

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION**

**WALTER KIDDE PORTABLE
EQUIPMENT INC.,
Plaintiff**

v.

**FIRST ALERT, INC. and
BRK BRANDS, INC.,
Defendants**

Civil Action No. 6:22-cv-566-ADA-DTG

**DECLARATION OF DR. CHARLES REINHOLTZ IN
SUPPORT OF PLAINTIFF'S CLAIM CONSTRUCTION**

I, Dr. Charles Reinholtz, of New Smyrna Beach, Florida, declare that:

1. I have personal knowledge of the matters set forth below and could competently testify regarding my opinions.

2. I have been retained by Fish & Richardson, P.C. on behalf of Walter Kidde Portable Equipment Inc. (“Kidde”) in a litigation Civil Action No. 6:22-cv-566-ADA-DTG (“action”).

3. I have been retained to provide expert testimony in the above-captioned matter. Specifically, I was asked to respond to opinions provided by Defendants First Alert, Inc. and BRK Brands, Inc. (“Defendants”) regarding the meaning of certain terms in the claims of U.S. Patent No. 7,123,158 (“the ’158 Patent”) and U.S. Patent No. 7,525,445 (“the ’445 Patent”).

I. QUALIFICATIONS AND BACKGROUND INFORMATION

A. Qualifications

4. I am Emeritus Professor and Chair at Embry-Riddle Aeronautical University, Daytona Beach, Florida. I was a Professor in the Department of Mechanical Engineering at Embry-Riddle from 2007 until May, 2022. I also served as Chair of the department from 2007 through 2017.

5. I received a Bachelor of Science degree in Mechanical Engineering from the University of Florida in 1976, a Master of Engineering from the University

of Florida in 1980, and a Doctor of Philosophy in Mechanical Engineering from the University of Florida in 1983.

6. From 1983 to 2007, I was a faculty member in the Department of Mechanical Engineering at Virginia Polytechnic Institute and State University (Virginia Tech) in Blacksburg, Virginia, most recently serving as Alumni Distinguished Professor from 2002 to 2007. In my time at Virginia Tech, I also served as the Assistant Department Head, W.S. White Chair for Innovation in Engineering Education and ABET Review Chair, among other appointments.

7. I have received numerous awards for accomplishments in these roles, including being named a Fellow in the American Society of Mechanical Engineers, being awarded both the Wine Award and the Alumni Teaching Award, two of the highest teaching honors awarded at Virginia Tech. I was also inducted into the Virginia Tech Academy of Teaching Excellence and served as the Chair of that organization. I also received the Dean's Award for Excellence in Teaching in the College of Engineering.

8. My University work includes teaching, mentoring, research, and service. I teach or have taught classes relating to all aspects of the design and analysis of structures and mechanical systems at the undergraduate and graduate level. I have also been primary advisor to seventy-six master's degree and thirteen Ph.D. students over the course of my career. My teaching and research have

generally been focused on the design and analysis of mechanisms, mechanical and electro-mechanical systems. My teaching has included courses on mechanisms and kinematics, mechanical design, controls, electro-mechanical systems, robotics, and project-based capstone design. Among the topics I routinely teach are the design and analysis of linkages, gears, gear trains, screws, clutches, escapements, and rotary-to-linear and linear-to-rotary motion mechanisms. I am also familiar with and teach the strategies used to control electro-mechanical systems and how to implement such strategies in software.

9. I have served as a consultant on numerous projects involving consumer products, including beach chairs, trampolines, fitness equipment, cervical traction devices for home use, printers, ladders, lawnmowers, drones, and robotic floor cleaning devices, to name a few.

10. I have extensive experience in the design, development and application of automated sensor-based electromechanical systems. These systems are generally designed to perceive the environment through variety of sensors, such as photoelectric and ionization-based sensors, and to react to environmental conditions by controlling a variety of output devices, including relays, piezoelectric buzzers, lights and motors.

11. My research has been broadly in the areas of mechanical design, mechanisms and robotics. My teaching and research routinely involve structural design and analysis of devices for coupling and fastening structural elements.

12. In 1978, I worked for Burroughs Corporation as a Design Engineer in Orlando, Florida. My job responsibilities included design of consumer products for ink jet and electrophotographic printing. I also worked full-time as a consultant to Milliken and Company during the summer from 1989 through 1996.

13. Working in both industry and academia, I have significant experience in the design, fabrication, modification, analysis, and implementation of a wide variety of consumer products. My publications include a popular textbook, “Mechanisms and Dynamics of Machinery,” published in 1987 focused on the analysis, design and application of coupling devices, cams, gears, linkages and similar devices.

14. I have also co-founded three successful companies and have been professionally involved in numerous start-up and entrepreneurial programs and competitions, including the Cairns Foundation Challenge, TREP Expo, Launch Your Venture, and Startup Weekend. I have also served on the advisory board for the Embry Riddle Center for Entrepreneurship from 2015 through 2021.

15. Additionally, I am a named inventor on two U.S. patents, have authored and co-authored numerous publications in the field of mechanical engineering,

machines, and/or mechanisms, and have worked, consulted, and testified in more than two dozen patent cases.

16. I have extensive experience and numerous publications related to the theory and application of devices and mechanisms for fastening, interlocking, coupling and guiding two or more elements in a mechanical system. For example, I am the coauthor of *Mechanisms and Dynamics of Machinery*, a popular mechanical engineering textbook that deals with the forces and relative motions imposed in coupled machine elements. The text provides a theoretical foundation and example applications to enable the design of mating surfaces to minimize assembly forces and to create smooth engagement between mating parts. For nearly 40 years I have also taught courses in mechanical design that deal directly with fasteners and fastening techniques, including bolting, riveting, welding, and brazing. In many cases, the techniques and elements used for coupling involve structural, fatigue, wear and ornamental considerations.

17. From 1995 through 1998, I worked with Black and Decker – DeWalt on improved designs for fastener systems. That research focused on testing and understanding the forces that are at play in various screwhead-screwdriver bit geometries. The work provided an improved understanding of the fundamentals of the bit/screw surface contact and its effect on force distribution. The work is documented in the master's thesis of Mr. Alex Adler, published in May 2008. I was

the Principal Investigator for the research project, and I also served as the Committee Chair for Mr. Adler's thesis.

18. I possess the knowledge, skills, experience, training and education to form an expert opinion and expert testimony in this matter. Additional details of my education and employment history, recent professional service, patents, publications, and other testimony are set forth in my current Curriculum Vitae, submitted as Appendix A.

B. Compensation

19. I am being compensated for the services I am providing in this declaration at my standard rate of \$500.00 per hour. The compensation is not contingent upon my performance, my opinions, the outcome of this matter, or any issues involved in or related to this matter.

C. Materials Considered

20. In writing this Declaration, I have considered the following: my own knowledge and experience, including my work experience in the fields of mechanical design (including devices and system for coupling, joining and activating), my experience in teaching mechanical design, and my experience in mentoring and working with others involved in those fields. In addition, I have reviewed the following publications and materials, along with other materials I cite in this declaration:

- U.S. Patent No. 7,123,158 (“the ’158 Patent”) and its accompanying prosecution history, including the prior art references discussed in the prosecution history;
- U.S. Patent No. 7,525,445 (“the ’445 Patent”) and its accompanying prosecution history, including the prior art references discussed in the prosecution history;
- Dr. Pratt’s declaration and any material cited in his deposition; and
- Any other materials cited herein.

II. OVERVIEW OF OPINIONS

21. I was asked to review an opinion that Defendants’ expert, Dr. John Pratt, provided on the below terms:

- “activate/deactivate system” (’158 Patent, claim 1)
- “activation mechanism” (’158 Patent, claim 12; ’445 Patent, claim 8)
- “permanent deactivation mechanism” (’158 Patent, claim 12; ’445 Patent, claim 8)
- “reattachment prevention mechanism” (’158 Patent, claim 12; ’445 Patent, claim 8)

22. Based on my review of Dr. Pratt’s opinions, the intrinsic record, the state of the art, and other materials considered in this declaration, it is my opinion

that those terms connote a specific class of structure and, thus, should not be interpreted as subject to Section 112, paragraph 6.

III. LEVEL OF ORDINARY SKILL IN THE ART

23. I have been advised that a person of ordinary skill in the art is a hypothetical person to which the claimed subject matter pertains with the capability of understanding the scientific and engineering principles applicable to the pertinent art. I understand that the following factors may be considered in determining the level of ordinary skill: the type of problems encountered in the art; prior art solutions to those problems; the speed with which innovations are made; the sophistication of the technology; and the educational level of active workers in the field. I also understand that not every factor may be present and that one or more factors may predominate.

24. In my opinion, a person of ordinary skill in the art (“POSITA”) relating to, and at the time of, the Critical Date of the ‘158 and ‘445 patents would have a Bachelor of Science (or equivalent degree) in Mechanical Engineering in combination with at least two years of work experience with mechanical hardware, particularly as used in sensor-based systems. Additional relevant education could compensate for less work experience, and vice versa.

25. Based on my knowledge, skill, and experience, I have a good understanding of the capabilities of a POSITA. Indeed, I have taught, participated

in organizations, and worked closely with many such persons over the course of my career. For example, from my teaching and industry experience, I am familiar with what an engineer would have known and found predictable in the art. From teaching and supervising my undergraduate and graduate students and from working with engineers and technicians in industry, I have an understanding of the knowledge that a person with this academic or professional experience possesses. Furthermore, I possess at least that knowledge and those capabilities myself.

IV. LEGAL STANDARDS

26. I am not an attorney or a legal expert, and I offer no opinions on the law. Kidde's counsel, however, has explained to me certain legal concepts, which I understand are relevant to my analysis and opinions below. Kidde's counsel has further explained to me that I must consider certain statutory and judicially created standards for purposes of claim construction. Below I provide those standards relevant to this declaration as explained to me by counsel for Kidde and as I understand them.

27. I understand from Kidde's counsel that terms in the patent claims must be read as they would have been understood by a "person of ordinary skill in the art" when the earliest application that led to each patent was filed. I have been advised that for the patents at issue in this case, the relevant time period is 2002 to 2004.

28. Kidde's counsel has explained to me that the claims of a patent set out specifically what the inventors claim to have invented. I understand that the claims can either be independent or dependent. It has been explained to me that an independent claim contains all the "limitations" or requirements to practice that claim, without making reference to another claim in the patent, and stands on its own. It has also been explained to me that a dependent claim makes reference to another claim, and adds additional limitation(s) or requirement(s) to the referenced claim.

29. I further understand that there are other parts of a patent, including the abstract, the figures of a patent, the background of the invention, the summary of the invention, and the detailed description of the invention. I understand that the background of the invention, the summary of the invention, and the detailed description are collectively referred to as the "specification" of a patent. It has been explained to me that these other parts of a patent (the abstract, the figures, and the specification) inform the claims, including describing the claimed invention and providing preferred examples of the claimed invention.

30. It has also been explained to me that the correspondence back and forth between the inventors and the U.S. Patent and Trademark Office (the Patent Office) leading up to the issuance of a patent is collectively called the "prosecution history." It has been explained to me that, in the process of obtaining a claim of a patent, the

inventors may make statements explaining the scope of their claimed invention that serves to define and/or narrow the scope of the claimed invention.

31. I understand that patent claim elements may be presented in the form of “means-plus-function.” I also understand that in a “means-plus-function” element, the patentee may describe the item or element by the result of a function accomplished or served, rather than the structure, material, or acts. I understand that a “means-plus-function” claim may be construed to include only the structure, material, or acts that are described in the patentee’s specification or their equivalents.

32. I understand that where a claim element does not use the word “means,” a rebuttable presumption that the claim element is not means-plus-function applies, and that this presumption is overcome only when it is shown by a preponderance of the evidence that the claim fails to recite sufficiently definite structure. Further, I understand that the fact that a claim limitation incorporates functional language does not automatically convert the words into means for performing such functions.

33. It is my understanding that a claim element recites sufficiently definite structure (and thus is not means-plus-function) when the words of the claim would be understood by a POSITA to have a sufficiently definite meaning as the name for a structure or class of structures, based on a reading of the claims, specification, prosecution history, and, if necessary, extrinsic evidence. I also understand that terms

that connote structure, when coupled with a description of the term's operation, generally provide sufficient structural meaning to a POSITA.

V. THE ASSERTED PATENTS

A. Overview of the '158 and '445 Patents

34. The '158 Patent is titled "Life Safety Alarm with a Sealed Battery Power Supply." It was filed on August 12, 2004, issued on October 17, 2006 and claims priority back to August 29, 2003. The '445 patent is a continuation of the '158 patent and shares the same title and specification. It was filed on September 14, 2006, and issued on April 28, 2009.

35. The '158 and '445 Patents relate to battery powered electronic devices, and more specifically, smoke alarms and carbon monoxide alarms:

The invention relates to battery powered electronic devices. More particularly, the invention relates to battery powered electronic devices, especially life safety alarms, for example smoke alarms and carbon monoxide alarms, where the batteries are sealed inside the device to prevent access to the batteries.

'445 Pat. at 1:16-21.¹

36. The '158 and '445 Patents identify a problem in the state of the art at the time, which was that user error can lead to incorrect installation of the battery in

¹ Because the '445 and '158 share a common specification, all citations are to the '445 patent unless otherwise indicated.

the safety alarm or incorrect installation of the safety alarm itself following a battery replacement, preventing the alarm from functioning properly:

In certain battery powered electronic devices it is especially important that the batteries be properly installed and that the batteries have sufficient power for proper operation of the device. One example of such an electronic device is a battery powered life safety alarm.

...

The batteries in many battery powered life safety alarm are often replaceable so that when the battery power is sufficiently depleted, the user can remove the depleted batteries and install fresh batteries. One consequence of having replaceable batteries is that the user must periodically access the alarm and change the batteries. When the alarm is mounted high on a ceiling or is located in a relatively inaccessible location, battery replacement can be difficult.

'445 Pat. at 1:30-34, 1:43-50.

37. To minimize user error, the '158 and '445 Patents describe sealing a long-life (typically 10 years) battery in the alarm without user access:

The invention relates to a life safety alarm that is battery powered and has an extended life. The invention further relates to a life safety alarm that is less prone to user mistakes. The batteries are sealed inside the alarm portion whereby the batteries cannot be accessed by the user. As a result, the batteries are not replaceable. Rather, the alarm portion is replaced at the end of the alarm life, for example after expiration of a predetermined time period. Because the batteries are not replaceable, the difficulties and mistakes that accompany battery replacement are eliminated.

Id. at 2:8-18.

38. The alarms also have features that permit the alarm to be: (1) activated upon installation; and (2) manually deactivated. Manual deactivation drains the alarm battery and prevents the alarm from being reattached to its mounting bracket. These features are discussed generally throughout the patents.

39. Smoke alarms and other life safety alarms existed prior to the '158 and '445 patents, and the patents build upon concepts that were known in the prior art. For example, the patents acknowledge that battery operated devices were well known in the arts:

Electronic devices that are powered by one or more batteries are well known. These devices are often designed to permit installation of the batteries, as well as replacement of the batteries as needed.

'445 Pat. at 1:26-29.

40. More specifically, life safety devices such as smoke alarms were well known:

Life safety alarms that detect potential life-threatening conditions and generate a warning signal are well known. Examples of such alarms includes smoke alarms, flame detectors, carbon monoxide alarms, and other life safety alarms that detect a potential life threatening condition and provide a warning signal to warn of the possible life threatening condition.

'445 Pat. at 1:35-42.

41. Even within smoke alarms, certain aspects of their operation were well known. The smoke detection system itself was known:

The specifics of the smoke detection system and the alarm electronics are not necessary for a proper understanding of the inventive concepts. Suitable smoke detection systems and alarm electronics for use in the alarm **10**, as well as the operation of a smoke alarm, would be known to those of skill in the art having read this specification.

'445 Pat. at 3:62-4:1.

42. The connection between the smoke alarm and the mounting bracket was also well known:

The alarm portion **12** is designed to be detachably connected to the mounting bracket **14**. In the illustrated embodiment, the portion **12** is connected to the bracket **14** via a twist on/twist off connection system of a type that is well known in smoke alarms.

'445 Pat. at 4:18-22.

B. '158 Prosecution History

43. The applicants filed Patent Application No. 10/916,922 (the application that ultimately resulted in the '158 patent) on August 12, 2004. This application claimed priority back to Provisional Application No. 60/499,245, which was filed on August 29, 2003. I have identified some noteworthy events below.

44. On January 10, 2005, the applicants submitted an Information Disclosure Statement ("IDS") that identified European Patent App. No. 0714158 A2, to Watson and filed by BRK Brands, Inc.

45. On January 11, 2005, the applicants submitted another IDS identifying more than twenty other prior art references, as show in the table below, which I excerpted from the file history at page 73:

U.S. PATENT DOCUMENTS						
EXAMINER INITIAL	DOCUMENT NO.	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
	2,985,741	05/23/1961	Ellmann			
	4,092,641	05/30/1978	Bellinghausen et al.			
	4,313,110	01/26/1982	Subulak et al.			
	4,389,635	06/21/1983	Gallagher			
	4,688,021	08/18/1987	Buck et al.			
	4,829,283	05/09/1989	Spang et al.			
	4,870,395	09/26/1989	Belano			
	4,901,056	02/13/1990	Bellavia et al.			
	5,028,911	07/02/1991	Wanar et al.			
	5,055,830	10/08/1991	Cousins et al.			
	5,103,216	04/07/1992	Sisselman			
	5,272,292	12/21/1993	Aubert			
	5,359,168	10/25/1994	Cunningham			
	5,444,434	08/22/1995	Serby			
	5,578,996	11/26/1996	Watson et al.			
	5,612,678	03/18/1997	Shibata			
	5,682,131	10/28/1997	Gow			
	5,793,295	08/11/1998	Goldstein			
	5,939,994	08/17/1999	Meier et al.			
	6,160,487	12/12/2000	DeLuca			
	6,297,745	10/02/2001	Meier			
	2002/0097162	07/25/2002	Chambers			
	6,433,700	08/13/2002	Malewski et al.			

January 11, 2005 Information Disclosure Statement.

46. On April 5, 2006, the Patent Office issued an Office Action. Of the 29 claims that were pending, claims 18-21 were allowed, claims 7, 12 and 14-17 were objected to as being dependent on a rejected base claim, and the remaining claims were rejected primarily over U.S. Pat. No. 5,578,996 to Watson et al. (“Watson”):

Disposition of Claims

- 4) ☒ Claim(s) 1-29 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☒ Claim(s) 18-21 is/are allowed.
6) ☒ Claim(s) 1-6, 8-11, 13 and 22-29 is/are rejected.
7) ☒ Claim(s) 7, 12 and 14-17 is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

April 5, 2006 Office Action (PDF page 29).

47. The objected to version of claim 7 is below:

7. The electronic device of claim 6, wherein when deactivated, the second portion cannot be reactivated and the second portion cannot be reattached to the first portion.

April 5, 2006 Office Action (PDF page 145-146).

48. With respect to the rejected claims, the Examiner offered a perspective on several of the terms relevant to this opinion. In independent claim 1, the Examiner identified the “cooperating features” in a prior art disclosure of Watson concerning the attachment between an alarm and a mount:

The claimed cooperating features on the first portion and the second portion that automatically activate the second portion upon initial attachment of the second portion to the first portion is met by the activating switch located within the base that is activated by mounting the detector on the flange using a rotating motion (column 5, lines 1-18).

Id. at 3 (PDF page 31).

49. The examiner also found the “activate/deactivate system” (which was a limitation in a dependent claim at the time) in a prior art disclosure in the form of an activating switch and a deactivating switch:

Regarding claim 5, the claimed cooperating features comprise an activate/deactivate system and wherein the activate/deactivate system is configured to automatically activate the second portion upon initial attachment of the second portion to the first portion is met by the activating switch that is activated when the detector is attached to the flange/bracket (column 5, lines 1-18) and the deactivating switch located on the detector (column 4, lines 40-51).

Id. at 4 (PDF page 32).

50. The examiner also found an “activation mechanism” (which was a limitation in a dependent claim at the time) in a prior art disclosure of an activating switch:

The claimed activation mechanism to activate the second portion is met by the activating switch (column 5, lines 1-18);

Id. at 5 (PDF page 33).

51. In response to this office action, the applicant amended the claims to include allowable subject matter. Those amendments included language from original claim 7:

1. (Currently Amended) An electronic device, comprising:
a first portion;
a second portion configured for attachment to the first portion, the second portion including electronics to operate the device and at least one battery for powering the electronics;
and
cooperating features on the first portion and the second portion that automatically activate the second portion upon initial attachment of the second portion to the first portion;
wherein the cooperating features comprise an activate/deactivate system, the activate/deactivate system being configured to automatically activate the second portion upon initial attachment of the second portion to the first portion;
wherein the activate/deactivate system is configured to enable the user to manually deactivate the second portion; and
wherein, when deactivated, the second portion cannot be reactivated and the second portion cannot be reattached to the first portion.

May 11, 2006 Response to Office Action (PDF page 19).

52. The Patent Office ultimately allowed the claims with the applicant's amendments.

53. Thus, based on the statements in the file history, the examiner understood the term "activation mechanism" to include an activation switch, the term "activate/deactivate system" to include an activating switch and a deactivating switch, and the term "cooperating features" to refer to parts of the first portion (e.g., the mounting bracket) that interact with parts of the second portion (e.g., the alarm) to automatically activate the second portion on initial attachment. .

C. '445 Prosecution History

54. The applicants filed Patent Application No. 11/532,010 (the application that ultimately resulted in the '445 patent) on September 14, 2006. This application

was a continuation of the application that resulted in the '158 patent. I have identified some noteworthy events below.

55. The originally filed claims of the '445 patent claims included claims in “means-plus-function”:

1. An electronic device, comprising:
a first portion;
a second portion configured for attachment to the first portion, the second portion including electronics to operate the device and at least one battery for powering the electronics;
and
cooperating features on the first portion and the second portion that automatically activate the second portion upon initial attachment of the second portion to the first portion.

* * *

11. The electronic device of claim 1, further comprising means for manually deactivating the second portion after the second portion has been activated, wherein the means for manually deactivating is accessible when the first and second portions are disconnected.

12. The electronic device of claim 11, further comprising means for preventing reactivation of the second portion after the second portion has been deactivated, and means for preventing reattachment of the first and second portions after the second portion has been deactivated.

Claims as filed Sept. 14, 2006 (PDF page 14-15).

56. The applicant also filed an IDS identifying what appears to be all of the prior art considered during the (at the time) co-pending parent application. *See* Sept. 14, 2006 IDS (PDF page 33).

57. On December 12, 2006, the applicant filed a preliminary amendment. In that preliminary amendment, the applicant canceled all existing claims and

submitted new claims that, instead of using “means for” language, used the words “an activation mechanism,” “deactivation mechanism,” and “reattachment prevention mechanism”:

37. (New) An electronic device, comprising:
 a first portion;
 a second portion configured for attachment to the first portion, the second portion including electronics to operate the device and at least one battery for powering the electronics;
 an activation mechanism to activate the second portion;
 a permanent deactivation mechanism to permit permanent deactivation of the second portion after the second portion has been activated; and
 a reattachment prevention mechanism to prevent reattachment of the first and second portions once the second portion is permanently deactivated.

See Claim 37 filed on December 14, 2006 (PDF page 46).

58. On September 20, 2007, the examiner rejected the claims under a double patenting rejection over the '158 patent. The examiner also rejected the claims over U.S. Pat. No. 6,297,745 to Meier (“Meier”) and U.S. Pat. No. 5,578,996 to Watson et al. (“Watson”). September 20, 2007 Office Action (PDF page 66-71). The only rejections to the asserted claims (which was then numbered as claim 37 and its dependents) in the Office Action were the double patenting rejections. *Id.* (rejections over Meier limited to claims 41, 44 and 45 and rejections over Watson limited to claims 42 and 43). Thus, the examiner did not comment on the scope of the “mechanism” terms.

59. On March 10, 2008, the applicant submitted a terminal disclaimer over the '158 patent. (PDF page 84).

60. The examiner allowed the asserted claims based on the submitted terminal disclaimer. *See* May 22, 2008 Office Action (PDF page 94-95); *see also* Notice of Allowance (PDF page 119-124).

VI. CLAIM CONSTRUCTION OPINIONS

61. Because three of the claim terms at issue include the word “mechanism,” below I first provide my opinions on the scope of the word “mechanism.” I then provide specific analysis for the different types of claimed mechanisms.

A. “Mechanism” generally

62. My own textbook on Mechanisms defines the term mechanism as “a combination of rigid or resistant bodies so formed and connected that they move upon each other with definite relative motion.” Mabie, H. H., and C. F. Reinholtz, *Mechanisms and Dynamics of Machinery*, 4th edition, John Wiley and Sons, New York, 1987, (Chapter 1, Section 1.2). In the mechanical arts, I believe this definition is consistent with the understanding of a POSITA at the time of the invention of the '158 and '445 patents. I note that Dr. Pratt and I provide similar definitions of a POSITA, including holding a Bachelor of Science degree in Mechanical Engineering. I believe the only substantive difference between our definitions is that

my definition requires familiarity with the application of mechanical systems to sensor based systems whereas Dr. Pratt's does not. It thus appears that we agree that the asserted patents are generally in the field of the mechanical arts.

63. My definition of the term "mechanism" in the mechanical arts is similar to one that Dr. Pratt provided in a prior case:

Q. What is a mechanism, Dr. Pratt?

A. It's a mechanical device.

...

Q. So a mechanism has more than one component; is that correct?

A. Generally a mechanism is a mechanical device where you have more than one component working in concert with one another.

Q. Does a mechanism normally involve some sort of motion between various parts?

A. It can, yes. Typically that's the case, yes.

Q. And so you would have a mechanism if you have multiple parts working together, one or more of them moving relative to something else to accomplish something; is that correct?

A. Yes.

Testimony of Dr. Pratt from *Barrette Outdoor Living, Inc. v. Fortress Iron, LP et al*, No. 3:21-cv-02008-E, Dkt. No. 24-7 at 48-49 (N.D. Tex. Mar. 10, 2022).

64. Thus, in the field of art relevant to the asserted patents, a "mechanism" is a mechanical device with multiple components working together to move with defined relative motion.

B. "Activation Mechanism" and "Deactivation Mechanism"

65. "Activation mechanism" and "permanent deactivation mechanism" are not subject to § 112, ¶ 6 because both terms connote sufficient structure to a POSITA.

66. In this art, an “activation mechanism” refers to a specific class of structures that includes switches and tabs. Those switches and tabs may be actuated, for example, through cooperating features or through intermediate levers, linkages or cams (i.e., surface to surface contact). The term “activation mechanism” denotes a class of structures known in the art to cause definite relative motion that activates the second portion upon attachment of the second portion to the first portion.

67. This opinion is consistent with literature and terminology used in the industry. For example, a data sheet describing Kidde’s Model 0910 alarm refers to a “self-activation mechanism.” See <https://www.kidde.com/home-safety/en/us/products/fire-safety/smoke-alarms/i9010/> (“The Kidde 0910 sealed battery operated smoke alarm features a self-activation mechanism making installation simple and easy.”). Similarly, BRK’s U.S. Patent No. 5,578,996 to Watson et al refers to an “activation switch mechanism.” U.S. Patent No. 5,578,996 at Abstract (“The detector includes an activation switch mechanism having a one-time, or single use turn-on characteristic. The activation switch mechanism switches the battery once from a non-conducting state to a state of electrical conduction with a control unit of the detector.”).

68. The intrinsic record similarly uses “activation” synonymously with known actuators, such as switches and tabs. 5:35-43 (referring to “switch actuating tab 46” as actuating electronic switch 48 which activates the device).

69. Documents cited in the prosecution history of the patents also use the term “activation” in a similar way. U.S. Patent No. 5,578,996 to Watson at Abstract (“The detector includes an activation switch mechanism having a one-time, or single use turn-on characteristic. The activation switch mechanism switches the battery once from a non-conducting state to a state of electrical conduction with a control unit of the detector.”); U.S. Pat. No. 6,433,700 to Malewski at 1:35-58 (describing as “conventional” a detector with an activation and deactivation switch); *see also* U.S. Pat. No. 5,359,168 at 2:44-54 (reciting the use of switches and tabs as resulting in “mechanical actuation or deactivation”).

70. These disclosures also relate to the “deactivation” term because deactivation would also use known structures such as switches and tabs, which may also be actuated through intermediate levers, linkages or cams.

71. Thus, “activation mechanism” and “deactivation mechanism” refers to a class of structures such as switches and tabs, which may be actuated through intermediate levers, linkages or cams.

C. “Reattachment Prevention Mechanism”

72. “Reattachment prevention mechanism” is not subject to § 112, ¶ 6 because it connotes sufficient structure to a POSITA.

73. In this art, a “reattachment prevention mechanism” refers to physical interference between components that stops relative motion of the components and prevents a user from connecting the alarm to the mounting plate.

74. An “attachment mechanism” refers to a class of structures with components that work together to create defined relative motion to create a coupling between the mounting bracket and the alarm.

75. In the context of smoke alarms, the mechanisms used to create this type of mechanical connection are well known. Most commonly, one component (*e.g.*, the mounting bracket) includes grooves and the other component (*e.g.*, the alarm) includes ridges. The grooves and ridges work together to create a defined relative motion, in this case the twisting motion associated with attaching the alarm to the mounting bracket.

76. The patents note that this type of attachment is “well known” in the art. ’445 Pat. at 4:18-24.

77. Because attachment mechanisms are well known in the art, a POSITA would be familiar with how those mechanisms work. A POSITA would also understand that the claimed reattachment prevention mechanism would include components that stop the relative twisting motion from occurring, thus preventing reattachment.

78. Thus, “reattachment prevention mechanism” refers to a class of structures with components that prevent relative motion through, for example, surface contact (*i.e.*, interference) between components.

D. “Activate/Deactivate System” (’158 Pat., cl. 1)

79. “Activate/Deactivate System” is not subject to § 112, ¶ 6 because it connotes sufficient structure to a POSITA.

80. In this art, “Activate/Deactivate System” refers to known classes of structure, such as switches and tabs.

81. In addition, “activate/deactivate system” is not subject to § 112, ¶ 6 because the surrounding claim language connotes structure.

82. Claim 1 from the ’158 patent recites an electronic device with three relevant parts: (a) “a first portion”; (b) “a second portion”; and (c) “cooperating features” on the two portions that interact when the two portions are connected. ’158 Pat. at cl. 1.

83. The claim then defines the “activate/deactivate system” by reference to these structural elements. *Id.* (“wherein *the cooperating features comprise an activate/deactivate system*”). Thus, the claim language makes clear that the “activate/deactivate system” is comprised of “cooperating features”, which are physical structures that interact when the two portions of the device are attached.

84. The dependent claims of the '158 patent support this interpretation. Dependent claims 5 and 6 identify additional structure that would be a part of the “activate/deactivate system”:

5. The electronic device of claim 1, wherein the activate/deactivate system comprises a slider configured for one-way movement and having three positions.

6. The electronic device of claim 5, wherein the device electronics comprises a three position switch connected to the slider.

'158 Pat., claims 5-6.

85. These dependent claims describe structural features of the activate/deactivate system.

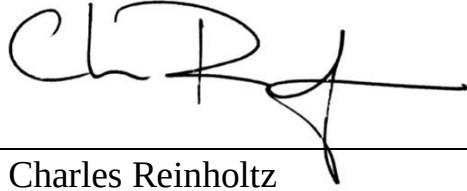
86. Thus, “activate/deactivate system” refers to the same of class of structures as a “activation mechanism” and “deactivation mechanism.”

VII. CONCLUSION

87. I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

88. I hereby declare that, to the best of my knowledge, all statements made in this declaration are true. I further declare that these statements were 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 the Title 18 of the United States Code.

Dated: 12/27/2022

By: 
Dr. Charles Reinholtz

APPENDIX A

Charles F. Reinholtz

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Education

Doctor of Philosophy, University of Florida, Mechanical Engineering, 1983
Master of Engineering, University of Florida, 1980
Bachelor of Science, University of Florida, 1976

Full-time Industrial Experience

1978, Burroughs Corporation, Orlando, Florida, Design Engineer, Non-impact Printing Group
1989-1996 Milliken and Company, Spartanburg, South Carolina, summer employment and consulting involving textile equipment design

Academic Employment Experience

Virginia Polytechnic Institute and State University, Blacksburg, Virginia
Assistant Professor, September 1983 to August 1988, Tenure Granted
Associate Professor, August 1988 to August 1993
Professor, August 1993 to 2007
W. S. White Chair for Innovation in Engineering Education, Aug. 1996 to Aug. 1999
Assistant Department Head and ABET Review Chair, 1996-2002
Alumni Distinguished Professor, 2002-2007
Embry-Riddle Aeronautical University, Daytona Beach, Florida
Professor and Chair, Department of Mechanical Engineering, 2007-2017
Professor, Department of Mechanical Engineering, 2017-2022
Emeritus Professor and Chair, 2022-

Membership in Professional Organizations and Honor Societies

<u>Society</u>	<u>Membership Grade</u>
ASME	Fellow
SAE	Member
American Nuclear Society	Member 1995-1997
Tau Beta Pi	Member
Pi Tau Sigma	Member
Sigma Xi	Member
Epsilon Lambda Chi	Member
ASEE	Member, 1984-1987, 1998-99
AUVSI	Member

Professional Honors and Awards

Benton Engineering Council Service Key, University of Florida, 1976-1977.
Procter and Gamble Best Paper Award, 9th Applied Mechanisms Conference, October 1985.
Presidential Young Investigator Award, 1987-1992, National Science Foundation
Certificate of Teaching Excellence, Virginia Polytechnic Institute and State University, 1987-88, 1997-98 and 2001-02.

ASME Outstanding Faculty Advisor Award, 1989-1990 and 1991-92
 Procter and Gamble Best Paper Award of Merit, 2nd National Applied Mechanisms and Robotics Conference, November 1991.
 George Wood Best Applied Mechanism Design Paper Award, 2nd National Applied Mechanisms and Robotics Conference, November 1991.
 Wine Award for Excellence in Teaching, Virginia Polytechnic Institute and State University, 1992.
 Virginia Tech Academy of Teaching Excellence, Inducted 1992
 Procter and Gamble Best Paper Award of Merit, 22nd ASME Mechanisms Conference, Scottsdale, Arizona, September 1992
 ASME National Faculty Advisor Award, 1995.
 Applied Mechanism Conference "Beyond the Call of Duty" Award for prodigious contributions to mechanism science, 1995.
 W. S. White Chair for Innovation in Engineering Education, Aug. 1996 to Aug. 1998
 Dean's Award for Excellence in Teaching, Virginia Tech College of Engineering, 1998
 South-Pointing Chariot Award, 1999 Applied Mechanisms and Robotics Conference, for lifetime contributions to the mechanism's community
 Ingersoll-Rand Faculty Award for Outstanding Contributions to the Mechanical Engineering Department, 2000
 National Instruments Award for Best Application of Measurement and Automation for the Development of a Tele-Operated CASE CX-160 Excavator Using FieldPoint, National Instruments Week 2002, Austin Texas, Aug 12-15, 2002.
 Virginia Tech Alumni Distinguished Professor, 2002-
 Outstanding Faculty Member Award selected and awarded by the students in Mechanical Engineering, April 2003.
 Fellow, American Society of Mechanical Engineers, 2003
 Alumni Teaching Award, Virginia Polytechnic Institute and State University, 2004
 National Instruments Virtual Instrumentation Applications Best Control Paper Award, Developing a Fully Autonomous Vehicle for Virginia Tech's Entry in the DARPA Grand Challenge," National Instruments NI Week 2006, Austin Texas.
 ASME Distinguished Service Award, 2005
 College of Engineering Certificate of Teaching Excellence, 2006-2007
 Volusia Manufacture's Association "Friend of Industry" Award, 2013

Funded Research

1. "Design Optimization of Spatial Mechanisms Subject to Real-World Constraints," National Science Foundation Grant MEA-8404313, June 15, 1984 through November 30, 1986, \$47,979, 100% Responsibility.
2. "Presidential Young Investigator Award: Interactive Spatial Mechanism Synthesis," National Science Foundation, Grant No. DMC 8657828, June 15, 1987 through January 31, 1993, \$312,000, 100% Responsibility.
3. "High-Speed Bearing Research," supported by the Industrial Drives Division of Inland Motor Corporation, Jan. 1, 1987 through Dec. 31, 1987, \$15,000, 100% Responsibility.
4. "Analysis of Warhead Structures," Department of the Navy, July 24, 1987 to November 15, 1987, \$99,348, Project Director with J. B. Kosmatka, R. H. Fries, A. L. Wicks, and L. D. Mitchell, Responsible for \$19,535.
5. "Analysis of Warhead Structures, Year 2," Department of the Navy, October 30, 1987 to March 31, 1988, \$174,000, Project Director with J. B. Kosmatka, R. H. Fries, A. L. Wicks, and L. D. Mitchell, Responsible for \$12,908.
6. "Hull Joint Model Test," Georgia Institute of Technology, May 16, 1988 to Aug. 16, 1988, \$10,141, Principal Investigator with R. H. Fries, Responsible for \$5,071.

7. "Design of Variable-Geometry Truss Manipulators," Virginia Center for Innovative Technology (CIT), 10/1/88 to 9/31/89, \$30,000, 100% Responsibility.
8. "Active Structures for Space Applications," 1/1/89 to 12/31/90, \$200,000, Principal Investigator with H. H. Robertshaw, Responsible for \$80,000.
9. "Computer-Aided Design of Fully-Wiped, Co-rotating Extruder Screws," Windward International and CIT, January 1, 1989 through December 31, 1989, \$44,029, Principal Investigator with Sanjay Dhande, Responsible for \$22,015.
10. "Construction of a NASP Mock-up," NASA Langley Research Center, February 1, 1989 to July 15, 1989, \$51,692, Principal Investigator with W. F. O'Brien, A. L. Wicks, and J. Marchman.
11. "Design of Advanced Manipulators for Steam Generator Maintenance," Babcock & Wilcox Co., November 1, 1989 to August 15, 1990, \$20,000, Principal Investigator with Sanjay Dhande, Responsible for \$15,000.
12. "Calibration, Control and Menu Design for an Advanced Steam-Generator Maintenance Manipulator," Babcock and Wilcox Co., February 1, 1991 through January 31, 1992, \$41,408, Principal Investigator with Sanjay Dhande, Responsible for \$31,056.
13. "Calibration, Control and Menu Design for an Advanced Steam-Generator Maintenance Manipulator," Virginia Center for Innovative Technology, February 1, 1991 through January 31, 1992, \$29,663, Principal Investigator with Sanjay Dhande, Responsible for \$22,247.
14. "Computer-Aided Design and Manufacture of Extruder Screw Elements," Windward International and CIT, July 1, 1990 through June 30, 1991, \$30,984, Principal Investigator with Sanjay Dhande, Responsible for \$15,492.
15. "Design of a Cellulose Acetate Preconditioning Heat Exchanger," Tennessee Eastman Co., October 1990 through July 1991, \$25,560, Principal Investigator with D. J. Nelson, Responsible for \$9,876.
16. "Continued Steam Generator Manipulator Support Based on Kinematic Control and Investigation of Vision Based Approach," Babcock and Wilcox Co., October 1, 1991 through September 31, 1992, \$40,000, Principal Investigator with A. L. Abbott, Responsible for \$32,000.
17. "Cellulose Acetate Packaging Study," Tennessee Eastman Co., October 1991 through July 1992, \$51,120, Principal Investigator with D. J. Nelson, Responsible for \$19,752.
18. "Continued Steam Generator Manipulator Support Based on Kinematic Control and Investigation of Vision Based Approach," Virginia CIT, January 1, 1992 through December 31, 1992, \$35,570, Principal Investigator with A. L. Abbott, Responsible for \$28,456.
19. "Preliminary Design of a Medical Waste Processing Machine," Virginia Center for Innovative Technology, June 1, 1992 through August 31, 1992, \$14,386, 100% Responsibility.
20. "Preliminary Design of a Medical Waste Processing Machine," Bioconversions Technologies, May 1, 1992 through January 31, 1993, \$16,377, 100% Responsibility.
21. "Conceptual Design of an Advanced Reactor Vessel Inspection Manipulator," B&W Nuclear Services Company, March 1, 1992 through February 28, 1993, \$30,000, 100% Responsibility.
22. "Engineering Development of a Medical Waste Processing Machine," Bioconversions Technologies, Aug. 15, 1992 to May 15, 1994, Principal Investigator with A. A. Kornhauser, \$93,088, responsible for \$46,544.
23. "Engineering Development of a Medical Waste Processing Machine," CIT, Aug. 15, 1992 to Aug. 14, 1993, Principal Investigator with A. A. Kornhauser, \$90,988, responsible for \$45,494.
24. "Enhancing the Capability and Performance of Nuclear Service Robots with Kinematic Analysis and Computer Vision," B&W Nuclear Services Co., Dec.1, 1992 to Nov. 30, 1993, with A. L. Abbott, \$50,000, responsible for \$40,000.

25. "Design of a Reactor Vessel Inspection Manipulator," B&W Nuclear Services, June 16, 1992 through June 15, 1993, \$100,146, 100% responsibility.
26. "Design of an Automated Needle/Armature Tray Loader," Siemens Automotive, Sept. 1, 1993 to Aug. 31, 1994, \$24,925, 100% Responsibility.
27. "Enhancing the Design and Performance of Nuclear Service Robots with Flexure Analysis, Computer Vision, and Optimization Techniques," B&W Nuclear Technologies, Dec.1, 1993 to Nov. 30, 1994, with A. L. Abbott, \$40,000, responsible for \$30,000.
28. "Enhancing the Design and Performance of Nuclear Service Robots with Flexure Analysis, Computer Vision, and Optimization Techniques," Center for Innovative Technology, Feb. 1, 1994 to Jan. 31, 1995, with A. L. Abbott, \$47,023, responsible for \$35,000.
29. "Design Studies for Nautilus," Nautilus, Inc, Jan.1, 1994 to Oct. 15, 1994, \$7,723, 100% responsibility.
30. "Design Studies for Nautilus," Center for Innovative Technology, Jan.1, 1994 to Dec. 31, 1994, \$13,795, 100% Responsibility.
31. "Rod Formation Dynamics," R. J. Reynolds Co., Jan. 1, 1994 to Dec. 31, 1994, with D. J. Nelson, 116,557, 50% Responsibility.
32. "A Short-term Proposal to Develop Cam-Design Software for Cadkey, Inc.," June 16, 1994 to Sept 15, 1994, \$9,981, 100% Responsibility.
33. "Design of an Automated Injector Body Tray Loader," Siemens Automotive, Sept. 1, 1994 to Aug. 31, 1995, \$20,744, 100% Responsibility.
34. "Design Studies for Nautilus," Nautilus, Inc, Dec 1, 1994 to Nov. 30, 1995, \$23,731, 100% Responsibility.
35. "Design Studies for Nautilus," Center for Innovative Technology, Dec.1, 1994 to Dec. 31, 1995, \$25,924, 100% Responsibility.
36. "Preliminary design and Equipment Selection for a Mulch-Making Machine," Fred Whitaker Co., June 1, 1995 to Dec. 31, 1995, \$10,920, %100 Responsibility.
37. "Improving the Kinematic Control of Robots with Computer Vision," NSF, July 15, 1995 to June 30, 1996, \$22,026, %100 Responsibility.
38. "Proposal to Increase Funding in Siemens Valve-Body Loader Project," Siemens Automotive, \$7,018, 100% Responsibility.
39. "Preliminary Design and Equipment Selection for a Mulch-Making Machine," CIT, June 1, 1995 to August 31, 1995, \$8,185, %100 Responsibility.
40. "Design of a Personal Smith Machine," Nautilus, Inc, July 1, 1995 to Oct. 31, 1995, \$12,273, 100% Responsibility.
41. "Development of Advanced Control Strategies for Variable Geometry Truss Manipulators," Batelle -Pacific Northwest Laboratory, Jan. 1, 1995 to June 31, 1995, \$10,000, with R. J. Salerno, 10% Responsibility.
42. "Curriculum Renewal in Mechanical Engineering at Virginia Tech," NSF SUCCEED, Sept. 15, 1995 to Dec. 15, 1995, with Paul Tidwell, \$4,500 (NSF), \$4,677 (Cost Sharing), 50% Responsibility.
43. "Development of a Parallel Architecture Robotic Wrist," Triad Investors, Jan. 1, 1996 to May 31, 1997, \$51,707, 100% Responsibility.
44. "Development of Advanced Control Algorithms for Variable Geometry Truss Manipulators," Batelle-Pacific Northwest Laboratory, Jan. 1, 1996 to June 31, 1996, \$10,000, 100% Responsibility.

45. "Curriculum Renewal in Mechanical Engineering at Virginia Tech – Year 5," NSF SUCCEED, June 16, 1996 to June 15, 1997, \$10,000 (NSF), \$10,000 (Cost Sharing), 100% Responsibility.
46. "Technology Assessment for a Robotic Vacuum Cleaner," Servus Robots Incorporated, Sept. 1, 1998 to Feb. 28, 1999 with John Bay, Bob Sturges, and Mike Deisenroth, \$8,333, 25% Responsibility.
47. "Technology Assessment for a Robotic Vacuum Cleaner," Virginia CIT, Oct. 1, 1998 to March 31, 1999 with John Bay, Bob Sturges, and Mike Deisenroth, \$25,000, 25% Responsibility.
48. "MBC Guidance Project," Long-Airdox Company, August 1998 to July 1999, P.I.: R.H. Sturges, Co-P.I.'s: M. P. Deisenroth, C.F. Reinholtz. \$100,000.
49. "MBC Guidance Project," Virginia Center for Innovative Technology (matching), August 1998 to July 1999, P.I.: R.H. Sturges, Co-P.I.'s: M. P. Deisenroth, C.F. Reinholtz. \$100,000.
50. "Vertical Integration of Mechatronics at Virginia Tech," NSF SUCCEED, Aug 1999 to July 2002, P.I.: W. R. Saunders, Co-P.I.'s: J. S. Bay, D. J. Leo, C.F. Reinholtz, \$18,000/year for three years.
51. Development of a Remote-Controlled CASE CX-160 Excavator, Naval Surface Warfare Center, Dahlgren G-64 Division, February 2003 to September 2003, Co-PI with A. L. Wicks, \$17,000
52. Investigation of Adaptive Structures for Morphing Aircraft, NASA Langley Research Center, \$65,078, July 1, 2002 to June 30, 2003, 25% (with H. Robertshaw and D. Inman).
53. Increased Scope for Delivery Orders 0019, Remote Control Excavator, Naval Surface Warfare Center, with Al Wicks, PI, \$21,223.
54. Develop the Joint Unmanned Systems Experimentation and Research (JOUSTER) Site, U.S Army RDECOM STTC, Orlando, FL, June 10, 2004 to June 9, 2007, \$12,200,000, C. Reinholtz, PI (55% Responsibility), A. Wicks, Co-PI (43% Responsibility), Carstensen Co-PI (2% Responsibility).
55. Virginia First Lego League 2004 Pilot High School Robotics Program, NASA Langley Research Center, Education Grant NNL04AA65G, \$20,000, July 9, 2004 to July 8, 2005, 100% Responsibility
56. Virginia First Lego League NIA Outreach Program, National Institute of Aerospace, Grant No. VT-03-1, \$8,000, February 1, 2005 to August 31, 2005, 100% Responsibility.
57. Heterogeneous Teams Of Autonomous Vehicles: Advanced Sensing And Control, Office of Naval Research, Dennis W. Hong, Naira V. Hovakimyan, Marty E. Johnson, Charles F. Reinholtz, Daniel J. Stilwell, A. L. Wicks, Craig A. Woolsey, Christopher L. Wyatt, 07/01/05 – 6/30/06, Total Funding: \$1,050,000, C. F. Reinholtz share: \$52,752.
58. Coordinated Sensing and Control for Surveillance and Tracking by Heterogeneous Autonomous Vehicle Teams, Daniel J. Stilwell, Christopher L. Wyatt, Craig A. Woolsey, Naira V. Hovakimyan, A. L. Wicks, Andy Kurdila, Charles Reinholtz and Michael Roan, Office of Naval Research 5/15/06 – 9/14/07, \$1,417,500, Reinholtz share: \$184,275.
59. Development Of An Autonomous Vehicle For The DARPA Urban Challenge, with Al Wicks and Dennis Hong, the Defense Advanced Research Projects Agency, 10/1/06 to 12/31/07, \$999,274.
60. Development of a Drive-by-Wire Commercial Vehicle, General Dynamics Robotics Systems (GDRS), \$54,256, 1-11-07 to 6-30-07.
61. Navigation And Autonomous Control For Nemesis, Applied Research Associates, Inc. (ARA), \$61,513, 7-1-06 to 6-30-07
62. Dynamic Model of CAT 777-797 Haul Trucks for Autonomous Operation, Caterpillar,

\$74,303, 7-1-06 to 6-30-07

63. Boeing Digitally Manufactured UAV Project, \$22,740, The Boeing Company, 10-15-2010 to 12-31-2010.
64. Reconnaissance and Autonomy for Small Robots – Canine (RASR-K9), Robotic Research, \$17,951.50, 1-1-2011 to 4-30-2012
65. Proposal to Develop an Autonomous Maritime System to Compete in the International Maritime Robotics Competition, AUVSI and the Office of Naval Research, \$30,000, 10-1-13 to 12-31-14.
66. Robotic Tool Kit (RTK) Logistics Automation, (OTA) #W15QKN-14-9-1002, U.S. Army TARDEC via Great Lakes Systems & Technology LLC, \$75,000, August 2018 through September 2019, with Patrick Currier and Eric Coyle.
67. Continued Development of Robotic Tool Kit (RTK) Logistics Automation and RTK Training, (OTA) #W15QKN-14-9-1002, U.S. Army GVSC via Great Lakes Systems & Technology LLC, \$100,000, November 2019 through November 2020, with Patrick Currier and Eric Coyle.

Refereed Papers in Major Technical Journals

1. Snorri Gudmundsson, Vladimir Golubev, Sergey Drakunov and Charles Reinholtz, “Bio-Inspired Methodologies for Energy Conservation and Harvesting Flight-Path Modeling for Unmanned Aerial System,” *AIAA Journal of Aerospace Information Systems*, Volume 16, Number 7, July 2019, <https://doi.org/10.2514/1.I010597>.
2. Christine M. Dailey, Charles Reinholtz, Thais Russomano, Michael Schuette, Rafael Baptista, Rodrigo Cambraia, “Resistance Exercise Machine within Lower Body Negative Pressure for Counteracting Effects of Microgravity”, *Gravitational and Space Research*, Vol 2, No. 1 ISSN: 0898-4697, 2014.
3. Hockley, C. J., Zuercher, T.A., Patel, H.V., Gamble, G.A., Kennedy, C.L. Coyle E.J., P.N. Currier, and C.F. Reinholtz, The Development of the ERAU Maritime RobotX Challenge Autonomous System, AUVSI North America, May 2014.
4. Jesse Hurdus, Andrew Bacha, Cheryl Bauman, Stephen Cacciola, Ruel Faruque, Peter King, Chris Terwelp, Patrick Currier, Dennis Hong, and Alfred Wicks and Charles Reinholtz, “VictorTango Architecture for Autonomous Navigation in the DARPA Urban Challenge,” *AIAA Journal of Aerospace Computing, Information, and Communication*, Vol. 5, December 2008, DOI: 10.2514/1.40547.
5. Charles Reinholtz, Dennis Hong, Al Wicks, Andrew Bacha, Cheryl Bauman, Ruel Faruque, Michael Fleming, Chris Terwelp, Thomas Alberi, David Anderson, Stephen Cacciola, Patrick Currier, Aaron Dalton, Jesse Farmer, Jesse Hurdus, Shawn Kimmel, Peter King, Andrew Taylor, David Van Covern, Mike Webster, “Odin: Team VictorTango's entry in the DARPA Urban Challenge,” *Springer Tracts in Advanced Robotics* 56, ISBN 978-3-642-03990-4, Edited by Martin Buehler, Karl Iagnemma, Sanjiv Singh, 2009.
6. Andrew Bacha, Cheryl Bauman, Ruel Faruque, Michael Fleming, Chris Terwelp, Charles Reinholtz, Dennis Hong, Al Wicks, Thomas Alberi, David Anderson, Stephen Cacciola, Patrick Currier, Aaron Dalton, Jesse Farmer, Jesse Hurdus, Shawn Kimmel, Peter King, Andrew Taylor, David Van Covern, Mike Webster, “Odin: Team VictorTango's entry in the DARPA Urban Challenge,” *Journal of Field Robotics*, Vol. 25, No. 8, pg 467-492, 2008
7. David G. Schmale III, Benjamin R. Dings, Charles Reinholtz, “Development and Application of an Autonomous Unmanned Aerial Vehicle for Precise Aerobiological Sampling Above Agricultural Fields,” *Journal of Field Robotics*, Vol. 25. No. 3, pg 133-147, 2008, Copyright

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8. Michael J. Furey, Charles F. Reinholtz, and Brian Vick, "Metal Transfer, Film Formation and Surface Temperatures on a Cam in an Automotive Engine," *Tribologia*, ISSN 0208-7774, June 2007.
9. Leedy, B., Putney, J., Bauman, C., Cacciola, S., Webster, J. M., Reinholtz, C. F., "Virginia Tech's Twin Contenders: A Comparative Study of Reactive and Deliberative Navigation," *Journal of Field Robotics*, 23(9), 709-727, September 2006.
10. Gombar, B., Terwelp, C., Fleming, M., Wicks, A. L. and Reinholtz, C.F., "JOUSTER: Joint Unmanned Systems Test, Experimentation and Research Facility," *International Test and Evaluation (ITEA) Journal*, December 2004/January 2005, pp. 9-13.
11. Stephen L. Canfield, R. Randall Soper, Charles F. Reinholtz, "Creating Highly Dexterous Manipulators Using Nonlinear Input Transmission," *ASME Journal of Mechanical Design*, Vol. 120, 1999.
12. Canfield, S. L., Soper, R. R., and Reinholtz, C. F., "Velocity Analysis of Parallel Manipulators by Truss Transformations," *Mechanism and Machine Theory*, No. 34, 1999, pp. 345 – 357.
13. Roman, Chris and Reinholtz, C. F., "Robust Course-Boundary Extraction Algorithms for Autonomous Vehicles", *IEEE Intelligent Systems*, Nov./Dec. 1998, pp.32-39.
14. Lee, H. Y., and C. F. Reinholtz, "Inverse Kinematics of Serial-Chain Manipulators," *ASME Journal of Mechanical Design*, Vol. 118, No. 3, September 1996, pp. 396 - 404.
15. Lee, H. Y., Fallon, J. B., Cordle, W. H., and Reinholtz, C. F., "Inverse Kinematic Analysis of a Mobile Underwater Inspection Robot," *Journal of Applied Mechanisms and Robotics*, Vol. 2, No. 3, July 1995.
16. Canfield, S. L. and Reinholtz, C. F., "Development of an All-Revolute-Jointed Constant-Velocity Coupling," *Journal of Applied Mechanisms and Robotics*, Vol. 2, No. 3, July 1995, pp.13-19.
17. Shooter, S. B., West, R. L. and Reinholtz, C. F., A Unified Approach to Teaching Analytical Cam Design Using Conjugate Geometry, *The International Journal of Mechanical Engineering Education*, Vol. 23, No. 2, April 1995, pp 145-156.
18. Voruganti, R. S., Dhande, S. G., and Reinholtz, C. F., "Symbolic and Computational Method for Design and Flat-Pattern Development of Bifurcation, Trifurcation- Type Transition Surfaces," *Transactions of the North American Manufacturing Research Institution of SME*, Volume XXII, pp 225-232, 1994.
19. Tidwell, P. H., Glass, S. W., Hildebrand, J. J., Reinholtz, C. F., and Shooter, S. B., "COBRA - Design and Development of a Manipulator for Nuclear Steam Generator Maintenance," *Journal of Applied Mechanisms and Robotics*, Vol. 2, No. 2, April 1994.
20. Padmanabhan, B., V. Arun, and C. F. Reinholtz, "Closed-Form Inverse Kinematic Analysis of Variable Geometry Truss Manipulators," *Journal of Mechanical Design*, ASME Transactions, Vol. 114, No. 3, September 1992, pp. 438-443.
21. Arun, V., C. F. Reinholtz, and L. T. Watson, "Application of New Homotopy Techniques to Variable Geometry Trusses," *Journal of Mechanical Design*, ASME Transactions, Vol. 114, No. 3, September 1992, pp. 422-427.
22. Voruganti, R. S., Dhande, S. G., and Reinholtz, C. F., "Symbolic and Computational Conjugate Geometry for the Manufacture of Helically Swept Surfaces," *Transactions of the North American Manufacturing Research Institution of SME*, Volume XX, pp 277-282, 1992.

23. Salerno, R. J., Reinholtz, C. F., and Dhande, S. G., "Kinematics of Long-Chain Variable Geometry Truss Manipulators," *Advances in Robot Kinematics*, pp. 179-187, Edited by S. Stifter and J. Lenarcic, Springer-Verlag Wien, New York, 1991.
24. Kosmatka, J. B., R. F. Fries, and C. F. Reinholtz, "Tension and Bending Stress Concentration Factors in U, V, and Opposed U-V Notches," *The Journal of Strain Analysis for Engineering Design*, Vol. 25, No. 4, 1990, 233-240.
25. Rogers, C. A., H. H. Mabie, and C. F. Reinholtz, "Design of Spur Gears Generated with Pinion Cutters," *Mechanism and Machine Theory*, Vol. 25, No. 6, 1990, pp. 623-634.
26. Mabie, H. H., C. A. Rogers, and C. F. Reinholtz, "Design of Spur Gears Cut by a Hob," *Mechanism and Machine Theory*, Vol. 25, No. 6, 1990, pp. 635-644.
27. Williams, II, R. L., and C. F. Reinholtz, "Proof of Grashof's Law Using Polynomial Discriminants," *Journal of Mechanisms, Transmissions and Automation in Design*, ASME Transactions, Vol. 109, No. 2, June 1987, pp. 178-182.
28. Reinholtz, C. F., G. N. Sandor, and J. Duffy, "Branching Analysis of Spherical RRRR and Spatial RCCC Mechanisms," *Journal of Mechanisms, Transmissions and Automation in Design*, ASME Transactions, Vol. 108, No. 4, Dec. 1986, pp. 481-486.
29. Williams, II, R. L., and C. F. Reinholtz, "Mechanism Link Rotatability and Limit Position Analysis Using Polynomial Discriminants," *Journal of Mechanisms, Transmissions and Automation in Design*, ASME Transactions, Vol. 108, No. 4, Dec. 1986, pp. 562-564.
30. Myklebust, A., M. J. Keil and C. F. Reinholtz, "MECSYN-IMP-ANIMEC: Foundation for a New Computer-Aided Spatial Mechanism Design System," *Mechanism and Machine Theory*, Vol. 20, No. 4, 1985, pp. 257-269.
31. Reinholtz, C. F., S. G. Dhande, and G. N. Sandor, "Kinematic Analysis of Planar Higher-Pair Mechanisms," *Mechanism and Machine Theory*, Vol. 13, No. 6, 1978, pp. 619-629.

Notes, Review Articles, and Shorter Communications in Major Technical Journals

1. Fallon, J. B., and C. F. Reinholtz, "Simple Machine," short article published in the 1993 Edition of Academic American Encyclopedia, Deluxe Library Edition, Grolier, Inc., Vol. S, p. 316. Also published in the 1994 New Grolier Multimedia Encyclopedia, CD ROM Edition.
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94. Reinholtz, C. F., "Integrating Computers into Kinematics Courses at VPI&SU," Proceedings of the Fourth National Conference on University Programs in Computer-Aided Engineering, Design and Manufacture, August 1986, pp. 127-130.
95. Mabie, H. H., C. F. Reinholtz, D. Puzio, and G. M. Irwin, "Optimum Design of Spur Gear Teeth Cut with a Hob," Proceedings of the Ninth Applied Mechanisms Conference, Kansas City, MO, 1985, Vol. 2, Session VIII.B, Paper VI.
96. Keil, M. J., A. Myklebust, and C. F. Reinholtz, "Prediction of Link Interference in Planar Mechanisms," Proceedings of the Ninth Applied Mechanisms Conference, Kansas City, MO, 1985, Vol. 1, Session III.B, Paper V, (Winner of Proctor and Gamble Best Paper Award).
97. Myklebust, A., C. F. Reinholtz, W. H. Francis, and M. J. Keil, "Design of a Radar Guidance Mechanism Using MECSYN-ANIMEC," ASME Paper 84-DET-139, presented at the 18th ASME Mechanisms Conference, Cambridge, Massachusetts, October 10, 1984.
98. Sandor, G. N., A. G. Erdman, E. Raghavacharyulu, and C. F. Reinholtz, "On the Equivalence of Higher and Lower Pair Planar Mechanisms," Proceedings of the Sixth World Congress of the International Federation for the Theory of Machines and Mechanisms, New Delhi, India, 1983.
99. Sandor, G. N., D. Kohli, X. Zhuang, and C. F. Reinholtz, "Synthesis of a Five-Link Spatial Motion Generator," ASME paper 82-DET-130, 1982.
100. Sandor, G. N., D. Kohli, A. Ghosal, and C. F. Reinholtz, "Closed-Form Analytic Synthesis of a Five-Link Spatial Motion Generator," Proceedings of the Seventh Applied Mechanisms Conference, Kansas City, MO, 1981, pp. XXVI-1 to XXVI-7

Patents

1. "Spatial, Parallel-Architecture, Robotic Carpal Wrist," U. S. Patent 5,699,695, Inventors: Canfield, S. L., Reinholtz, C. F., Salerno, R. J., and Ganino, Anthony J., Assignee: Virginia Tech Intellectual Properties, Inc., Awarded December 23, 1997.
2. "Snubber Profile," U. S. Patent 4,998,942, Inventor: Reinholtz, Charles F. Assignee: Milliken Research Corporation, Spartanburg, S.C., Awarded March 12, 1991.

Invited Presentations at National Meetings

1. "Test Drive an Autonomous Vehicle: Experiences from the 2007 DARPA Urban Challenge," Presentation to USAA, 19 January 2009, San Antonio, TX
2. "Challenges and Opportunities Offered by the DARPA Grand Challenge," Invited Presentation and Panel Discussion at the 2004 AIAA Unmanned Aerial Vehicle Conference, Chicago, IL, September 2004.

3. "Product Safety and Product Liability," Invited Lecture at the 2001 ASME World Congress, New York, NY, Nov.13, 2001
4. "Life after Tenure" Invited Speaker and Panelist at the ASEE Annual Conference and Exposition, Charlotte NC, June 20-23, 1999.
5. "Reduced Complexity Robotics," Invited presentation at the 1998 ASME Design Technical Conferences, 25th Biennial Mechanisms Conference, Atlanta, GA, September 1998.
6. "Trends and Opportunities in Mechanisms Research," Plenary Panel Session Speaker at the 4th National Applied Mechanisms and Robotics Conference, Cincinnati, Ohio, December 10-14, 1995.
7. "Trends and Opportunities in Robotics," Opening Plenary Session Lecture at the 10th Applied Mechanisms Conference, Dec. 6-9, 1987, New Orleans, Louisiana.
8. "Observations on Robotics and Mechanisms Research," Opening Plenary Panel Session Speaker at the 2nd National Applied Mechanisms and Robotics Conference, November 3-6, 1991, Cincinnati, Ohio, November 3-6, 1991.

University Service

Invited Speaker at the following University Events and Alumni Association Chapter Meetings:

June 23, 2005, Research Triangle Park Alumni Chapter, Raleigh, NC
 March 18, 2004, Greensboro, NC Triad Alumni Chapter
 March 31, 2004, Atlanta Alumni Chapter
 November 1, 2004, Committee of 100 - Hotel Roanoke
 November 21, 2004, Class of 1968, Donaldson Brown

Advisor to the following Embry Riddle Autonomous Vehicle Teams:

Unmanned Aerial Systems Competition, 2007-Present
 International Aerial Robotics Competition, 2007-Present
 Intelligent Ground Vehicle Competition, 2007-Present
 RoboBoat, 2007-Present
 RoboSub, 2007-Present
 Maritime RobotX Competition, 2013-Present
 EcoCAR (CAVs Advisor), 2016-Present

Member, College Promotion and Tenure Committee 2018-21

Fulbright Scholarship Advisory Committee 2005

Advisor to the Virginia Tech Autonomous Aerial Vehicle Competition Team, 2004-

Advisor to the Virginia Tech DARPA Grand Challenge Team, 2003-

Virginia FIRST Lego League Coordinator, 2002-

Advisor to the Virginia Tech Intelligent Ground Vehicle Competition Team, 1995-

Advisor to Entering Honors Students 2003-

Horton Honors Scholarship Selection Committee 2003-

Member, University Strategic Planning Committee, 2001

Chair, Virginia Tech Academy of Teaching Excellence 2000-2001

Vice Chair, Virginia Tech Academy of Teaching Excellence 1999-2000

Member, University Promotion and Tenure Committee 2000-2001

Member, College Promotion and Tenure Committee 2000-2001

Chair, Mechanical Engineering Curriculum Committee 1997-2002

Chair, Mechanical Engineering ABET Review, 1998-2002

Member, College of Engineering Curriculum Committee 1997-2002

Member, 1st Year Special Curriculum Review Committee 1997

Member, Engineering Dean Search Committee, 1993-4

Chairman, Mechanical Engineering Honors and Awards and Publicity Committee, 1993-99

Member, Mechanical Engineering Honors and Awards and Publicity Committee, 1993-99

Chairman, College Wine Teaching Award Committee, 1992-95
 Chairman, University Wine Teaching Award Committee, 1995-96
 Member, Mechanical Engineering Department Head Search Committee, 1992-93
 Member, Mechanical Engineering Curriculum Committee, 1984-87, 1992-2004
 Member, Mechanical Engineering Tenure and Promotion Committee, 1989-2004
 Member, Mechanical Engineering Graduate Committee, 1987-89
 Member, Mechanical Engineering Recruiting Committee, 1992-93
 Member, Sigma Xi High School Teaching Award Committee 1987-88, Chairman 1989
 Member, College of Engineering Commencement Committee, 1988-
 Faculty Advisor to the Virginia Tech Student Section of ANS, 1993-
 Faculty Advisor to the Virginia Tech Student Section of ASME, 1988-
 Faculty Advisor to the Virginia Tech Chapter of Tau Beta Pi, 1984-88
 Host for the Virginia Tech Academic Challenge, 1991

Professional Service

<u>Society</u>	<u>Positions Held</u>
ASME	Secretary of the Virginia Section 1987-92 Chairman of the National Student Mechanism Competition 1987-88 Chairman of the Joint Regional Conference 1989 and 2000 Virginia Tech Student Section Advisor, 1988-2007 Member of the ASME Mechanisms Committee, 1990-1993 Associate Technical Editor, <i>ASME Journal of Mechanical Design</i> , 1991-93 Paper Review Chairman, 22nd ASME Mechanisms Conference, Sept. 1992 Conference Arrangements Chairman, 23rd ASME Mechanisms Conference, Sept. 1994 Member, ASME National Design Contest Committee, 1996-2002 Virginia Section Newsletter Editor, 1994-2000 Region IV Senior Representative to the National Student Sections Committee, 1995-2000
Sigma Xi	High School Teaching Award Committee, Member 1987-88, Chair 1989
ANS	Student Section Advisor, Virginia Tech, 1993-95
NAE	Invited review Board member, National Academies' National Research Council (NRC) Army Research Laboratory Technical Assessment Board (ARLTAB), May 2004

Graduate Advising

Master's Degree Students Completed				
	Degree	Name	Completion Date	Title
1	MS	Robert L Williams, II	8/85	Synthesis and Design of the RSSR Spatial Mechanism for Function Generation
2	MS	Arun Veeraraghavan	3/86	Computer Aided Design of the RCCC Spatial Mechanism
3	MS	Michael A. Klatt	10/86	Design Optimization of Planar Mechanisms
4	MS	Kevin K. Moyers	11/87	A Microcomputer-Based Data Acquisition System for Diagnostic Monitoring of High-Speed Electric Motors
5	MS	Christodoulos S. Demetriou	12/87	A PC Implemented Kinematic Synthesis System for Planar Mechanisms
6	MS	Dipen P. Gokhale	12/87	Kinematic Analysis and Animation of a Variable-Geometry Truss Robot
7	MS	William R. Seith	5/88	Design of a Flying Cutter
8	MS	George M. Clessas	5/88	Direct Calculation of Cable Tension in a Store Separation Program Which Models the Launch of an Aerial Tow Target
9	MS	Mark W. Biegler	8/88	Determination of Stress Concentration Factors Using Experimental Methods
10	MS	Nandan Joshi	2/88	Mobility Analysis of Variable-Geometry Trusses
11	MS	Vasant Marathe	12/88	Design of a Hot Melt Book Binding Machine
12	MS	Babu Padmanabhan	12/88	Design of a Robotic Manipulator Using Variable-Geometry Trusses as Joints
13	MS	Robert J. Salerno	6/89	Shape Control of High Degree-of-Freedom Variable-Geometry Truss Manipulators
14	MS	Ravinder S. Voruganti	8/90	Symbolic and Computational Conjugate Geometry for Design and Manufacturing Applications
15	MS	Steven B. Shooter	12/90	Conceptual Manipulator Design for Limited Access Workspaces
16	MS	Paul Mele	5/91	Mechanical Design of a Stewart Platform-Based Crawling Vehicle
17	M.S.	William K. Carpenter	12/92	Design of Medical Waste Treatment Systems Employing Bioremediation
18	MS	Allen Maples	5/93	Design of a Robust Acoustic Positioning System for an Underwater Nuclear Reactor Vessel Inspection Robot
19	MS	William Cordle	5/93	Numerical Inverse Kinematics for a Six Degree-of-Freedom Manipulator
20	MS	Glenn Melnyk	6/93	Mechanisms for Automated Toolhead Changing in Nuclear Steam Generator Robotics
21	MS	Steve Payne	5/94	A CAD-Interactive Software Package for the Synthesis of Planar Disk Cams
22	MS	Anil K. Garg	8/94	Design, Installation and Testing of a Bioremediation-Based System for Treating Regulated Medical Waste
23	MS	Todd Denkins	12/94	Design Methodology to reduce the Number of Actuators in Complex Mechanisms

24	MS	Joseph Calkins	12/94	Real-Time Compensation of Static Deflections in Robotic Manipulators
25	MS	Randy Soper	8/95	Synthesis of Planar Four-Link Mechanisms for Force Generation
26	MS	Keith Garguilo	8/95	Design and Testing of a Nonlinear Mechanical Advantage Demonstration Mechanism
27	MS	Ganino, A. J.	5/96	Mechanical Design of the Carpal Wrist: A Parallel-Actuated, Singularity-Free Robotic Wrist
28	MS	Larkin, Susan	6/96	Wheeled Autonomous Mobile Robots for use in Harsh Environments: A Survey of Recent Publications
29	MS	Iskandar, Kurnia	6/96	Computer Assisted Synthesis of Wrapping Cam Mechanisms
30	MS	Riutort, Kevin	7/96	Applied Design and Implementation of Straight-Line Mechanisms
31	MS	Saccoccio, Greg	8/96	Error Modeling of the Carpal Wrist
32	MS	Scardina, Mike	10/96	Optimal Synthesis of Force-Generating Planar Four-Link Mechanisms
33	MS	Palmer, Matthew	12/96	Kinematics of Beam-Flexure Four-Bar Linkages with Applications in a Compound Bow
34	MS	Coombs, Dana	2/97	Design of User-Weight-Based Exercise Machines
35	MS	Doyle, Matthew	12/97	The Foundation for CADSPAM
36	MS	Hayes, Thomas J.	12/97	The Creative Entrepreneurs Organization
37	MS	Adler, Alex	5/98	Testing and Understanding Screwdriver Bit Wear
38	MS	Haynie, C. Dean	8/98	Mechanical Design and Navigation Strategies for a Zero-Turn-Radius Autonomous Vehicle
39	MS	Holland, Michael	12/98	Assembly Optimization for Double-Row Ball Bearings
40	MS	Abbott, Michael	6/00	Dynamics and Control of the Biplanar Bicycle
41	MS	Conner, David	8/00	Sensor Fusion, Navigation, and Control of Autonomous Vehicles
42	MS	Jillcha Wakjira	1/01	Design of a SMA Heat Engine
43	MS	Carr, Angela	5/01	Position Control Comparison of Equilibrated and Mass Counterweight Systems
44	MS	Kedrowski, Philip	5/01	Development and Implementation of a Self-Building Global Map for Autonomous Navigation
45	MS	Blackett, Ricardo	5/01	Optimization of Multi-Degree-of-Freedom Force Generating Mechanisms
46	MS	Matthew Thompson	7/01	Design of a Cyclic Sliding, Dynamically Loaded Wear Testing Device for the Evaluation of Total Knee Replacement Materials
47	MS	Rundgren, Brian	12/01	Design and Optimization of Force Generation Linkages to Include Dynamic Effects
48	MS	Schiller, Ean	9/02	Heat Engine Driven by Shape Memory Alloys: Prototyping and Design

49	MS	Gopinath, Sudir	12/02	Using Color and Shape Analysis for Boundary Line Extraction in Autonomous Vehicle Applications
50	MS	Whittier, Will	12/02	Kinematic Analysis of Tensegrity Structures
51	MS	Terwelp, Chris	5/03	Remote Control of Hydraulic Equipment for Unexploded Ordnance Remediation
52	MS	Henshaw, Graham	5/03	Single-Session Design: Design Methodology in Compressed Timeframes Derived from the Robot Rivals Television Series
53	MS	Corey, Chris	12/03	Epicyclic Gear Train Solution Techniques with Application to Tandem Bicycling
54	MS	Fleming, Michael	12/03	Teleoperated Control of Hydraulic Equipment for Hazardous Material Handling
55	MS	Stubbs, Matthew	12/03	Kinematic Design and Analysis of a Morphing Wing
56	MS	Bacha, Andrew	5/05	Line Detection and Lane Following for an Autonomous Robot
57	MS	Frentzel, John	5/05	A Wireless Instrumented Payload for Testing Unmanned Vehicles
58	MS	Naik, Ankur	12/05	Arc Path Collision Avoidance Algorithm for Autonomous Ground Vehicles
59	MS	Barnett, Shane	12/05	Development of a Tow Capacity Test Device for Small Unmanned Vehicles
60	MS	Cooper, Jared	12/05	Modeling of a Small-Scale Remote Controllable Helicopter for Simulation and Control Development
61	MS	Baity, Sean	5/06	Development of a Next-generation Experimental Robotic Vehicle (NERV) that Supports Intelligent and Autonomous Systems Research
62	MS	Leedy, Brett	5/06	Two Minds for One Vehicle: A Case Study in Deliberative and Reactive Navigation
63	MS	Gombar, Brett	5/06	Design and Evaluation of a Mobile Instrumentation Platform for Unmanned Vehicle Testing
64	MS	Putney, Joseph	5/06	Reactive Navigation of an Autonomous Ground Vehicle Using Dynamic Expanding Zones
65	MS	Willis, Christopher Ryan	5/06	A Kinematic Analysis and Design of a Continuously Variable Transmission
66	MS	James Hayward Bittorf	6/06	Mechanical Device to Assist the Landing of Unmanned Aerial Vehicles
67	MS	Ramirez, Rachael	8/06	Computer Vision Based Analysis of Broccoli for Application in a Selective Autonomous Harvester
68	MS	Grant Edward Gothing	7/07	Development of the “Discretized Dynamic Expanding Zones with Memory” Autonomous Mobility Algorithm for the Nemesis Tracked Vehicle Platform
69	MS	David Burns Van Covern	7/07	Collaborative Target Localization and Inspection Using a Heterogeneous Team of Autonomous Vehicles
70	MS	Thomas James Alberi	4/08	A Proposed Standardized Testing Procedure for Autonomous Ground Vehicles

71	MS	Patrick Norman Currier	4/08	Development of an Automotive Ground Vehicle Platform for Autonomous Urban Operations
72	MS	Jesse Lee Farmer	2/08	Kinematic Analysis of a Two Body Articulated Robotic Vehicle
73	MS	Chris Hockley	12/10	Development of an Autonomous Monocopter
74	MS	Katrina Corley	4/11	Supervisory Autonomous Control of Homogeneous Teams of Unmanned Ground Vehicles: Application to The Multi-Autonomous Ground-Robotic International Challenge
75	MS	Robert Andrew Lister	5/11	Classification of Marine Vessels in a Littoral Environment Using a Novel Training Database
76	MS	Kevin Rigby	8/11	Localization of Aircraft Using Wide-Baseline Stereopsis
77	MS	Lafe Zabowski	8/11	A Low Cost, Computer Vision Based, Target Tracking Hexapod
78	MS	Christine Dailey	5/12	A Novel Resistance Exercise Machine for Use in a Lower Body Negative Pressure Box to Counteract the Effects of Weightlessness

Ph.D. Students Completed				
1	PhD	Robert L. Williams II	5/88	Planar Robotic Mechanisms: Analysis and Configuration Comparison
2	PhD	Arun Veeraraghavan	9/90	The Solution of Variable-Geometry Truss Problems Using New Homotopy Continuation Methods
3	PhD	Shahriar Tavakkoli	6/91	Shape Design Using Intrinsic Geometry
4	PhD	Babu Padmanabhan	12/92	A Study of Isostatic Framework with Application to Manipulator Design
5	PhD	Robert J. Salerno	12/93	Positional Control Strategies for a Modular, Long-Reach, Truss-Type Manipulator
6	PhD	Paul Tidwell	8/95	Wrapping Cam Mechanisms
7	PhD	J. Barry Fallon	8/95	Improving the Kinematic Control of Robots by Estimating the End-Effector Pose Directly with Computer Vision
8	PhD	Steven B. Shooter	12/95	Information Modeling in Mechanical Design: With Application to Cam Mechanism Design
9	PhD	Ravi S. Voruganti	12/95	Robot System Characterization: Error Modeling, Identification, Analysis and Calibration
10	PhD	Canfield, Steve	5/98	Development of the Carpal Wrist
11	PhD	Stulce, John	1/02	Conceptual Design of a Multibody Passive-Legged Crawling Vehicle
12	PhD	Calkins, Joseph	8/02	Quantifying Coordinate Uncertainty Fields in Coupled Spatial Measurement Systems
13	PhD	Snorri Gudmundsson	12/16	A Biomimetic, Energy-Harvesting, Obstacle-Avoiding, Path-Planning Algorithm for UAVs

Charles F. Reinholtz, Ph.D.**Deposition and Court Testimony, 2017-Present**

Year	Counsel	Opposing Counsel	Case Information (Client Shown in Boldface)	Plaintiff/ Defendant	Deposition/ Court Appearance
2017	Williams Mullen	McDermott Will & Emery LLP	SwimWays Corporation and Kelsyus LLC v. Aqua-Leisure Industries, Inc., Civil Action No. 2:16-cv-260	Plaintiff	Deposition, June 12, 2017, Washington, DC
2017	Cooper & Dunham LLP	Kilpatrick Townsend & Stockton LLP	AU New Haven, LLC and Trelleborg Coated Systems US, Inc. (represented by Cooper & Dunham LLP) v. YKK Corporation, Civil Action No. 15-CV-03411 (S.D.N.Y.)	Plaintiff	Deposition, September 22, 2017, New York, NY
2017	Faegre, Baker Daniels LLP	Masuda, Funai, Eifert & Mitchell, Ltd	Lippert Components Manufacturing, Inc., and Backsaver International, Inc. D/B/A Gorilla-Lift, v. MORryde International Inc. et al., Case No. 3:16-cv-00264-TLS-MGG	Plaintiff	Markman Hearing Court Testimony, October 26, 2017, South Bend, Indiana
2017	Fish & Richardson P.C	Quinn Emanuel Urquhart & Sullivan, LLP	Sanofi-Aventis U.S. LLC et al, Plaintiffs, v. Merck Sharp & Dohme Corp., Defendant., 1:16-cv-00812	Plaintiff	Deposition, December 19, 2017, New York, NY
2018	Calfee, Halter & Griswold LLP	Quinn Emanuel Urquhart & Sullivan, LLP	Lincoln Electric Company , et al. Plaintiffs, v. Harbor Freight Tools USA Inc., Defendants, Case No. 1:17-CV-02329	Plaintiff	Deposition, February 22, 2018, Cleveland, OH
2018	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Sterne, Kessler, Goldstein & Fox, P.L.L.C.	Caterpillar v. Wirtgen GmbH, et. al., In the Matter of Certain Road Construction Machines and Components Thereof, ITC Investigation No. 337-TA-1088	Complainant	Deposition, May 10, 2018, Washington, DC

2018	Fish & Richardson P.C	Quinn Emanuel Urquhart & Sullivan, LLP	Sanofi-Aventis U.S. LLC et al, Plaintiffs, v. Merck Sharp & Dohme Corp., Defendant., 1:16-cv-00812	Plaintiff	Deposition, April 13, 2018, New York, NY
2018	Fish & Richardson P.C	Quinn Emanuel Urquhart & Sullivan, LLP	Sanofi-Aventis U.S. LLC et al, Plaintiffs, v. Merck Sharp & Dohme Corp., Defendant., 1:16-cv-00812	Plaintiff	Court Testimony, U. S. District Court, District of Delaware, May 29-31, 2018, Wilmington, DE
2018	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Sterne, Kessler, Goldstein & Fox, P.L.L.C	Caterpillar v. Wirtgen GmbH, et. al., In the Matter of Certain Road Construction Machines and Components Thereof, ITC Investigation No. 337-TA-1088	Complainant	Deposition, July 24, 2018, Washington, DC
2018	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Sterne, Kessler, Goldstein & Fox, P.L.L.C	Caterpillar v. Wirtgen GmbH, et. al., In the Matter of Certain Road Construction Machines and Components Thereof, ITC Investigation No. 337-TA-1088	Complainant	ITC Court Testimony, September 25 and 26, 2018, Washington, DC, ALJ: Dee Lord
2018	Weil, Gotshal & Manges LLP	Wilson, Sonsini, Goodrich & Rosati	Sanofi-Aventis , Plaintiffs v. Mylan GmbH, Biocon Ltd., Defendant, C.A. No. 17-cv-09105-SRC-CLW	Plaintiff	Deposition, October 30, 2018, Washington, DC
2019	Weil, Gotshal & Manges LLP	Wilson, Sonsini, Goodrich & Rosati	Sanofi-Aventis , Plaintiffs v. Mylan GmbH, Biocon Ltd., Defendant, C.A. No. 17-cv-09105-SRC-CLW	Plaintiff	Markman Hearing Court Testimony, April 12, 2019, Newark, New Jersey
2019	Steptoe & Johnson LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Autel Robotics v SZ DJI Technology, et. al., In the Matter of Certain Unmanned Aerial Vehicles and Components Thereof, ITC Investigation No. 337-TA-1133	Complainant	Deposition, July 19 and 12, 2019, Washington, DC
2019	Weil, Gotshal & Manges LLP	Wilson, Sonsini, Goodrich & Rosati	Sanofi-Aventis , Plaintiffs v. Mylan GmbH, Biocon Ltd., Defendant, C.A. No. 17-cv-09105-SRC-CLW	Plaintiff	Deposition, October 15, 2019, Washington, DC
2019	Steptoe & Johnson LLP	Finnegan, Henderson,	Autel Robotics v SZ DJI Technology, et. al., In the Matter of Certain	Complainant	ITC Court Testimony, Oct 21 to 23, 2019, Washington, DC

		Farabow, Garrett & Dunner, LLP	Unmanned Aerial Vehicles and Components Thereof, ITC Investigation No. 337-TA-1133		ALJ: Charles Bullock
2019	Kirkland & Ellis, LLP	Gibson Dunn and Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	iRobot Corp. v. SharkNinja, Civil Action No. 1:19-cv-12125	Plaintiff	Deposition, October 28, 2019, Washington, DC
2019	Steptoe & Johnson LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Autel Robotics v SZ DJI Technology, Inter Partes Review, Case IPR2019-00249 and Case IPR2019-00250, Patent 7,979,174 B2	Patent Owner	Deposition, October 31, 2019, Chicago, IL
2019	Steptoe & Johnson LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Autel Robotics v SZ DJI Technology, Inter Partes Review, Case PGR2019-00016, Patent 10,044,013B2, PGR 2019-00014, Patent 9,979,000, Case IPR2019-00343, Patent 9,260,184 B2	Patent Owner	Deposition, November 15, 2019, Orlando, FL
2019	Weil, Gotshal & Manges LLP	Wilson, Sonsini, Goodrich & Rosati LLP	Sanofi-Aventis v. Mylan GmbH, Biocon Ltd., Defendant, C.A. No. 17-cv-09105-SRC-CLW	Plaintiff	Court Testimony, December 2-4, 2019, Newark, NJ
2019	Fish & Richardson P.C	Pepper Hamilton LLP	2019, Floodbreak, LLC , Plaintiff, v. Art Metal Industries, LLC, et al., Defendants, No. 3:18-cv-503, United States District Court District of Connecticut, 2019.	Plaintiff	Deposition, December 13, 2019, Bridgeport, CT
2020	Steptoe & Johnson LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Autel Robotics v SZ DJI Technology, Inter Partes Review, Case IPR2019-00846, Patent 9,260,184 B2	Patent Owner	Live Video Deposition, April 3, 2020, New Smyrna Beach, FL
2020	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Sterne, Kessler, Goldstein & Fox, P.L.L.C	Caterpillar v. Wirtgen GmbH, et. al., Modification Proceeding in the Matter of Certain Road Construction Machines and Components Thereof, ITC Investigation No. 337-TA-1088	Complainant	Live Video Deposition, May 12, 2020, New Smyrna Beach, FL

2020	Step toe & Johnson LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	Autel Robotics v SZ DJI Technology, Inter Partes Review, Case IPR2019-00846, Patent 9,260,184 B2	Patent Owner	Live Video Deposition, June 16, 2020, New Smyrna Beach, FL
2020	Fish & Richardson P.C	Davis & Kuelthau, s.c.	Wash World Inc., Plaintiff, v. Belanger Inc., et al. , Defendants, Case No.: 19-Cv-1562, United States District Court Eastern District of Wisconsin	Patent Owner	Deposition, December 3, 2020, (appearing by videoconference from Eugene, OR)
2020	Fish & Richardson P.C	Troutman Pepper Hamilton Sanders LLP	Floodbreak, LLC , Plaintiff v. A rt Metal Industries, LLC, et al., Defendants, No. 3:18-cv-503, United States District Court District of Connecticut.	Patent Owner	Court Testimony, December 9 & 10, Bridgeport, CT (appearing by videoconference from Florence, OR)
2020	Sterne, Kessler, Goldstein & Fox, P.L.L.C	Willkie Farr & Gallagher LLP	Civil Action No. 5:19-cv-6021	Defendant	Deposition, December 21, 2020, (appearing by videoconference from Moab, UT)
2021	Faegre Drinker Biddle & Reath LLP	RuyakCherian LLP	Team Worldwide Corporation, Plaintiff, v. Academy, Ltd. D/B/A Academy ports + Outdoors, et al. , Defendants, Lead Case No. 2:19-cv-00092-JRG-RSP	Defendant	Deposition, January 5 & 6, 2021, (appearing by videoconference from Colorado Springs, CO)
2021	Durie Tangri LLP	Kramer Levin Naftalis & Frankel LLP	Midwest Athletics and Sports Alliance, LLC v. Xerox Corporation (represented by Durie Tangri LLP) v Case No. 6:19-CV-06036-EAW-MJP.	Defendant	Deposition, September 20, 2021 (appearing by videoconference from New Smyrna Beach, FL)
2021	Kirkland & Ellis, LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	iRobot Corp. v. SharkNinja, In The Matter of Certain Robotic Floor Cleaning Devices And Components Thereof, ITC Investigation No. 337-TA-1252	Complainant	Deposition, October 6, 2021 (appearing by videoconference from New Smyrna Beach, FL)

2021	Fish & Richardson P.C	Latham & Watkins LLP and Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	AbbVie Inc. and AbbVie Biotechnology Ltd, Plaintiff, v Alvotech Hf. , Civil Action No. 1:21-cv-2258, United States District Court for the Northern District of Illinois Eastern Division.	Defendant	Deposition, December 6, 2021, (appearing by videoconference from Boulder, CO)
2022	Kirkland & Ellis, LLP	Finnegan, Henderson, Farabow, Garrett & Dunner, LLP	iRobot Corp. v. SharkNinja, In The Matter of Certain Robotic Floor Cleaning Devices And Components Thereof, ITC Investigation No. 337-TA-1252	Complainant	Court Testimony, January 6, 7 and 12 (appearing by videoconference from the offices of Kirkland & Ellis, Washington, DC), ALJ: MaryJoan McNamara
2022	Faegre Drinker Biddle & Reath LLP	Crowell & Moring	Wonderland Nurserygoods Co., Ltd., Plaintiff, v. Baby Trend, Inc. , Denny Tsai and Betty Tsai, Defendants, Case No. 5:14-cv-01153-JWH-SPx	Defendant	Deposition, April 12, 2022, Daytona Beach, FL
2022	Sterne, Kessler, Goldstein & Fox, P.L.L.C	Willkie Farr & Gallagher LLP	Provisur Technologies, Inc., Plaintiff, v. Weber, Inc., Textor, Inc., et. al. , United States District Court, Western District of Missouri, St. Joseph Division, Case No. 5:19-CV-06021.	Defendant	Deposition, May 5, 2023, Washington, DC
2022	Fish & Richardson P.C	Davis & Kuelthau, s.c.	Wash World Inc., Plaintiff, v. Belanger Inc., et al. , Defendants, Case No.: 19-Cv-1562, United States District Court Eastern District of Wisconsin	Patent Owner and Defendant	Court Testimony, August 2 &3, United States District Court Eastern District of Wisconsin, Green Bay, WI
2022	Faegre Drinker Biddle & Reath LLP	Crowell & Moring	Graco Children's Products Inc. and Wonderland Nurserygoods Co., Ltd. v. Baby Trend, Inc. et. al. , "In the Matter of Certain Playards and Strollers," ITC Investigation No. 337-TA-1288	Defendant	Deposition, September 27-28, 2022, Indianapolis, Indiana
2022	Sterne, Kessler, Goldstein & Fox, P.L.L.C	Willkie Farr & Gallagher LLP	Provisur Technologies, Inc., Plaintiff, v. Weber, Inc., Textor, Inc., et. al. , United States District Court, Western District of Missouri, St. Joseph Division, Case No. 5:19-CV-06021.	Defendant	Court Testimony, October 25 &26, United States District Court, Western District of Missouri, Kansas City

2022	Faegre Drinker Biddle & Reath LLP	Crowell & Moring	Graco Children's Products Inc. and Wonderland Nurserygoods Co., Ltd. v. Baby Trend, Inc. et. al. , "In the Matter of Certain Playards and Strollers," ITC Investigation No. 337-TA-1288	Defendant	ITC Court Testimony, Washington, DC, December 13-15, 2022, ALJ: Bryan F. Moore
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