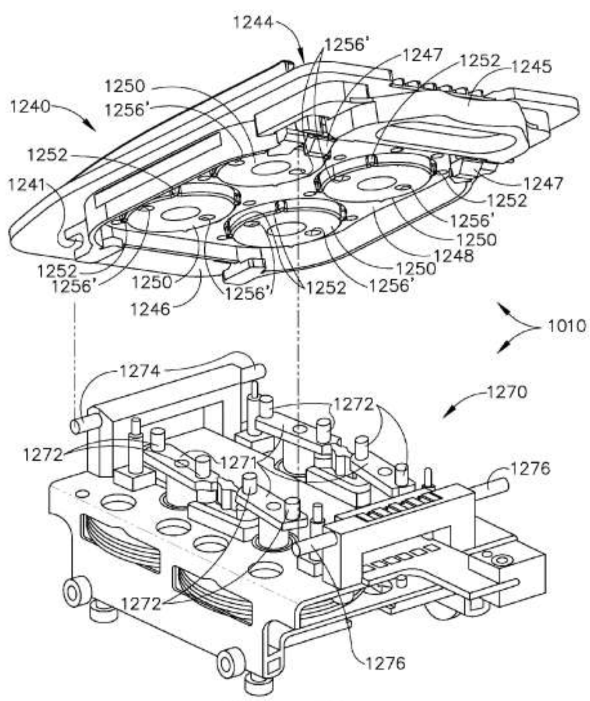


FIG. 39

IS1001, FIG. 39.

[2.4] said adapter portion operably supporting a rotatable adapter body configured to operably engage a corresponding one of the rotatable drive elements when said adapter portion is coupled to the tool holder and

Tierney discloses this limitation. IS1003, ¶75. Tierney's adapter portion (adapter 128) operably supports a rotatable adapter body (rotatable body 134). *Id.*; IS1005, 10:44-67, FIGs. 7A-F. Rotatable body 134 is also configured to operably engage a corresponding one of the rotatable drive elements (drive element 119) when adapter 128 is coupled to the tool holder (holder 129). *Id.*, 5:20-25, 10:63-11:4, FIGs. 6-7M, 14A-C; *see also* Ground 1, element [1.5].

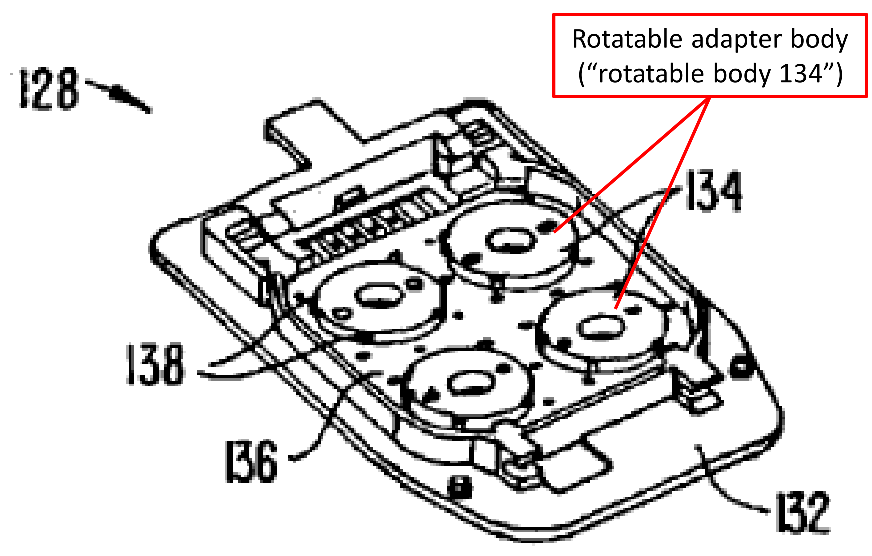


FIG. 7A.

[2.5] wherein a rotatable driven element is configured to operably engage said rotatable adapter body when said tool mounting portion is coupled to said adapter portion.

Tierney discloses this limitation. IS1003, ¶76. Tierney discloses a rotatable driven element (driven element 118) configured to operably engage the rotatable adapter body (rotatable body 134) when the tool mounting portion (proximal housing 108) is coupled to the adapter portion (adapter 128). *Id.*; IS1005, 5:22-25, 11:1-16, FIGs. 6-7M, 14A-C; *see also* Ground 1, element [1.5].

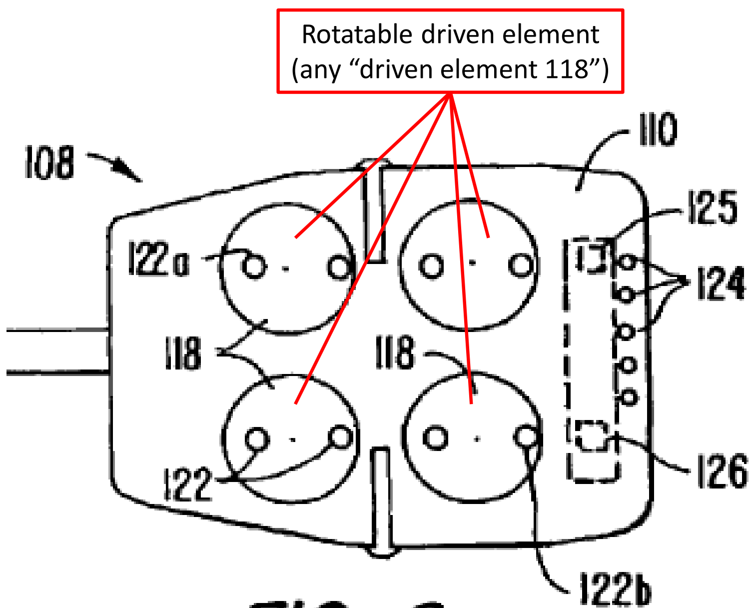


FIG. 6.

[3] The tool mounting device of claim 2 wherein the corresponding rotatable drive element has a pair of spaced drive pins that are configured to be received in corresponding first drive holes in said rotatable adapter body when said adapter portion is coupled to the tool holder

Tierney discloses this limitation. IS1003, ¶77. Tierney's rotatable drive element (drive element 119) has a pair of spaced drive pins that are configured to be received in corresponding first drive holes (openings 140 on the holder side) in the rotatable adapter body (rotatable body 134) when the adapter portion (adapter 128) is coupled to the tool holder (holder 129). *Id.*; IS1005, 10:57-67, FIGs. 7B, 7E, 7F, 7J.

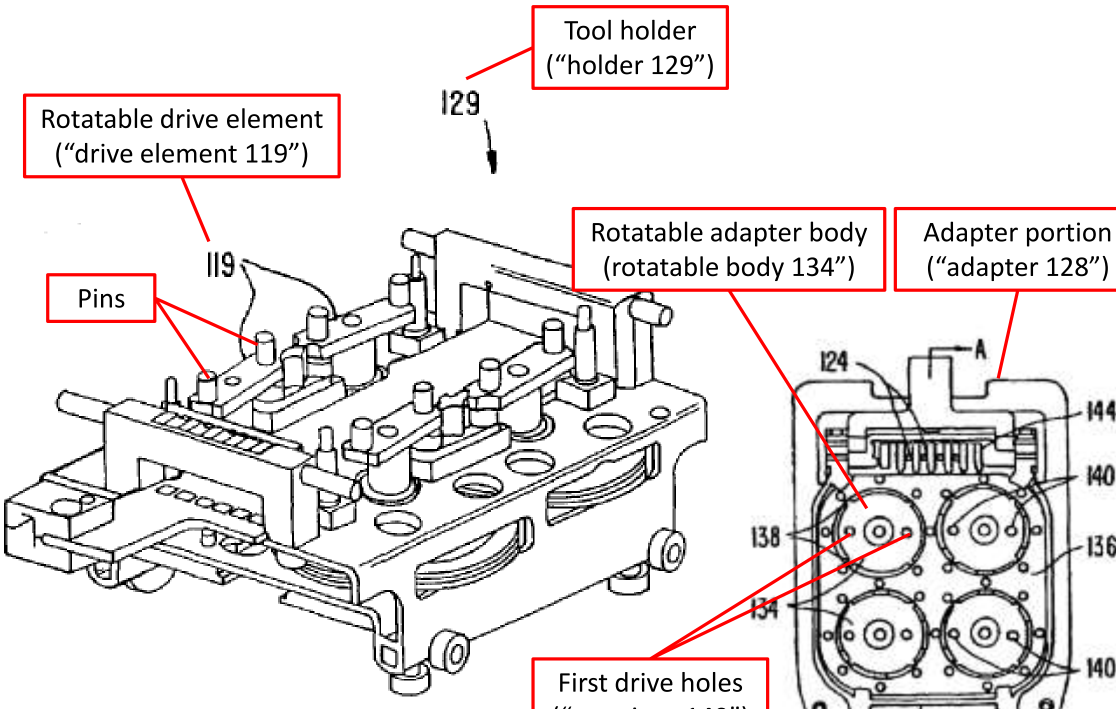


FIG. 7J.

FIG. 7E.

[4] The tool mounting device of claim 3 wherein said rotatable driven element has a pair of spaced driven pins protruding therefrom that are configured to be received in corresponding second drive holes in said rotatable adapter body when said tool mounting portion is coupled to said adapter portion

Tierney discloses this limitation. IS1003, ¶78. Tierney's rotatable driven element (driven element 118) has a pair of spaced driven pins (pins 122) that are configured to be received in corresponding second drive holes (openings 140 on the tool side) in the rotatable adapter body (rotatable body 134) when the tool mounting portion (proximal tool housing 108) is coupled to the adapter portion (adapter 128). *Id.*; IS1005, 10:15-17, 11:1-32, FIGs. 6, 7C.

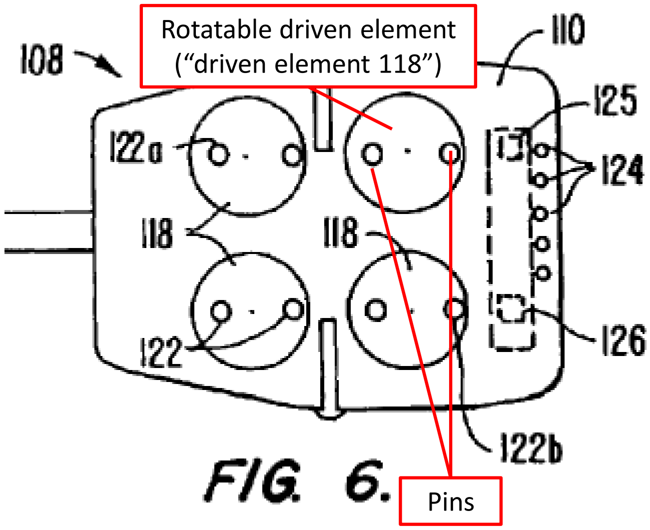


FIG. 6.

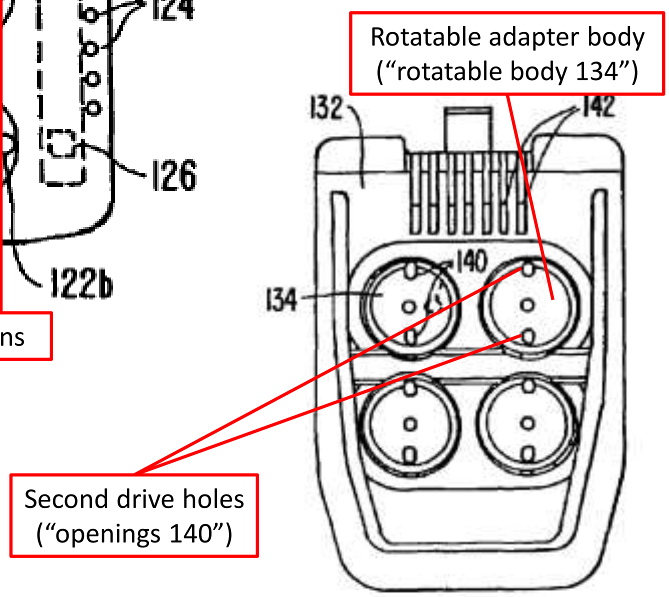


FIG. 7C.

[5] The tool-mounting device of claim 4 further comprising a releasable latch arrangement on said adapter portion for releasably coupling said adapter portion to the tool holder

Tierney discloses this limitation. IS1003, ¶79. Tierney discloses a releasable latch arrangement (latch 145) on the adapter portion (adapter 128) for releasably coupling adapter 128 to the tool holder (holder 129). *Id.*; IS1005, 11:23-24 ("A latch 145 releasably affixes the adaptor [128] to the holder [129]."), FIGs. 7D-E.

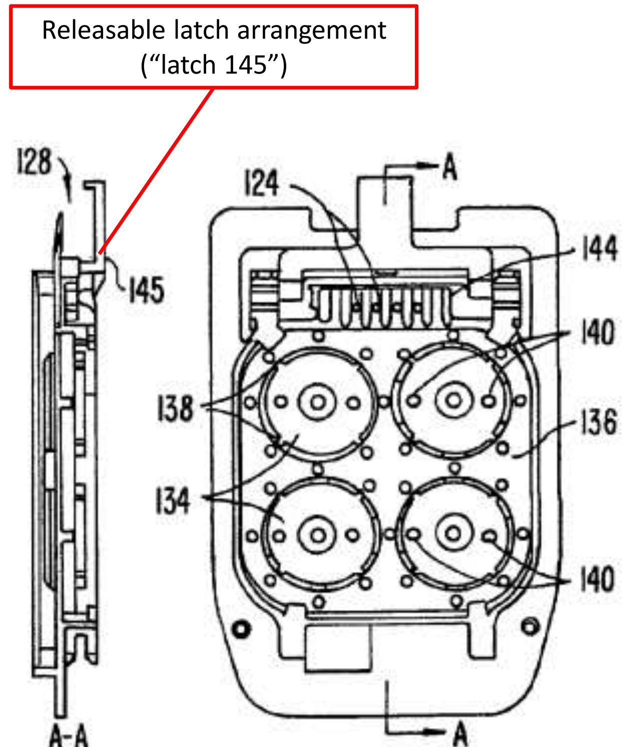


FIG. 7D. FIG. 7E.

[6.1] The tool mounting device of claim 1 wherein said transmission arrangement comprises:

See Ground 1, claim [1].

[6.2] a first control assembly operably interfacing with said elongated shaft assembly to apply said first control motion thereto

Whitman discloses this limitation. IS1003, ¶81. In the combination of Whitman and Tierney, Whitman's transmission arrangement (including function selector module 1110) comprises a first control assembly (one selected from among the rotation driver 202, articulation driver 201, clamping driver 88, and firing driver 98) operably interfacing with Whitman's elongated shaft assembly (shaft portion 11b and hinge portion 11c) to apply the first control motion (actuation of the selected driver) thereto. The control assembly interfaces with the elongated shaft assembly because the end effector (to which the control motions are applied) is attached to the distal end of the elongated shaft whereas the control motions are introduced at the proximal end of the elongated shaft and are conveyed through the elongated shaft. *Id.*; IS1004, ¶76; *see also* Ground 1, element [1.7].

For example, "FIG. 5(c) illustrates [in bold] some of the components of the handle 1103 that form the clamping driver 88 [(first control assembly)] and that function to move, *e.g.*, to open, the first jaw 50 relative to the second jaw 80 . . . ." IS1004, ¶¶155-69, FIGs. 5C, 6C; *see also* ¶81 (noting that "clamping driver 88 may include any type of drive mechanism capable of moving the first jaw 50 and the second jaw 80 relative to each other"). As shown in FIG. 5C, clamping driver 88 includes clamping spur gears 627 and 655, clamping gear shaft 651, first, second, and third clamping miter gears 657, 659, 661, and second clamping gear shaft 681. *Id.*

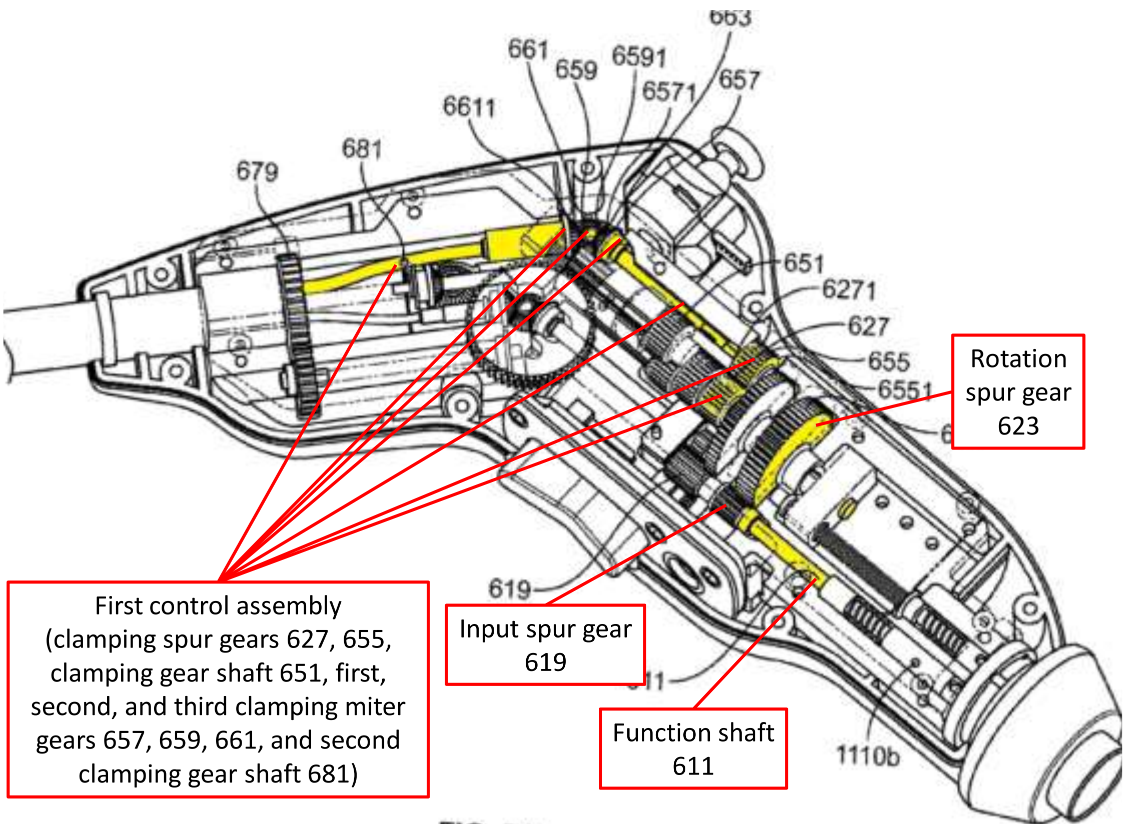


FIG. 5C

Second clamping gear shaft 681 of clamping driver 88 operably interfaces with the elongated shaft assembly (specifically, the clamping shaft 527 portion) to apply the first control motion thereto. *Id.*, ¶109, FIGs. 5C, 6C; IS1003, ¶82.

Similarly, Whitman describes the components for each of the rotation driver, the articulation driver, and the firing driver as well. All interface with the elongated shaft assembly and any of these drivers can alternatively correspond to the "first control assembly" of the claim to transmit control motions to the end effector at the distal end of the elongated shaft assembly. IS1003, ¶¶83-85; IS1004, ¶¶102-06, 140-54, 172-94, FIGs. 3B, 5A, 5B, 5D, 6A, 6B, 6D.

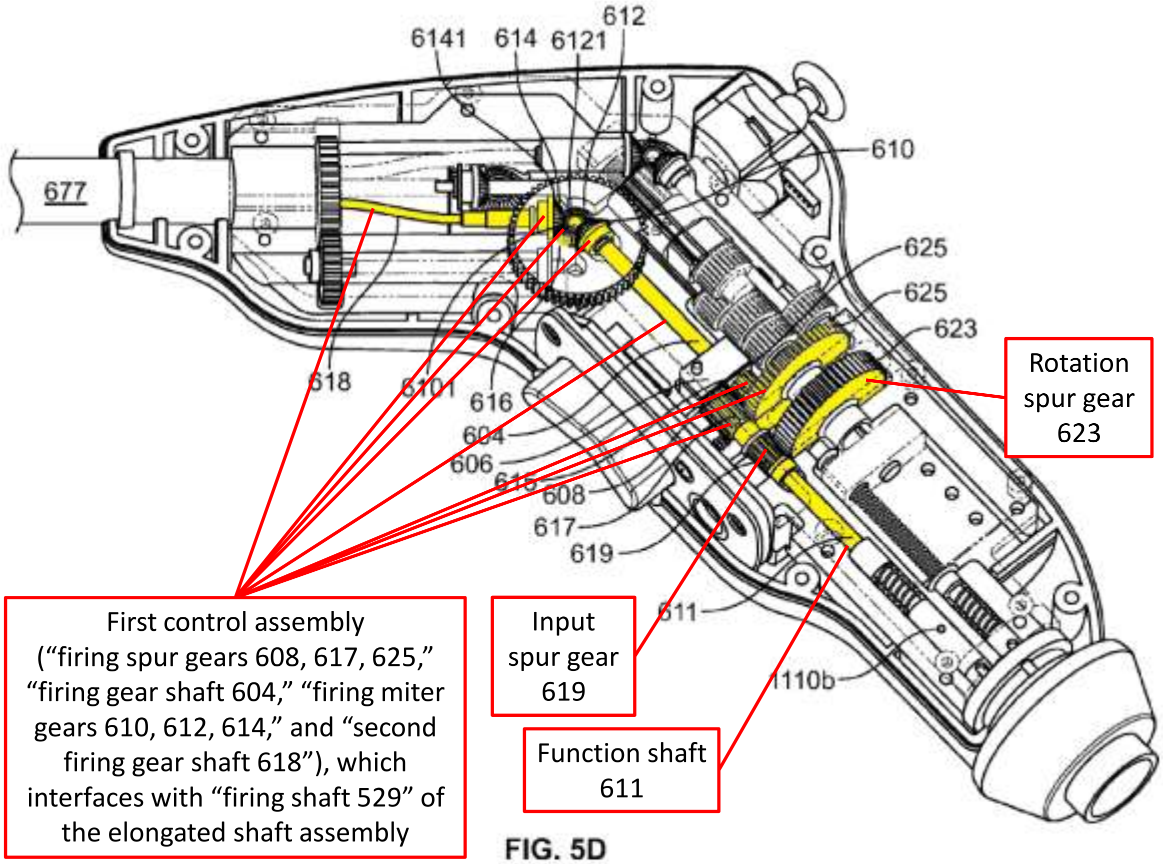


FIG. 5D

IS1004, ¶172, FIG. 5D (illustrating the firing driver).

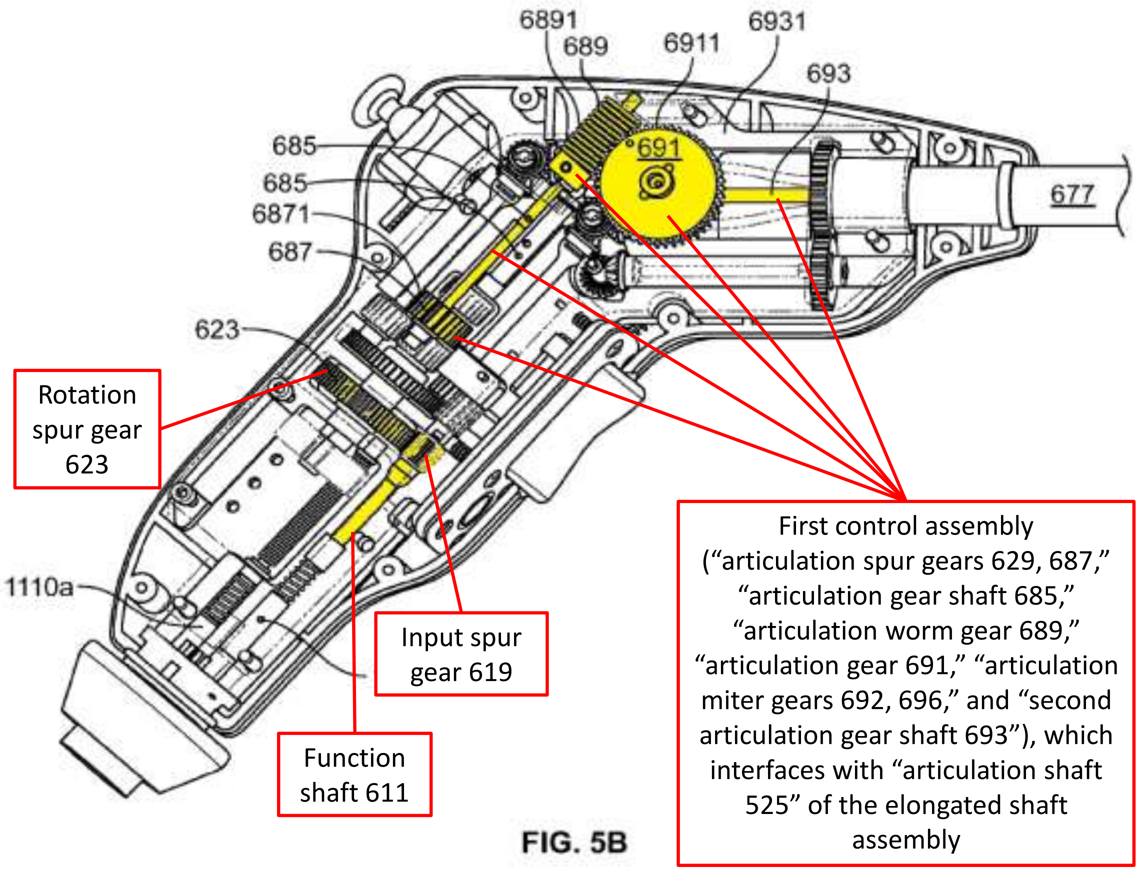


FIG. 5B

Id., ¶147, FIG. 5B (illustrating the articulation driver).

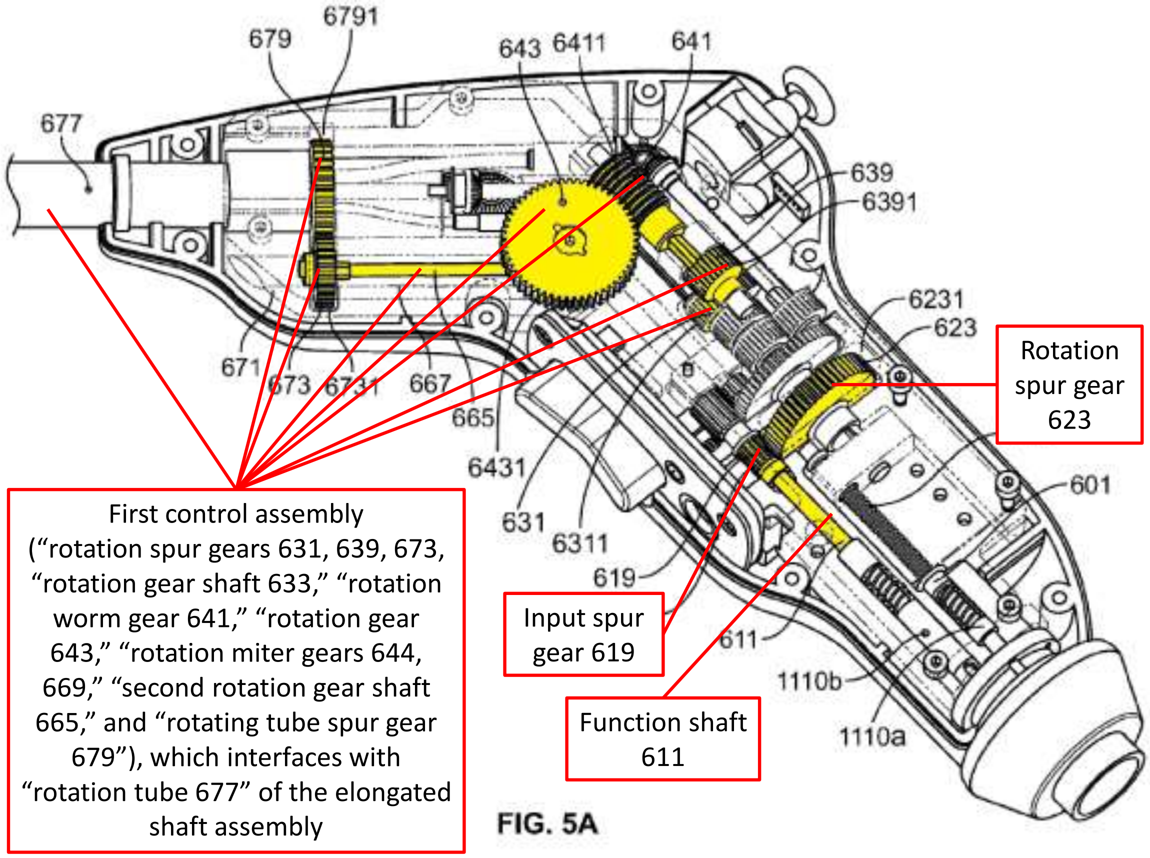


FIG. 5A

Id., ¶140, FIG. 5A (illustrating the rotation driver).

[6.3] a second control assembly operably interfacing with said elongated shaft assembly to apply said second control motion thereto; and

Whitman discloses this limitation. *See* Ground 1, element [6.2]. Any one of rotation driver 202, articulation driver 201, clamping driver 88, and firing driver 98 not identified as the “first control assembly” can be identified as the “second control assembly” that applies a “second control motion.” Any two drivers constitute the first and second control assemblies. IS1003, ¶86.

[6.4] a transmission shifter assembly communicating with the control unit of the robotic system and

Tierney in view of Whitman discloses this limitation. *Id.*, ¶87. In the

Tierney/Whitman combination, the function selector module 1110 of the transmission assembly forms a transmission shifter assembly that shifts between four functions (rotation, articulation, clamping, and firing; *see* Ground 1, elements [1.6]-[1.7]) and that communicates with the control unit (master controller 150) of Tierney's robotic surgical system 10 (*see* Ground 1, element [1.6]). IS1003, ¶87; *see also* Ground 1, elements [1.4], [6.2]. The Whitman function selector module 1110 generates electric signals to inform the controller of which function has been selected. *See* Ground 1, elements [1.6]. In the Tierney/Whitman combination, these control signals would be sent to Tierney's control unit. As stated in Ground 1, element [1.6], "[d]epending on the position of the function selector block 609 [of function selector module 1110], corresponding signals to and from various ones of the optical sensors 3001, 3002, 3003 and 3004 are blocked, thereby providing a suitable controller with an indication when the surgical device 11 is in one of the four above-described functional positions . . . ." IS1004, ¶226; *see also* ¶¶140, 147, 231, 241-44.

[6.5] [said transmission shifter assembly] configured to receive said rotary output motion from said rotatable drive element of the tool drive assembly,

Tierney in view of Whitman discloses this limitation. IS1003, ¶89. As explained above (*see* Ground 1, element [1.5]), in the Tierney/Whitman combination, Whitman's transmission shifter assembly (function selector module 1110) is configured to receive a rotary output motion from a rotatable drive element 119 of Tierney's tool drive assembly (the combination of tool holder 129, drive elements 119, and motors 70 of manipulator 58) via first rotatable shaft 1110a, which would receive rotary motion from Tierney's driven element 118. *Id*.

[6.6] said transmission shifter assembly configured to shift between said first and second positions in response to control inputs from the control unit of the robotic system

Tierney in view of Whitman discloses this limitation. IS1003, ¶90; Ground 1, element [1.6]. In the Tierney/Whitman combination, Whitman's transmission shifter assembly (function selector module 1110) would be configured to shift between first and second positions in response to control inputs from the control unit (master controller 150) of Tierney's robotic surgical system 10. *Id*., ¶92. The control unit would provide control inputs to one of motors 70 in Tierney's tool drive assembly to drive a designated drive element 119, and a selected driven element 118, coupled to Whitman's first rotatable drive shaft 1110a. *Id*. That drive element 119 would cause the first rotatable drive shaft 1110a to turn, which causes the function selector block to shift among the four positions that determine which of the four functions will be applied to the end effector. *Id*.

[6.7] such that when said transmission shifter assembly is in said first position, said rotary output motion is applied to said first control assembly and when said transmission shifter assembly is in said second position, said rotary output motion is applied to said second control assembly.

Tierney in view of Whitman discloses this limitation. IS1003, ¶93; Ground 1, element [1.7]. When Whitman's transmission shifter assembly (function selector module 1110) is in a first position, the rotary output motion from Tierney's rotatable drive element 119 is applied to a first selected Whitman control assembly (rotation driver 202, articulation driver 201, clamping driver 88, or firing driver 98). When the transmission shifter assembly is in a second position, rotary output motion from Tierney's rotatable drive element 119 is applied to a second selected Whitman control assembly (one of rotation driver 202, articulation driver 201, clamping driver 88, and firing driver 98, which is not selected as the first control assembly). *Id.*; IS1004, ¶¶79-82, FIGs. 2B, 3B.

[10.1] The tool mounting device of claim 1

See Ground 1, claim [1].

[10.2] wherein said elongated shaft assembly has an articulation joint therein

Whitman discloses this limitation. IS1003, ¶95. Whitman discloses an articulation joint (hinge portion 11c) at the distal end of the elongated shaft assembly (shaft portion 11b and hinge portion 11c). *Id.*; IS1004, ¶71. As explained in Whitman, "the jaw portion 11a is pivotably coupled to the shaft portion 11b by the hinge portion 11c. Specifically, the jaw portion 11a is pivotable relative to the shaft portion 11b about a pivot axis B . . . ." *Id.*, ¶71, FIGs. 2B, 3A.

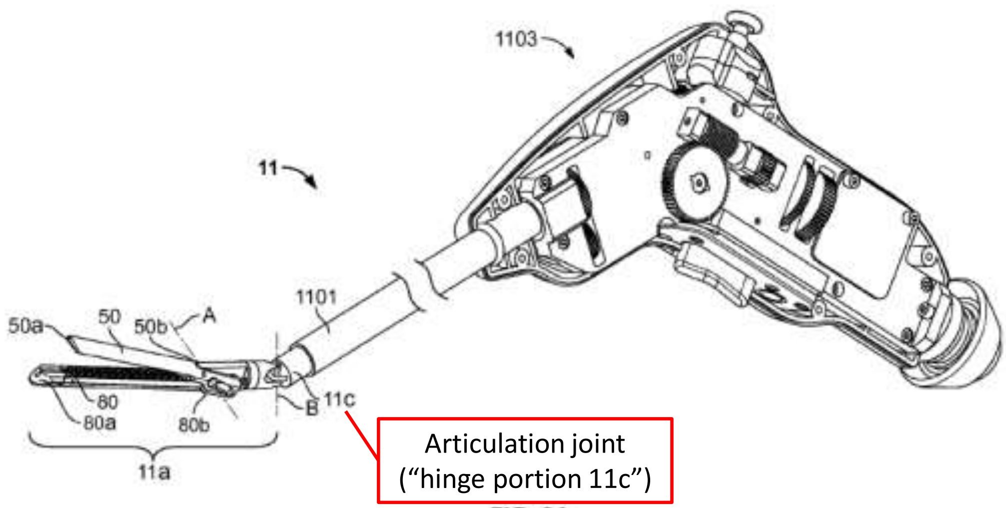
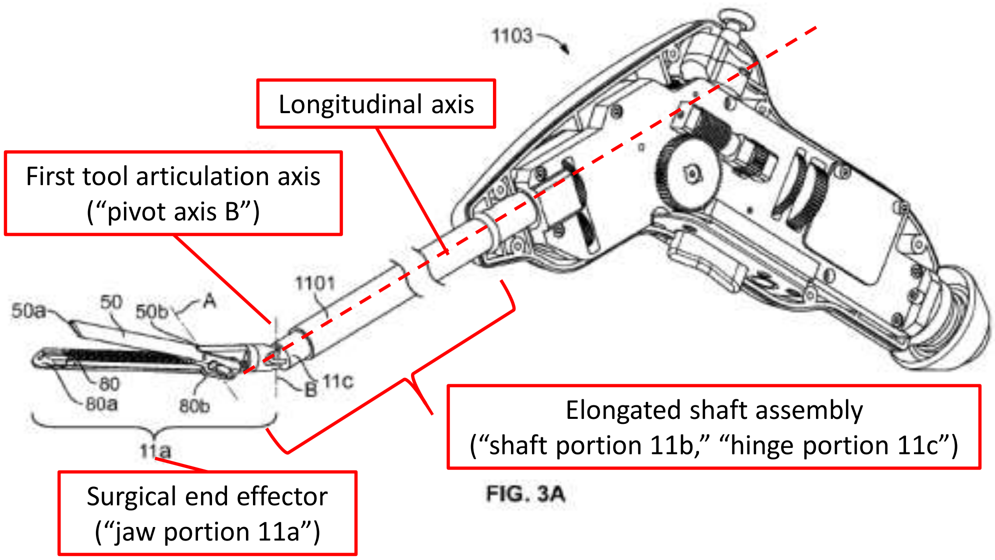


FIG. 3A

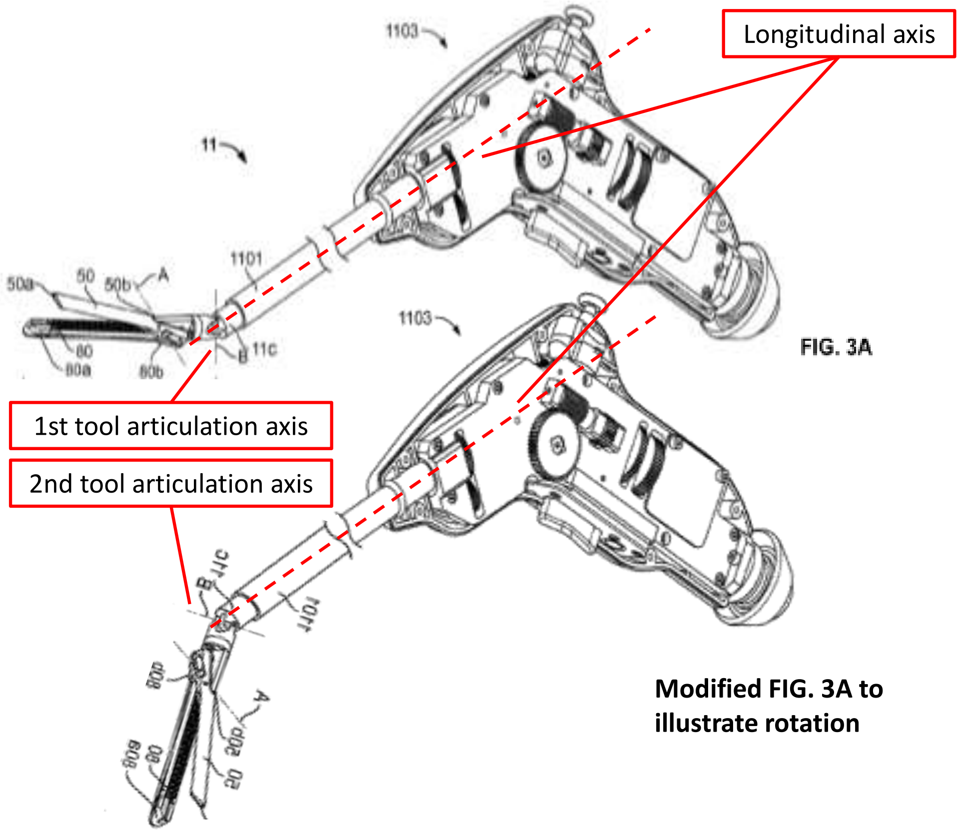
[10.3] such that upon application of said first control motion to said surgical end effector, said surgical end effector articulates about a first tool articulation axis that is substantially transverse to a longitudinal tool axis defined by said elongated shaft assembly

Whitman discloses this limitation. IS1003, ¶96; *see* Ground 1, elements [1.7], [10.2]. In Whitman, the first control motion provides articulation. Thus, for this claim, the function selector block is placed in the second position, which couples shaft 1110b to the articulation driver 201. In the Tierney/Whitman combination, application of this first control motion (rotary control motion of Whitman's transmission) to the end effector (jaw portion 11a) causes jaw portion 11a to articulate about a first tool articulation axis (pivot axis B) that is substantially transverse to a longitudinal axis defined by the elongated shaft assembly (shaft portion 11b, hinge portion 11c). IS1004, ¶79, FIGs. 2B, 3A; *see also* Ground 1, elements [1.7], [10.2].



[11] The tool mounting device of claim 10 wherein said articulation joint is configured to enable said surgical end effector to pivot about a second tool articulation axis upon application of another said control motion to said surgical end effector

Whitman discloses this limitation. IS1003, ¶97. Whitman's articulation joint (hinge portion 11c) is configured to enable the end effector (jaw portion 11a) to pivot about a second tool articulation axis when the joint is rotated. *See* Ground 1, elements [1.7], [10.2]. As shown in the modified image of FIG. 3A below, the articulation pivot axis B can rotate to create a second tool articulation axis. IS1003, ¶97.



IS1004, FIG. 3A; modified FIG. 3A (showing result of rotating the end effector).

[12.1] The tool mounting device of claim 1 wherein said surgical end effector further comprises

See Ground 1, claim [1].

[12.2] a surgical staple cartridge and

Whitman discloses this limitation. IS1003, ¶99. Whitman discloses a "stapling and cutting cartridge" in second jaw 80. IS1004, ¶89; *see also* ¶132, FIGs. 3A, 4E, 5E.

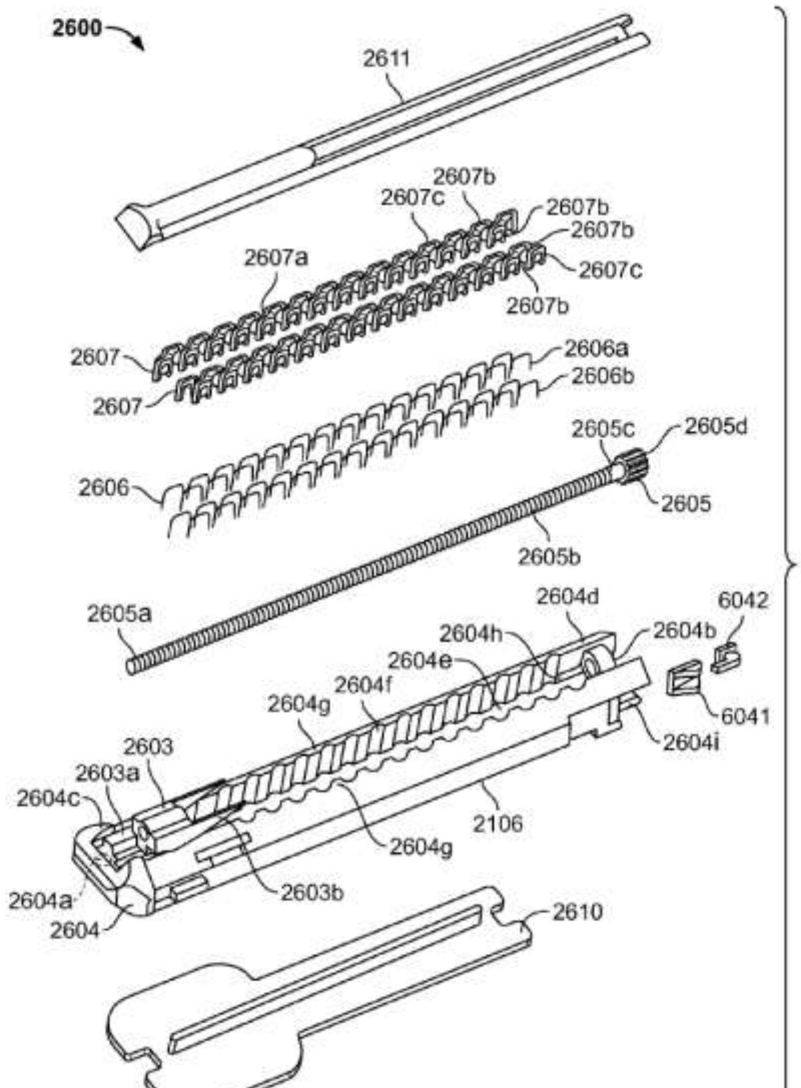


FIG. 4E

[12.3] wherein said portion of said surgical end effector comprises an anvil selectively movable relative to said surgical staple cartridge between an open position and a closed position in response to a closure control motion applied thereto by said transmission arrangement.

Whitman discloses this limitation. IS1003, ¶100. Whitman's end effector (jaw portion 11a) comprises an anvil (anvil member 700). *Id*.; IS1004, ¶¶74, 136, FIGs. 2B, 3A, 4C, 4F. Anvil member 700 is selectively movable relative to the staple cartridge 104, 2600 in the second jaw 80 in response to the closure control motion provided by the clamping driver 88. *Id.*, ¶¶70, 81, FIGs. 4C, 5C, 6C; *see also* Ground 1, elements [1.7], [6.7], [12.2] (description of clamping operation).

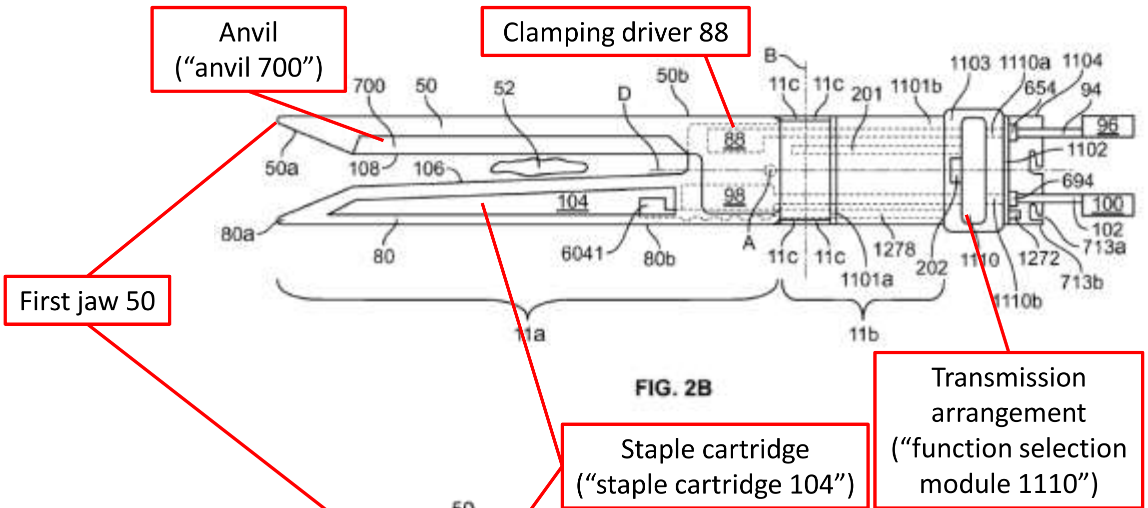


FIG. 2B

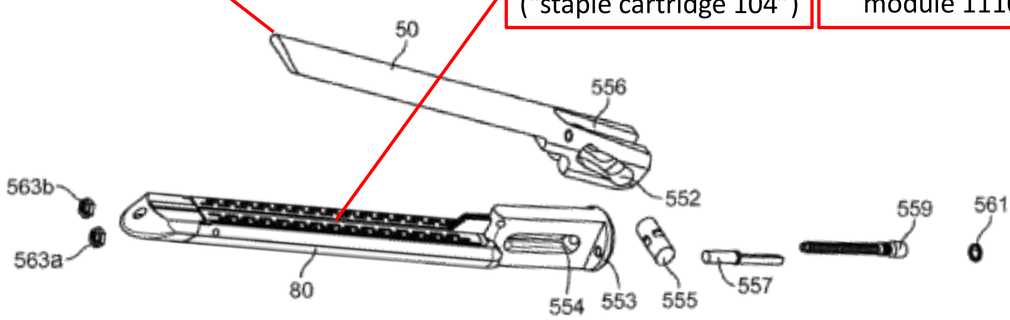
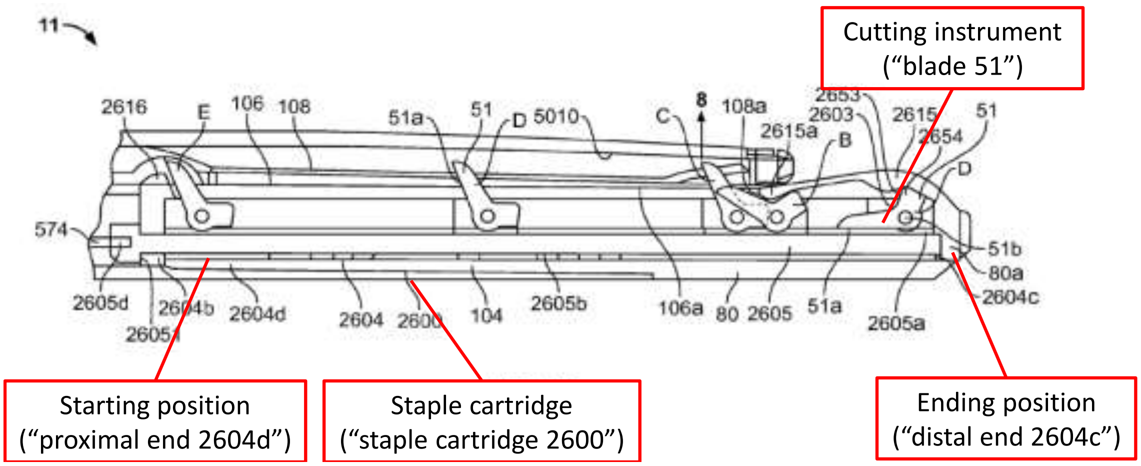


FIG. 4C

[13] The tool mounting device of claim 12 wherein said another portion of said surgical end effector comprises a cutting instrument that is axially movable within said surgical staple cartridge between a starting position and an ending position in response to a firing motion applied thereto by said transmission arrangement

Whitman discloses this limitation. IS1003, ¶102. Whitman's end effector (jaw portion 11a) comprises a cutting instrument (blade 51). IS1004, ¶¶181, 194, FIG. 5E. Blade 51 is axially movable within staple cartridge 2600 between a starting position (proximal end 2604d) and an ending position (distal end 2604c) in response to a firing motion (actuation of firing driver 98, including firing shaft 557 and wedge driver 2605) applied thereto by said transmission arrangement (when function selector module 1110 is placed in the fourth position). *Id.*, ¶¶194, 225, 244, FIGs. 2B, 4C, 5D, 5E, 6D; *see also* Ground 1, elements [1.7], [6.7] (description of firing operation).



B. Ground 2: Claims 7, 14, 16-20, and 23-26 are obvious over Tierney in view of Whitman and further in view of Zemlok

[7.1] The tool mounting device of claim 6 wherein said transmission shifter assembly comprises:

See Ground 1, claim [6].

[7.2] a shifter drive gear configured to receive said rotary output motion from said rotatable drive element of the tool drive assembly when said tool mounting portion is coupled thereto

Tierney in view of Whitman discloses this limitation. IS1003, ¶104. In Whitman, the transmission shifter assembly (function selector module 1110) includes a shifter drive gear (*e.g.*, input spur gear 619) connected to the second rotatable drive shaft 1110b, which is configured to receive rotary output motion from a rotatable drive element (drive shaft 102) of a tool drive assembly (electro-mechanical driver component 1610) when the tool mounting portion (handle 1103) is coupled to electro-mechanical driver component 1610. *Id*.; IS1004, ¶¶76-78, 147, FIGs. 2A-B, 3B, 11-12.

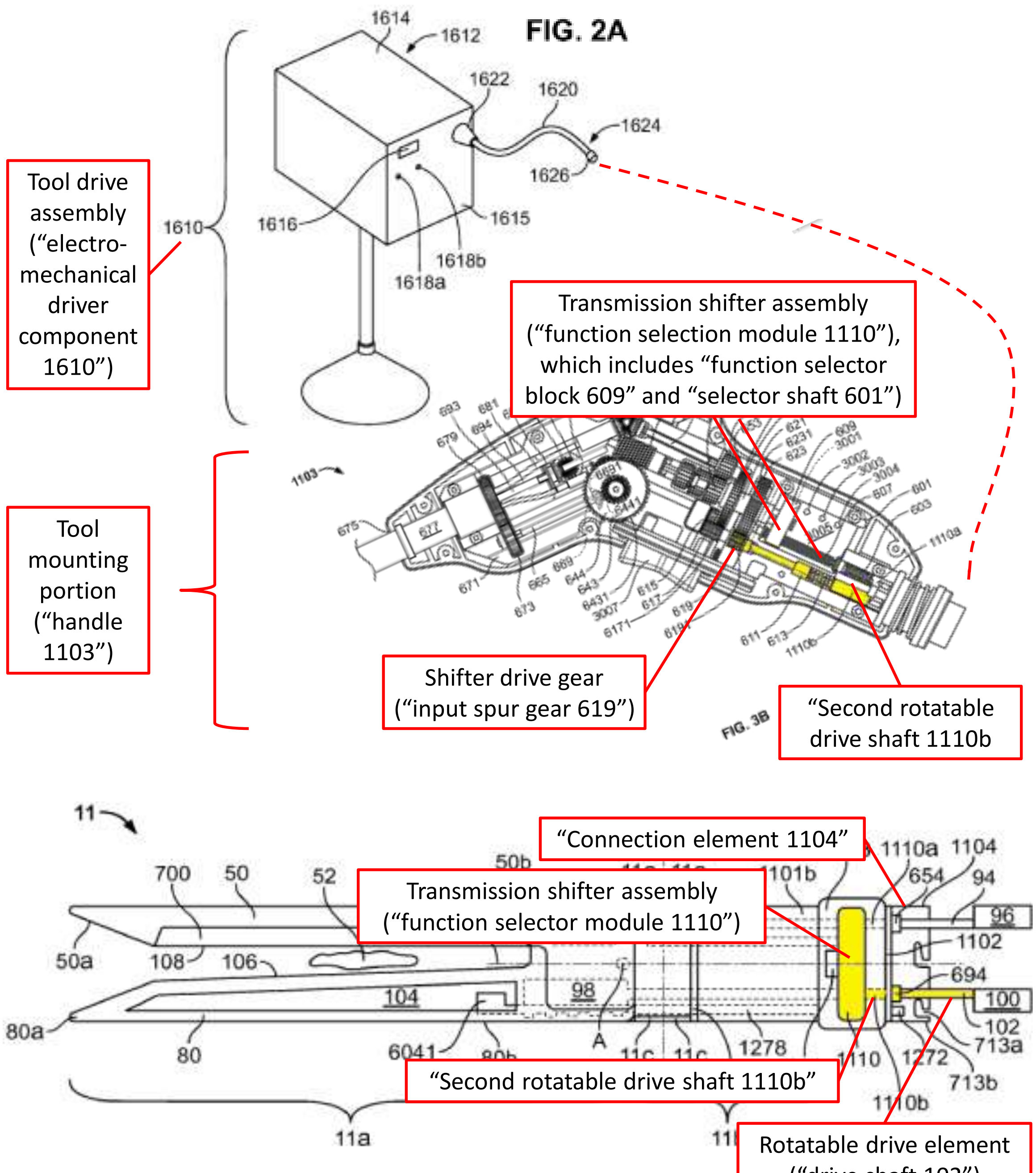


FIG. 2B

In the Tierney/Whitman combination, Whitman's drive shafts 1110a and 1110b would be coupled to Tierney's rotatable driven elements 118 instead of interfacing with Whitman's electro-mechanical driver 1610. IS1003, ¶105; Ground 1, elements [1.5], [1.6]. Thus, a POSITA would have understood that the shifter drive gear (Whitman's input spur gear 619) in the Tierney/Whitman combination would be configured to receive rotary output motion from rotatable drive element 119 of Tierney's tool drive assembly (via driven element 118) when Tierney's tool mounting portion (proximal housing 108) is coupled to the tool holder 129 of Tierney's tool drive assembly. *Id.*

[7.3] a shifter shaft in meshing engagement with said shifter drive gear

Whitman discloses this limitation. IS1003, ¶106. Whitman discloses a shifter shaft (gear shaft 621 and its mounted rotation spur gear 623) in meshing engagement with the shifter drive gear (input spur gear 619 meshes with the shifter shaft's rotation spur gear 623). *Id.*; IS1004, ¶¶ 142-43, FIG. 3B; *see also* ¶¶150, 158, 268, FIGs. 18A-B.

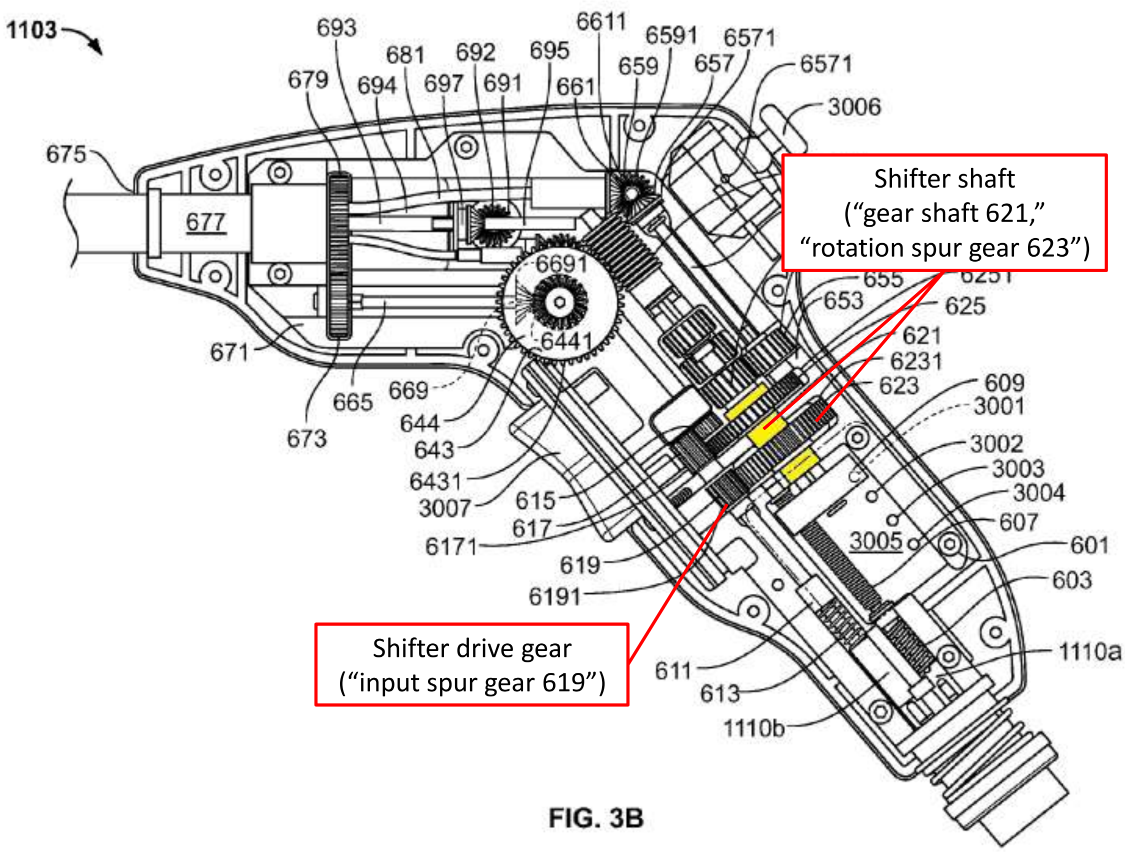


FIG. 3B

[7.4] a shifter driven gear mounted on said shifter shaft

Whitman discloses this limitation. IS1003, ¶107. Whitman discloses a shifter driven gear (any of fire spur gear 625, clamping spur gear 627, articulation spur gear 629, or rotation spur gear 631) mounted on the shifter shaft (gear shaft 621 and its mounted rotation spur gear 623). *Id.*; IS1004, ¶¶96, 143, 150, 158, FIGs. 3B-C.

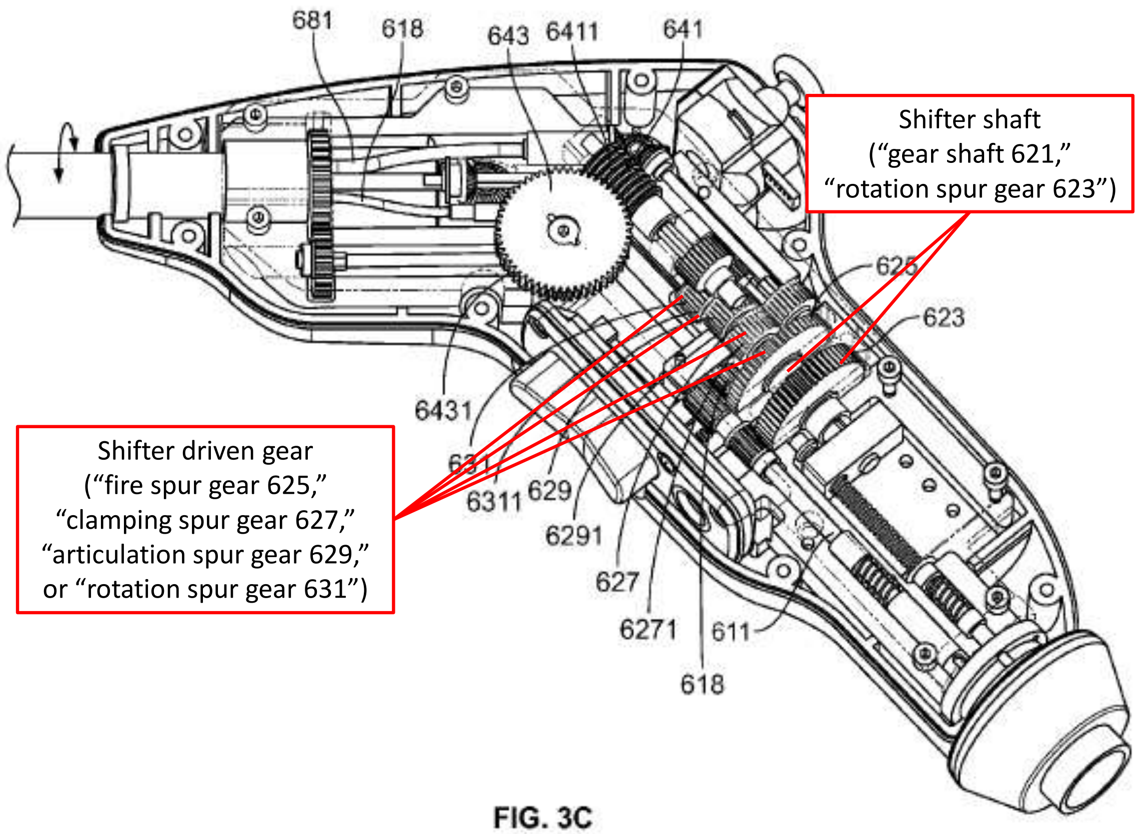


FIG. 3C

[7.5] such that rotation of said shifter shaft rotates said shifter driven gear and wherein said shifter driven gear is selectively axially movable on said shifter shaft between said first position wherein said shifter driven gear is in driving engagement with said first control assembly and said second position wherein said shifter driven gear is in driving engagement with said second control assembly in response to said control inputs

Tierney in view of Whitman and further in view of Zemlok discloses this limitation. IS1003, ¶108. In the Tierney/Whitman combination, Whitman's constant mesh transmission uses rotating gears that are selectively coupled to the shifter shaft (gear shaft 621 and its rotation spur gear 623), rather than the conventional axially sliding gear-type of transmission (sliding mesh transmission) claimed here, in which a single gear changes axial position to selectively actuate different control assemblies.

Nevertheless, it would have been obvious in view of Zemlok to modify Whitman's transmission shifter assembly to use a shifter driven gear that is selectively axially movable on said shifter shaft between said first position and a second position so that the driven gear is shifted from being in driving engagement with a first control assembly to being in driving engagement with a second control assembly (any two of clamping driver 88, firing driver 98, articulation driver 201, and/or rotation driver 202). *Id.*, ¶109.

Zemlok, for example, discloses a "[s]hift motor 220 [that] is configured to selectively move [a] drive gear 200 between a plurality of positions." IS1006, ¶48, FIGs. 5-7, 9-11, 14. The "drive gear 200" of Zemlok is mounted on the shifter shaft and corresponds to the recited "driven gear" of claim 7. In the '431 Patent, the "driven gear" is "driven" by the shaft rotation, and drives gears associated with each function depending on the driven gear's axial position. Zemlok's transmission works in the same way. Zemlok's "drive gear 200" is located on and driven by a shaft (drive motor shaft 218), and selectively drives gears associated with each function depending on drive gear 200's axial position. *Id.*

Each of the gears that the drive gear 200 can mesh with provides a different function (*e.g.*, articulation or rotation). FIG. 10 illustrates the transmission with the "driven gear" (drive gear 200) in the third position.

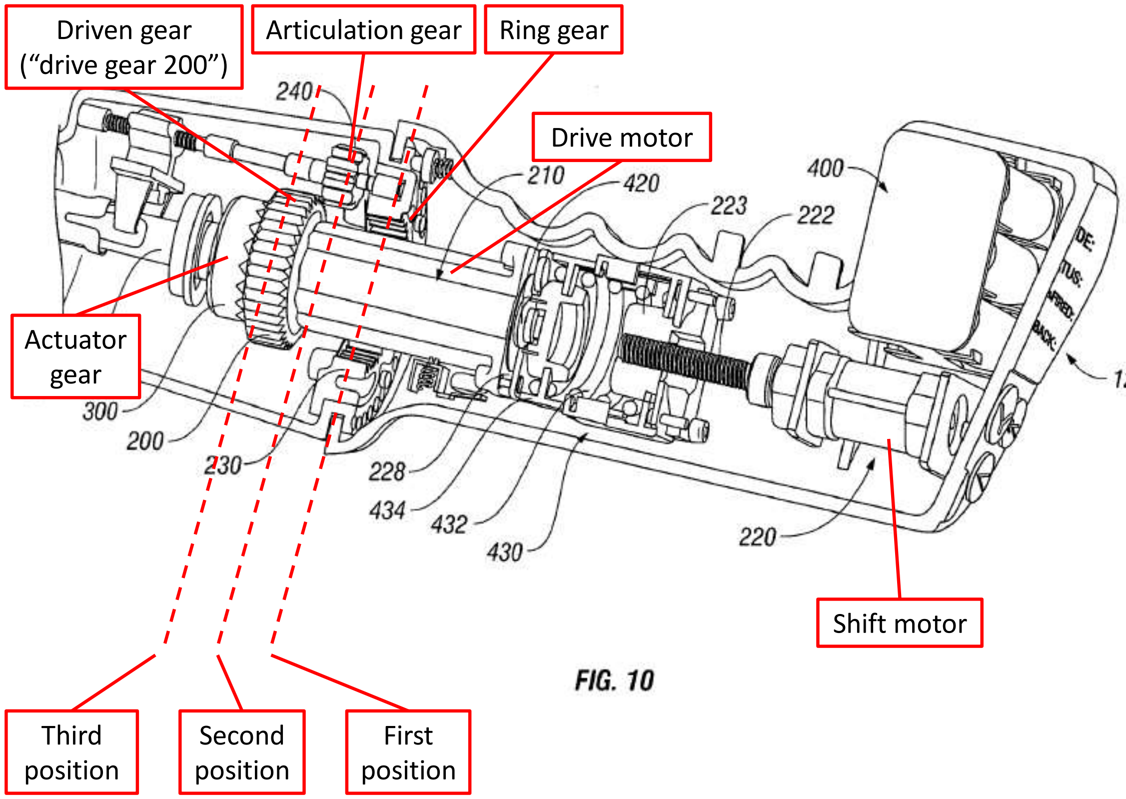


FIG. 10

IS1006, FIG. 10.

"The first position, illustrated in FIGs. 5 and 6, enables rotation of end effector 160; the second position, illustrated in FIG. 7, enables articulation of end effector 160; and the third position, illustrated in FIGS. 9-11 and 14, enables actuation of powered surgical instrument 100." *Id*., ¶48; *see also* ¶47 ("It is envisioned that a three-position solenoid, for instance, can be used as an alternative to shift motor 220."), FIGs. 4-7, 9-11, 14.

A POSITA would have been motivated to use Zemlok's transmission because it is more compact and uses fewer parts (*i.e*., can be less expensive) than Whitman's transmission. IS1003, ¶113. In addition, Zemlok's sliding gear transmission is a robust, more common, known solution, offering a simpler design more attractive to a POSITA than Whitman's stationary gear transmission. *Id*. A POSITA would have been motivated to choose Zemlok's transmission over Whitman's more complex transmission because the main drawback of sliding transmissions—matching speeds of the sliding gear and the output gears—is not an issue in the Whitman and Zemlok surgical instruments. *Id*. The gears will be stationary before shifting because the shifter is shifting function and not shifting between speeds. *Id*. Power being applied to one function will be stopped before power is applied to power a second function. *Id*. Finally, space is often a premium in surgical tools, and Zemlok's transmission is smaller; thus, a POSITA would be motivated to use Zemlok's sliding transmission design to conserve space. *Id*.

Zemlok's sliding transmission was also an obvious design choice. *Id*., ¶114. There are a few different standard transmission types and by far the most common were sliding mesh and constant mesh. *Id*. Zemlok is an example of a sliding mesh and Whitman is an example of a constant mesh. Each is an obvious design choice for a device needing a transmission. *Id*.; *KSR*, 550 U.S. at 417. A POSITA could have easily used Zemlok's gear shifter in Whitman's surgical instrument. *Id*.

[14.1] A tool mounting device for coupling a surgical end effector capable of performing at least two actions in response to control motions applied thereto to a rotatable drive element that is operably supported on a tool holder of a robotic system that is operatively coupled to a control unit, said tool mounting device comprising

See Ground 1, elements [1.1], [2.2] (discussing the "rotatable drive element" of the tool drive assembly).

[14.2] a tool mounting portion operably supporting a rotatable driven element thereon,

See Ground 1, element [2.5] (discussing rotatable driven elements 118 mounted on tool mounting portion (which includes proximal housing 108)).

[14.3] said rotatable driven element having a pair of spaced driven pins protruding therefrom

See Ground 1, claim [4].

[14.4] an adapter portion operably attachable to the tool holder and said tool mounting portion for establishing an interface therebetween,

See Ground 1, element [2.3].

[14.5] said adapter portion operably supporting a rotatable adapter body having a first pair of drive holes therein configured to receive corresponding drive pins protruding from the rotatable drive element when said adapter portion is coupled to the tool holder, said rotatable adapter body further having a pair of driven holes therein for receiving said driven pins therein when said adapter portion is coupled to said tool mounting portion

See Ground 1, claims [3] (tool holder side of adapter) and [4] (tool side of adapter).

[14.6] an elongated shaft assembly having a proximal end portion operably supported on said tool mounting portion and a distal end portion operably interfacing with said surgical end effector to apply said control motions thereto; and

See Ground 1, element [1.3].

[14.7] a transmission arrangement operably supported on said tool mounting portion and comprising:

See Ground 1, element [1.4].

[14.8] a first control assembly operably interfacing with said elongated shaft assembly to apply a first said control motion thereto

See Ground 1, element [6.2].

[14.9] a second control assembly operably interfacing with said elongated shaft assembly to apply a second said control motion thereto

See Ground 1, element [6.3].

[14.10] a transmission shifter assembly comprising:

See Ground 1, element [6.4].

[14.11] a shifter drive gear operably coupled to said rotatable driven element for receiving a rotary output motion therefrom

See Ground 2, element [7.2] (shifter drive gear is coupled to rotatable driven element (driven element 118 of Tierney) which receives rotary motion from the drive element (drive element 119 of Tierney).

[14.12] a shifter shaft in meshing engagement with said shifter drive gear

See Ground 2, element [7.3].

[14.13] a shifter driven gear mounted on said shifter shaft

See Ground 2, element [7.4].

[14.14] such that rotation of said shifter shaft rotates said shifter driven gear and wherein said shifter driven gear is selectively axially movable on said shifter shaft between a first position wherein said shifter driven gear is in driving engagement with said first control assembly and a second position wherein said shifter driven gear is in driving engagement with said second control assembly

See Ground 2, element [7.5].

[14.15] a shifter solenoid operably interfacing with said shifter driven gear to selectively move said shifter driven gear between said first and second positions in response to corresponding control inputs from the control unit of the robotic system

See Ground 2, element [7.5] (citing IS1006, ¶47 ("It is envisioned that a three-position solenoid . . . can be used . . . .")).

[16.1] The tool mounting device of claim 14

See Ground 2, claim [14].

[16.2] wherein said elongated shaft assembly has an articulation joint therein

See Ground 1, element [10.2].

[16.3] such that upon application of said first control motion to said surgical end effector, said surgical end effector articulates about a first tool articulation axis that is substantially transverse to a longitudinal tool axis defined by said elongated shaft assembly

See Ground 1, element [10.3].

[17] The tool mounting device of claim 16 wherein said articulation joint is configured to enable said surgical end effector to pivot about a second tool articulation axis upon application of another said control motion to said surgical end effector

See Ground 1, claim [11].

[18.1] The tool mounting device of claim 17 wherein said surgical end effector comprises:

See Ground 2, claim [17].

[18.2] a surgical staple cartridge;

See Ground 1, element [12.2].

[18.3] an anvil selectively movable relative to said surgical staple cartridge between an open position and a closed position in response to a closure control motion applied thereto by said transmission arrangement.

See Ground 1, element [12.3].

[19] The tool mounting device of claim 18 wherein said surgical end effector further comprises a cutting instrument that is axially movable within said surgical staple cartridge between a starting position and an ending position in response to a firing motion applied thereto by said transmission arrangement.

See Ground 1, claim [13].

[20.1] A tool mounting device for coupling a surgical end effector configured to selectively perform at least two actions in response to control motions applied thereto to a tool drive assembly of a robotic system that is operatively coupled to a control unit of the robotic system, said tool mounting device comprising

See Ground 1, element [1.1].

[20.2] a tool mounting portion configured for operable attachment to the tool drive assembly of the robotic system

See Ground 1, element [1.2].

[20.3] an elongated shaft assembly having a proximal end portion operably supported on said tool mounting portion and a distal end portion operably interfacing with said surgical end effector to apply said control motions thereto

See Ground 1, element [1.3].

[20.4] a transmission arrangement comprising:

See Ground 1, element [1.4].

[20.5] a first control assembly operably interfacing with said elongated shaft assembly to apply a first said control motion thereto

See Ground 1, element [6.2].

[20.6] a second control assembly operably interfacing with said elongated shaft assembly to apply a second said control motion thereto; and

See Ground 1, element [6.3].

[20.7] a transmission shifter assembly communicating with the control unit of the robotic system and

See Ground 1, element [6.4].

[20.8] [said transmission shifter assembly] configured to receive a rotary output motion from the tool drive assembly,

See Ground 1, element [6.5].

[20.9] said transmission shifter assembly configured to shift between first and second positions in response to control inputs from the control unit of the robotic system

See Ground 1, element [6.6].

[20.10] such that when said transmission shifter assembly is in said first position, said rotary output motion is applied to said first control assembly and when said transmission shifter assembly is in said second position, said rotary output motion is applied to said second control assembly and

See Ground 1, element [6.7].

[20.12] wherein said transmission shifter assembly further comprises: a shifter drive gear configured to receive said rotary output motion from the tool drive assembly when said tool mounting portion is coupled thereto

See Ground 2, element [7.2].

[20.13] a shifter shaft in meshing engagement with said shifter drive gear; and

See Ground 2, element [7.3].

[20.14] a shifter driven gear mounted on said shifter shaft

See Ground 2, element [7.4].

[20.15] such that rotation of said shifter shaft rotates said shifter driven gear and wherein said shifter driven gear is selectively axially movable on said shifter shaft between said first position wherein said shifter driven gear is in driving engagement with said first control assembly and said second position wherein said shifter driven gear is in driving engagement with said second control assembly in response to said control inputs.

See Ground 2, element [7.5].

[23.1] The tool mounting device of claim 20

See Ground 2, claim [20].

[23.2] wherein said elongated shaft assembly has an articulation joint therein

See Ground 1, element [10.2].

[23.3] such that upon application of said first control motion to said surgical end effector, said surgical end effector articulates about a first tool articulation axis that is substantially transverse to a longitudinal tool axis defined by said elongated shaft assembly.

See Ground 1, element [10.3].

[24] The tool mounting device of claim 23 wherein said articulation joint is configured to enable said surgical end effector to pivot about a second tool articulation axis upon application of another said control motion to said surgical end effector.

See Ground 1, claim [11].

[25.1] The tool mounting device of claim 20

See Ground 2, claim [20].

[25.2] wherein said surgical end effector comprises: a surgical staple cartridge; and

See Ground 1, element [12.2].

[25.3] an anvil selectively movable relative to said surgical staple cartridge between an open position and a closed position in response to a closure control motion applied thereto by said transmission arrangement.

See Ground 1, element [12.3].

[26] The tool mounting device of claim 25 wherein said surgical end effector further comprises a cutting instrument that is axially movable within said surgical staple cartridge between a starting position and an ending position in response to a firing motion applied thereto by said transmission arrangement.

See Ground 1, claim [13].

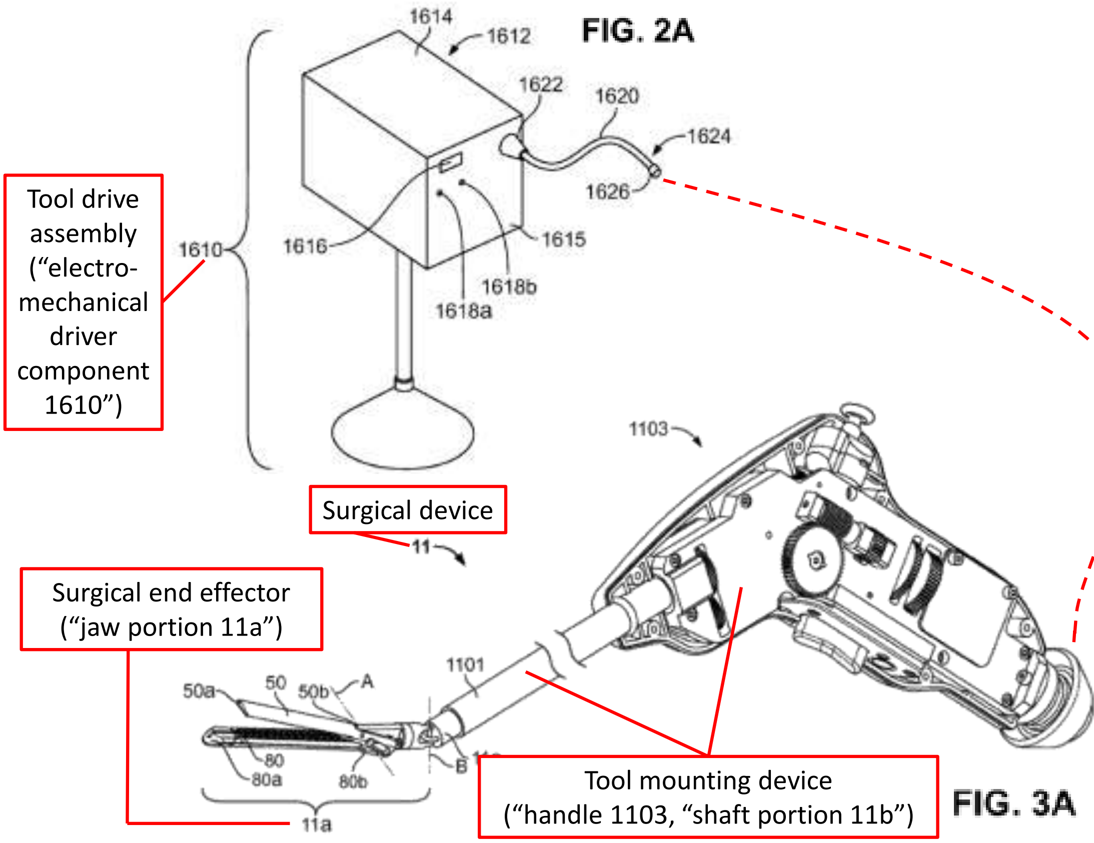
C. Ground 3: Claim 1, 2, 6, and 10-13 are anticipated by Whitman

[1.1] A tool mounting device for coupling a surgical end effector configured to selectively perform at least two actions in response to control motions applied thereto to a tool drive assembly of a robotic system that is operatively coupled to a control unit of the robotic system, said tool mounting device comprising

If this preamble is deemed to be a limitation, Whitman discloses it. IS1003, ¶160.

"<u>A tool mounting device for coupling a surgical end effector . . . to a tool drive assembly of a robotic system . . .</u>"

Whitman discloses a tool mounting device (handle 1103 and shaft portion 11b) for coupling a surgical end effector (jaw portion 11a) to a tool drive assembly (electro-mechanical driver component 1610) of a robotic system (the combination of electromechanical driver component 1610 and surgical device 11). *Id.*; IS1004, ¶¶70, 73, 212, FIGs. 2A, 2B, 3A, 3B.



The combination of Whitman's electromechanical driver component 1610 and surgical device 11 is a "robotic system" because it is a self-powered, steerable, computer-controlled device that can be programmed to aid in the positioning and manipulation of surgical instruments, and act as a remote extension of a human surgeon. IS1003, ¶¶162-64; *see also* IS1010-1015 (discussing various surgical robots). Indeed, "controller 1122 is provided in . . . remote power console 1612 [of electro-mechanical driver component 1610] and is configured to control all functions and operations of the electro-mechanical driver component 1610 and the linear clamping, cutting and stapling device 11 . . . ." IS1004, ¶220; *see also* ¶230

("[T]he controller 1122 is configured to read or select from the memory unit 1130, an operating program or algorithm corresponding to the type of surgical instrument . . . ."), FIG. 12; IS1012-IS1015. And Whitman's surgical instrument is steerable via steering cables attached to the flexible shaft connecting the instrument to the electro-mechanical driver. IS1003, ¶162; IS1004, ¶¶212, 215, 217-18, 231-32.

"<u>A surgical end effector configured to selectively perform at least two actions in response to control motions applied thereto</u>"

Whitman's end effector (jaw portion 11a) is configured to selectively perform at least two actions (at least two of clamping, firing, articulating, and rotating) in response to control motions (actuations of clamping driver 88, firing driver 98, articulation driver 201, and/or rotation driver 202) applied thereto. IS1004, ¶¶76, 79, 139-45, FIGs. 2B, 5A; IS1003, ¶165.

"<u>A tool drive assembly of a robotic system that is operatively coupled to a control unit of the robotic system</u>"

Whitman's tool drive assembly (electro-mechanical driver component 1610) includes, and therefore is operatively coupled to, a control unit (*e.g.*, controller 1122 and/or wireless remote control unit 1148) of the robotic system (electro-mechanical driver system 1610 and surgical device 11). IS1003, ¶170; IS1004, ¶¶220, 231, 233, 236, FIGs. 12, 15-16.

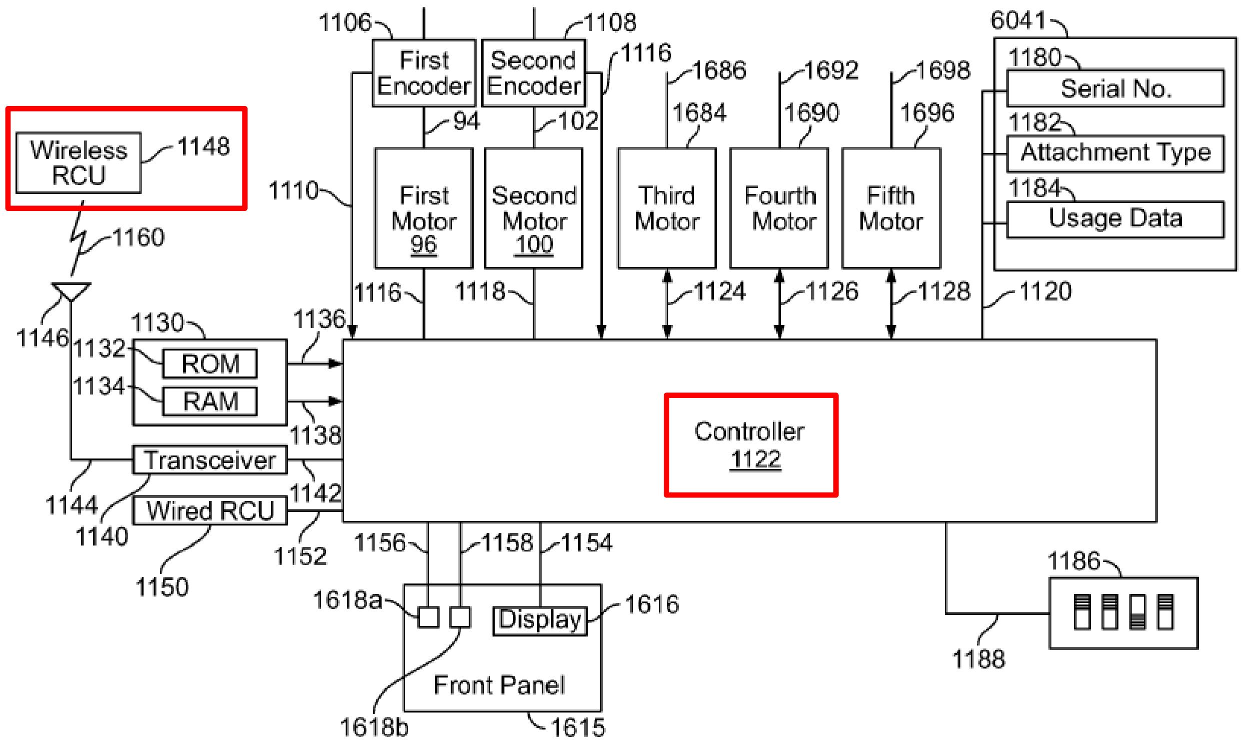
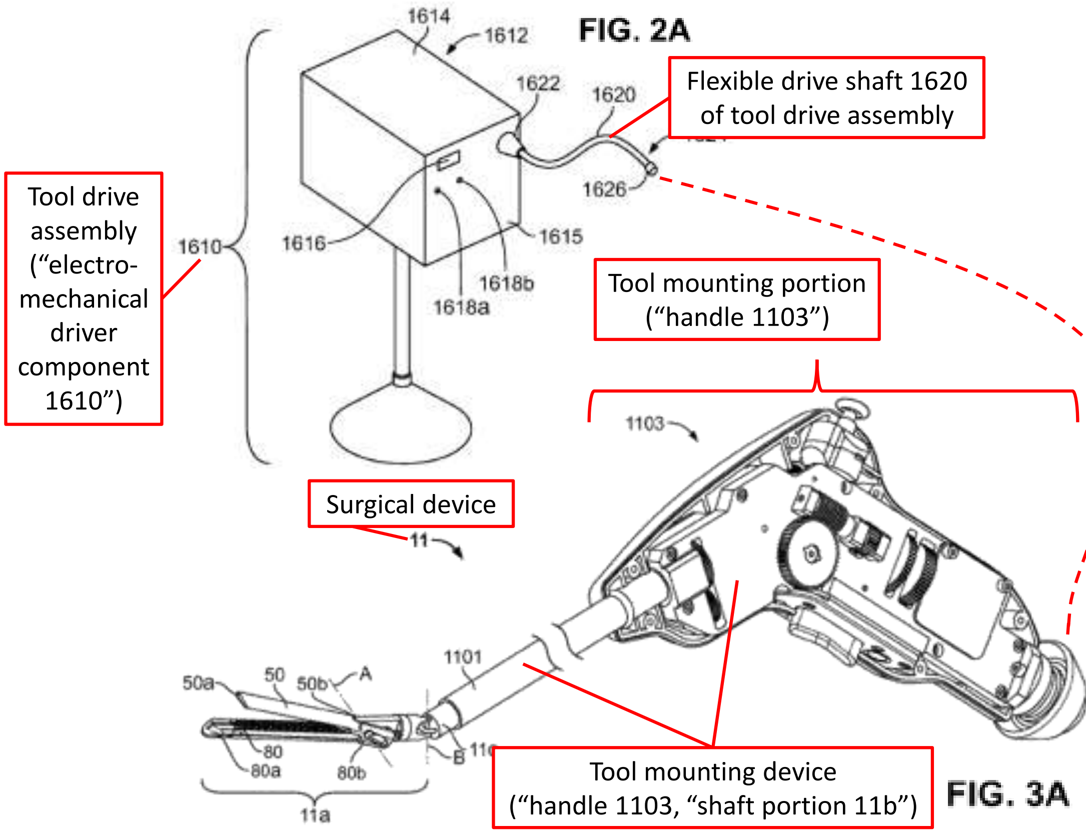


FIG. 12

[1.2] a tool mounting portion configured for operable attachment to the tool drive assembly of the robotic system

Whitman discloses this limitation. IS1003, ¶171. Whitman discloses a tool mounting portion (handle 1103) configured for operable attachment to the tool drive assembly (electro-mechanical driver component 1610) of the robotic system (electro-mechanical driver system 1610 and surgical device 11); specifically the flexible drive shaft 1620 component. *Id*.; IS1004, FIGs. 2A-B, 3A, 10.



Notably, "surgical device 11 may include a connection element 1104 that includes a quick connect sleeve 713 having quick connect slots 713a that engage complementary quick connect elements 1664 of a flexible drive shaft 1620 . . . ." IS1004, ¶210.

[1.3] an elongated shaft assembly having a proximal end portion operably supported on said tool mounting portion and a distal end portion operably interfacing with said surgical end effector to apply said control motions thereto

Whitman discloses this limitation. IS1003, ¶172. Whitman discloses an elongated shaft assembly (shaft portion 11b, hinge portion 11c) that has a proximal end portion (proximal portion 1101b) and a distal end portion (distal portion 1101a). *Id.*; IS1004, ¶¶71-73, FIG. 2B; *see also* ¶139.

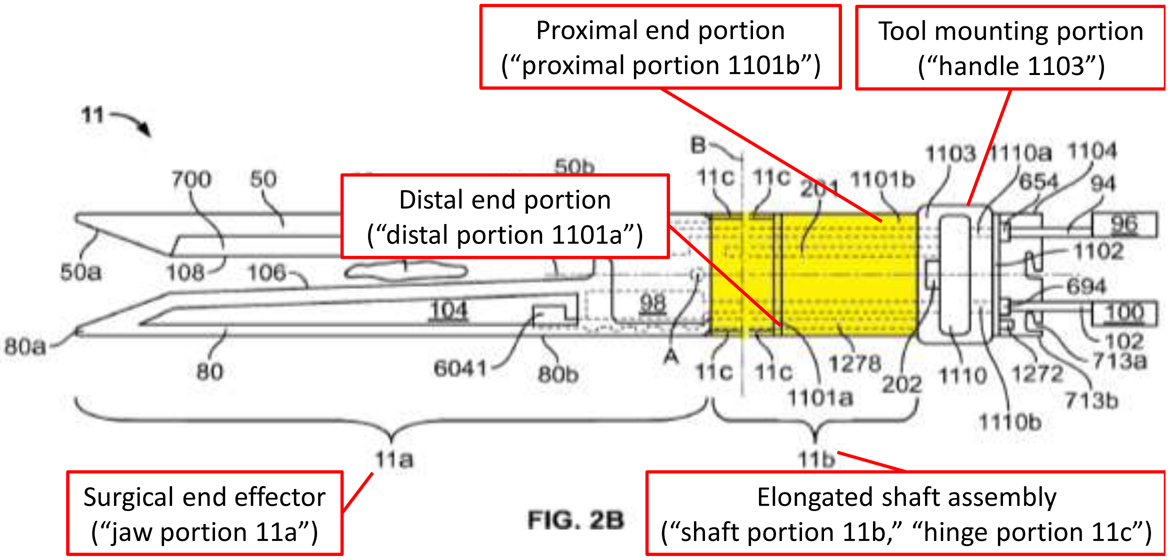


FIG. 2B

As shown above, proximal portion 1101b of shaft portion 11b attaches to handle 1103 and is therefore operably supported on the tool-mounting portion (handle 1103). *Id*. Similarly, distal portion 1101a includes hinge portion 11c, which operably interfaces with the surgical end effector (jaw portion 11a) to apply the control motions (rotary control motions of Whitman's transmission) thereto. *Id*.

[1.4] a transmission arrangement operably supported on said tool mounting portion

See Ground 1, elements [1.4], [1.6]-[1.8] (discussing Whitman's transmission arrangement). For Ground 3, the transmission arrangement is operably supported on Whitman's tool mounting portion (handle 1103) instead of Tierney's tool mounting portion. IS1003, ¶173.

[1.5] such that when said tool mounting portion is attached to the tool drive assembly said transmission arrangement is configured to operably interface with a rotatable drive element of the tool drive assembly to receive a rotary output motion therefrom

Whitman discloses this limitation. IS1003, ¶174. When Whitman's tool mounting portion (handle 1103) is attached to the tool drive assembly (electro-mechanical driver component 1610), the transmission arrangement (including function selector module 1110) is configured to operably interface with a rotatable drive element (drive shaft 102) of the tool drive assembly (electro-mechanical driver component 1610) to receive a rotary output motion therefrom. *Id.*; IS1004, ¶¶73, 78, FIGs. 2B, 3B.

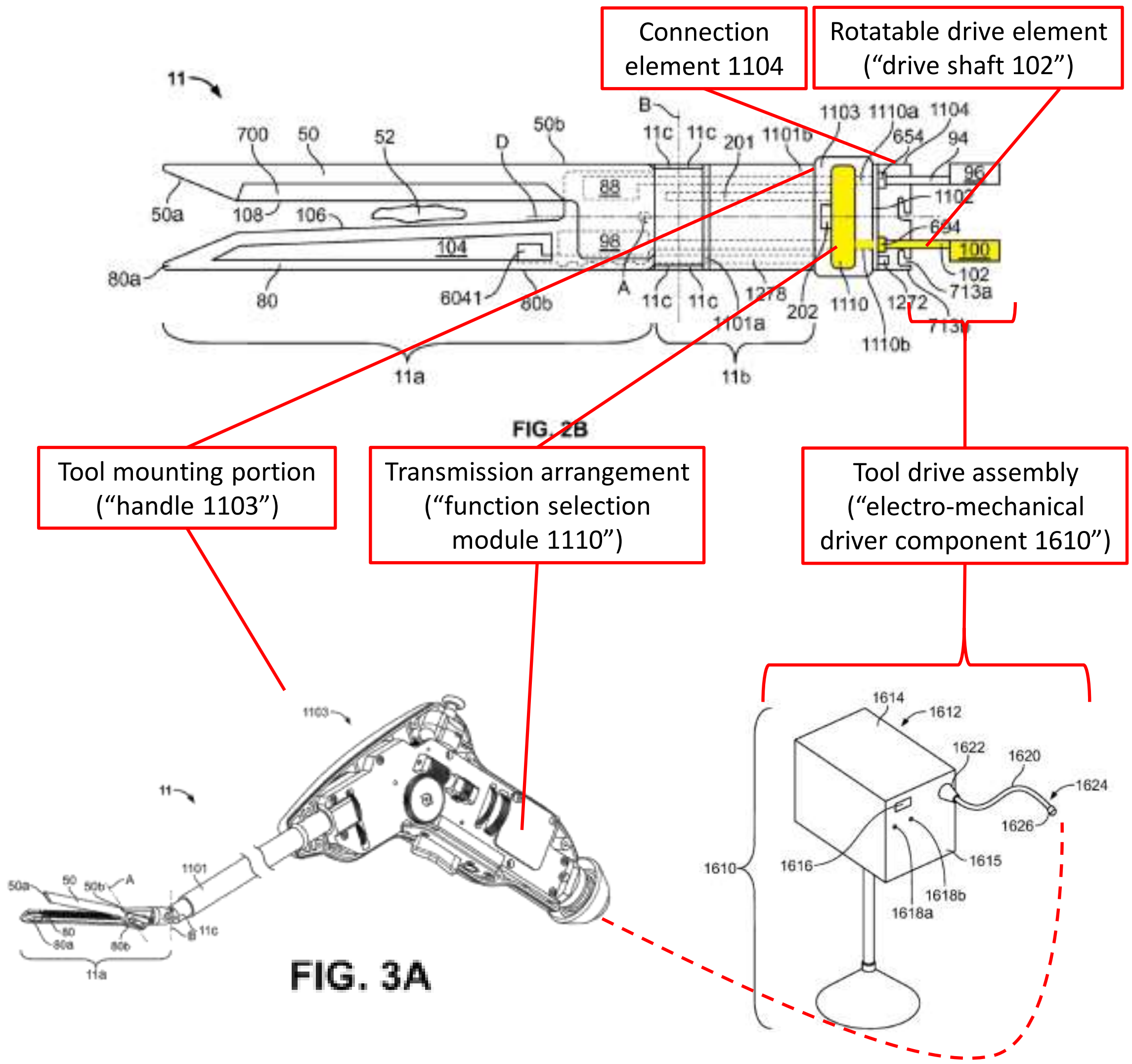


FIG. 2A

As "shown [above] in FIG. 2(b), the connection element 1104 of the handle 1103 may enable the second rotatable drive shaft 1110b to be coupled to a fourth rotatable drive shaft 102 via a second drive socket 694. The fourth rotatable drive shaft 102 is in turn coupled to, or coupleable to, a second motor 100. In this manner, operation of the second motor 100 to rotate the fourth rotatable drive shaft 102, the second drive socket 694 and second rotatable drive shaft 1110b may drive the particular driver mechanism that has previously been selected by the operation of the function selection module 1110." IS1004, ¶78, FIG. 2B.

[1.6] said transmission arrangement communicating with the control unit of the robotic system and being responsive to actuation motions therefrom to move between first and second positions

Whitman discloses this limitation. IS1003, ¶¶176-78. Whitman's transmission arrangement (including function selector module 1110) communicates with the control unit (*e.g.*, controller 1122 and/or wireless RCU 1148) of the robotic system and is responsive to actuation motions (actuation of first motor 96 and drive shaft 94) therefrom. *Id.*; Ground 1, element [1.6].

[1.7] such that when said transmission arrangement is in said first position, an application of said rotary output motion thereto by said rotatable drive element of the tool drive assembly causes a first one of said control motions to be applied to a portion of said surgical end effector through said elongated shaft assembly and when said transmission arrangement is in said second position, said application of said rotary output motion thereto by said rotatable drive element of the tool drive assembly causes a second one of said control motions to be applied to another portion of said surgical end effector through said elongated shaft assembly.

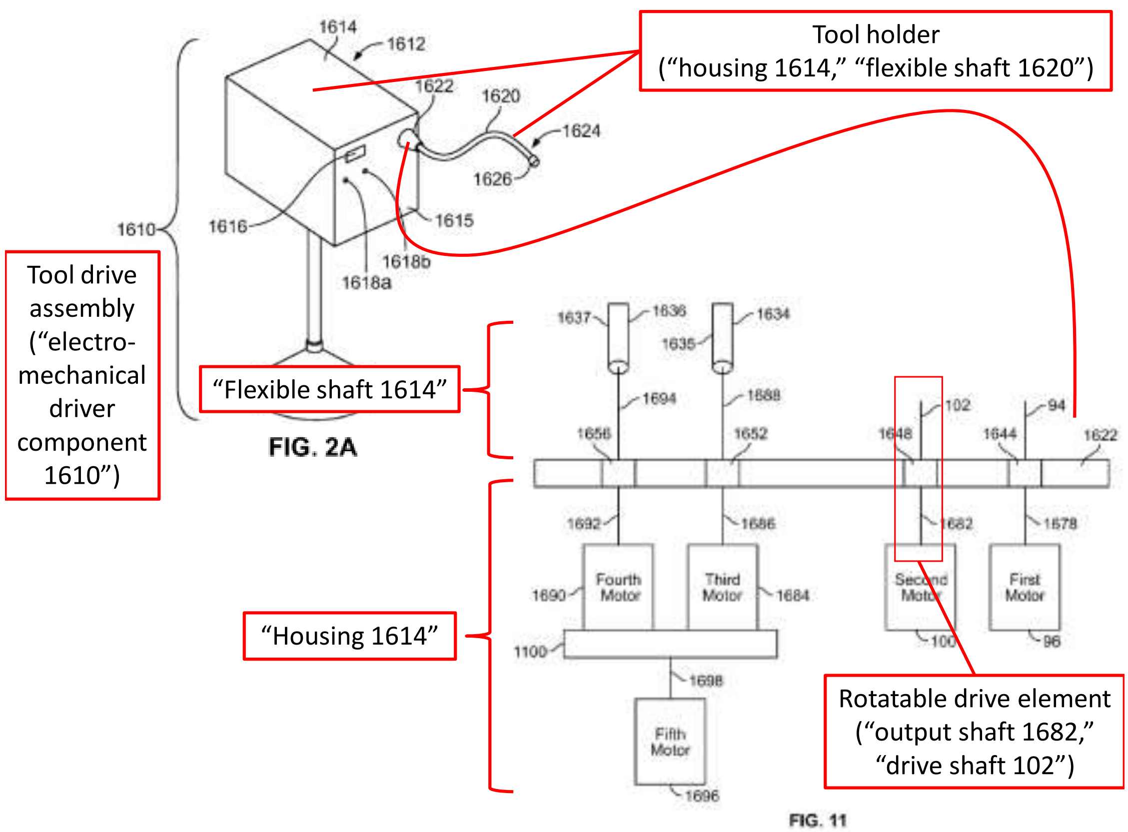
See Ground 1, element [1.7]. For Ground 3, instead of Tierney's drive element 119, the rotatable drive element (drive shaft 102) of Whitman's tool drive assembly applies the rotary motion to the transmission arrangement (including function selector module 1110) to rotate drive shaft 1110b and cause the first and second control motions to be applied to the portions of the end effector. *Id*.

[2.1] The tool mounting device of claim 1

See Ground 3, claim [1].

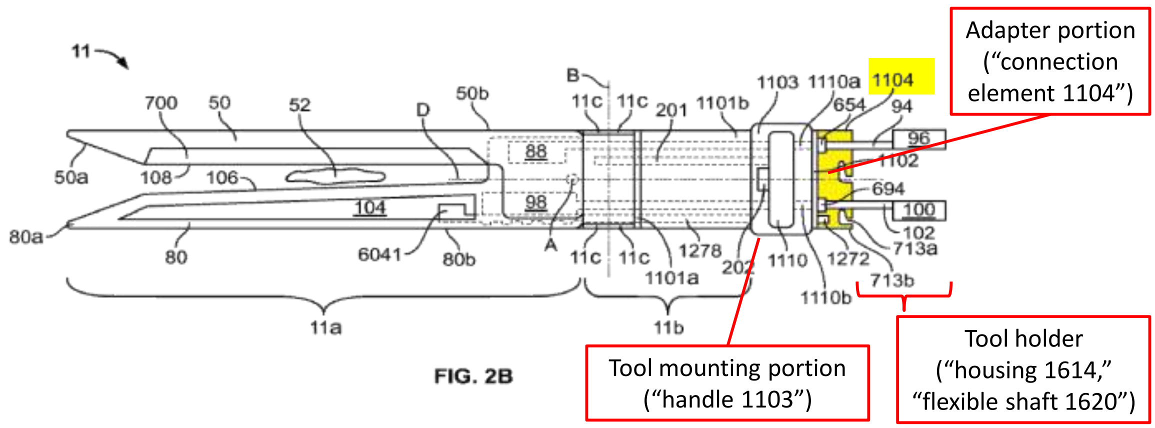
[2.2] wherein the tool drive assembly of the robotic system comprises at least one rotatable drive element operably supported on a tool holder and

Whitman discloses this limitation. IS1003, ¶181. Whitman's tool drive assembly (electro-mechanical driver component 1610) includes at least one rotatable drive element (output shaft 1682 and drive shaft 102) operably supported on a tool holder (housing 1614 and flexible shaft 1620). *Id.*; IS1004, ¶217; *see also* ¶214 ("[D]rive shafts of the motor arrangement contained within the housing 1614."), FIG. 7 (showing drive shaft 102 within flexible shaft 1620), FIG. 2A (showing location of first coupling 1622).



[2.3] wherein said tool mounting device further comprises an adapter portion operably attachable to the tool holder and said tool mounting portion for establishing an interface there between,

Whitman discloses this limitation. IS1003, ¶¶182-83. Whitman discloses an adapter portion (connection element 1104) that is operably attachable to the tool holder (housing 1614 and flexible shaft 1620) and the tool mounting portion (handle 1103) for establishing an interface there between. *Id.*; IS1004, ¶¶73, 77, 78, 86, 210, 212, FIGs. 2A, 2B, 10.



[2.4] said adapter portion operably supporting a rotatable adapter body configured to operably engage a corresponding one of the rotatable drive elements when said adapter portion is coupled to the tool holder and

Whitman discloses this limitation. IS1003, ¶184. Whitman's adapter portion (connection element 1104) operably supports a rotatable adapter body (drive socket 694). *Id.*; IS1004, FIG. 2B. A POSITA would have understood that drive socket 694 is rotatable because it is engaged between two rotating drive shafts 102 and 1110b. IS1003, ¶184.

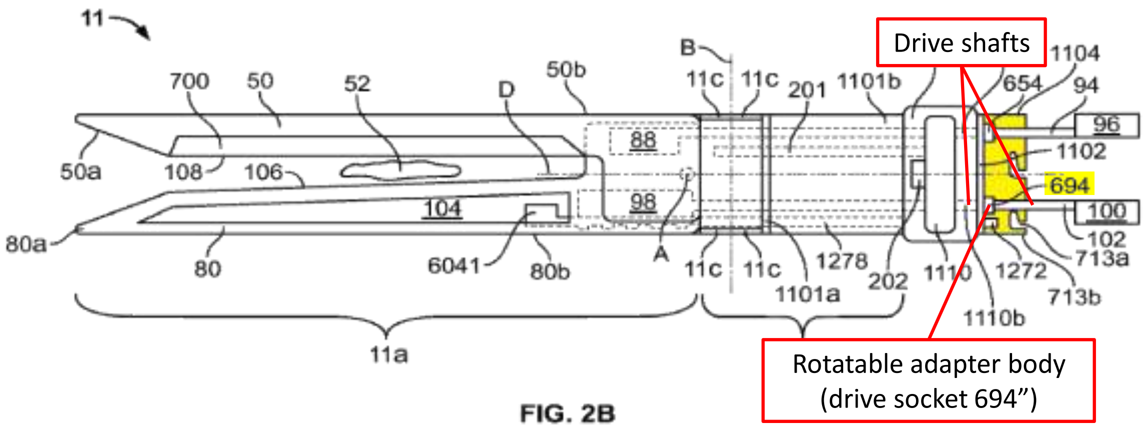


FIG. 2B

Drive socket 694 is configured to operably engage (couple with) a corresponding one of the rotatable drive elements (drive shaft 102) when the adapter portion (connection element 1104) is coupled to the tool holder (flexible shaft 1620 and housing 1614). *Id.*, ¶185; IS1004, ¶78, FIG. 2A; *see also* FIG. 10 (confirming that second coupling 1626 couples connection element 1104 to flexible shaft 1620 and housing 1614).

[2.5] wherein a rotatable driven element is configured to operably engage said rotatable adapter body when said tool mounting portion is coupled to said adapter portion

Whitman discloses this limitation. IS1003, ¶186. Whitman discloses a rotatable driven element (drive shaft 1110b). *Id.*; IS1004, ¶78, FIG. 2B. Drive shaft 1110b is configured to operably engage Whitman's rotatable adapter body (drive socket 694) when the tool mounting portion (handle 1103) is coupled to the adapter portion (connection element 1104). *Id.*

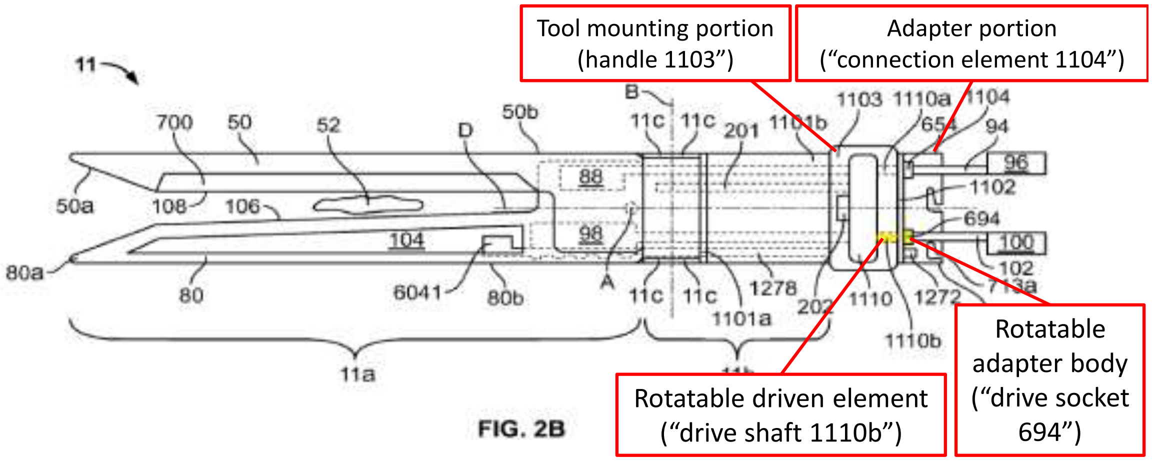


FIG. 2B

[6.1] The tool mounting device of claim 1 wherein said transmission arrangement comprises:

See Ground 3, claim [1].

[6.2] a first control assembly operably interfacing with said elongated shaft assembly to apply said first control motion thereto

See Ground 1, element [6.2].

[6.3] a second control assembly operably interfacing with said elongated shaft assembly to apply said second control motion thereto; and

See Ground 1, elements [6.2]-[6.3].

[6.4] a transmission shifter assembly communicating with the control unit of the robotic system and

Whitman discloses this limitation. IS1003, ¶190. Whitman's function selector module 1110 is a transmission shifter assembly (*see* Ground 1, element [6.4]) that communicates with the control unit (controller 1122, wireless RCU 1148, and/or wired RCU 1150) of Whitman's robotic system. *See* Ground 3, elements [1.1], [1.6].

[6.5] [said transmission shifter assembly] configured to receive said rotary output motion from said rotatable drive element of the tool drive assembly,

Whitman discloses this limitation. IS1003, ¶191. Whitman's transmission shifter assembly (function selector module 1110) is configured to receive the rotary output motion from the rotatable drive element (drive shaft 102) of Whitman's tool drive assembly (electromechanical driver system 1610). Specifically, "function selector module 1110 causes engagement of a second rotatable drive shaft 1110b with a selected one of various drivers 88, 98, 201, 202 . . . . [T]he second rotatable drive shaft 1110b [can] be coupled to a fourth rotatable drive shaft 102 via a second drive socket 694." IS1004, ¶¶76-78, FIG. 2B.

[6.6] said transmission shifter assembly configured to shift between said first and second positions in response to control inputs from the control unit of the robotic system

Whitman discloses this limitation. IS1003, ¶192; *see* Ground 1, element [6.6] (describing function selector module 1110). For Ground 3, instead of control input from Tierney's control unit, Whitman's transmission shifter assembly (function selector module 1110) is configured to shift between said first and second positions in response to control inputs (electrical signals) to motor 96 from Whitman's control unit (*e.g.*, controller 1122). *Id*. As explained in Whitman, "controller 1122 is electrically and logically connected with . . . motor[] 96 . . . and is configured to control . . . motor[] 96 . . . ." IS1004, ¶230. And "operation of the first motor 96 . . . actuate[s] the function selection module 1110" (shifts it between the first and second positions). *Id*., ¶¶76-77.

[6.7] such that when said transmission shifter assembly is in said first position, said rotary output motion is applied to said first control assembly and when said transmission shifter assembly is in said second position, said rotary output motion is applied to said second control assembly.

Whitman discloses this limitation. IS1003, ¶193; *see* Ground 1, elements [1.7], [6.7]. For Ground 3, instead of the rotary output motion from Tierney's rotatable drive element, rotary output motion from Whitman's rotatable drive element (output shaft 1682 and drive shaft 102) is applied to the first and second control assemblies. *Id*.; IS1004, ¶¶79-82, FIGs. 2B, 3B.

[10.1] The tool mounting device of claim 1

See Ground 3, claim [1].

[10.2] wherein said elongated shaft assembly has an articulation joint therein

See Ground 1, element [10.2].

[10.3] such that upon application of said first control motion to said surgical end effector, said surgical end effector articulates about a first tool articulation axis that is substantially transverse to a longitudinal tool axis defined by said elongated shaft assembly

See Ground 1, element [10.3].

[11] The tool mounting device of claim 10 wherein said articulation joint is configured to enable said surgical end effector to pivot about a second tool articulation axis upon application of another said control motion to said surgical end effector

See Ground 1, claim [11].

[12.1] The tool mounting device of claim 1 wherein said surgical end effector further comprises

See Ground 3, claim [1].

[12.2] a surgical staple cartridge and

See Ground 1, element [12.2].

[12.3] wherein said portion of said surgical end effector comprises an anvil selectively movable relative to said surgical staple cartridge between an open position and a closed position in response to a closure control motion applied thereto by said transmission arrangement.

See Ground 1, element [12.3].

[13] The tool mounting device of claim 12 wherein said another portion of said surgical end effector comprises a cutting instrument that is axially movable within said surgical staple cartridge between a starting position and an ending position in response to a firing motion applied thereto by said transmission arrangement

See Ground 1, claim [13].

D. Ground 4: Claim 11 is Obvious over Tierney in view of Whitman and further in view of the Timm Application

In Ground 1, claim 11 is shown to have been obvious over Tierney in view of Whitman. To the extent that the Board disagrees that Whitman discloses a "second tool articulation axis," it would have been obvious to modify Whitman to add a second tool articulation axis, as taught by the Timm Application.

As shown in the figures below, the Timm Application discloses the same two-axis articulation joint disclosed in the '431 Patent. IS1003, ¶203; IS1016, ¶182, FIG. 41.

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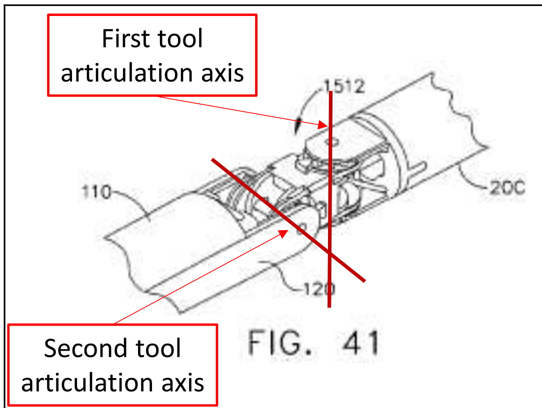
<td>
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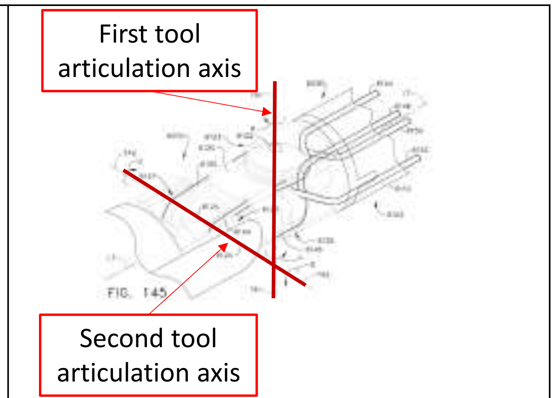
<td>
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<td>Timm Application</td>
<td>’431 Patent</td>
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A POSITA would have been motivated to modify Whitman based on the teachings of the Timm Application by adding a second articulation pivot joint providing a second articulation axis for several reasons. First, a surgeon would have a greater range of motion than with just a single articulation axis. IS1003, ¶204. For example, it was well-known before the priority date that articulation about two axes was desirable: “Some surgical tools employ a roll-pitch-yaw mechanism for providing three degrees of rotational movement to an end effector around three perpendicular axes. The pitch and yaw rotations are typically provided by a wrist mechanism coupled between a shaft of the tool and an end effector . . . .” IS1017, 2:51-57. Second, the Timm Application’s use of both a vertical and a horizontal articulation joint is simple and efficient. IS1003, ¶205.

It would have been well within the ordinary skill in the art for a POSITA to modify Whitman, based on the teachings of the Timm Application, to include a second articulation joint of the Timm Application following the Whtiman articulation joint, or, alternatively, replacing the Whitman articulation joint with the 2-axis Timm Application's articulation joint. A POSITA would know how to drive a pair of cables to manipulate the second articulation joint, or drive two pairs of cables to operate both articulation joints, as taught by the Timm Application. The two pivot joints combined would provide articulation along two degrees of freedom in the same manner as that of the Timm Application and the '431 Patent. IS1003, ¶¶205-207.

VIII. CONCLUSION

Claims 1-7, 10-14, 16-20, 23-26 of the '431 Patent are invalid pursuant to Grounds 1-4 set forth above. Accordingly, Petitioner requests *Inter Partes* Review of these challenged claims.

Respectfully submitted,

Dated September 11, 2018

/Steven R. Katz/

Steven R. Katz, Reg. No. 43,706
John C. Phillips, Reg. No. 35,322
Ryan P. O'Connor, Reg. No. 60,254
Fish & Richardson P.C.
3200 RBC Plaza
60 South Sixth Street
Minneapolis, MN 55402
T: 858-678-5070
F: 877-769-7945

(Control No. IPR2018-01703)

Attorneys for Petitioner

CERTIFICATION UNDER 37 C.F.R. § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter partes* Review totals 13,777 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated September 11, 2018

/Steven R. Katz/

Steven R. Katz, Reg. No. 43,706
John C. Phillips, Reg. No. 35,322
Ryan P. O'Connor, Reg. No. 60,254
Fish & Richardson P.C.
3200 RBC Plaza
60 South Sixth Street
Minneapolis, MN 55402
T: 858-678-5070
F: 877-769-7945

Attorneys for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on September 11, 2018, a complete and entire copy of this Petition for *Inter partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

JOSEPH F. SHIRTZ
JOHNSON & JOHNSON
ONE JOHNSON & JOHNSON PLAZA
NEW BRUNSWICK NJ 08933-7003

/Diana Bradley/
Diana Bradley
Fish & Richardson P.C.
60 South Sixth Street, Suite 3200
Minneapolis, MN 55402
(858) 678-5667