

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Patent of: Shelton, IV  
U.S. Pat. No.: 8,479,969 Attorney Docket No.: 11030-0049IP5  
Issue Date: July 9, 2013  
Appl. Serial No.: 13/369,609  
Filing Date: Feb. 9, 2012  
Title: DRIVE INTERFACE FOR OPERABLY COUPLING A  
MANIPULATABLE SURGICAL TOOL TO A ROBOT

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**DECLARATION OF DR. BRYAN KNODEL IN SUPPORT OF PETITION  
FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,479,969  
(ANDERSON AS PRIMARY REFERENCE)**

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I, Bryan Knodel, declare as follows:

1. I have been engaged as an expert by Fish & Richardson P.C. on behalf of Intuitive Surgical, Inc. (“Petitioner”) for the above-captioned *inter partes* review. I understand that this proceeding involves United States Patent No. 8,479,969 entitled “Drive Interface for Operably Coupling a Manipulatable Surgical Tool to a Robot” by Frederick E. Shelton IV, filed February 9, 2012, and issued July 9, 2013 (the “’969 Patent” or “’969”). I understand that the ’969 Patent is currently assigned to Ethicon LLC.

2. I have reviewed and am familiar with the specification of the ’969 Patent. I will cite to the specification using the following format (’969 Patent, 1:1-10). This example citation points to the ’969 Patent specification at column 1, lines 1-10.

3. I have reviewed and am familiar with the file history of the ’969 Patent (“FH”). I understand that the file history is being provided as an exhibit in a single PDF document. I will cite to the PDF pages when I cite to the file history.

4. I have also reviewed the Petition for *Inter Partes* Review of the ’969 Patent and am familiar with the following prior art used in the Petition:

- IS1007 U.S. Patent No. 6,817,974 to Cooper *et al.* (“Cooper”)
- IS1008 U.S. Patent No. 6,699,235 to Wallace *et al.* (“Wallace”)
- IS1009 U.S. Patent No. 6,331,181 to Tierney *et al.* (“Tierney”)

- IS1010 U.S. Patent No. 6,783,524 to Anderson *et al.* (“Anderson”)
- IS1011 U.S. Patent No. 7,510,107 to Timm *et al.* (“Timm”)
- IS1012 U.S. Patent No. 5,465,895 to Knodel *et al.* (“Knodel”)
- IS1013 U.S. Patent No. 5,954,259 to Viola *et al.* (“Viola”)
- I also considered U.S. Published Application No. 2008/0167672 (IS1014), which is the grandparent application to the ’969 Patent (filed as U.S. Application No. 11/651,807 (“’807 Application”).

I have been asked to provide my technical review, analysis, insights and opinions regarding the ’969 Patent and the above-noted references.

## I. QUALIFICATIONS

5. My resume is being provided with this Declaration. As indicated there, I have eight publications and I am a named inventor on over 130 patents for medical devices. I have extensive experience with surgical instruments, and surgical staplers in particular, which is the subject matter of the ’969 Patent.

6. Specifically, I have been involved in the research and development, design, and manufacture of medical devices including surgical cutting and stapling devices since 1992, and am qualified to present the analysis provided in this declaration.

7. I was employed in the Research and Development department as an engineer of Ethicon Endo-Surgery. I was the lead design engineer for endoscopic linear staplers/cutters. In this lead design engineer role, it was my responsibility to understand every aspect of these devices.

8. One early patent of mine is U.S. Patent No. 5,465,895, entitled “Surgical Stapler Instruments,” and granted on November 14, 1995. This patent is referenced in the Background section of the ’969 Patent’s specification as “disclos[ing] an endocutter with distinct closing and firing actions,” but was not cited by the Examiner during prosecution. ’969 Patent, 2:13-16. The ’895 Patent states: “The present invention relates in general to surgical stapler instruments which are capable of applying lines of staples to tissue while cutting the tissue between those staple lines and, more particularly, to improvements relating to stapler instruments and improvements in processes for forming various components of such stapler instruments.” My ’895 Patent specifically discloses jaws that open and close and a gear-driven knife to cut stapled tissue. I am thus generally familiar with such mechanisms for surgical instruments.

9. Beginning in 1998, I have been a consultant for medical device companies and law firms. I have consulted in the areas of conceptual design, prototyping, and turnkey product design.

10. In addition, I have worked on a variety of surgical products for use in a wide range of surgical procedures including female reproductive system, female incontinence, female pelvic floor dysfunction, lung volume reduction, colon, GERD, bariatrics, CABG, heart valve repair, hernia, general surgical procedures, and surgical stapling, which is the general subject matter of the patent-at-issue.

11. As part of my consulting practice, I have also acted as a non-testifying expert in a patent litigation case in the area of medical devices.

12. I have not testified as an expert witness at trial or by deposition during the previous four years.

13. I am being compensated at my usual and customary rate of \$200/hour for my work on this case, plus reimbursement for actual expenses. My compensation is not contingent upon the conclusions I reach, the outcome of this *inter partes* review, or any litigation involving the '969 Patent.

## II. MY UNDERSTANDING OF CLAIM CONSTRUCTION

14. I understand that claim terms are read in light of the patent's specification and file history as understood by a person of ordinary skill in the art at the time of the purported invention. I further understand that in an *inter partes* review proceeding of an unexpired patent, such as the '969 Patent, the claim terms are to be given their broadest reasonable interpretation ("BRI") consistent with the specification. I understand that constructions under the BRI standard should be at least as broad as constructions under the plain and ordinary meaning standard used in district court litigation.

## III. LEGAL STANDARDS

15. I am not a lawyer and do not provide any legal opinions. Although I am not a lawyer, I have been advised that certain legal standards are to be applied by

technical experts in forming opinions regarding meaning and validity of patent claims.

16. As part of this inquiry, I have been asked to consider the level of ordinary skill in the field that someone would have had at the time the claimed invention was made. In deciding the level of ordinary skill, I considered the following:

- the levels of education and experience of persons working in the field;
- the types of problems encountered in the field; and
- the sophistication of the technology.

17. I understand that a claim is invalid if a single prior art reference (including information that the single prior art reference specifically incorporates by reference) discloses a claimed invention (the invention thus lacks novelty) or if the claim would have been obvious to one of ordinary skill in the art at the time of the purported invention based on the teachings of one or more prior art references.

18. I understand that the time of the purported invention is the earliest possible effective filing date of the application that discloses the claimed subject matter. For the '969 Patent, the filing date is February 9, 2012. The '969 Patent claims priority as a continuation of application No. 13/118,259 (the "'259 application"), filed on May 27, 2011, which is a continuation-in-part of application No. 11/651,807 (the "'807 application"), filed on Jan. 10, 2007 and issued as U.S.



Patent No. 8,459,520 (“the ’520 patent”). I reviewed the ’807 application and saw no disclosure of a robotic instrument interface to a tool drive assembly having rotatable body portions, as required by the claims, and therefore I understand that the ’969 Patent cannot use the ’807 application’s filing date for an effective filing date. My understanding, therefore, is that the ’969 Patent has a priority date no earlier than May 27, 2011.

19. I am informed that a claim can be invalid based on anticipation if each limitation of the claim is found in the four corners of a single prior art reference (including any incorporated material), either explicitly or inherently.

20. I am informed that a claim can be invalid based on obviousness in light of a single prior art reference alone (based on general knowledge in the art), or based upon a combination of prior art references, where there is some reason one of ordinary skill in the art would make the combination.

21. I am informed that when evaluating whether an invention would have been obvious, the question is whether the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person of ordinary skill in the art at the time the purported invention was made. In other words, the question is not whether a single element “would have been obvious” but whether the claim as a whole would have been obvious given what was known in the prior art.

22. I understand that an obviousness analysis should (1) identify the particular references that, singly or in combination, make the patent obvious; (2) specifically identify which elements of the patent claim appear in each of the asserted references; and (3) explain a motivation, teaching, need or market pressure that would have inspired a person of ordinary skill in the art to combine prior art references to solve a problem. I understand that certain objective indicia should be considered, if available, regarding whether a patent claim would have been obvious or nonobvious. Such indicia include: commercial success of products covered by the patent claims; a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results achieved by the invention as compared to the closest prior art; praise of the invention by the infringer or others in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; and the patentee proceeded contrary to the accepted wisdom of the prior art. I am not aware of any such indicia that would be pertinent to the challenged claims.

23. Furthermore, I understand that the United States Supreme Court in its *KSR vs. Teleflex* decision ruled that “if a technique has been used to improve one device, and a person of ordinary skill in the art would have recognized that it

would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond that person's skill."

#### **IV. LEVEL OF ORDINARY SKILL IN THE ART**

24. A person of ordinary skill in the art at the time of the alleged invention ("POSITA") would have had the equivalent of a Bachelor's degree or higher in mechanical engineering with at least 3 years working experience in the design of comparable surgical devices. Additional education in a relevant field, such as mechanical engineering or robotics (to the extent pertinent), or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above.

25. I am a person of at least ordinary skill in the art, and was such a person as of the priority date of the '969 Patent, which I am informed by counsel that, for purposes of this petition, is May 27, 2011. I was also a person of at least ordinary skill in the art as of January 10, 2007, the filing date of the grandparent '807 application.

#### **V. OVERVIEW OF THE '969 PATENT**

26. The '969 Patent's specification generally has two parts. It first discusses a hand-held embodiment at length (at roughly columns 11-22), and this material generally comes from the grandparent '807 application filed in 2007. In 2011, the applicant filed a "continuation-in-part" application that added new material related to a robotic embodiment, essentially adapting the handheld

surgical instrument to work with then-existing surgical robot systems, such as those made by Intuitive Surgical. Each of the claims of the '969 Patent concern the robotic embodiments as each requires a “tool mounting portion” to interface to “rotatable body portions” on a robotic “tool drive assembly.” '969 Patent at 11:12-42; 23:50-24:39; *accord* '969 Patent, Title. The robotic surgical systems disclosed and claimed by the '969 Patent include components that were both typical and expected of systems in the art at the time of the priority date of the '969 Patent. These components include a “master controller” and “robotic arm cart” and a tool drive assembly with multiple rotary drive members controlling surgical end effectors. '969 Patent, 23:50-62; 24:62-25:29; FIGs. 26-27. Each of these components may be found in the prior art, and in particular the prior art of Petitioner Intuitive Surgical. *Compare* '969 Patent, FIGs. 27 and 29 (“tool drive assembly”) *with* Tierney FIGs. 7J and 7E (Driven disks, receiving rotary drive motions from rotary drive elements on tool drive assembly of robotic surgical system).

## **VI. PROSECUTION HISTORY OF THE '969 PATENT**

27. While the application that led to the '969 Patent was pending, the Patent Office issued one and only one rejection, over Tierney, directed to two independent claims. FH at 280-284. The Patent Office also indicated that a number of dependent claims were allowable, FH at 284, and Applicant amended

the independent claims to include the subject matter identified as allowable. FH at 295-310. However, as discussed below, the subject matter identified as allowable was well-known to those of skill in the art, as shown in Anderson, Cooper and the other references cited here. The Examiner then issued a notice of allowance, FH at 328-330, and Patent Owner filed a request for continued examination containing over 2,000 new references on February 22, 2013. FH at 357-438, 471. A new Notice of Allowance followed two weeks later on March 7, 2013. FH at 547-552.

## VII. THE '969 PATENT'S PRIORITY DATE

28. As discussed above, the '969 Patent claims priority as a continuation of application No. 13/118,259, filed on May 27, 2011, which is a continuation-in-part of application No. 11/651,807, filed on Jan. 10, 2007 and issued as the '520 Patent. I have not been asked to consider, and so have not considered, whether the parent '259 Application provides written description support for the '969 Patent.<sup>1</sup> I have, however, considered whether the grandparent '807 Application that led to the '520 Patent provides written description support for the challenged claims (nos.

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<sup>1</sup> I understand that Intuitive has not conceded that any previously-filed application provides written description support for any claim of the '969 Patent, but merely does not challenge the priority claim to the parent '259 Application for purposes of this Petition.

19-26) of the '969 Patent, and I have concluded that it does not. In particular, each challenged claim of the '969 Patent claims a “tool mounting portion” “being configured to operably interface with the tool drive assembly” and further recites that the “tool drive assembly” is part of a robotic system. '969 Patent, 88:13-96:60. The claims also recite that the recited instrument has components that interface with “rotatable body portions” on the robotic tool drive assembly.

29. The grandparent '807 Application does not disclose, and one of ordinary skill at the time of the priority date of the '969 Patent would not have understood the '807 Application to disclose, these limitations. Rather, it discusses – and thus one of ordinary skill in the art would have understood it to disclose – only a “handheld endoscopic surgical instrument” with a mention that the instrument may be used in “robotic-assisted surgery.” '807 Application, ¶¶15, 89, FIGs. 1-2. There is no disclosure in the '807 Application of the details of any surgical robot and no mention of the tool drive assembly, the tool mounting portion, or the rotatable body portions on the tool drive assembly. A person of skill in the art would not understand the inventors to have possession of the alleged invention of the challenged claims prior to the filing of the 2011 application.

30. Because the '807 Application does not disclose the robotic limitations of the claims, I understand that the '969 Patent is not entitled to the filing date of the '807 Application, and thus the earliest possible filing date the '969 Patent

would be the date of the '259 Application, which is May 27, 2011. Again, I offer no opinion as to whether the parent '259 Application provides written description support for any claim of the '969 Patent, and understand that the burden to show such a disclosure in an alleged priority document falls on the patentee.

### **VIII. INTERPRETATION OF THE '969 PATENT CLAIMS AT ISSUE**

31. As a preliminary matter, I observe that the '969 Patent uses the terms “instrument” and “tool” interchangeably. *E.g.*, '969 Patent, Title, Abstract, 1:54-65, 2:21-24, 2:50-3:2, 3:6-22, 3:66-4:3, 4:10-20, 10:64-11:42, 24:11-43. The specification does not describe any difference between these terms, and one of ordinary skill in the art would have understood them to be synonymous at least as used within the disclosure of the '969 Patent.

32. Beyond the clarification above, I see no reason that one of ordinary skill in the art would have understood the broadest reasonable interpretation of the terms of the challenged claims of the '969 Patent to require clarification beyond the plain meaning of those terms.

### **IX. OVERVIEW OF THE ASSERTED PRIOR ART**

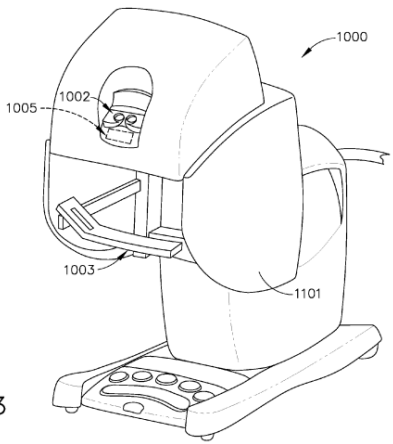
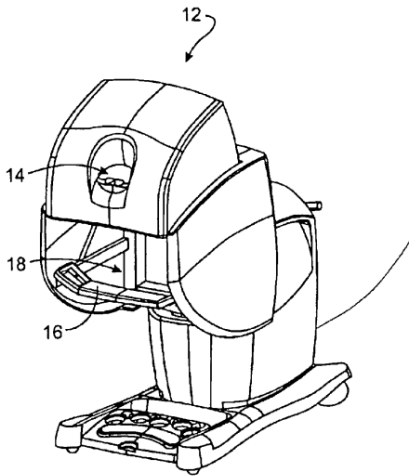
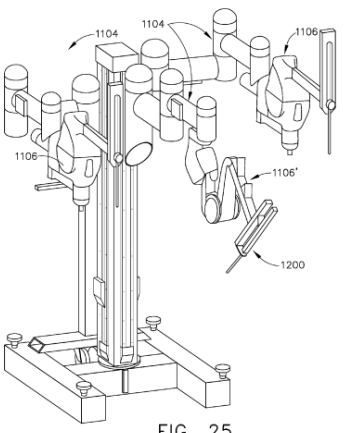
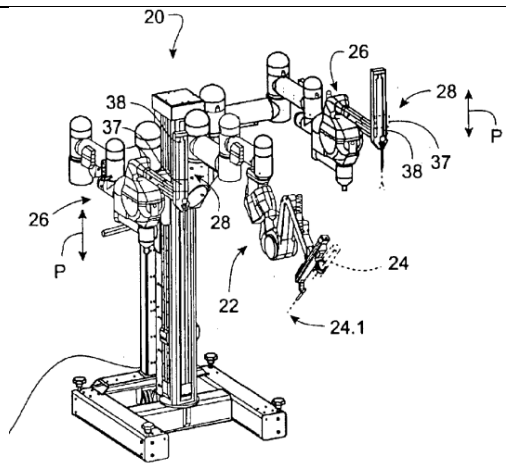
#### **A. Anderson**

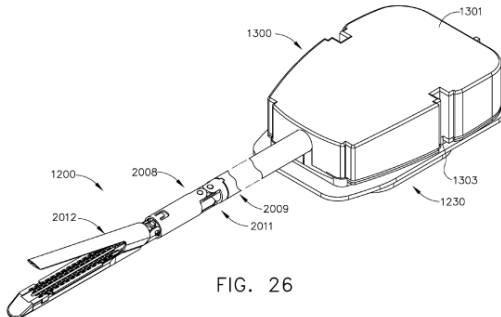
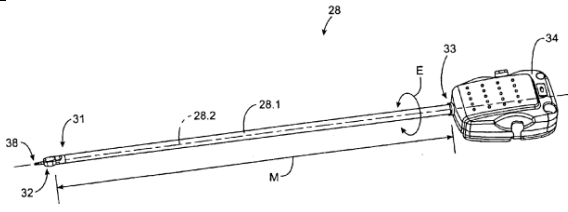
33. Anderson (U.S. Patent No. 6,783,524 assigned to petitioner, Intuitive Surgical, Inc.) describes a surgical robot, and is assigned to Intuitive Surgical, the Petitioner here. The surgical robot in Anderson is specifically designed to interface with a variety of surgical instruments, such as surgical staplers, tissue

graspers, and tissue cutters. Anderson, 7:6-25; 11:32-65; 16:25-36; FIGs. 2-3; 12A-D. Anderson describes a surgical robot of the same type as that disclosed in the Tierney reference considered by the Examiner and referenced in the '969 Patent, and further contains additional disclosure pertinent to the '969 Patent claims. Anderson discloses that its system is for use with surgical tools similar to those described in the '969 Patent and depicts surgical tools which have end effectors that can be rotated by either a cable drum or gear configuration. Specifically, Anderson's surgical tool comprises an end effector connected via an elongate shaft to a base which mounts the tool to a robotic surgical system. Anderson FIG. 2, 11:32-65. Anderson's shaft rotates about the longitudinal axis shown in FIG. 2. Anderson's end effector may include, for example, a pivotable gripper for gripping tissue. Anderson 15:30-60. Anderson's base has a plurality of "transmission members" that transmit rotational motion from a robotic arm to the end effector. Anderson 11:66-12:22; 16:7-23. Anderson teaches an end effector that may be rotated using a cable-driven system, and also discloses "a gear train" that may be used, and, in particular, "a right-angled helical gear pair." Anderson 16:37-46; 23:25-36.

34. Also of note is that the figures of the '969 Patent have a striking resemblance to those of the prior-art Anderson reference:



<b><u>Robotic Controller</u></b>	
<b><u>'969 Patent</u></b>	<b><u>Anderson</u></b>
 <p>FIG. 23</p>	 <p>FIG. 1</p>
<b><u>Robotic Manipulator</u></b>	
<b><u>'969 Patent</u></b>	<b><u>Anderson</u></b>
 <p>FIG. 25</p>	

<b><u>Surgical Tool With Proximal Tool Holder</u></b>	
<b><u>'969 Patent</u></b>	<b><u>Anderson</u></b>
 <p>FIG. 26</p>	 <p>FIG. 2</p>

### **B. Cooper**

35. Cooper (U.S. Patent No. 6,817,974 also assigned to petitioner, Intuitive Surgical, Inc.) discloses a surgical tool, such as a stapler, for surgical robots similar to that of Anderson, with a focus on various articulating wrists. Cooper at FIG. 36; 17:26-50. In addition, Cooper has a figure depicting a gear-driven embodiment in which a helical gear pair, including a tube gear, is used to rotate the shaft and end effector. Cooper at FIG. 64; 24:1-23.

### **C. Timm**

36. Timm discloses a surgical stapler with an articulation joint. Timm, 2:25-55; 1:42-53; Abstract, FIG 1. In particular, the surgical stapler of Timm discloses an elongate shaft with articulation ball joint 2760, a proximal spine segment 2720 on one side of the ball joint, and a distal spine segment 2740 on the

other, where the spine and end effector may be “removably associated with” a “robotic or computer” actuator. Timm, FIG. 52; 28:50-29:3; *see also* FIGs. 62-66; 8:3-7; 12:1-3; 28:45-49; 31:62-32:31; 30:58-31:35. Timm also discloses a gear-driven knife that is selectively movable with respect to the lower jaw of the stapler. *E.g.*, Timm, Abstract

**D. Wallace**

37. The Wallace reference (U.S. Patent No. 6,699,235 also assigned to petitioner, Intuitive Surgical, Inc.) teaches a “robotic surgical tool for use in a robotic surgical system” that, similar to the instruments of Anderson, includes a shaft supporting a surgical end effector with a “tool base 62 [that] includes an interface 64 which mechanically and electrically couples the tool 50 to a manipulator on the robotic arm cart.” Wallace, FIGs. 1, 2A; Abstract; 7:33-56:

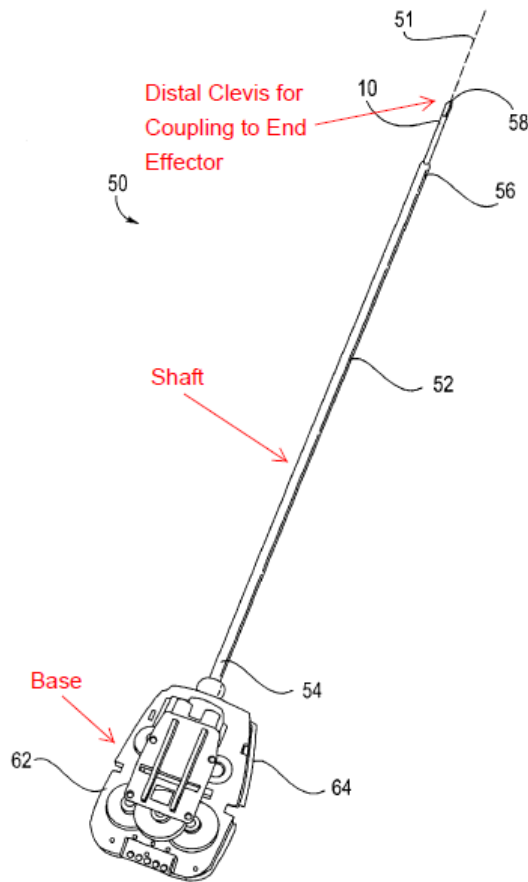


Fig. 1

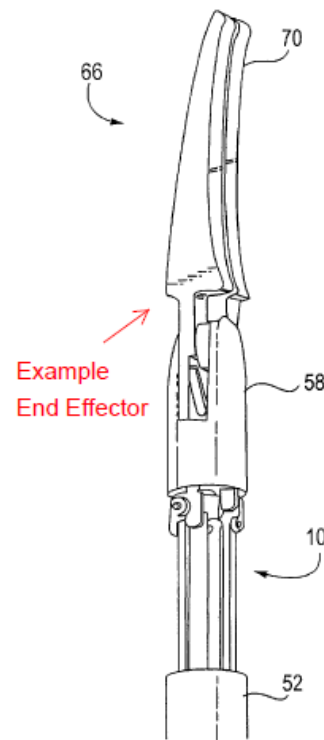
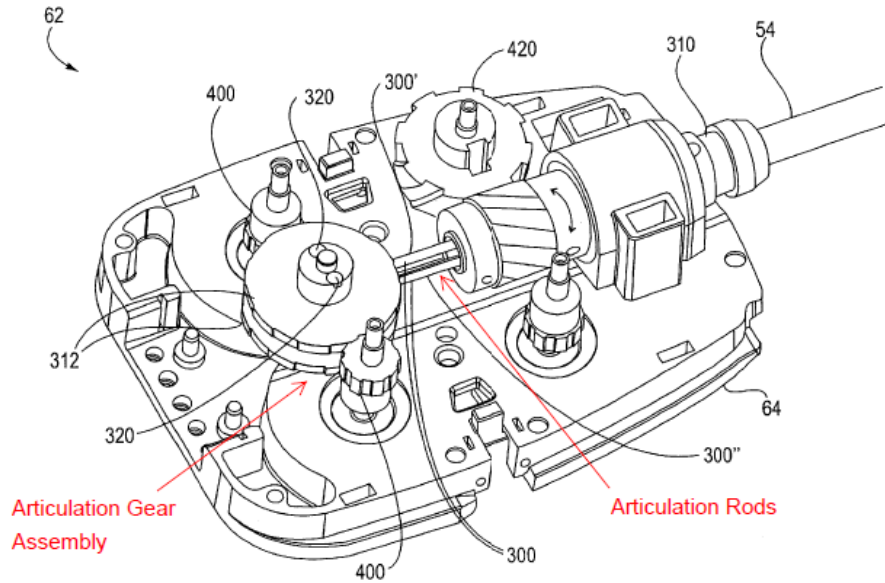


Fig. 2A

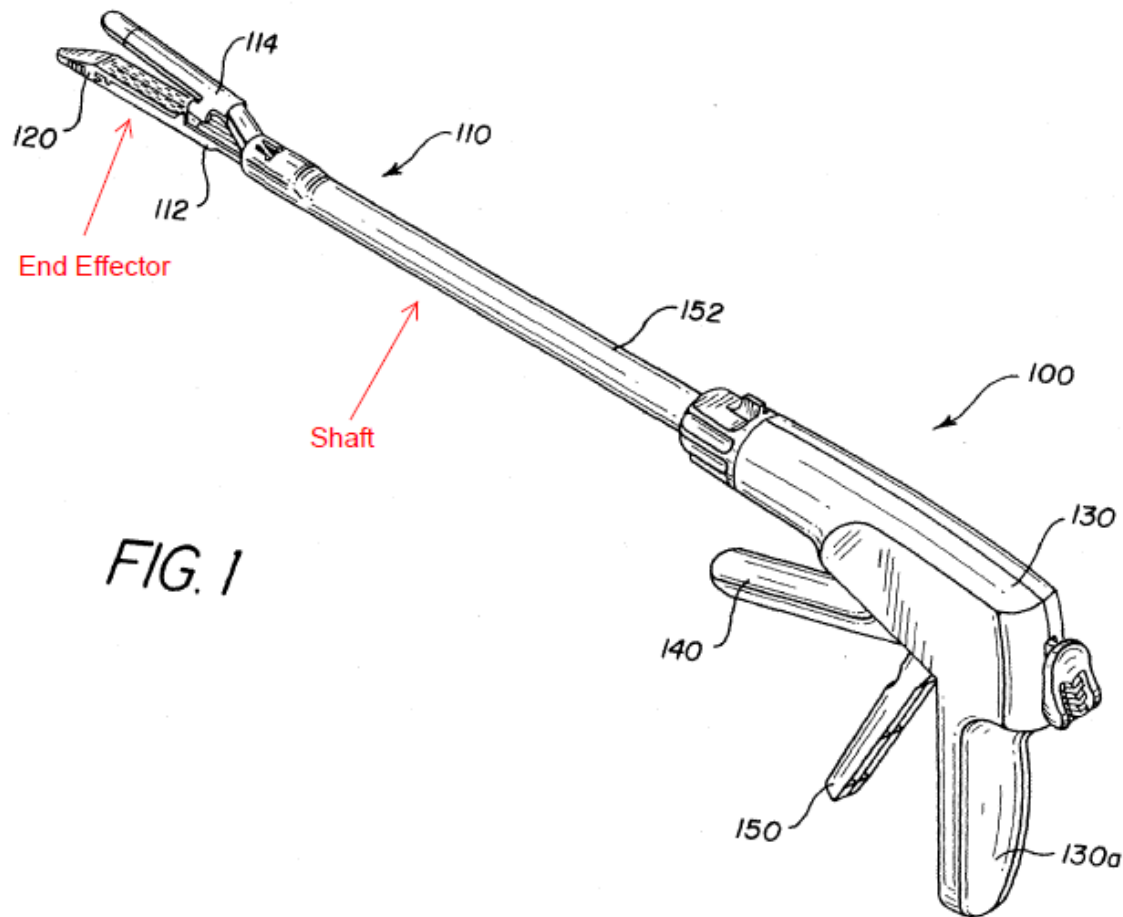
38. Wallace also teaches a “wrist joint or mechanism” operated by moving articulation rods using gears, as shown in Figure 30. Wallace, 7:57-65; 13:6-14:15, FIG. 30 (including “sector gears 312” and “gears 400”).



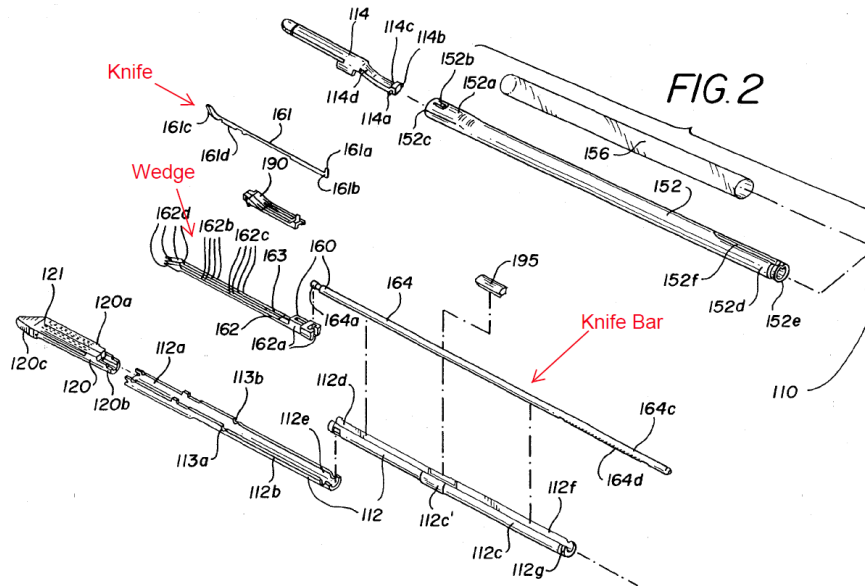
### E. Knodel

39. Knodel teaches “[a] surgical stapler instrument ... for applying lateral lines of staples to tissue while cutting the tissue between those staple lines.”

Knodel, Abstract. The surgical instrument of Knodel also has a shaft that supports an end effector, as may be seen in FIG. 1:



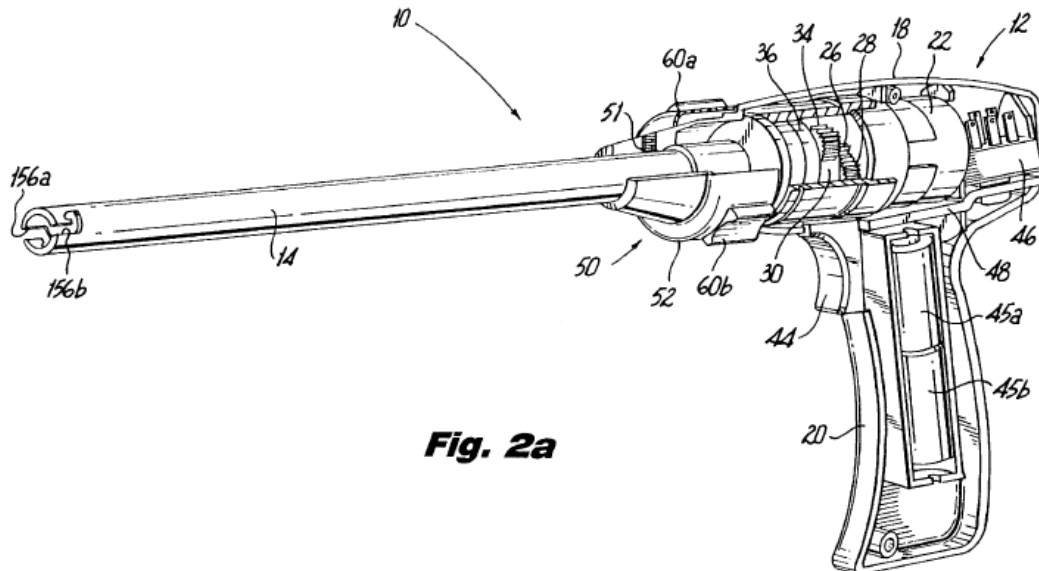
Knodel, FIG. 1; 5:52-6:10. Knodel also teaches a shaft supporting a drive bar that it refers to as “drive member 164” and which moves distally within the shaft thereby imparting driving force on wedge work member 162 and knife 161 as shown in FIG. 2:



Knodel, FIG. 2; 9:10-17; 10:65-11:12; 10:10-18; *see also* FIG. 6; 10:65-11:12; 9:10-35.

## F. Viola

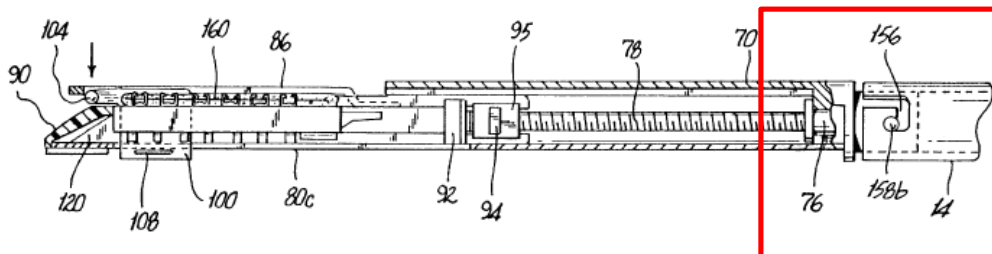
40. Viola discloses a surgical stapling tool with an end effector stapler that uses a drive screw. The end effector of Viola may be attached via “J-shaped engagement slot 156 formed in body portion 14”:



**Fig. 2a**

Viola, 7:44-45, Fig. 2a.

41. Viola also discloses an end effector that can be rotatably attached to the elongated shaft using “engagement pins 158a and 158b”:



**Fig. 10**

Viola, 7:46, Fig. 10.

## X. APPLICATION OF THE PRIOR ART TO THE '969 PATENT

### A. Ground 1: Anderson View of Cooper

42. Claim 23 of the '969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Cooper. For example,



Anderson discloses all limitations of claim 23 except for an explicit disclosure of a “tube gear” for rotating the end effector. Cooper discloses the tube gear.

43. I note that although Anderson was before the Examiner during prosecution, it was not used in any rejection and there is no evidence in the prosecution record that the Examiner considered Anderson in connection with the Cooper reference. I examine each limitation of the relevant claims of the '969 Patent and I discuss the motivation to combine Anderson with Cooper. One of skill in the art would have readily understood that supplementing Anderson's disclosure with details from Cooper concerning Cooper's helical drive and tube gears is merely the application of a known technique (generate shaft rotation by using tube gears) to a known system (e.g., the surgical instrument of Anderson which has a gear option) ready for improvement to yield predictable results.

44. One of skill in the art would find many reasons to modify Anderson to include the gear arrangement of Cooper. First, one of skill in the art would have understood that the gear structure of Cooper and Anderson's disclosure of a “right-angled helical gear pair” are extremely similar. Anderson, 22:59-23:30. Indeed, one of skill in the art would have been motivated to replace Anderson's spool 94 and roll drum 96 with Cooper's helical drive gear 840 and follower gear 842 because Anderson specifically discloses that the pictured roll drum/spool pair shown in FIG. 13 may be replaced by a “right-angled helical gear pair.” Anderson,

22:59-23:30.

45. One of skill in the art would recognize that Cooper discloses that its teachings would result in “improved efficiency and cost-effectiveness” over conventional way of conveying motion, Cooper, 24:21-23, and one of skill in the art would apply the gear arrangement of Cooper into the system taught by Anderson to achieve these benefits. In addition, the gear arrangement of Cooper can provide greater torque than the arrangement of Anderson, which would have served to reduce the size and possibly expense of the motor required. In addition, Cooper’s gear structure is significantly less complex than the cable embodiment and related components. Anderson, 22:59-23:30.

46. Finally, one of skill in the art would have modified the teachings of Anderson to include the teachings of Cooper because both teach surgical instruments that may be releasably attached to a robotic surgical system that may provide rotational driving motion, and thus modifying Anderson as I describe here would have led to predictable results without significantly altering or hindering the functions performed by Anderson’s system. Indeed, Anderson teaches that “various alternatives, modifications and equivalents may be used” and Cooper suggests such an improvement. Anderson at 25:10-11.

1. [23.P] A surgical tool for use with a robotic system that has a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to provide at least one rotary output motion to at least one rotatable body portion supported on the tool drive assembly, said surgical tool comprising:

47. One of ordinary skill in the art would have understood Anderson to disclose this limitation.

48. Regarding the phrase “[a] surgical tool for use with a robotic system,” Anderson teaches “a robotic surgical instrument for use with a robotic surgical system,” and that “surgical instrument 28” is “configured to releasably engage a robotic surgical system”, which may be viewed in Figure 2:

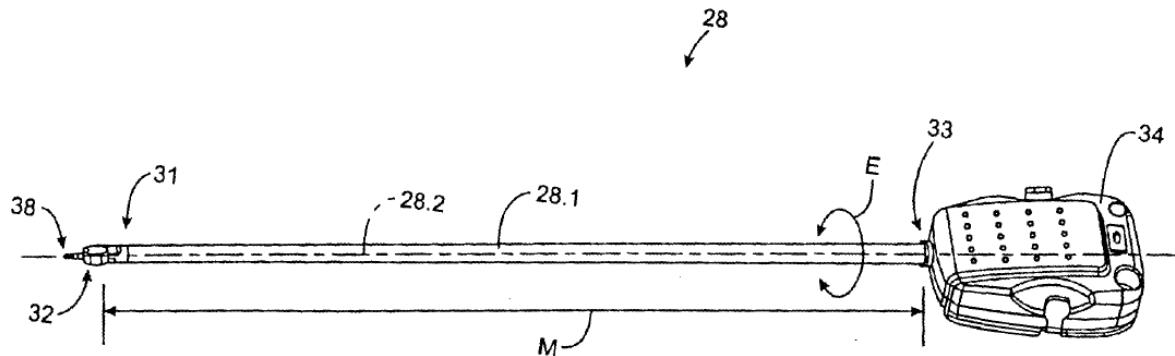
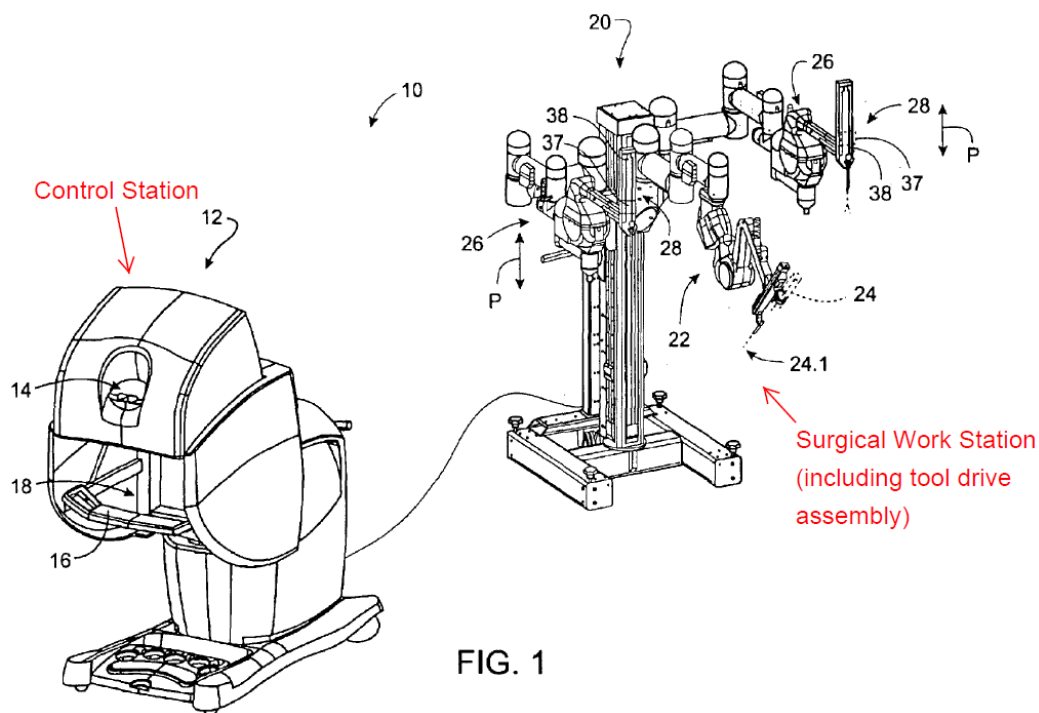


FIG. 2

Anderson, FIG. 2; 16:7-23; 11:32-42; 10:65-11:31; 4:7-11; Abstract.

49. Regarding the phrase “has a tool drive assembly that is operatively coupled to a control unit,” Anderson teaches “control station 12” that controls “surgical workstation” 20 which has the surgical tool drive assembly and attendant

surgical tools, and one of skill in the art would have understood that the control station corresponds to the “control unit” claimed by the ’969 Patent. Anderson, FIG. 1; 10:21-64. This may be seen below:



50. Regarding the phrase “operable by inputs from an operator,” control station 12 may be operated by “operator control input” from “a surgeon or other user.” Anderson, 10:40-64; 11:59-65; 5:61-6:8.

51. Regarding the phrase “configured to provide at least one rotary output motion to at least one rotatable body portion supported on the tool drive assembly,” one of ordinary skill in the art would have understood that the Anderson manipulator has motors that drive rotating “engaging members” which drive shafts 70.1, 72.1, 74.1, and 76.1 on the attached instrument, as disclosed by

Anderson:

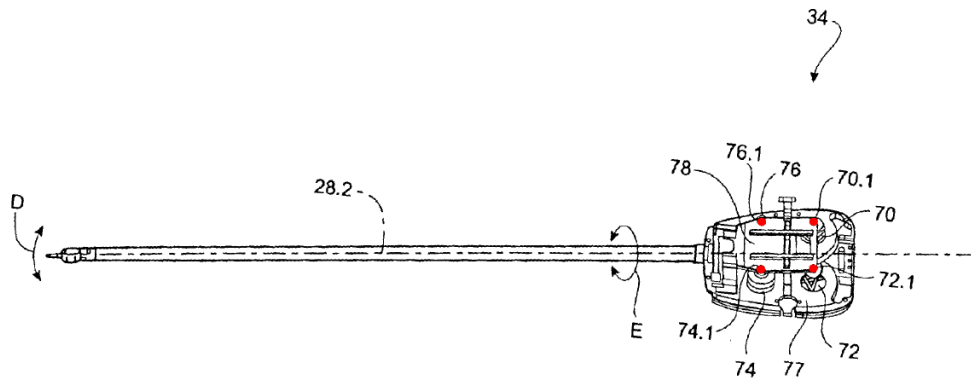


FIG. 3

Anderson, FIG. 3 (in red). Anderson teaches that the above base 34 attaches to a robotic arm assembly 26, including its motors and engaging members that attach to and apply rotary motion to the above shafts. Anderson, FIG. 3; 11:66-12:22; Abstract. Anderson teaches that the engaging members have rotary motion applied by “actuators,” which may include “electric motors or the like, to cause selective angular displacement of each engaging member” to the interface of the rotatable shafts within base 34. Anderson, FIG. 3; 11:66-12:22; Abstract. For these reasons, one of ordinary skill in the art would have readily understood that Anderson teaches “rotatable body portions supported on the tool drive assembly.”

2. **[23.1] a surgical end effector comprising at least one component portion that is selectively movable between first and second positions relative to at least one other component portion thereof in response to control motions applied to said selectively movable component portion;**

52. One of ordinary skill in the art would have understood Anderson to disclose this limitation.

53. Regarding the “selectively movable” component portions, Anderson teaches a plurality of end effectors with such portions, including “end effector 81,” which “includes a gripper 82 hingedly attached to shaft 84.” Anderson, FIG. 10; 15:3-38; 15:48-60. Anderson discloses additional selectively movable component portions such as a “pivotally mounted gripper or clamp 303” that pivots to mate with “ultrasonic blade 304.” Anderson, FIG. 20; 22:8-20; 24:54-65.

54. Regarding the phrase “in response to control motions,” Anderson discloses that “components of base 90 enable forces originating at one or more master controllers of a robotic surgical system to be transmitted to end effector 81 to achieve an effect at a surgical site” and that “gripper 82 of end effector 81 is movable by one or more actuator rods housed within shaft 86,” and one of skill in the art would have understood such controller-generated forces and actuation of actuator rods to constitute control motions. Anderson, 16:7-23; 16:62-17:22 10:40-12:22; 24:54-65. One of ordinary skill in the art would have understood from these disclosures that the same control motions applied to end effector 81 or its gripper 82 could be applied to gripper 303 (discussed in the previous paragraph), which thus also moves “in response to control motions applied to said selectively movable component portion.”

3. [23.2] an elongated shaft assembly including a distal end operably coupled to said surgical end effector and defining a longitudinal tool axis, said elongated shaft assembly including a tube gear segment on a proximal end thereof; and

55. One of ordinary skill in the art would have understood Anderson in view of Cooper to disclose this limitation.

One of ordinary skill would have understood that Anderson discloses an “elongated shaft” assembly that includes “shaft 307” and may include other components within or around the shaft such as outer sheath 312, actuator rods, and spools or gears. Anderson, 22:8-19; 5:11-17; 23:25-30. The shaft assembly defines longitudinal “instrument axis 311” and to which Anderson’s “end effector 302” is attached at the distal end. Anderson, 21:66-22:11; 22:8-19; FIG. 20.

56. Regarding the “tube gear,” Anderson in view of Cooper discloses the recited “tube gear.” Anderson discloses two mechanisms to rotate the shaft: a cable-driven mechanism and gear-driven mechanism. Only the cable-drive mechanism is depicted in the figures. Anderson’s Figure 22 shows one such cable-driven mechanism where “roll-barrel 336” is connected to “roll interface member 344” via cable, which can thus impart rotary motion to “roll-barrel 336”, as can be seen below:

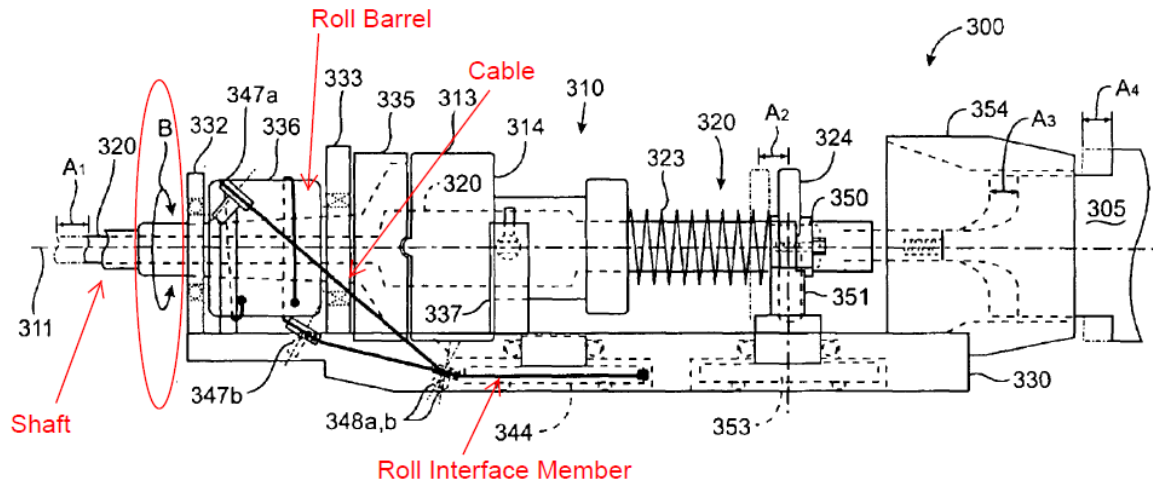


FIG. 22

Anderson, FIG. 22; 22:8-28; 22:59-23:14.

57. Anderson shows a slightly different configuration in FIG. 13. In this figure, a roll-barrel (here numbered 96) is operable to rotate the shaft shown in “in generally the same manner” as roll-barrel 336:



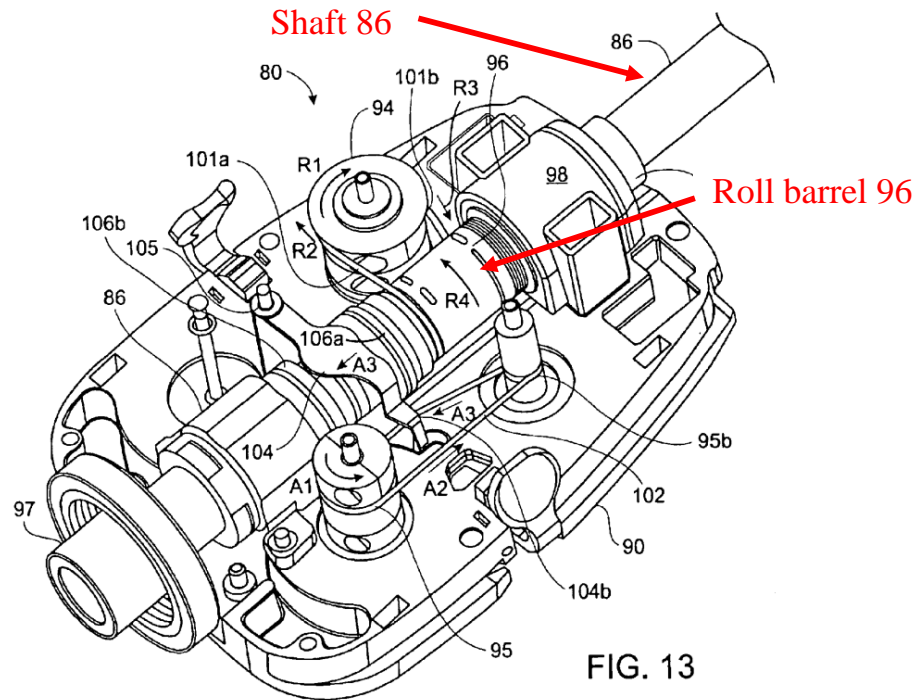


FIG. 13

Anderson FIG. 13; 22:59-61; 16:36-61.

58. Anderson further teaches a “a gear train or other mechanical transmission means, *e.g.*, a right-angled helical gear pair, may be used to rotationally couple the interface member 344 with the receiver 335,” Anderson, 22:59-23:30. One of ordinary skill in the art would have understood this teaching to mean that a right-angled gear pair could be substituted for spool and roll barrel and the gear pair would be aligned so that they were in meshing engagement with each other. In the FIG. 22, cable-driven configuration roll-barrel 336 and interface member 344 would both be replaced with helical gears and moved so that the gears’ teeth engage each other. Similarly, in Anderson’s FIG. 13 cable-driven configuration, actuator spool 94 and roll-barrel 96 would be replaced with helical

gears with meshingly engaged teeth.

59. While Anderson does not depict its gear-driven mechanism, Cooper does have such images. Like Anderson, Cooper discloses a surgical instrument with a base (that it calls “back end mechanism 410”) with a rotatable shaft and end effector:

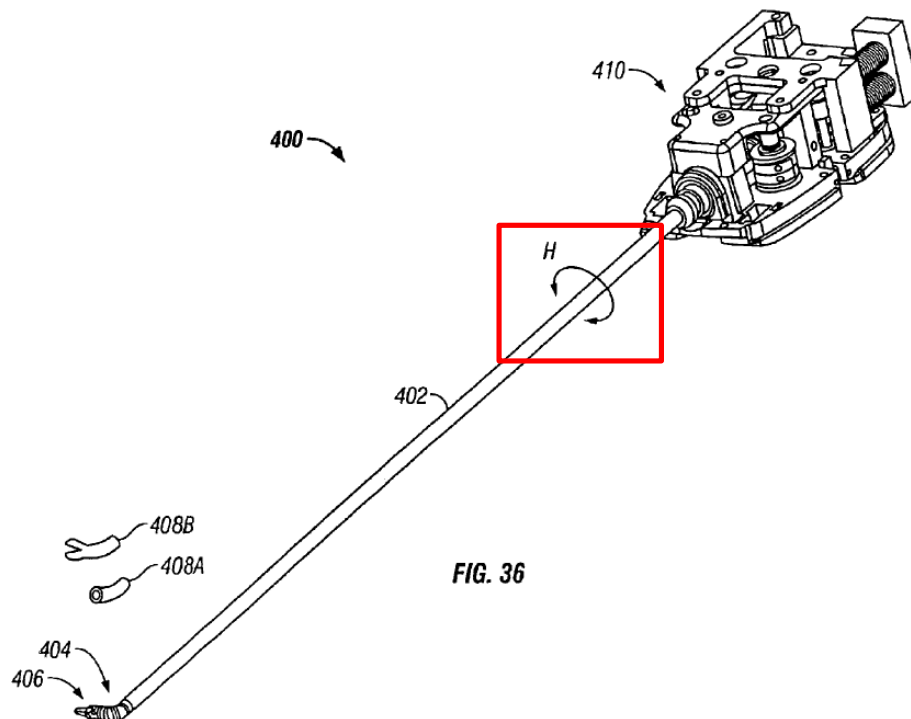
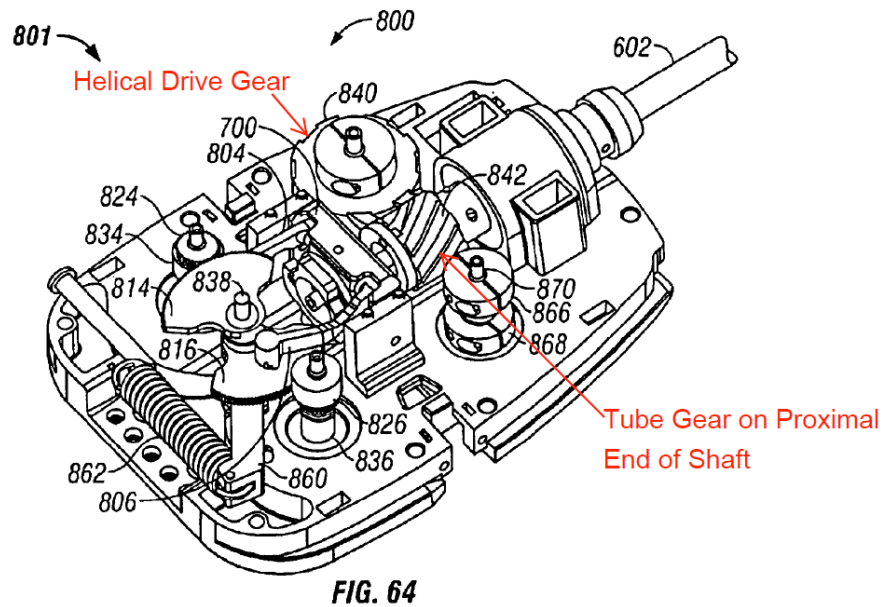


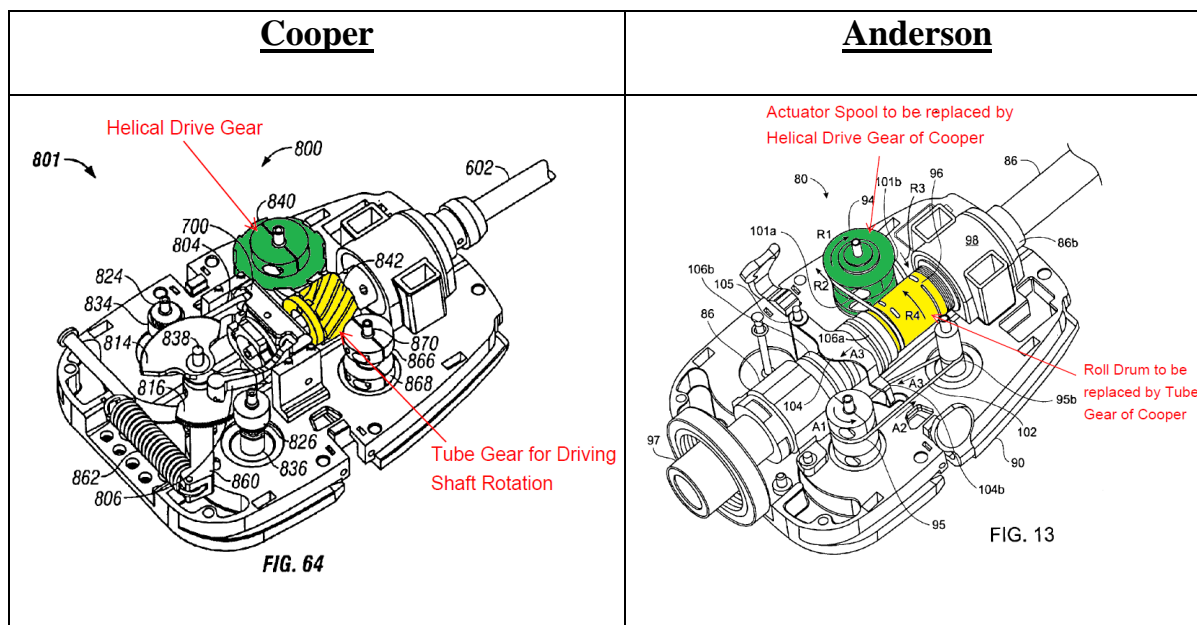
FIG. 36

Cooper, FIG. 36; 17:26-50. Cooper also teaches that “helical drive gear 840” positioned at a right angle to “follower gear 842” (which corresponds to the ’969 Patent’s tube gear), both of which effect rotation of Cooper’s shaft:



Cooper, FIG. 64; 24:1-23.

60. One of ordinary skill in the art would have readily understood that Cooper's "helical drive gear 840" and "follower gear 842" correspond to the "right-angled helical gear pair" disclosed by Anderson. This is clear when FIG. 13 of Anderson is compared to FIG. 64 of Cooper:



Anderson, FIG. 13; 16:25-61; 22:59-23:30; Cooper, FIG. 64; 24:1-23. One of ordinary skill in the art would have understood that Cooper's follower gear 842 is a "tube gear" because it is tube shaped so that it fits over the proximal end of the shaft such that actuation of the gear rotates the shaft. The tube gear of Cooper serves the same function and is in essentially the same location as the tube gear in the '969 Patent. Multiple reasons would have prompted one of ordinary skill in the art to modify Anderson's FIG. 13 and/or FIG. 22 to use the gear arrangement of Cooper. One of ordinary skill in the art would have recognized that the teaching of a "right-angled helical gear pair" in Anderson describes the tube gear structure of Cooper. Anderson, 22:59-23:30. Also, one of ordinary skill in the art would have recognized that such a configuration would lead to "improved efficiency and cost-effectiveness" over other methods of conveying rotational motion. Cooper, 24:21-

23. For example, one of ordinary skill in the art would have recognized that a gear pair requires only two parts whereas the cable embodiment additionally requires a cable and means to attach the cable to the spool and roll barrel. Anderson, 22:59-23:30. A gear arrangement can also provide greater torque than a comparable cable arrangement. Also, one of ordinary skill in the art would have been prompted to modify Anderson's device to include Cooper's helical drive gear and tube gear because doing so would be merely the application of a known technique (use of tube gears to generate shaft rotation) to a known system (e.g., Anderson's surgical instrument) ready for improvement to yield predictable results. Here, both Anderson and Cooper disclose surgical instruments configured to releasably couple to a robotic surgical system to receive rotational driving motion from the robotic surgical system and one of ordinary skill in the art would have recognized that applying Cooper's suggestions to Anderson's surgical instrument would have led to predictable results without significantly altering or hindering the functions performed by Anderson's surgical instrument. Indeed, Anderson contemplates that "various alternatives, modifications and equivalents may be used" and Cooper suggests just such an improvement. Anderson at 25:10-11. Finally, both Anderson and Cooper are assigned to the same entity—Intuitive Surgical, Inc.—and both relate to similar surgical tools for robotic-assisted surgery and thus one of ordinary skill in the art would look to both references. Anderson, 1:14-18; Cooper, 1:44-47.

61. Accordingly, in view of these teachings, one of ordinary skill in the art would have understood that this limitation is disclosed by Anderson in view of Cooper.

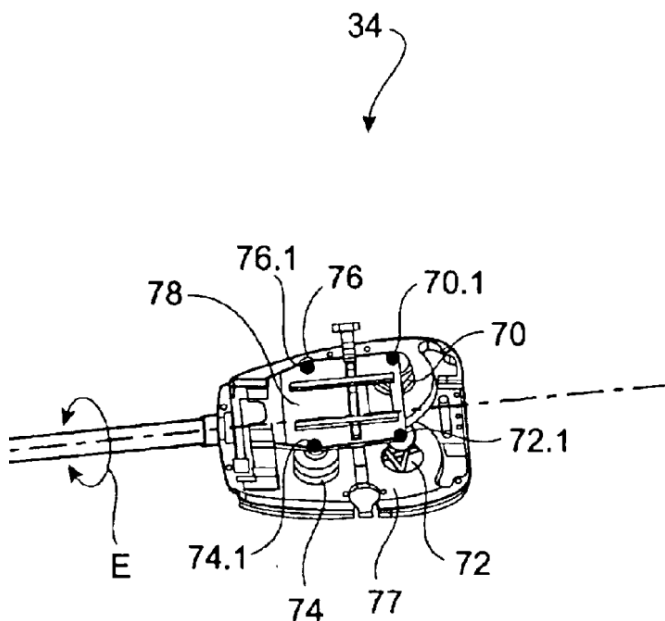
4. [23.3] a tool mounting portion operably coupled to said elongated shaft assembly, said tool mounting portion being configured to operably interface with the tool drive assembly when coupled thereto,

62. One of ordinary skill in the art would have understood that Anderson discloses this limitation.

63. Anderson's "tool mounting portion" is the "base" on the proximal end of the instrument. Anderson teaches that "[b]ase 34 is generally configured to releasably engage a robotic surgical system, such as robotic surgical system 10 in FIG. 1." Anderson teaches that the "surgical work station 20" has motors (which corresponds to the "tool drive assembly") to drive the instrument via the instrument "base." Anderson, 11:35-38, FIG. 3; 22:8-19, FIG. 20; 23:30-35.

64. In Anderson, the "base" is coupled to an elongate shaft and is also coupled to the robot arm (and thus the "tool drive assembly") via "engaging members." Anderson, FIGS. 11-22 11:32-36; 11:66-12:22; 18:19-24; 22:10-14; 22:20-33; 22:59-67. One of ordinary skill in the art would have understood that the engaging members on the robot arm provide rotary motion to the engaging members on the instrument "base," which impart rotary motion to shafts 70.1, 72.1, 74.1, 76.1, each of which "includes an engaging member (not shown)

configured to releasably couple with a complementary engaging member (not shown) rotatably mounted on the carriage 37 of a robotic arm assembly 26 (see FIG. 1).” Anderson, 12:4-18 (description of instrument 28 also generally applies to instrument 300), FIG. 3:



5. [23.4] said tool mounting portion comprising a rotational transmission assembly comprising a rotational gear assembly in meshing engagement with the tube gear segment and operably coupled to one of the at least one rotatable body portions supported on the tool drive assembly

65. One of ordinary skill in the art would have understood that Anderson in view of Cooper discloses this limitation.

66. Anderson’s base (“tool mounting portion”) has rotational transmission assemblies in the form of rotationally coupled engaging members that rotate the shafts. As taught by Anderson, when the gear-driven embodiment is used, the

shafts would rotate a drive gear that is in meshing engagement with a tube gear. One of ordinary skill in the art would have understood that the drive gear (*e.g.*, gear 840) would be the recited “rotational gear assembly” which is in meshing engagement with tube gear 842 and also operably coupled via the “engaging members” in the base to the engaging members and motors on the robot arm (the “tool drive assembly”). Anderson, FIG. 21; 16:36-61; 22:8-19; 22:59-23:30; 11:66-12:22.

67. Shafts 70.1, 72.1, 74.1, 76.1 of Anderson each include an engaging member releasably mounted to carriage 37 of robotic arm assembly 26, where the engaging members are coupled to actuators and cause angular displacement of the engaging members. Anderson, 11:66-12:16. In addition, Cooper explicitly discloses a rotational transmission system in which the driven gear in the right-angle helical gear pair used to rotate the end effector is a tube gear. One of ordinary skill would have understood that in the Anderson-Cooper combination the right-angle helical pair of Cooper rotates the transmission member of Anderson that in turn rotates the end effector. Anderson, 23:26-31.



6. [23.5] such that upon application of a rotary output motion in a first direction to said rotational gear assembly by said at least one rotatable body portion, said rotational gear assembly rotates said elongated shaft assembly and said surgical end effector in a first rotary direction about said longitudinal tool axis and upon application of said rotary output motion in a second direction to said rotational gear assembly, said rotational gear assembly rotates said elongated shaft assembly and said surgical end effector about said longitudinal tool axis in a second rotary direction relative to the tool mounting portion.

68. One of ordinary skill in the art would have understood that Anderson in view of Cooper discloses this limitation.

69. Anderson teaches a surgical tool with a shaft that may be rotated in two rotational directions as shown below, and further teaches that the roll barrel 336 and roll interface member 344 may both be replaced with a “right-angle helical gear pair” to rotate the shaft, and accordingly one of skill would have understood Anderson to disclose helical gears that cause the elongate shaft to rotate in two directions. Anderson, 22:59-67; 23:26-30; 16:57-61; 22:59-23:14 (“A robotic surgical system interface member ... is configured to engage[] the pivotally mounted instrument roll interface member 344 so as to controllably rotate interface member 344 in either direction through a selected range of motion”).

70. Arrow B of Figure 22 shows the shaft assembly rotation in two directions:

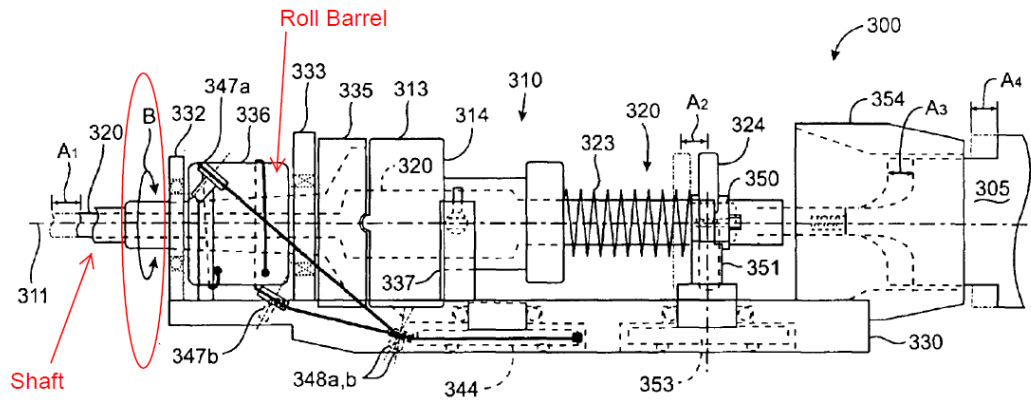
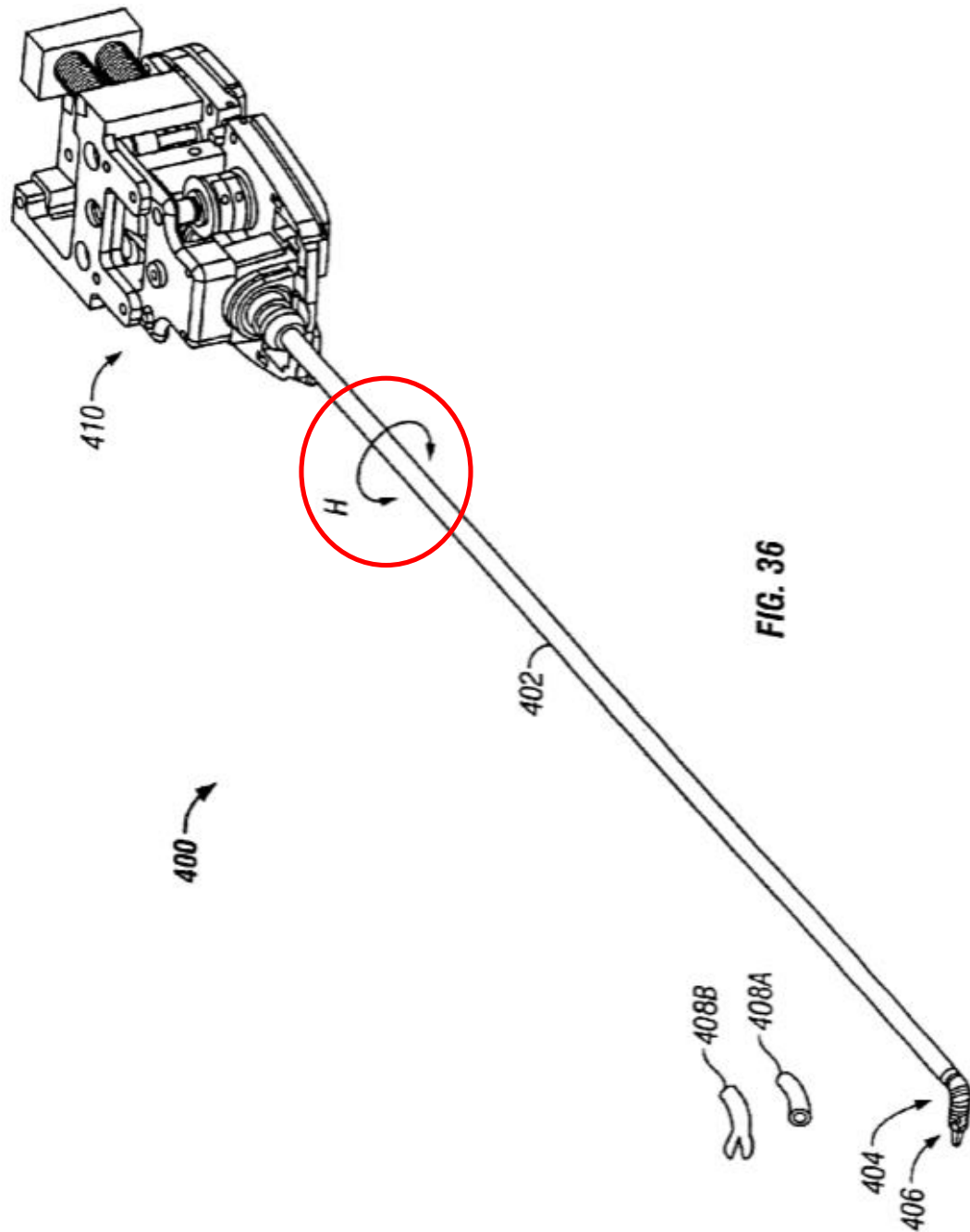


FIG. 22

71. Cooper also teaches an end effector that can be rotatably controlled by a robotic controller to rotate longitudinally in either direction. Cooper states that the robotic arm is used to manipulate the back end mechanism 410 to operate ... the end effector” and discloses a bidirectional arrow H in Figure 36. Cooper, 17:34-49, Fig. 36.



One of ordinary skill in the art would have recognized that Cooper thus teaches rotating an end effector in two directions via control motions from the robot arm. Based on the teachings of both Anderson and Cooper as I discuss here, one of

ordinary skill in the art would readily recognize that the combination of Anderson and Cooper would yield a robotic instrument that may be controlled by an operator to rotate an end effector in either direction along a longitudinal access of an elongate shaft via the use of a tube gear on the proximal end of the shaft.

**B. Ground 2: Anderson in View of Timm**

72. Claim 24 of the '969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Timm.

73. I note that although Anderson was before the Examiner during prosecution, it was not used in any rejection and there is no evidence in the prosecution record that the Examiner considered Anderson in connection with the Timm reference. I examine each limitation of claim 24 of the '969 Patent as follows and I discuss the motivation to combine Anderson with Timm.

74. One of skill in the art would have readily understood that modifying Anderson to use Timm's end effector is merely the application of a known technique (surgical stapler design) to a known system (*e.g.*, the surgical instrument of Anderson) ready for improvement to yield predictable results.

75. One of skill in the art would have had many reasons to modify Anderson to include the end effector of Timm. First, Anderson discloses a robotic surgical system that can accommodate a variety of end effectors that may be controlled via rotary motions. Timm is such an end effector. Timm discloses a

surgical stapler whose motions are controlled via rotary motions. In addition, one of skill in the art would have understood that the end effector of Timm would allow a surgeon better access to a surgical site than the tool of Anderson because the Timm's end effector allows for "the ability to articulate in multiple directions relative to the proximal spine segment." Timm, 22:56-65; 9:2-4.

76. Also, one of skill in the art would have been motivated to combine Anderson and Timm because both references specifically invites combination with other references. Anderson, 23:25-36; Timm, 28:45-49; 8:3-7; 12:1-3.

77. One of skill in the art would have understood that the combination of Anderson and Timm to include Timm's surgical stapler end effector, shaft, and at least part of its gear-driven actuation assemblies. One of ordinary skill would have also readily understood that using Timm's gear mechanism to drive the knife and dynamic clamping member would advantageously provide for "changes in the gear ratios ... to attain improved mechanical advantages for driving the knife assembly 170 (dynamic clamping assembly 150, knife 155, sled 160) within the elongate channel assembly." Timm, 19:22-27. In view of these teachings, one of skill in the art would have seen to use Timm's gear-driven actuation assemblies to actuate Timm's end effectors. One of ordinary skill in the art would have recognized that when adapting Timm for use with a robotic system, Timm's handle would be replaced with Anderson's tool mounting portion and Anderson's rotary shafts

would drive Timm's rotary gears. Replacing Timm's handle and trigger with Anderson's tool mounting portion (base) would yield predictable advantages and would combine known parts according to their known functions.

78. One of skill in the art would also have been motivated to use Timm's gear-driven closure mechanism in combination with Anderson's system in order to take advantage of the "quick disconnect" feature of Anderson, resulting in a system combining Anderson's tool mounting assembly with the end effector, closure tube, and actuation assemblies of Timm. Timm, 38:25-33; 37-57. One of skill in the art would have recognized the advantage of being able to quickly change instruments as discussed by Timm and would have desired to adapt Timm's stapler with its gear-driven closure tube so that the end effector/proximal shaft portion could be quickly disconnected from the tool mounting portion at the point where Timm's radial gears in the closure mechanism mesh. The radial gears in the quick disconnect feature permit the proximal closure tube to transmit rotary motion to the intermediate closure tube through the quick disconnect joint.

79. In addition, one of skill in the art would have recognized that Anderson discloses – but does not provide complete implementation details – for a wrist mechanism, and that Timm provides the details of the "wrist-like rotational or pivotal joint" movement discussed by Anderson. Anderson, 6:43-54.

80. Anderson also discloses the use of a "stapler probe," and Timm

provides the specifics of such a “stapler probe” contemplated by Anderson, where the stapler probe of Timm teaches numerous drive segments and spine segments connected by an articulation joint allowing for increased directional control over the instrument taught by Anderson. Anderson, 7:15-25; Timm, 8:3-16; 28:41-29:3; 35:36-63. Accordingly, one of ordinary skill in the art would have been motivated to combine Timm’s stapler with Anderson’s robotic system.

81. In addition, one of ordinary skill in the art would have modified the teachings of Anderson with the teachings of Timm because Anderson discloses “actuators, such as electric motors” and Timm teaches “proximal spine segment 2720 ... [that] may be supported [by] any one of a number of known arrangements” including being “removably associated with a . . . robotic or computer” actuator. Anderson, 11:59-65; Timm, 28:45-49; 8:3-7; 12:1-3.

82. Also, one of ordinary skill in the art would have modified the teachings of Anderson with the teachings of Timm because both teach surgical instruments with end effectors that may be releasably attached to a robotic surgical system and thus modifying Anderson as I describe here would have led to predictable results without significantly altering or hindering the functions performed by Anderson’s system. Indeed, Anderson teaches that “various alternatives, modifications and equivalents may be used” and Timm suggests such an improvement. Anderson at 25:10-11.

1. **[24.P] A surgical tool for use with a robotic system that has a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to provide at least one rotary output motion to at least one rotatable body portion supported on the tool drive assembly, said surgical tool comprising:**

83. One of ordinary skill would have understood that this element is disclosed by Anderson. *See* my analysis above regarding the identical limitation [23.P], which I incorporate by reference.

2. **[24.1] a surgical end effector comprising at least one component portion that is selectively movable between first and second positions relative to at least one other component portion thereof in response to control motions applied to said selectively movable component portion;**

84. One of ordinary skill would have understood that this element is disclosed by Anderson. *See* my analysis above regarding the identical limitation [23.1], which I incorporate by reference.

85. One of ordinary skill in the art would also understand Timm to disclose this limitation because Timm has numerous selectively movable components within its stapler end effector. First, Timm teaches “dynamic clamping member 150” with “knife 155” that may be “part of the replaceable staple cartridge assembly” and which moves through the cartridge during stapler firing. Timm, 10:1-10; 9:31-55, 11:36-56, Fig. 9. The “dynamic clamping member” of Timm is movable between first and second positions responsive to control motions generated by a gear assembly when a user fires the stapler. Timm,



11:36-56; 14:39-15:12; FIGs. 18-21. Second, the end effector of Timm has a “closure ring” that can be moved to push the anvil to the closed position, which similarly moves relative to the rest of the end effector, particularly the anvil, and thus satisfies this limitation. Timm, FIGs. 49, 27:38-47. Rotary control motions cause a proximal closure tube to turn an intermediate closure tube. Timm, 27:6-24.

86. Accordingly, in view of these teachings, one of ordinary skill in the art would have understood this limitation to be disclosed by Anderson in view of Timm.

3. *[24.2] an elongated shaft assembly defining a longitudinal tool axis and comprising: a distal spine portion operably coupled to said end effector; and a proximal spine portion pivotally coupled to said distal spine portion at an articulation joint to facilitate articulation of said surgical end effector about an articulation axis that is substantially transverse to said longitudinal tool axis; and*

87. One of ordinary skill would have understood that Timm discloses this limitation. Regarding the “elongated shaft assembly defining a longitudinal tool axis,” every embodiment of the surgical instruments disclosed by Anderson and Timm contain an elongated shaft assembly defining a longitudinal tool axis. Anderson, FIG. 20; 21:66-22:11 (“instrument axis 311”); Timm, Fig. 1; *see also* Timm, FIGS. 1, 41-44, 50-90 (showing numerous components that are part of various shaft assembly embodiments, including cables, gears, articulation components, etc.

88. Regarding the “distal spine portion operably coupled to said end effector,” Timm teaches that “distal spine segment 2740 is attached to the elongate channel assembly 120” “to which the anvil 110” is pivotally attached.” Timm, 28:65-29:3. The end effector of the Timm surgical instrument comprises the elongate channel assembly 120” and anvil 110”. Timm, 28:65-29:3; 8:3-16; 9:12-30.

89. Regarding the “proximal spine portion pivotally coupled to said distal spine portion at an articulation joint to facilitate articulation of said surgical end effector about an articulation axis that is substantially transverse to said longitudinal tool axis,” Timm teaches that the “distal spine segment 2740” discussed above is attached or coupled to “articulation ball joint 2760”, which “affords the distal spine segment 2740 the ability to articulate in multiple directions relative to the proximal spine segment 2720.” Timm, FIG. 52; 28:41-29:3; FIGs. 62-66; 31:62-32:31 (“lockable articulation joint”). One of ordinary skill would have readily understood that the disclosures of Timm relate to articulation axes substantially transverse to the claimed longitudinal axis. Timm, FIG. 52; 28:41-29:3. The ball joint of Timm would naturally position the axis distal of the joint in a transverse relation to the longitudinal axis. Multiple reasons would have prompted one of ordinary skill in the art to modify Anderson to include pivotally coupled distal and proximal spine portions (as suggested by

Timm). One of ordinary skill in the art would have recognized that such a configuration would allow for “the ability to articulate in multiple directions relative to the proximal spine segment” thereby allowing a surgeon to better approach a surgical site from the correct angle. Timm, 22:56-65; 9:2-4 (“permit the surgeon to articulate tool assembly 100 about the "Y" and "Z" axes as needed during a surgical procedure”). This ability to articulate the spine in multiple directions would improve the performance of Anderson’s surgical instrument and increase the utility of the device.

90. Also, one of ordinary skill in the art would have been motivated to modify Anderson’s surgical robot to use Timm’s instrument because Anderson contemplates that its instruments will provide “wrist-like rotational or pivotal joint” movements, and Timm provides the necessary details for implementing such a joint. Anderson, 6:43-54. One of ordinary skill in the art would have been motivated to look to Timm for details on how to implement a “stapler probe” as contemplated by Anderson. Timm provides details on how to construct a particular surgical stapler and provide the various drive mechanisms for use with such a surgical stapler. One of ordinary skill in the art would have recognized that the proximal and distal spine segments connected via an articulation joint of Timm’s surgical stapler would provide the benefits of increased directional control within a patient. Anderson, 7:15-25; Timm, 8:3-16; 28:41-29:3; 35:36-63. One of

ordinary skill in the art would have been motivated to adapt the Timm surgical stapler for use with the Anderson robotic system because Timm specifically teaches that its “proximal spine segment 2720 ... may be supported [by] any one of a number of known arrangements” including being “removably associated with a . . . robotic or computer” actuator such as that described by Anderson. Anderson 11:59-65 (“actuators, such as electric motors,”); Timm, 28:45-49; 8:3-7; *see also* 12:1-3 (“use of the above described tool assembly 100 as part of a robotic system is also envisioned.”). Finally, one of ordinary skill in the art would have been prompted to combine Anderson and Timm to use Timm’s surgical stapler adapted for use with the Anderson robotic system because doing so would be merely the application of a known technique (surgical stapler design) to a known system (e.g., Anderson’s surgical robot) ready for improvement to yield predictable results. Here, both Anderson and Timm disclose surgical instruments having shafts and end effectors and configured to releasably couple to a robotic surgical system and one of ordinary skill in the art would have recognized that applying Timm’s suggestions to Anderson’s surgical instrument would have led to predictable results without significantly altering or hindering the functions performed by Anderson’s surgical instrument.

91. In the combination, Timm’s shaft and end effector, including its articulation joint, would be modified with a tool mounting portion as disclosed in

Anderson (the Anderson “base”) so that it can be connected to the Anderson robot. Accordingly, in view of these teachings, one of ordinary skill in the art would have understood that this limitation to be disclosed by Anderson in view of Timm.

4. *[24.3] at least one gear-driven portion that is in operable communication with said at least one selectively movable component portion of said surgical end effector and wherein said surgical tool further comprises:*

92. One of ordinary skill would have understood that Anderson in view of Timm discloses this limitation. Anderson teaches two distinct embodiments – one that is cable-driven and one that is gear-driven, but only depicts the former. *See* Anderson, 15:48-60; 16:62-17:9; 23:25-36 (collectively disclosing “other actuation interface devices” like “a gear train or other mechanical transmission means.”).

93. Timm teaches a plurality of “selectively moveable component portions” that are “in operable communication” with” a “gear-driven portion”, including a dynamic clamping member and a closure ring. I first consider Timm’s “dynamic clamping member 150” having “knife 155”, and then consider Timm’s “gear-driven portion” that moves and thereby moves to drive the closure ring, which in turn pivots the anvil into a closed position.

94. Timm teaches that “dynamic clamping member 150” and “knife 155” are moved with respect to the end effector’s anvil and cartridge by a gear-based winch assembly using advance and retraction cables (annotated with a red box), as seen in Figure 17, and both of which are connected to dynamic clamping member

150:

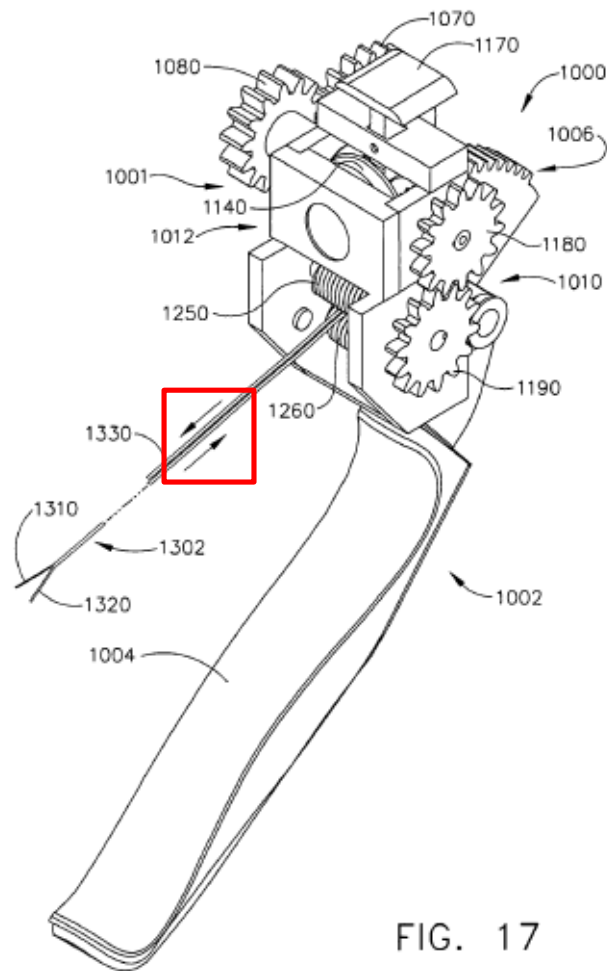


FIG. 17

Timm, 13:4-14 (“advance cable 1302 and the retract[ion] cable 1330 may be driven by, for example, a cable drive system 1000 which, for example may comprise a manually actuatable winch assembly 1001”); FIGs. 13, 17. Timm further teaches that winch assembly 1001 comprises a number of gears and gear-driven portions that collectively work to drive the clamping member and knife:

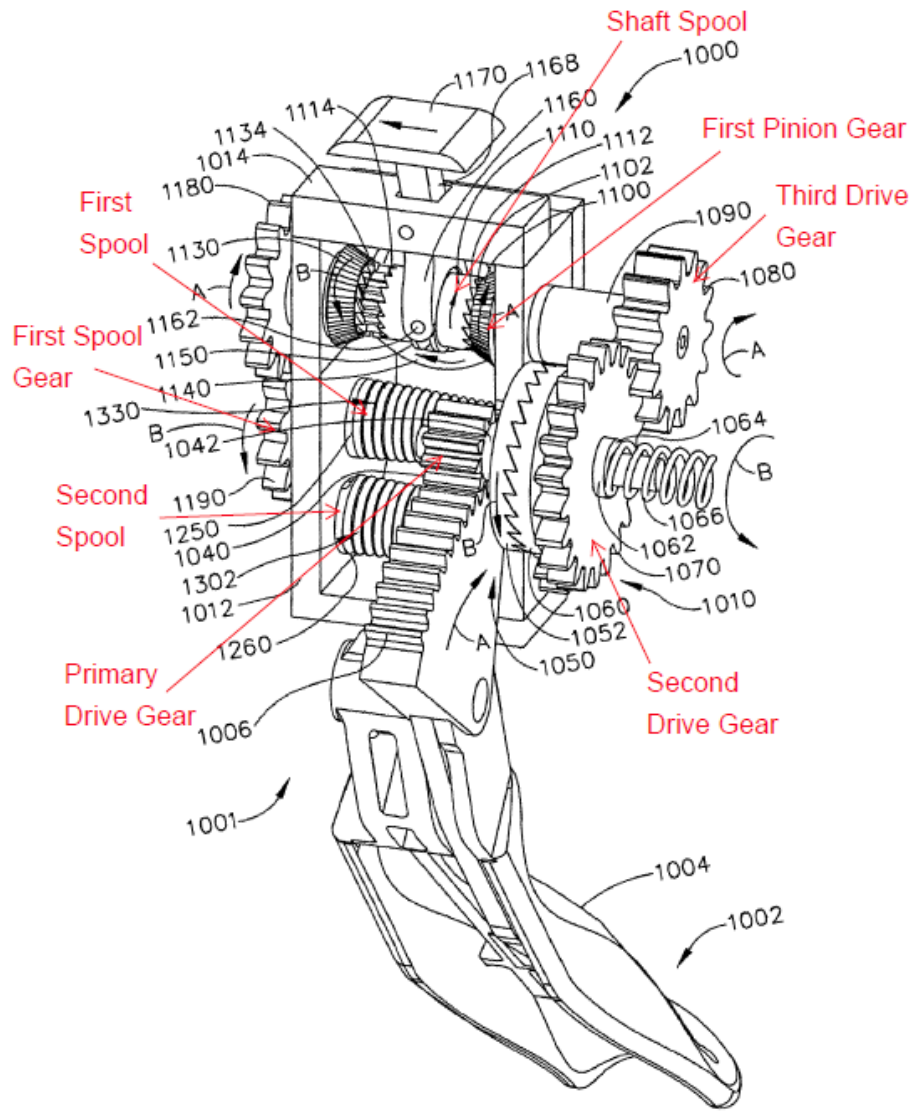


FIG. 18

Timm, FIG. 18; 11:36-56; 14:39-15:12 (“gear segment 1006,” “primary drive gear 1040,” “second drive gear 1070,” third drive gear 1080”). As shown in Figure 18, the clamping member is moved by cables 1302 and 1330, which are wrapped around gear-driven spools 1250 and 1260. Timm, 14:25-38, 16:1-29, FIG. 18.

95. The Timm device is fired by actuating firing trigger 1004, which is

operatively coupled to turn the gears and gear-driven portions discussed above, including second spool 1260, which winds up advance cable 1302 while unwinding the retract cable from first spool 1250. Timm, 13:32-42; 14:25-15:12. Advance cable 1302 passes beyond dynamic clamping member 150, around a pulley, and back to the clamping member and so when spooling up that cable advances dynamic clamping member 150 to advance distally:

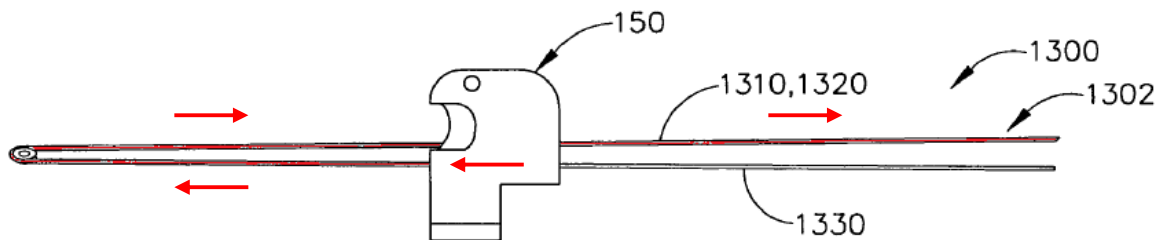


FIG. 15

Timm, FIG. 15 (annotated to show direction of movement of advance cable 1302 and dynamic clamping member 150), 15:2-12; 16:1-29. This movement is enabled by the transmission assembly pictured in Figures 18 (above) and 19 (below).

96. “[F]irst teeth 1102 of the first pinion gear 1100 are in meshing engagement with the primary teeth 1112 of the shaft spool 1110,” and one of skill in the art would have understood shaft spool 1110 to satisfy the claimed “gear-driven portion.” Timm, FIG. 18; 14:39-15:12. Shaft spool 1110 rotates, thereby



providing rotational motion to “first spool gear 1190 that is attached to the shaft 1200 of the first payout spool 1250”, thereby rotating spool 1250 to let you retract cable 1330. Timm, FIG. 18; 14:39-15:12. First spool 1250 in turn provides rotational motion to second spool 1260 “to wind up the advance cable 1302” via “first spool transfer gear 1220, reversing gear 1230, and second spool drive gear 1240”. Timm, 14:39-15:12; FIGs. 18-19. Accordingly, one of skill in the art would also understand the gears causing first spool and second spool to rotate to satisfy the claimed “gear-driven portion.” Timm, 15:13-25; FIG. 21; 18:1-52 (“a drive gear 1410 [] is in meshing engagement with a rack 1420” to “advance the dynamical clamping member 150, knife 155, and sled 160 in the distal direction”).

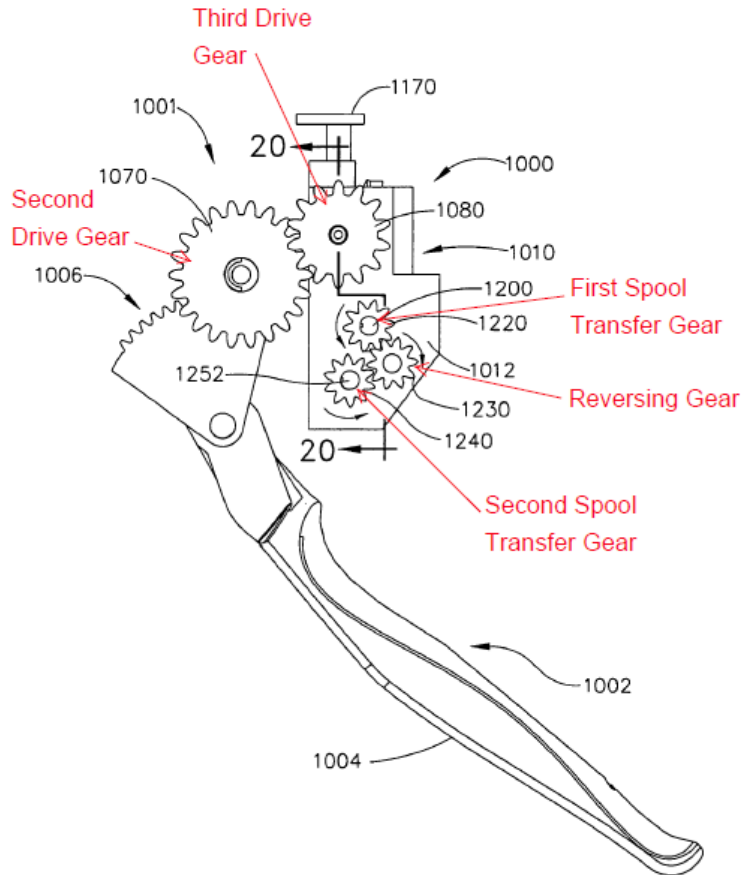
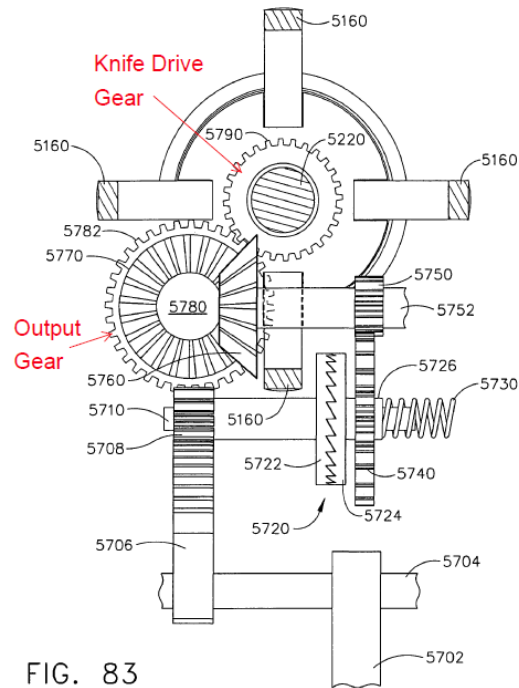


FIG. 19

Timm, FIG. 19.

97. Timm teaches a different gear-driven mechanism to actuate the dynamic clamping member that is pictured in Figures 83 and 84 in which “output gear 5782 ... in meshing engagement with a knife drive gear 5790 attached to the proximal end 5226 of the knife drive shaft 5220” effects the advancement of the dynamic clamping member and associated knife:



Timm, FIGs. 83, 84; 42:4-36.

98. One of ordinary skill in the art would have understood that the combination of Anderson and Timm would include the surgical stapler end effector and shaft of Timm (as described above), and would have included part or all of any of the specific gear-driven actuation assemblies described by Timm to drive the motions of Timm's surgical tool. This is especially true given that Anderson contemplates "other actuation interface devices" such as "a gear train or other mechanical transmission means" and Timm discloses that its surgical instrument "may be supported [by] any one of a number of known arrangements" including being "removably associated with" a "robotic or computer" actuator such as that described by Anderson. Anderson, 23:25-36; Timm, 28:45-49; 8:3-7; *see also*

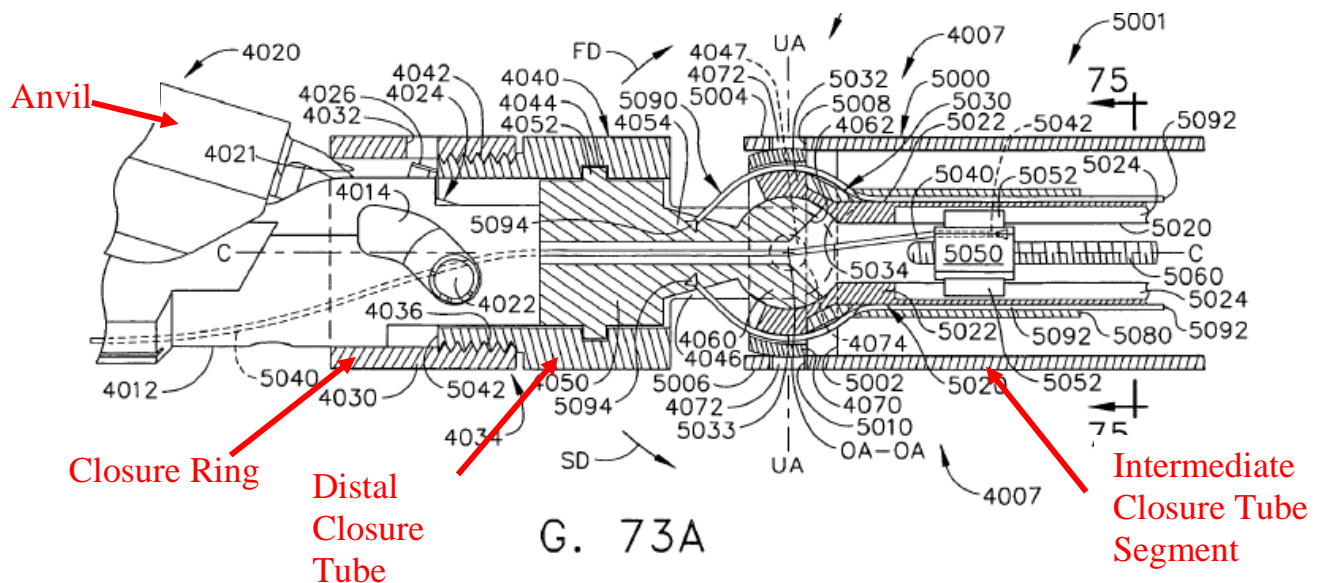
12:1-3 (“use of the above described tool assembly 100 as part of a robotic system is also envisioned.”).

99. Furthermore, one of ordinary skill in the art would have recognized that use of Timm’s gear mechanism for driving the knife/dynamic clamping member would have allowed for “changes in the gear ratios ... to attain improved mechanical advantages for driving the knife assembly 170 (dynamic clamping assembly 150, knife 155, sled 160) within the elongate channel assembly.” Timm, 19:22-27. One of ordinary skill in the art would have therefore elected to use the known gear-driven actuation assemblies described by Timm to activate the end effectors described by Timm in the system resulting from the predictable combination of Anderson with Timm to achieve predictable advantages.

100. One of ordinary skill in the art would have understood that in the combination of Anderson and Timm, the surgical stapler end effector, shaft, and actuation assemblies of Timm (as described above) would be driven by Anderson’s rotary robotic interface in the tool mounting portion. In the combination, the trigger of Timm (which imparts a rotary actuation motion) would be replaced with the rotatable body portion of Anderson and the driven gear would be placed at the proximal end of the shaft.

101. Timm also discloses a closure ring driven by a series of gears, which closure ring advances to pivot the anvil into the closed position. Timm, FIGs. 50,

48; 27:25-52; 10:54-11:7. As Timm teaches, “as the distal closure tube segment 4040 is rotated, the closure ring 4030 is driven axially in the distal direction DD. As the closure ring 4030 moves in the distal direction DD, it rides up a ramp 4021 on the proximal end of anvil assembly 4020 to cause the anvil assembly 4020 to pivot to a closed position.” Timm, 36:16-21. Distal closure tube segment 4040 in turn is driven by the intermediate closure tube segment. Timm, 38:25-44, 36:45-37:8, 35:64-36:24; FIG. 73A.



Timm, FIG. 73A.

102. The intermediate closure tube segment 5001 is in turn driven by proximal closure tube segment 5020, which is located at a “quick disconnect” for attaching the disposable and permanent portions of Timm, and these two portions are coupled in part by radial gears placed on the meshing surfaces of the two portions. Timm, 38:25-44. Accordingly, gears cause the movement of the

intermediate closure tube, and thus one of ordinary skill would have understood that the intermediate closure tube is a “gear-driven portion.” The specification of Timm explains: “[The] intermediate closure tube segment 5001 has a series of *radial gear teeth* 5003 formed thereon for *meshing engagement with gear teeth 5124* ... on a distal end 5122 of a proximal closure tube segment 5020” such that rotation of the proximal closure tube causes rotation of the intermediate closure tube. Timm, 38:37-44. The figures in Timm show where the radial gears are located. For example, Figure 76 shows a front facing view of the intermediate closure tube with the radial gear teeth illustrated as boxes around the circumference of the intermediate closure tube face:

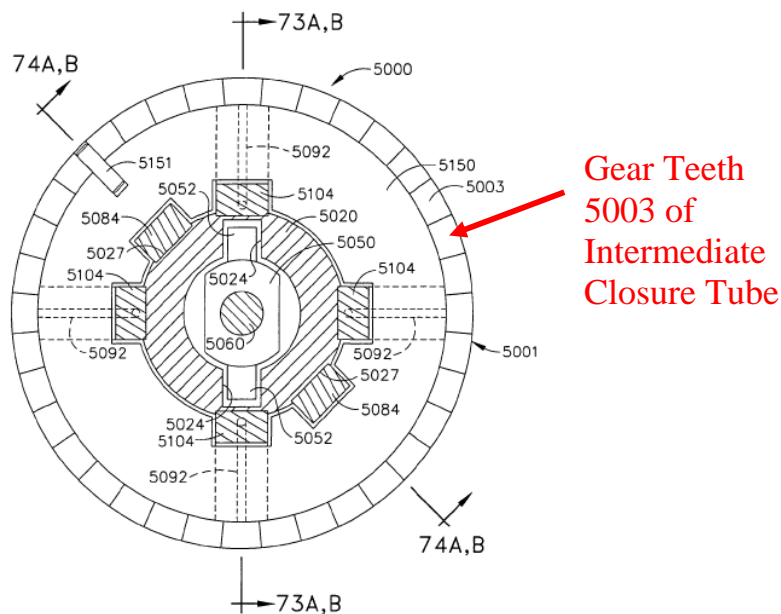
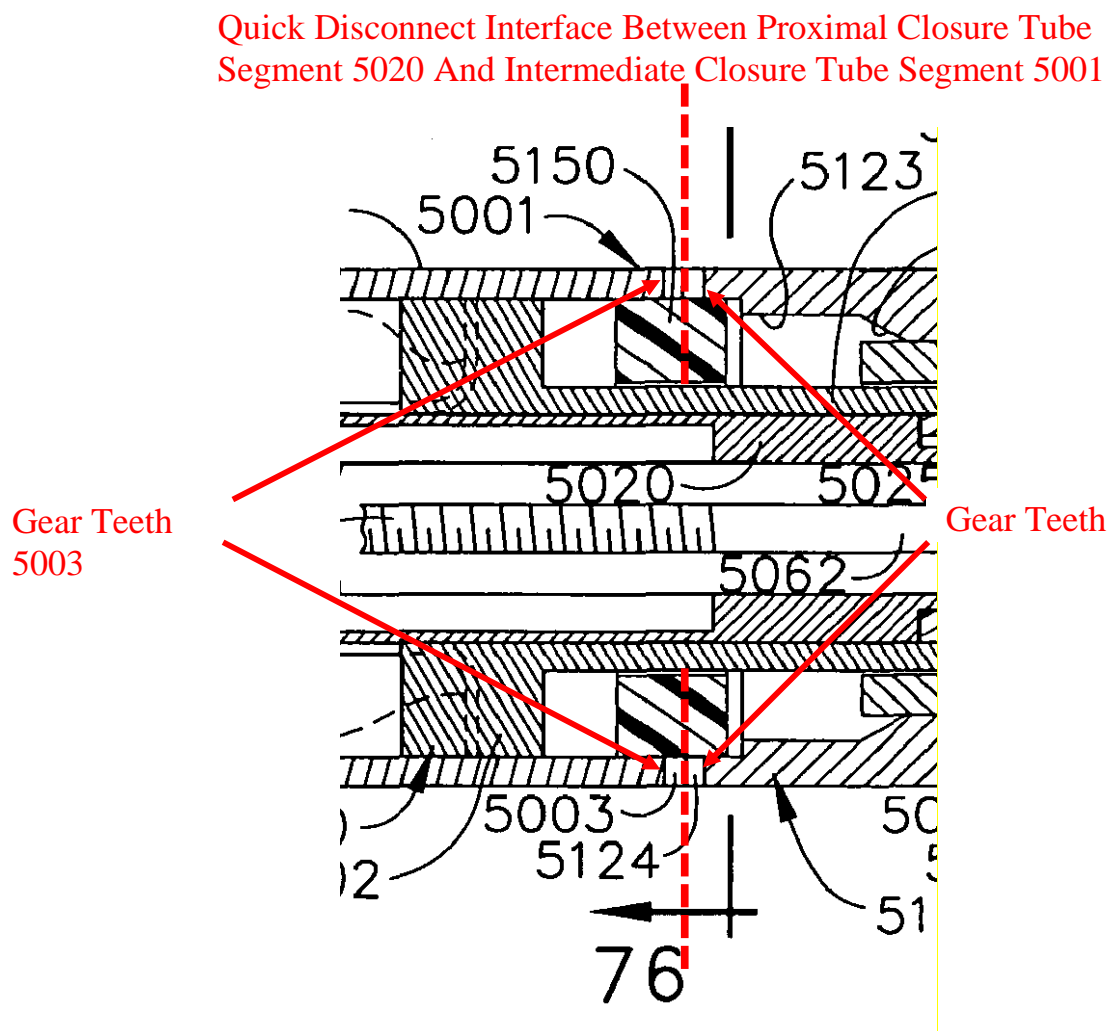


FIG. 76

Timm, FIG. 76. A cross sectional view of the radial gears are shown in FIG. 73B,

which illustrates the quick disconnect feature 4008. The following excerpt shows the location of the radial gears:



Timm, FIG. 73B (excerpt).

103. One of ordinary skill in the art would have been motivated to use the gear-driven closure mechanism of Timm with the Anderson system to gain the benefit of Timm's "quick disconnect" feature. "As indicated above, the disposable

reload unit 4002 in various embodiments may be constructed to be disposable after one use. To facilitate quick detachment of a reload unit 4002 and reattachment of a new reload unit 4002 without the use of tools, a quick disconnect joint 4008 may be employed.” Timm, 38:25-33; 37-57. Furthermore, one of ordinary skill in the art would have understood that in the combination of Anderson and Timm, the surgical stapler end effector, closure tube, and actuation assemblies of Timm (as described above) would be driven by Anderson’s rotary robotic interface in the tool mounting portion.

5. *[24.4] a tool mounting portion operably coupled to a proximal end of said proximal spine portion, said tool mounting portion being configured to operably interface with the tool drive assembly when coupled thereto, said tool mounting portion comprising:*

104. One of ordinary skill would have understood Anderson in view of Timm to disclose this limitation. This element is very similar to element [23.3], and my analysis with respect to that element is incorporated here. One of skill in the art would have readily understood that the Anderson-Timm combination would connect the proximal end of the proximal portion of the Timm shaft to the tool mounting portion of Anderson. Anderson, 22:8-33; 22:59-67; 18:20-24; 11:66-12:22; FIGs. 1, 3, 20. I understand that, on January 23, 2018, the PTO entered a Certificate of Correction replacing the word “distal” with the word “proximal” in element [24.4]. IS1002 (FH), 686. If the PTAB finds the Certificate to be



ineffective, then Prisco still discloses this limitation. Specifically, in the combination, Anderson's tool mounting portion would be operably coupled to the distal end of the proximal spine portion of Timm's shaft via the proximal spine portion itself. Anderson, 22:8-33; 22:59-67; 18:20-24; 11:66-12:22; FIGs. 1, 3, 20.

6. *[24.5] a driven element rotatably supported on said tool mounting portion and configured for driving engagement with a corresponding one of the at least one rotatable body portions of the tool drive assembly to receive corresponding rotary output motions therefrom; and*

105. One of ordinary skill would have understood Anderson in view of Timm to disclose this limitation.

106. Regarding the phrase “a driven element rotatably supported on said tool mounting portion,” Anderson teaches that the surgical instrument base includes transmission members 70, 72, 74, and 76, that comprise “spools secured on shafts 70.1, 72.1, 74.1, and 76.1,” which one of skill would have understood to constitute driven elements, and are “configured to rotate.” Anderson, 11:66-12:22.

107. Regarding the phrase “configured for driving engagement with a corresponding one of the at least one rotatable body portions of the tool drive assembly to receive corresponding rotary output motions therefrom,” Anderson's Figure 3 shows shafts coupled to engaging members, and the specification teaches that “[a]t the outer surface, each shaft 70.1, 72.1, 74.1, 76.1 includes an engaging

member (not shown) configured to releasably couple with a complementary engaging member (not shown) rotatably mounted on the carriage 37 of a robotic arm assembly 26 (see FIG. 1).” Anderson, 11:66-12:22, FIG. 3. Anderson also teaches that the robotic tool drive assembly provides rotational motion to “instrument roll interface member 344.” Anderson, 22:59-23:30. Anderson also teaches that “instrument actuator interface member 353a and 353b” may be driven by rotational motion from robotic surgical system. Anderson, 24:23-39. One of skill in the art implementing the Anderson-Timm combination would readily understand that the Anderson’s base has shafts that extend from it that can drive Timm’s gear assemblies. *See also* my discussion of tool mounting portion and tool drive assembly in element [23.3] above.

7. **[24.6] a transmission assembly in operable engagement with said driven element and in meshing engagement with a corresponding one of said at least one gear-driven portions to apply actuation motions thereto to cause said corresponding one of said at least one gear-driven portions to apply at least one control motion to said selectively movable component.**

108. One of ordinary skill would have understood Anderson in view of Timm to disclose this limitation. For example, using the robotic surgical system with driven elements of Anderson to replace the handle of Timm (leaving Timm’s end effector, transmission assembly, and shaft) would disclose this limitation. Anderson states that rotation of transmission members 70, 72, 74, and 76 in response to rotation of “actuators, such as electric motors” causes the “[m]ovement

of end effector 38,” and that the end effector is actuated by the rotation of the actuation interface members 353a-b. Anderson, 11:59-12:22. Anderson further discloses that this causes actuation of the end effector. *Id.*, 24:31-65.

109. The first selectively moveable component would consist of the modification including the transmission members of Anderson to drive Timm’s transmission assembly, thereby driving the gear-drive dynamic clamping member and gear-driven knife. One of ordinary skill would have modified the tool disclosed in Figures 18-20 of Timm to receive rotational motion for the drive gears of the Anderson transmission members. Timm, FIGs. 18-20; 14:39-15:12. Timm discloses a second and third drive gears, pinon gear 1100, shaft spool 1110, output gear 1180, first spool gear 1190, first and second spool transfer gears 1220 and 1240, and reversing gear 1230, all of which are part of the transmission assembly. Timm, FIGs. 18-20; 14:39-15:12. The shaft spool 1110, first spool 1250, and second spool 1260 of Timm include gears that are meshingly engaged with part of the transmission assembly, and function to make the “clamping member 150” and “knife 155” advance to form a clamping action. Timm, FIGs. 18-20; 14:39-15:25.

110. Regarding Timm’s embodiment of Figure 21, one of skill in the art would readily recognize that the Anderson transmission members would be easily substituted in the system of Timm to functionally engage with the “drive gear 1410 [in meshing engagement with a rack 1420” to “advance the dynamical clamping

member 150, knife 155, and sled 160 in the distal direction.” Timm, FIG. 21; 18:1-52.

111. Regarding Timm’s embodiments of Figures 83 and 84, one of skill in the art would readily recognize that Anderson’s transmission members would provide rotational motion to Timm’s “drive gear 5750,” gears 5760 and 5782 would be part of the transmission assembly of the combination, and that advancement of the knife and dynamic clamping member is driven by Timm’s knife drive gear, which meshingly engages with output gear 5782. Timm, FIG. 83; 42:4-36.

112. Regarding the other selectively movable component taught by Timm, one of skill in the art would readily understand that the disclosure of Timm would easily be modified to enable the transmission assembly to accept rotatable movement from the transmission members of Anderson, and thus the transmission assembly and intermediate closure tube segment 5001 would be meshedly engaged. Timm, 22:43-55; 38:34-44; 42:37-47. See also my discussion above regarding element [24.3], which I incorporate here.

113. Anderson teaches “other actuation interface devices” such as “a gear train or other mechanical transmission means” and Timm teaches a shaft that “may be supported [by] any one of a number of known arrangements,” and may even be “removably associated with” a “robotic or computer” actuator. Anderson, 23:25-

36; Timm, 28:45-49; 8:3-7; 12:1-3. One of skill in the art would have readily understood that modifying Anderson to use Timm's surgical stapler end effector, shaft, and transmission assemblies, would include part or all of the specific gear-driven transmission assemblies described by Timm to drive the closure ring because the transmission members of Anderson which are driven by "actuators, such as electric motors" are simply replacing the force input from the user that would be applied onto trigger 1002 shown in Figure 19 (above).

114. This is especially true given that Anderson contemplates "other actuation interface devices" such as "a gear train or other mechanical transmission means" and Timm discloses that its shaft "may be supported [by] any one of a number of known arrangements" including being "removably associated with" a "robotic or computer" actuator such as that described by Anderson. Anderson, 23:25-36; Timm, 28:45-49; 8:3-7; *see also* 12:1-3 ("use of the above described tool assembly 100 as part of a robotic system is also envisioned.").

### **C. Ground 3: Anderson in View of Timm and Wallace**

115. Claims 25-26 of the '969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Timm in further view of Wallace.

116. I note that although Anderson was before the Examiner during prosecution, it was not used in any rejection and there is no evidence in the

prosecution record that the Examiner considered Anderson in connection with the Timm or Wallace references. I examine each limitation of the relevant claims of the '969 Patent as follows and I discuss the motivation to combine Anderson in view of Timm in further view of Wallace.

117. One of skill in the art would have readily understood that replacing the Timm's cable-driven articulation joint (of the Anderson-Timm combination) with the gear-driven articulation rods of Wallace connected to Timm's distal spine (again in the Anderson-Timm combination) would be merely the application of a known technique (surgical stapler design) to a known system (*e.g.*, Anderson's surgical robot) ready for improvement to yield predictable results.

118. One of skill in the art would have found many reasons to modify the Anderson-Timm combination to use Wallace's gear-driven articulation assembly. First, one of skill in the art would have seen that while Timm contemplates use with "a robotic system", it's disclosure of an active articulation system only details the implementation of an active articulation system relevant to handheld (and manually-operated) surgical instruments and that Wallace teaches active articulation with a robotic surgical system. Timm, 12:1-3; 8:3-7; 37:55-38:8; 40:34-63 (manual manipulation); Wallace, Abstract; 7:33-56; 13:6-14:15.

119. Next, one of skill in the art would have recognized that Wallace teaches a "simple" articulation design that "reduce[s] possible points of failure"

and “allows ease of assembly, reduction of parts and an increased range of motion,” Wallace, 10:59-67; Wallace, 2:61-3:5, and thus would have been motivated to alter the Anderson-Timm combination to achieve these benefits of Wallace.

120. Finally, modifying the Anderson-Timm combination to use the gear-driven articulation system of Wallace is the application of a known technique (as taught by Wallace) to a known system (the Anderson-Timm combination) would not constitute a significant alteration or hindrance. Indeed, Anderson teaches that “various alternatives, modifications and equivalents may be used” and Wallace suggests such an improvement. Anderson at 25:10-11.

1. **[25] The surgical tool of claim 24 wherein said at least one gear-driven portion comprises an articulation system interfacing with said distal spine portion and said transmission assembly.**

121. As I discussed above, one of ordinary skill in the art would have found that the combination of Anderson in view of Timm discloses every limitation of claim 24, from which this claim depends. One of ordinary skill would have understood the additional limitations of this claim to be disclosed by Anderson in view of Timm in further view of Wallace. Timm’s articulation system is cable-driven (*see, e.g.*, Timm, 37:55-38:9), and it would have been obvious to one of skill in the art to replace the cable-drive articulation system of Timm with the gear-driven system of Wallace. One of skill in the art would have

readily recognized that Anderson (and the Anderson-Timm combination) teaches that its disclosure may be combined with “other actuation interface devices” including “a gear train or other mechanical transmission means,” and would further understand that Anderson’s suggestion to combine other actuation interfaces would apply to any and all actuation motions. Anderson, 23:25-36. One of ordinary skill would have readily recognized that Anderson’s invitation for other actuation interfaces readily suggests a combination with the disclosure of Wallace regarding gear-driven actuation. Wallace, 13:6-14:15; Anderson, 23:25-36.

122. Turning to Wallace, much like Anderson (and Cooper, which has similar figures), it discloses robotic surgical tool for use in a system including a “tool base 62 includ[ing] an interface 64 which mechanically and electrically couples the tool 50 to a manipulator on the robotic arm cart”, which base supports a shaft that in turn supports a surgical end effector:



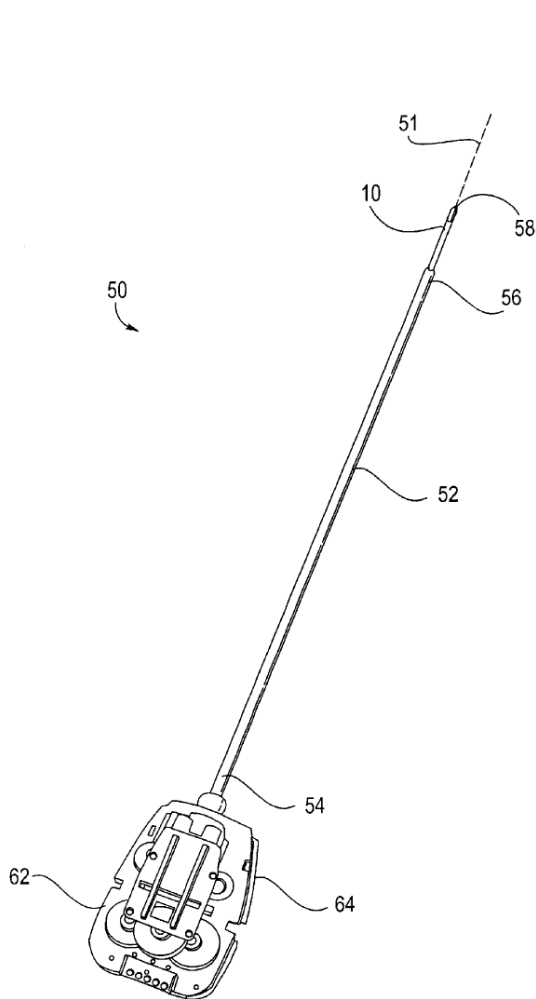


Fig. 1

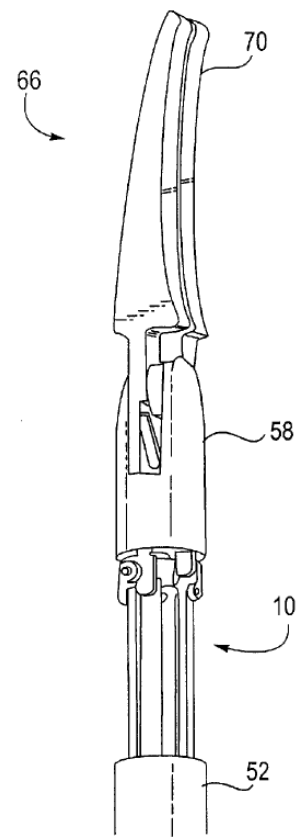
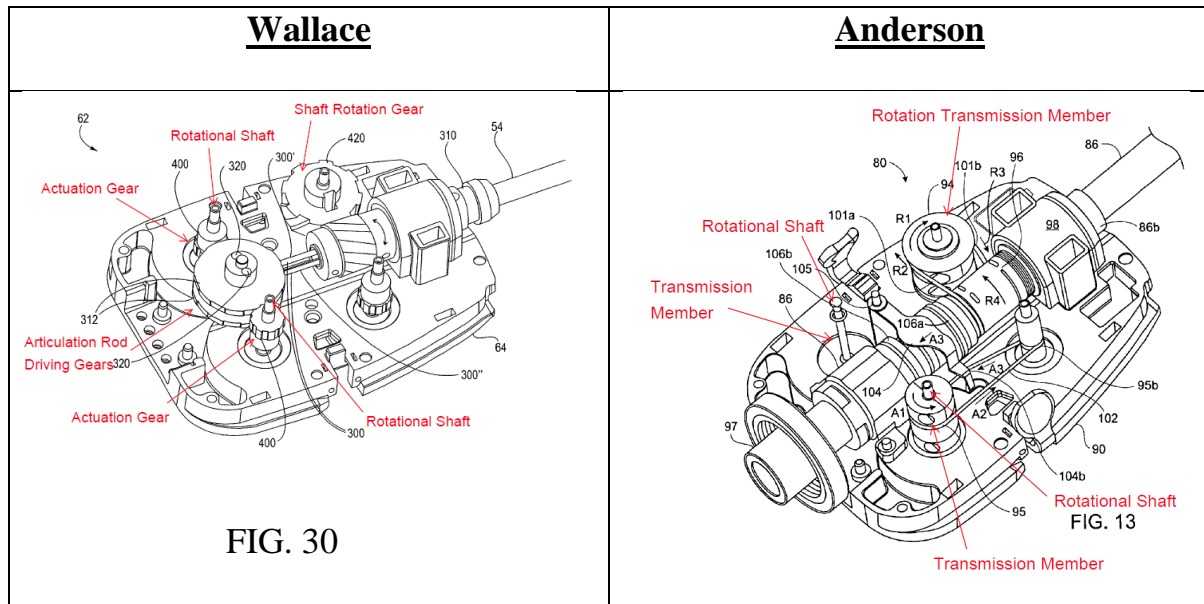


Fig. 2A

Wallace, FIGs. 1, 2A; Abstract; 7:33-56.

123. Wallace teaches that “sector gears 312” and “gears 400” are part of a gear assembly that drives “a plurality of rods” that in turn actuates a “wrist joint or mechanism” that is part of an articulation assembly, all of which function together to make the wrist joint articulate. Wallace, 7:57-65; 13:6-14:15; FIG. 30. One of skill in the art would have readily understood that “[m]anipulation of the rods 300 actuates the wrist mechanism to position the *distal* clevis in a desired orientation”

and that the articulation rods are “gear-driven.” Wallace, 13:44-48. One of skill in the art would readily understand that replacing the cable-driven articulation joint of Timm with the gear-driven articulation rods of Wallace, which would connect to Timm’s distal spine segment would yield predictable results. The comparison of the teachings of Wallace and Anderson is instructive, and would have made clear to one of skill in the art that Wallace’s gears 400 and sector gears 312, combined with the rotational shafts of Anderson, form at least part of the transmission assembly that drives the articulation rods – in particular, Anderson’s four transmission members would interface with gears 400 (and sector 312) of Wallace, with one used to rotate the end effector, one to open and close the end effector, and two for articulation (one for each degree of freedom). Anderson, 11:66-12:22; 22:59-23:30; 24:23-39; 16:25-32; FIGs. 3, 13, 21-22; Wallace, 13:44-14:15; 13:6-25, Fig. 30.



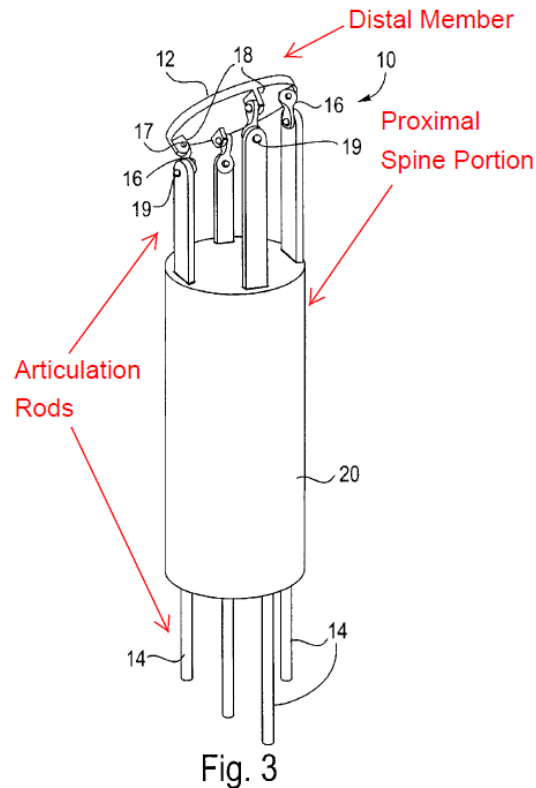
2. [26] The surgical tool of claim 25 wherein said transmission assembly comprises an articulation transmission and wherein said articulation system comprises: a first articulation bar having a distal end coupled to a proximal portion of said elongated shaft assembly at a first lateral point that is laterally offset in a first lateral direction from said articulation axis, said first articulation bar having a proximal end that operably interfaces with said articulation transmission; and a second articulation bar having a distal end coupled to said proximal portion of said elongated shaft assembly at a second lateral point that is laterally offset in a second lateral direction from said articulation axis, said second articulation bar having a proximal end that operably interfaces with said articulation transmission.

124. As I discussed above, one of ordinary skill in the art would have found that the combination of Anderson, Timm, and Wallace discloses every limitation of claims 24 and 25, from which this claim depends. One of ordinary

skill would have understood the additional limitations of this claim to be disclosed by Anderson in view of Timm in further view of Wallace.

125. The combination of Anderson, Timm, and Wallace discloses an “articulation transmission.” For example, as discussed above with respect to claim 25, figure 30 of Wallace shows an articulation including “sector gears 312” and “gears 400.” Wallace, FIG. 30; 13:6-14:14.

126. The combination of Anderson, Timm, and Wallace also discloses a “first second articulation bar” and a “second articulation bar.” Wallace discloses an articulation assembly with four articulation bars (rods 14) that that are offset in different directions and “extend through a guide tube 20” terminating at “distal member 12.” Wallace 7:57-8:12. “As the rods 14 are slid up and down the guide slots 30 of the guide tube 20, the orthogonal linkages 16 transfer the motion to the distal member 12.” Wallace, 8:13-24. This may be seen in Figure 30 of Wallace:



Wallace, FIG. 3.

127. The combination of Anderson, Timm, and Wallace also discloses a “first articulation bar having a proximal end that operably interfaces with said articulation transmission” and a “second articulation bar having a proximal end that operably interfaces with said articulation transmission.” “Manipulation of the rods 300 [*i.e.*, articulation bars] actuates the wrist mechanism to position the distal clevis in a desired orientation.” Wallace 13:44-14:14; *see also* FIGs. 24-30.

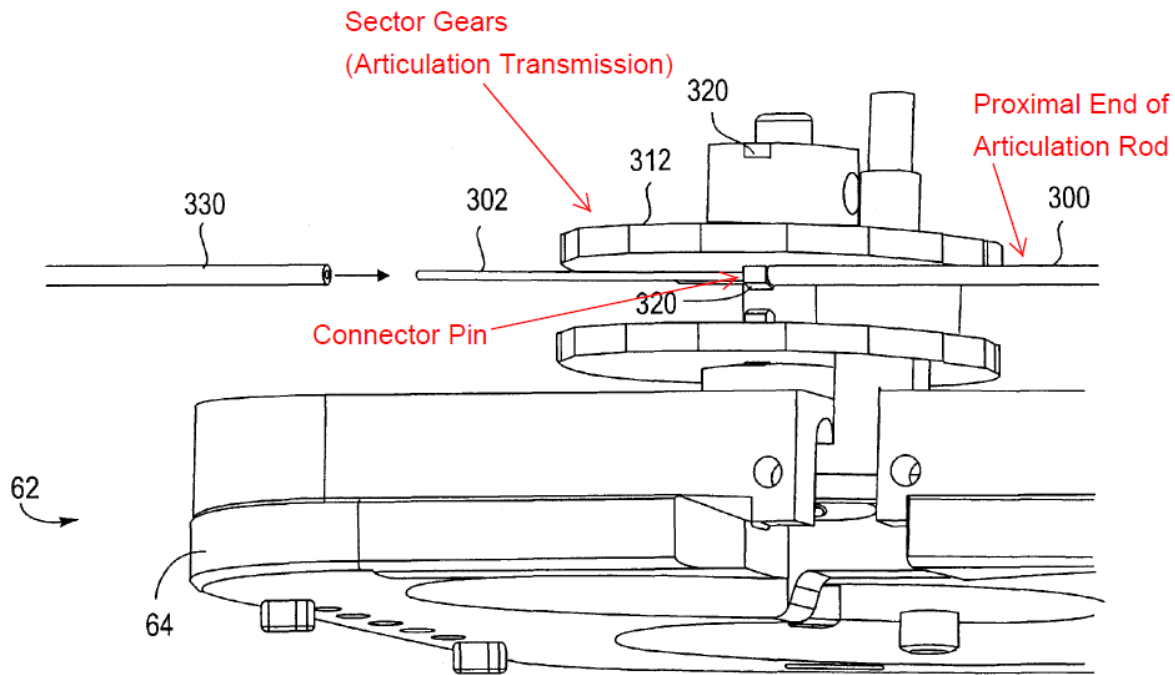


Figure 29

Wallace, FIG. 29, 13:44-14:14; *see also* FIGs. 24-30.

#### **D. Ground 4: Anderson in View of Knodel**

128. Claims 19-20 of the '969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Knodel.

129. I note that although Anderson was before the Examiner during prosecution, it was not used in any rejection and there is no evidence in the prosecution record that the Examiner considered Anderson in connection with the Knodel reference. I examine each limitation of the relevant claim of the '969 Patent as follows and I discuss the motivation to combine Anderson with Knodel. One of skill in the art would have readily understood that modifying Anderson to

use Knodel's gear-driven knife bar and surgical stapler assembly is merely the application of a known technique to a known system (*e.g.*, Anderson's surgical system) ready for improvement to yield predictable results.

130. One of skill in the art would have found many reasons to modify Anderson to include the gear-driven knife bar and surgical stapler assembly of Knodel. First, one of skill in the art would have understood that Knodel's teaching of an end effector for a "surgical stapler," as well as the related gear assembly, and knife bar assembly are just the type of "stapler probe" contemplated by Anderson. Anderson, 7:19-25; Knodel, 5:52-6:10; 9:10-17; 10:65-11:12; 10:10-18. In an effort to increase the number of uses of the Anderson surgical stapler, one of ordinary skill would naturally have turned to Knodel for implementation details.

131. Next, one of skill in the art would have recognized that Knodel's disclosure of an "improved motion transfer mechanism which is easily adaptable for use in various stapler instruments," Knodel, 1:53-67, was desirable and would have modified Anderson to include Knodel's end effector with gear-driven knife bar assembly. Indeed, one of skill in the art would readily understand that Anderson teaches a surgical system that could be readily improved by the disclosures of Knodel.

132. Finally, one of skill in the art would have modified the teachings of Anderson with the teachings of Knodel because both teach surgical instruments

each with a gear-driven end effector, and thus modifying Anderson as I describe here would have led to predictable results without significantly altering or hindering the functions performed by Anderson's system. Indeed, Anderson teaches that "various alternatives, modifications and equivalents may be used" and Knodel suggests such an improvement. Anderson at 25:10-11.

1. **[19.P] A surgical tool for use with a robotic system that has a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to provide at least one rotary output motion to at least one rotatable body portion supported on the tool drive assembly, said surgical tool comprising:**

133. One of ordinary skill would have understood this element to be disclosed by Anderson. See my analysis above regarding the identical limitation [23.P], which I incorporate by reference.

2. **[19.1] a surgical end effector comprising: a surgical staple cartridge; and a cutting instrument that is axially movable within said surgical staple cartridge between a starting position and an ending position in response to control motions applied thereto**

134. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Knodel.

135. As to the phrase "a surgical end effector comprising: a surgical staple cartridge," the Anderson discloses instruments that may have a variety of end effectors such as surgical staplers. Anderson, 7:6-25. Knodel teaches "[a] surgical stapler instrument ... for applying lateral lines of staples to tissue while cutting the



tissue between those staple lines” and a “staple cartridge 120” located in the end effector. Knodel, Abstract, 5:52-65.

136. As to the phrase “a cutting instrument that is axially movable within said surgical staple cartridge,” Knodel teaches an end effector that includes “a knife 161” and “releasably receives a staple cartridge 120.” Knodel, 5:52-65.

137. Knodel further teaches movement of the knife is effected by movement of pusher block 162a of wedge 162, which occurs responsive to “movement of the firing trigger.” Knodel, 10:10-18; 10:49-11:12, 12:1-6.

3. *[19.2] an elongated shaft assembly operably coupled to said surgical end effector, said elongated shaft assembly comprising at least one gear-driven portion comprising a knife bar that is movably supported within said elongated shaft assembly for selective axial travel therein, said knife bar interfacing with said cutting instrument;*

138. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Knodel.

139. As to the “elongated shaft assembly operably coupled to said surgical end effector,” both Anderson and Knodel teach surgical end effectors operably coupled to an elongated shaft. Anderson, FIG. 2; 11:43-65; Knodel, FIG. 1; 5:52-6:10.

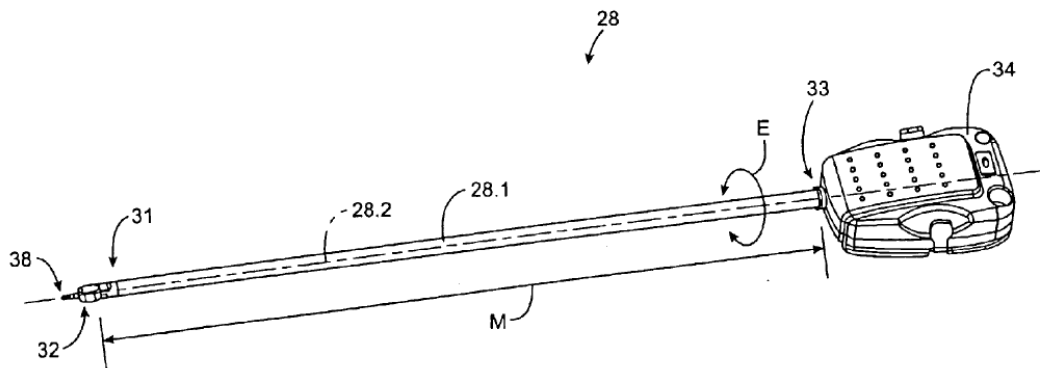


FIG. 2

Anderson Fig. 2

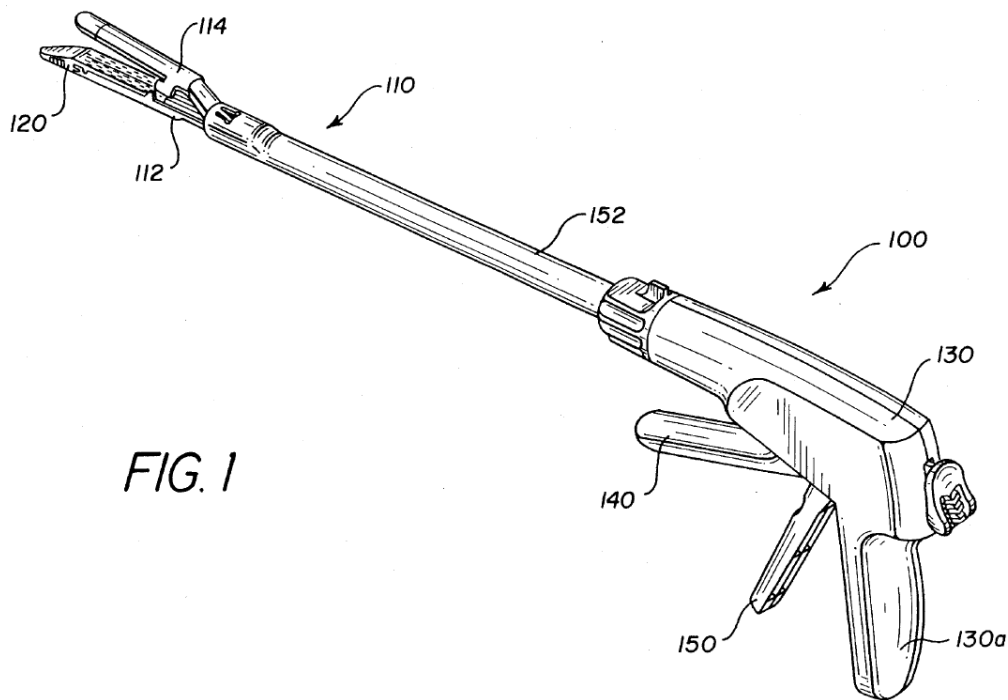


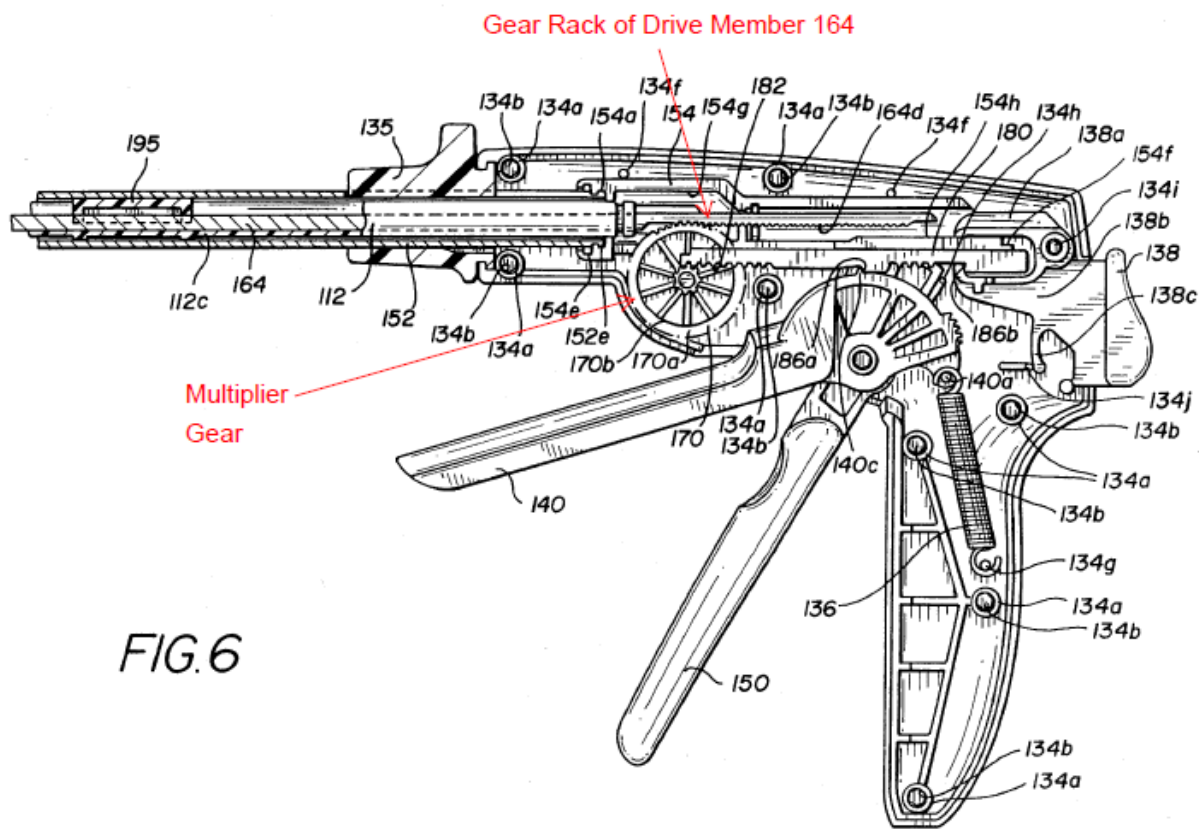
FIG. 1

Knodel Fig. 1

140. As to the phrase “said elongated shaft assembly comprising at least one gear-driven portion comprising a knife bar,” Knodel discloses this limitation.

In particular, Knodel teaches a “knife 161” that interfaces through “pusher block 162a,” and “drive member 164” to receive distal movement. Knodel, FIG. 2; 9:10-17 (“[d]istal movement of the wedge work member 162 also effects distal movement of the knife 161.”); 10:65-11:12; 10:10-18.

141. Knodel also teaches that multiplier gear 170 engages gear rack 164d of drive member 164, and thereby effects movement of drive member 164:



Knodel, FIG. 6; 10:65-11:12; 9:10-35.

4. *[19.3] a tool mounting portion operably coupled to said elongated shaft assembly, said tool mounting portion being configured to operably interface with the tool drive assembly when coupled thereto, said tool mounting portion comprising:*

142. One of ordinary skill would have understood this element to be disclosed by Anderson. *See* my analysis above regarding the identical limitation [23.3], which I incorporate by reference. Additionally, one of ordinary skill in the art would have understood that modifying Anderson to include the surgical stapler end effector and knife bar (“drive member 164”) of Knodel would have included using one of Anderson’s “transmission members 70, 72, 74, and 76” having “shafts 70.1, 72.1, 74.1, and 76.1” and/or “instrument actuator interface member 353a and 353b” to provide rotational motion to the gear assembly that drives Knodel’s drive member 164. Anderson, 11:66-12:22; 22:59-23:30; 24:23-39; FIGs. 3, 21-22.

When making the combination, the interface portions of Anderson would be used to transfer the rotary forces from the robot arm to the removable instrument, and the transmission members and shafts are part of that interface. The shafts may then be used to provide rotary power to the instrument gears or other instrument actuation mechanisms.

5. *[19.4] a driven element rotatably supported on said tool mounting portion and configured for driving engagement with a corresponding one of the at least one rotatable body portions of the tool drive assembly to receive corresponding rotary output motions therefrom; and*

143. One of ordinary skill would have understood this element to be disclosed by Anderson. *See* my analysis above regarding the identical limitation [24.5], which I incorporate by reference. Moreover, one of skill in the art would have readily understood that substituting the end effector 164 and knife bar of Knodel into the system of Anderson and its “transmission members 70, 72, 74, and 76” having “shafts 70.1, 72.1, 74.1, and 76.1” and/or “instrument actuator interface member 353a and 353b” would provide rotary motion to the gear assembly driving drive member 164 of Knodel. Anderson, 11:66-12:22; 22:59-23:30; 24:23-39; FIGs. 3, 21-22.

6. *[19.5] a transmission assembly in operable engagement with said driven element and in meshing engagement with the knife bar to apply actuation motions thereto to cause said knife bar to apply at least one control motion thereto.*

144. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Knodel. Anderson teaches that transmission members 70, 72, 74, and 76 rotate responsive to the rotation of “actuators, such as electric motors” of the robotic arm assembly, causing the “[m]ovement of end effector 38” and that the end effector is actuated by the rotation of actuation interface members 353a-b when rotated, Anderson, 11:59-12:22, 24:31-65.

145. One of skill in the art would have readily understood that substituting the end effector and knife bar of Knodel to include the “transmission members 70, 72, 74, and 76” having “shafts 70.1, 72.1, 74.1, and 76.1” and/or “instrument actuator interface member 353a and 353b” of Anderson would yield predictable results, and thus would have understood that the transmission assembly of the combination of Knodel’s gear assembly, including “gear rack 164d” meshingly engaged with a multiplier gear 170, in communication with the transmission members of Knodel would operatively engage one or more of Anderson’s shafts (the driven element). Anderson, 11:66-12:22; 22:59-23:30; 24:23-39; FIGs. 3, 21-22; Knodel, FIG. 6; 10:65-11:12; 9:10-35.

7. *[20] The surgical tool of claim 19 wherein said knife bar has a knife gear rack formed on a proximal end thereof and wherein said transmission assembly comprises a knife transmission assembly comprising a knife gear assembly in meshing engagement with said knife gear rack, said knife gear assembly operably coupled to one of the at least one rotatable body portions supported on the tool drive assembly such that upon application of a rotary output motion in a first direction to said knife gear assembly by said at least one rotatable body portion, said knife bar drives said cutting instrument distally through said surgical staple cartridge and upon application of said rotary output motion in a second direction to said knife gear assembly, said knife bar moves said cutting instrument proximally through said surgical staple cartridge.*

146. Claim 19 of the '969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Knodel. One of ordinary

skill would have understood the additional limitations of this claim to be disclosed by Anderson in view of Knodel.

147. Regarding the phrase “said knife bar has a knife gear rack formed on a proximal end thereof,” Knodel teaches that “proximal end 164c of the drive member 164 is provided with a gear rack 164d,” Knodel, 9:10-35, FIGs. 6, 10, 12, which one of skill in the art would readily understand describes the knife bar of ‘969.

148. Regarding the phrase “said transmission assembly comprises a knife transmission assembly comprising a knife gear assembly in meshing engagement with said knife gear rack,” Knodel’s Figure 6 shows the meshing engagement of gear rack 164d and gear 170a, and the specification teaches that “[t]he first pinion gear 170a is engaged with the gear rack 164d provided on the metal drive member 164.” Knodel, 9:10-35; FIGs. 6, 10, 12.

149. Regarding the phrase “said knife gear assembly operably coupled to one of the at least one rotatable body portions,” as I explained above, one of skill in the art would have understood that the modification of Anderson to use Knodel’s end effector and knife bar would use “transmission members 70, 72, 74, and 76” having “shafts 70.1, 72.1, 74.1, and 76.1” and/or “instrument actuator interface member 353a and 353b” of Anderson to transmit rotary motion to the gear assembly configured to drive member 164 of Knodel. Anderson, 11:66-

12:22; 22:59-23:30; 24:23-39; FIGs. 3, 21-22.

150. As to moving the knife bar “proximally” and “distally,” Knodel discloses that “drive member 164” is a component of “reciprocating section 160,” which is in turn “adapted to move back and forth along an axis of the implement portion.” Knodel, 9:10-17; Abstract; 2:21-41 (“motion of the actuator causes the drive member to move back and forth between first and second drive positions.”); 10:65-11:12 (“movement of the firing trigger 140 causes the metal drive member 164 and the wedge work member 162 to reciprocate between a first reciprocating position, shown in FIGS. 6, 7, 7A and 10, and a second reciprocating position, shown in FIGS. 11 and 12.”); 13:5-9. One of skill in the art would have recognized that the reciprocating motion taught by Knodel could be implemented through the shafts (70.1, 72.1, 74.1, or 76.1) of Anderson due in part to Knodel’s disclosure that “the motion transfer mechanism 220 of the present invention is easily modifiable.” Knodel, 11:13-25.

#### **E. Ground 5: Anderson in View of Viola**

151. Claims 21-22 of the ’969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Viola.

152. I note that although Anderson was before the Examiner during prosecution, it was not used in any rejection and there is no evidence in the prosecution record that the Examiner considered Anderson in connection with the



Viola reference. I examine each limitation of the relevant claim of the '969 Patent as follows and I discuss the motivation to combine Anderson with Viola.

153. One of skill in the art would have found many reasons to modify Anderson with Violas's surgical stapler driven by a drive screw. First, one of skill in the art would have understood that Viola's teaching of a "surgical stapler," related end effector, drive screw and other actuation drive mechanisms are just the type of "stapler probe" contemplated by Anderson. Anderson, 7:19-25; Viola, 4:5-178. In an effort to increase the number of uses of the Anderson surgical stapler, one of ordinary skill would naturally have turned to Viola for implementation details.

154. Next, Viola discloses a "beneficial mechanism that" "increase[s] the torque delivered by the motor assembly" and in so doing reduces the amount of force needed to be applied by the motor. Viola, 2:1-20, 4:18-25. Such a reduction of required force would be desirable to one of skill in the art, and would have served to reduce the size and possibly expense of the motor required by Anderson.

155. Lastly, Anderson and Viola both disclose motorized surgical instruments with end effectors driven by gears attached to the end of a shaft and thus modifying Anderson as I describe here would have led to predictable results without significantly altering or hindering the functions performed by Anderson's system. Indeed, Anderson teaches that "various alternatives, modifications and

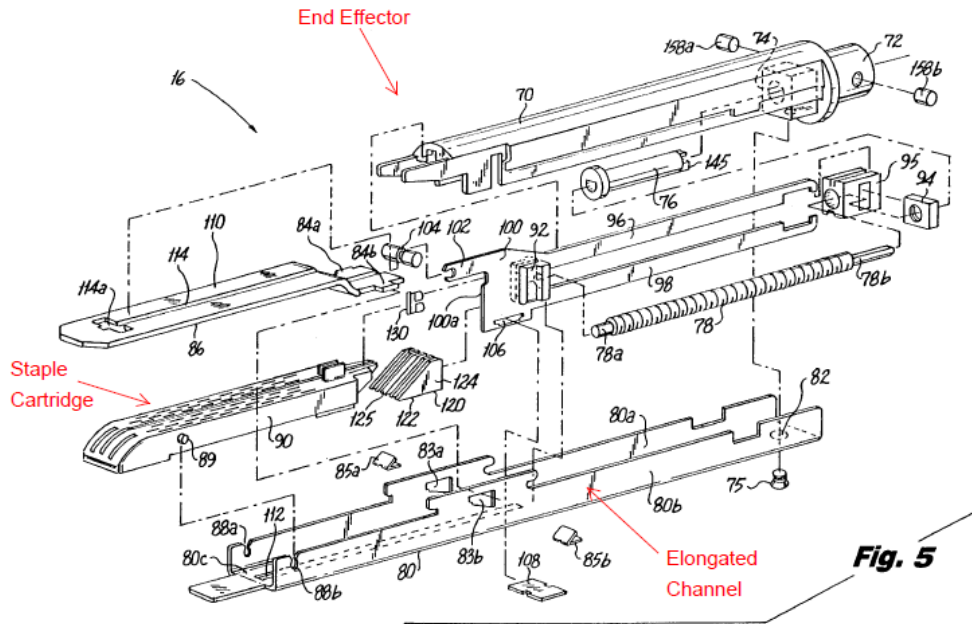
equivalents may be used” and Viola suggests such an improvement. Anderson at 25:10-11.

1. **[21.P] A surgical tool for use with a robotic system that has a tool drive assembly that is operatively coupled to a control unit of the robotic system that is operable by inputs from an operator and is configured to provide at least one rotary output motion to at least one rotatable body portion supported on the tool drive assembly, said surgical tool comprising:**

156. One of ordinary skill would have understood this element to be disclosed by Anderson. See my analysis above regarding the identical limitation [23.P], which I incorporate by reference.

2. **[21.1] a surgical end effector comprising: an elongated channel configured to support a surgical staple cartridge therein;**

157. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola. Both Anderson and Viola teach surgical end effectors with an elongate channel and Viola, in particular, discloses that its “surgical stapler” comprises an end effector with “cartridge assembly 16” having “an elongated housing channel 80” with “retainer cartridge 90” that retains “a plurality of surgical fasteners”, which one of skill in the art would readily understand comprises a staple cartridge:

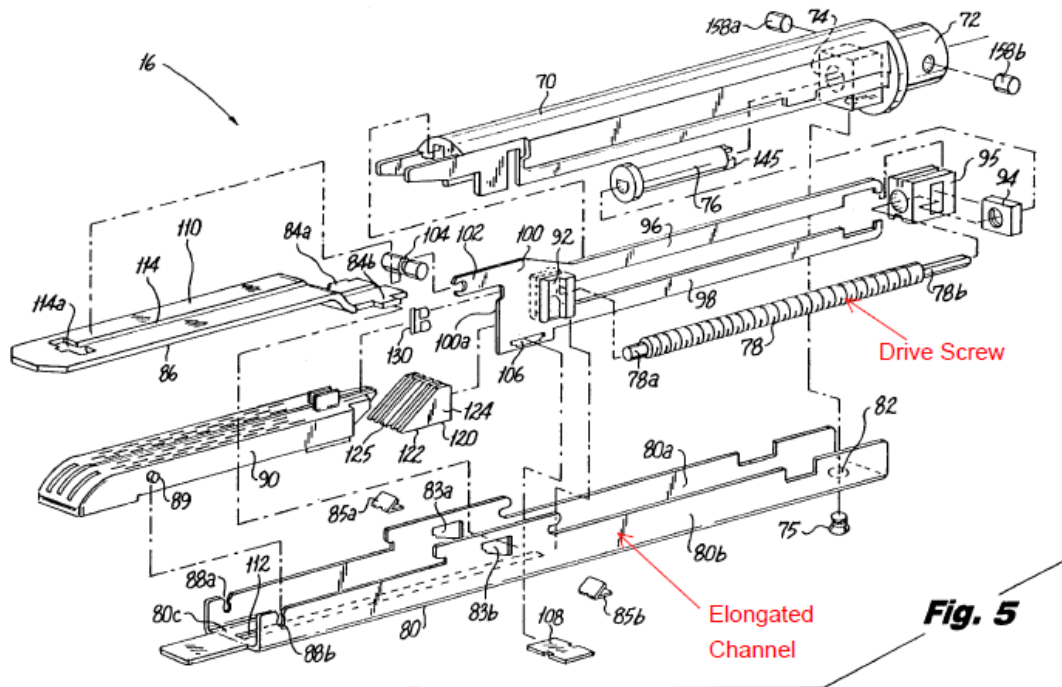


Anderson, 7:6-25; Viola, FIG. 5; 4:5-17; 5:44-58; 6:3-32. One of ordinary skill would have recognized that Viola's retainer cartridge 90 is a staple cartridge.

3. **[21.2] a rotary end effector drive shaft operably supported within an elongated channel;**

158. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola.

159. As shown in Figure 5, Viola teaches "axial drive screw 78," which is supported within the elongated channel and rotates axially to provide longitudinal movement to housing 95:



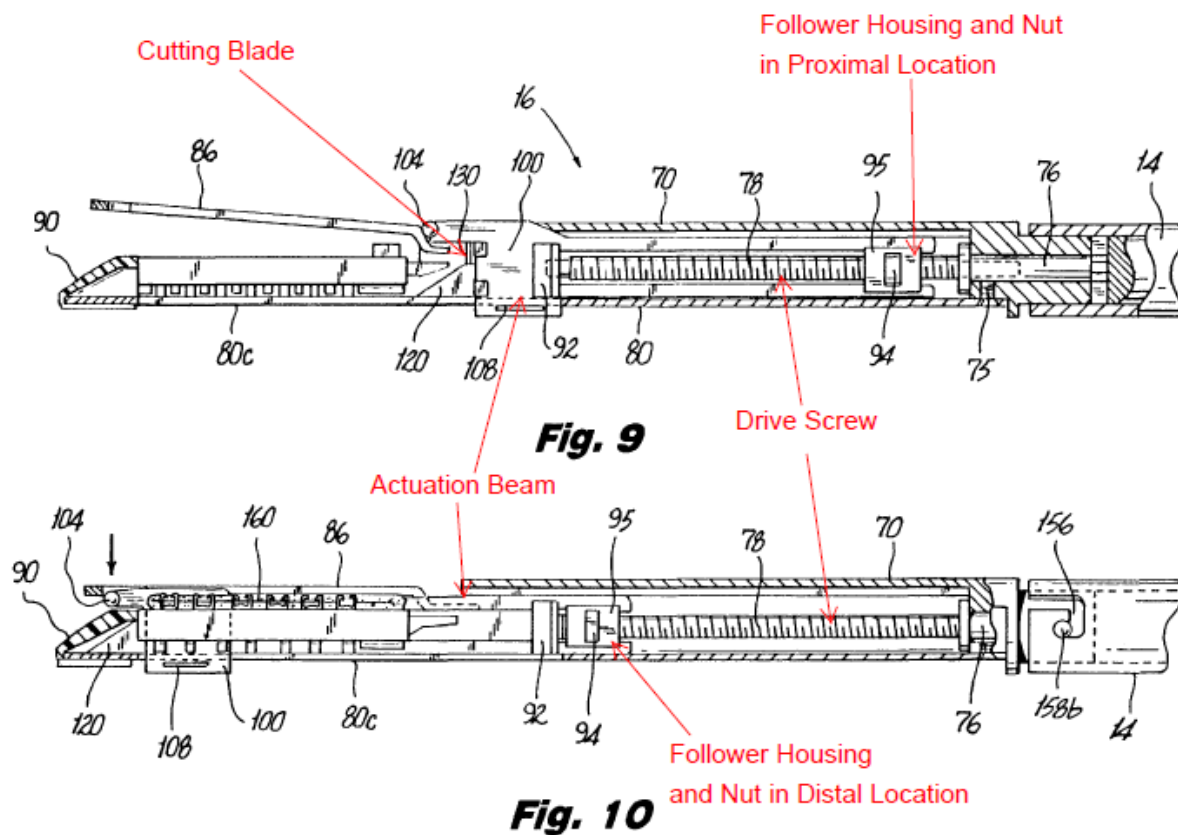
Viola, FIGs. 5, 9; 5:55-6:55.

4. [21.3] a knife member having a tissue-cutting portion thereon threadedly received on said rotary end effector drive shaft such that rotation of said rotary end effector drive shaft in a first direction causes said knife member to move in a distal direction through said surgical staple cartridge and when said rotary end effector drive shaft is rotated in a second direction, said knife member moves in a proximal direction through said surgical staple cartridge and wherein said surgical tool further comprises:

160. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola.

161. As to the phrase “a knife member having a tissue-cutting portion thereon threadedly received on said rotary end effector drive shaft,” Viola teaches a cutting blade (*i.e.*, knife member) that is operatively coupled to “axial drive

screw 78” (*i.e.*, rotary end effector drive shaft) by follower nut 94 within housing 95 as shown in Figures 9 and 10.



Viola, FIGs. 9-10; 6:37-59.

162. As to the phrase “such that rotation of said rotary end effector drive shaft,” Viola teaches that the rotation of drive screw 78 causes follower nut 94 within housing 95 to move along distally along the drive screw, thereby causing “actuation beam 100 [to] translate[] distally with the follower housing.” Viola, FIGs. 9-10; 6:37-59; 7:65-8:5.

163. Viola teaches that the motor assembly may be reversed, Viola, 2:50-

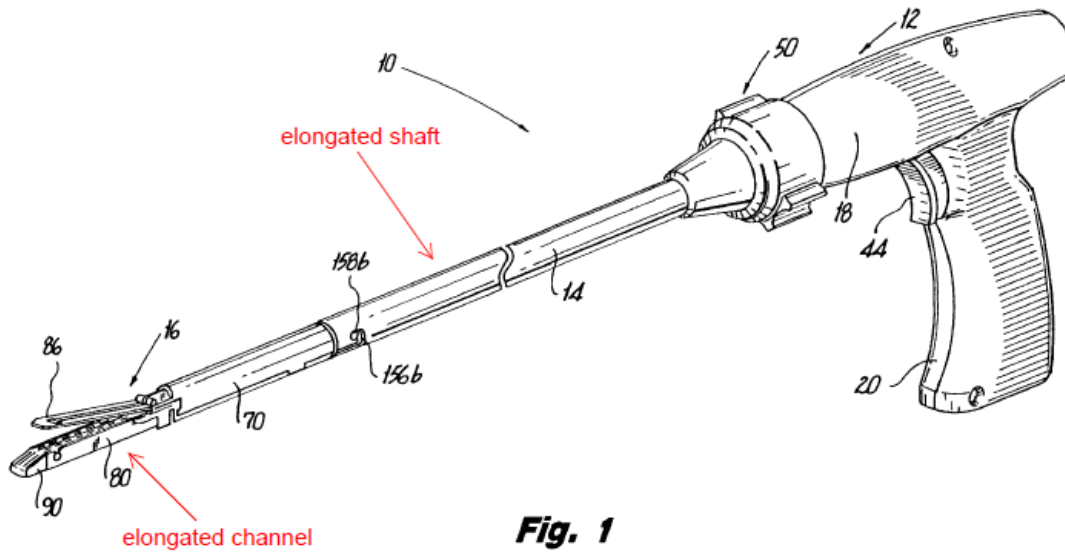
54; 5:9-12; 7:56-65, and one of skill in the art would readily understand that reversing the motor assembly would serve to rotate drive screw 78 in the opposite direction, thereby moving the follower nut 94 within housing 95 and actuation beam 100 proximally. In addition, Viola uses an I-beam design which prevents the jaws from opening when the knife is in the distal position. Therefore, one of ordinary skill in the art would recognize that the actuation beam must be returned proximally to allow the jaws to open.

164. One of skill in the art would also have recognized that Anderson teaches a knife member that is retractable and actuation spools that are reversible. Anderson, 16:52-61, 17:51-54; 22:59-23:14; 24:40-53; FIG. 13; FIG. 21 (elements C and D illustrating reversibility of actuators.

5. *[21.4] an elongated shaft assembly operably coupled to said elongated channel, said elongated shaft assembly comprising at least one gear-driven portion that is in operable communication with said rotary end effector drive shaft:*

165. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola.

166. Regarding the phrase “an elongated shaft assembly operably coupled to said elongated channel,” Viola teaches an elongated shaft attached to an “elongated housing channel 80” by “cartridge adapter 70” as seen in Figure 1:



Viola; FIG. 1; 4:10-17; 5:44-58.

167. Regarding the phrase “said elongated shaft assembly comprising at least one gear-driven portion that is in operable communication with said rotary end effector drive shaft,” Viola teaches that the elongated shaft contains “axial drive screw 78” that receives rotational motion from drive shaft 42, which in turn receives rotational motion from gear set 24. Viola, 7:56-65; 4:18-39. This may be seen in Figure 2:

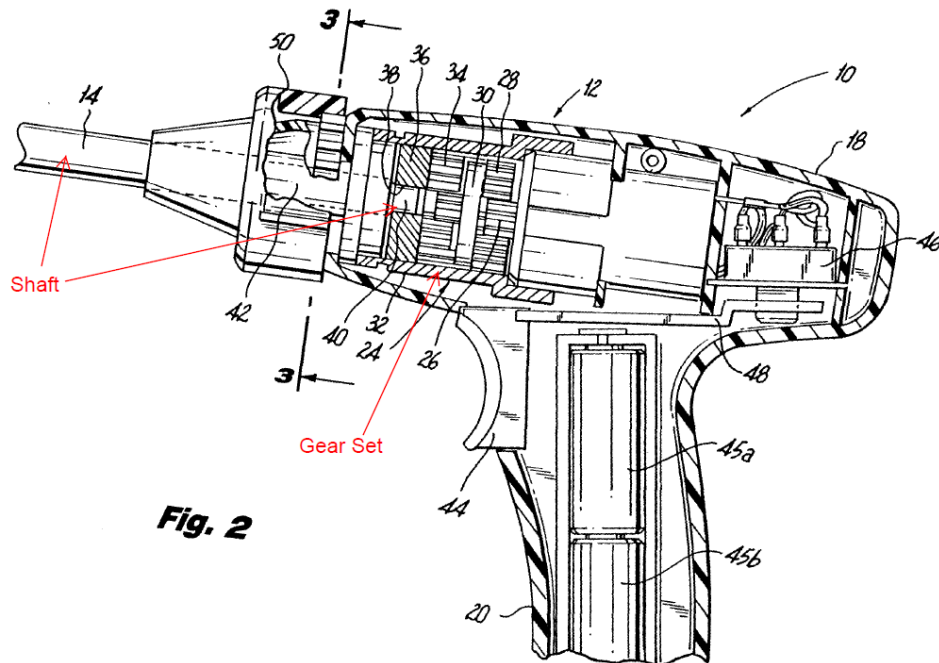


Fig. 2

Viola, FIG. 2.

6. [21.5] a tool mounting portion operably coupled to said elongated shaft assembly, said tool mounting portion being configured to operably interface with the tool drive assembly when coupled thereto, said tool mounting portion comprising:

168. One of ordinary skill would have understood this element to be disclosed by Anderson. See my analysis above regarding the identical limitation [23.3], which I incorporate herein by reference.



7. *[21.6] a driven element rotatably supported on said tool mounting portion and configured for driving engagement with a corresponding one of the at least one rotatable body portions of the tool drive assembly to receive corresponding rotary output motions therefrom; and*

169. One of ordinary skill would have understood this element to be disclosed by Anderson. *See* my analysis above regarding the identical limitation [24.5], which I incorporate herein by reference.

8. *[21.7] a transmission assembly in operable engagement with said driven element and in meshing engagement with a corresponding one of said at least one gear-driven portions to apply actuation motions thereto to cause said corresponding one of said at least one gear-driven portions to apply at least one control motion to said rotary end effector drive shaft.*

170. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola.

171. The combination of Anderson and Viola would use the transmission assembly of Anderson (including its “transmission members 70, 72, 74, and 76” having “shafts 70.1, 72.1, 74.1, and 76.1” and/or “instrument actuator interface member 353a and 353b”) with the drive screw-driven surgical stapler mechanism through the application of rotational motion to gear set 24, and thus drive screw 78, of Viola, which one of skill in the art would have readily understood. Anderson, 11:66-12:22; 22:59-23:30; 24:23-39; FIGs. 3, 21-22; Viola, 7:56-65; 4:18-39. Indeed, one of ordinary skill in the art would have understood that drive screw 78 receives rotational motion from drive shaft 42, the proximal end of which (40) is

coupled to “hub member 36,” which in turn is driven by “planetary gears 34,” which in turn are meshingly engaged with “pinion portion of carrier 30.” Viola, FIG. 2; 4:18-39; 7:56-65.

9. *[22] The surgical tool of claim 21 wherein one of said at least one of said gear-driven portions comprises an elongated proximal drive shaft operably supported in said elongated shaft assembly*

172. As discussed above, Claim 21 of the '969 Patent would have been obvious to one of ordinary skill in the art over Anderson taken in view of Viola.

173. One of ordinary skill would have understood the additional limitations of this claim to be disclosed by Anderson in view of Viola. For example, Viola teaches that “[d]rive shaft 42 extends from hub 36 through the elongate body portion [shaft] 14 of surgical apparatus 10 to the cartridge assembly 16.” Viola, 4:34-39.

10. *[22.1] and having a distal end in driving engagement with said rotary end effector drive shaft,*

174. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola. Viola teaches that “[d]rive shaft 42 extends from hub 36 through the elongate body portion [shaft] 14 of surgical apparatus 10 to the cartridge assembly 16.” Viola, 4:34-39. It further discloses that “[c]oupling 76 is detachably connected ... to the distal end of drive shaft 42”

serving to “transmit[] rotational motion from the drive shaft 42 to the drive screw 78.” Viola, 5:65-6:2; 6:45-52; 7:14-20.

11. [22.2] and wherein said transmission assembly comprises a rotary drive transmission operably supported on said tool mounting portion and in driving engagement with a proximal end of said proximal drive shaft and operably coupled to one of the at least one rotatable body portions supported on the tool drive assembly such that, upon application of a rotary output motion in one direction to said rotary drive transmission by said at least one rotatable body portion, said proximal drive shaft rotates said rotary end effector drive shaft in said first direction and upon application of said rotary output motion in a second direction to said rotary drive transmission, said proximal drive shaft causes said rotary end effector drive shaft to rotate in said second direction.

175. One of ordinary skill would have understood this element to be disclosed by Anderson in view of Viola. I explained above regarding claim 21, which explanation is incorporated by reference, why one of skill in the art would combine Anderson and Viola such that Viola’s mechanism is drivingly engaged with the transmission assembly of Anderson, how rotating the drive shaft of Viola in one direction would cause the knife to move distally and rotating it in the opposite direction would move the knife proximally. *See* Anderson, 4:18-39, 11:66-12:22; 22:59-23:30; 24:23-39; FIGs. 3, 21-22; 5:65-6:2; 7:14-20; 7:56-65.

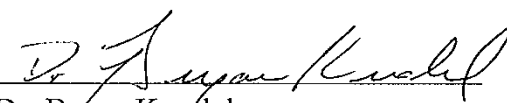
## XI. CONCLUSION

176. Based on the detailed analysis above, claims 19-26 of the ’969 Patent are rendered invalid because they would have been obvious to a person of ordinary

skill in the art at the time the purported invention was made in light of grounds 1-5 as discussed above.

177. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both (under Section 1001 of Title 18 of the United States Code).

Executed this 13th day of June, 2018.

  
Dr. Bryan Knodel

# APPENDIX A

**BRYAN D. KNODEL**  
P. O. Box 22024  
Flagstaff, AZ 86002

**Ph.D. Mechanical Engineering – Thermal Science Emphasis**  
University of Illinois at Chicago, 1995

**M.S. Mechanical Engineering**  
University of Illinois at Chicago, 1988

**B.S. Thermo-Mechanical Engineering and Energy Conversion**  
University of Illinois at Chicago, 1983

## **EXPERIENCE**

### **1/98-Present: President, Bryan D. Knodel, Inc.**

Specializing in medical device consulting services including intellectual property, conceptual design, working prototypes, and turnkey product development. Developed products spanning a wide range of surgical procedures including; female reproductive system, female incontinence, female pelvic floor dysfunction, lung volume reduction, colon, GERD, bariatrics, CABG, heart valve repair, hernia, general surgical procedures. Experienced in numerous technologies including; endoscopic linear stapling, endoscopic multiple clip appliers (and clip design), endoscopic hernia repair (and mesh anchor design), anastomotic devices (and implant design), automatic suturing devices, bipolar and mono-polar devices, pneumatic powered medical devices, electrical powered medical devices, radiation delivery devices, and others.

### **7/05-1/15: Vice President Research and Development, CARDICA, Inc.**

Responsible for all aspects of research and development for products related to the automatic creation of distal and proximal anastomosis, femoral artery closure devices, PFO closure devices, and the first 5mm diameter linear cutter. Dedicated to professional development of the next generation of design engineers through direct mentoring. Responsible for technical direction, schedules, and budgets. Fostered strong relationships with key suppliers to leverage their vast experience against the technical challenges faced.

### **6/92-12/97: Principal Engineer, ETHICON ENDO-SURGERY a Johnson and Johnson Company.**

Lead Design Engineer and Principal Inventor of the entire Endoscopic Linear Cutter Product Line consisting of 14 product codes with 16 patents awarded. Increased market share from 17% to over 60%. Instructor at the EES "Operational Excellence" school in Cincinnati, OH. Developed and taught "Design for Profitability" course which combined "Design for Manufacturability" (DFM) and "Design for Assembly" (DFA) concepts along with material from my own experience called "Design for Simplicity" and "Design for Quality".

### **2/90-6/92: Senior Engineer, ETHICON a Johnson and Johnson Company.**

Development Team Leader responsible for the rapid design, fabrication, and validation of low cost manufacturing equipment used for the production and packaging of surgical sutures. Dramatic reductions in development time were achieved using fundamentally simplified design concepts in conjunction with the principles of DFMA (Design for Manufacturability and Assembly).

**1/84-12/89:** Research Engineer, **CBI Research Corporation**, Plainfield, Illinois.

Principal Inventor of a revolutionary, patented, refrigeration system capable of providing chilled water or ice-water slurry at high thermal efficiencies. Executed U.S. Department of Energy funded research in advanced energy transmission fluids. Designed and operated the thermal system associated with a full-scale failure test of a nuclear reactor personnel airlock for Sandia National Laboratory. Developed a computer simulation to predict hydrocarbon emissions from petroleum storage tanks for the American Petroleum Institute.

## **U.S. PATENTS**

### ***Heat Transfer and Fluid Technologies***

4,596,120	Apparatus and Method for Cold Aqueous Liquid and/or Ice Production, Storage and Use for Cooling and Refrigeration.
4,754,610	Apparatus and Method of Ice Production by Direct Refrigerant Contact with Aqueous Liquid.
4,838,039	Direct Contact Evaporator/Freezer.
4,914,921	Refrigeration Method and Apparatus using Aqueous Liquid Sealed Compressor.
5,139,549	Apparatus and Method for Cooling using Aqueous Ice Slurry.
5,307,641	Method and Apparatus for Producing Ice by Direct Contact of a Non-Hydrate Producing Refrigerant with Water.

### ***Medical Device Technologies***

5,307,976	Linear Stapling Mechanism with Cutting Means
5,332,142	Linear Stapling Mechanism with Cutting Means
5,415,335	Surgical Stapler Cartridge containing Lockout Mechanism
5,465,895	Surgical stapler instrument
5,485,947	Linear Stapling Mechanism with Cutting Means
5,487,500	Surgical Stapler Instrument
5,553,765	Surgical Stapler with Improved Operating Lever Mounting Arrangement
5,562,241	Surgical Stapler Instrument
5,597,107	Surgical Stapler Instrument
5,653,721	Override Mechanism for an Actuator on a Surgical Instrument
5,662,258	Surgical Stapler Instrument
5,662,667	Surgical Clamping Mechanism
5,697,542	Endoscopic Surgical Stapler with Compact Profile
5,762,255	Surgical Instrument with Improvement Safety Lockout Mechanisms
5,769,303	Endoscopic Surgical Stapler with Compact Profile
5,779,131	Endoscopic Surgical Stapler with Compact Profile
5,779,132	Endoscopic Surgical Stapler with Compact Profile
5,814,055	Surgical Clamping Mechanism
5,823,066	Articulation Transmission Mechanism for Surgical Instruments
5,849,020	Inductively Coupled Electrosurgical Instrument
5,897,563	Method for Using a Needle Holder to Assist in Suturing
5,916,215	Inductively Coupled Electrosurgical Trocar
5,925,041	Monopolar Electrosurgical Trocar
5,951,552	Capacitively Coupled Cordless Electrosurgical Instrument
5,961,514	Cordless Electrosurgical Instrument
5,984,921	Method and Apparatus for Applying Electrical Energy to Medical Instruments
5,993,464	Surgical Stapling Instrument
6,030,403	Method and Apparatus for Applying Electrical Energy to Medical Instruments

6,066,144	Surgical Anastomosis Method
6,086,606	Manually-operable Surgical Tool Suitable for Laparoscopy Adaptable for Different Functions by Quick Change of Operational Elements
6,095,969	Female Incontinence Control Device Actuated by Abdominal Pressure
6,106,519	Capacitively Coupled Electrosurgical Trocar
6,117,132	Inductively Coupled Electrosurgical Trocar
6,120,501	Method and Apparatus for Applying Electrical Energy to Medical Instruments
6,187,002	Capacitive Electrosurgical Trocar Including Adapter
6,206,875	Method of Capacitively Coupling Energy to an Electrosurgical Instrument
6,238,383	Apparatus and Method to Facilitate Intermittent Self-catheterization
6,328,687	Female Incontinence Control Device Actuated by Abdominal Pressure
6,371,967	Inductively Coupled Electrosurgical Instrument
6,425,900	Method for Attaching Hernia Mesh
6,428,180	Surgical Illumination Device and Method of Use
6,447,524	Fastener for Hernia Mesh Fixation
6,572,626	Surgical Instrument having a Fastener Delivery Mechanism
6,585,684	Automated System for the Radiation Treatment of a Desired Area within the Body of a Patient
6,709,445	Forceps for Dissecting Free Tissue in Body Cavities
6,755,338	Medical Instrument
6,773,438	Surgical Instrument having a Rotary Lockout Mechanism
6,824,547	Endoscopic Clip Applier and Method
6,830,174	Medical Instrument
6,863,658	Automated System for the Radiation Treatment of a Desired Area within the Body of a Patient
7,001,408	Surgical Device with Expandable Member
7,267,682	Anastomosis Staple
7,285,131	System for performing anastomosis
7,300,444	Surgical system and method for connecting hollow tissue structures
7,303,570	Anastomosis tool having a connector holder
7,320,692	Tissue closure system
7,344,544	Vascular Closure System
7,458,978	Vascular Closure System Utilizing Staples
7,462,185	Intravascular Stapling Tool
7,473,258	Surgical Stapler
7,503,474	Medical Instrument
7,530,987	Surgical Tool for Creating an Incision in a Tubular Vessel
7,533,790	Surgical Stapler
7,569,064	Apparatus and Method for Closing an Atrial Appendage
7,641,668	Fluid Delivery System and Related Methods of Use
7,670,348	Heart Defect Closure Apparatus
7,678,121	Surgical Stapling Tool
7,682,368	Anastomosis Tool Actuated with Stored Energy
7,699,859	Method of Performing Anastomosis
7,727,245	Method for Closing an Opening in Tissue with a Splayable Staple
7,753,250	Surgical Stapler with Splaying Mechanism
7,766,924	System for Performing Anastomosis
7,794,471	Compliant Anastomosis System
7,875,053	Apparatus and Method for Closure of Patent Foramen Ovale
7,922,742	Medical Instrument
7,954,683	Feeder Belt with Integrated Surgical Staples



8,066,720	Surgical Method for Stapling Tissue
8,070,036	True Multi-Fire Surgical Stapler configured to fire staples
8,087,562	Anvil for Surgical Instrument
8,114,118	Medical Instrument
8,123,795	System for Attaching an Abdominal Aortic Stent or the like
8,147,511	Fluid delivery system and related methods of use
8,152,794	Endoscopic Instrument
8,163,010	Staple-based heart valve treatment
8,187,315	Partial stent for treatment of a vascular aneurysm
8,261,958	Stapler cartridge with staples frangibly affixed thereto
8,272,551	Methods for utilizing a driverless surgical stapler
8,308,757	Hydraulically actuated robotic medical instrument
8,317,071	Endocutter with auto-feed buttress
8,317,072	Feeder belt for true multi-fire surgical stapler
8,356,740	Controlling compression applied to tissue by surgical tool
8,365,971	True multi-fire linear cutter
8,365,973	D-shaped surgical staples
8,394,102	Surgical tools for treatment of spinal stenosis
8,403,956	Multiple-use surgical stapler
8,439,245	True multi-fire endocutter
8,439,246	Surgical stapler with cartridge-adjustable clamp gap
8,469,253	Surgical staples attached to resorbable holder
8,475,474	Anastomosis method utilizing tool with fluid-driven actuator
8,475,493	Surgical staple for anastomosis
8,496,155	Surgical stapler with angled feeder belts
8,505,800	Feeder belt for true multi-fire surgical stapler
8,556,153	Stapler cartridge with staples frangibly affixed thereto
8,556,935	Method of manufacturing surgical staples
8,574,246	Compliant anastomosis system utilizing suture
8,574,253	Method, system, and device for tissue removal
8,628,555	Fluid delivery system and related methods of use
8,631,992	Feeder belt with padded staples for true multi-fire surgical stapler
8,636,189	Active wedge for surgical stapler
8,647,363	Robotically controlled hydraulic end effector system
8,662,369	Barbed surgical staple
8,679,155	Surgical method utilizing a true multiple-fire surgical stapler
8,701,960	Surgical stapler with reduced clamp gap for insertion
8,771,312	Anastomosis fasteners
8,789,738	Surgical method for stapling tissue
8,801,753	Surgical staple for anastomosis
8,844,788	True multi-fire linear cutter
8,864,774	Tympanic membrane pressure equalization tube delivery system
8,915,934	Anastomosis system with anvil entry hole sealer
8,926,658	Endocutter with auto-feed buttress
8,985,427	Feeder belt with internally manufactured staples for true multi-fire surgical stapler
8,998,951	Method for manufacturing surgical staples
9,084,600	Anvil-side staple trap
9,144,427	Surgical method utilizing a true multiple-fire surgical stapler
9,155,536	Circular stapler
9,168,039	Surgical stapler with staple of different sizes

9,289,208	Articulation insert for surgical instrument
9,320,519	Single-trigger clamping and firing of surgical stapler
9,332,985	Barbed surgical staple
9,345,478	Method for surgical stapling
9,386,986	Staple and feeder belt configurations for surgical stapler
9,408,605	Single-trigger clamping and firing of surgical stapler
9,770,366	Tympanic membrane pressure equalization tube

## **PUBLICATIONS**

Knodel, B.D., "Pressure Drop and Heat Transfer in Turbulent Ice-Water Slurries in Horizontal Pipes," Doctoral Thesis, University of Illinois at Chicago, 1995.

Knodel, B.D., "Phase II – Direct Freeze Ice Slurry District Cooling," Presented at the 80<sup>th</sup> Annual Conference of the International District Heating and Cooling Association, Virginia Beach, VA, June, 1989.

Knodel, B.D. and France, D.M., "Pressure Drop in Ice-Water Slurries for Thermal Storage Applications," Experimental Heat Transfer, Vol. 1, pp. 265-275, 1988.

Knodel, B.D., "Phase I – Direct Freeze Ice Slurry District Cooling," Presented at the 79<sup>th</sup> Annual Conference of the International District Heating and Cooling Association, Chautauqua, NY, June, 1988.

Knodel, B.D. and France, D.M., "Ice-Slurry Flow in a Circular Pipe," International Communications in Heat and Mass Transfer Journal, Vol. 15, No. 2, April, 1988.

Knodel, B.D., "Pressure Drop Characteristics of Ice-Water Slurries in Slug Flow Through Horizontal Pipes," Master's Thesis, University of Illinois at Chicago, 1988.

Knodel, B.D., "R&D Pilot Plant for Evaluating a Direct Freeze Ice Slurry Based District Cooling System," Report to the U.S. Department of Energy, September, 1987.

Knodel, B.D., "Performance of an Ice-Water Slurry Based District Cooling System," Presented at the 78<sup>th</sup> Annual Conference of the International District Heating and Cooling Association, Baltimore, MD, 1987.