

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NXTGEN TOYS, LLC,
PETITIONER,

v.

ZIPSTRING, LLC,
PATENT OWNER.

Case IPR2024-01213
Patent 11,674,774

DECLARATION OF DR. BARRY KUDROWITZ

TABLE OF CONTENTS

	Page No.
I. INTRODUCTION	4
A. Qualifications	4
II. MATERIALS REVIEWED	6
III. SUMMARY OF MY OPINIONS	8
IV. LEGAL PRINCIPLES.....	8
A. Understanding of Patent Law.....	8
B. Claim Construction.....	10
C. Level of Ordinary Skill in the Art	11
V. THE '774 PATENT.....	13
A. Priority of '774 Patent.....	13
B. Summary of the '774 Patent.....	13
C. Summary of the Prosecution of the '774 Patent.....	17
VI. Background of the Technology	18
A. History of String Shooter Devices.....	18
B. Background Knowledge of Physics of String Shooter Devices.....	19
C. Background Knowledge of Fibers Extending From String	22
VII. OVERVIEW OF THE PRIOR ART	25
B. Summary of Yeany	25
C. Summary of Abello	29
D. Summary of Wagner	31
E. Summary of Scorch	33
VIII. REASONS THE CHALLENGED CLAIMS OF THE '774 PATENT ARE UNPATENTABLE.....	36
A. Yeany anticipates claims 1-3, 12 and 15-17	36
B. Abello in view of Yeany renders obvious claims 1-3, 12, and 15-17.....	54
C. Wagner in view of Yeany renders obvious claims 1-3, 12 and 15.....	71

D.	Wagner in view of Yeany and Scorch renders obvious claims 4, 16 and 17	81
IX.	Oath.....	90

I, Barry Kudrowitz, declare as follows:

I. INTRODUCTION

1. I have been retained on behalf of NXTGen Toys, LLC in connection with the above captioned *Inter Partes* Review (IPR) of U.S. Patent No. 11,674,774 ('774 Patent). I have been asked to study and provide my opinions as an independent expert witness regarding technology described in the '774 Patent. I am being compensated at my usual and customary rate for my time. Such compensation, however, does not influence my opinion nor does the outcome of this proceeding impact my compensation.

A. Qualifications

2. My qualifications and professional experience are described in my curriculum vitae. I have been informed that a copy of my curriculum vitae will be submitted with my declaration. The following is a summary of my relevant qualifications and professional experience.

3. I have a Ph.D. of Mechanical Engineering from the Massachusetts Institute of Technology (MIT). Prior to that I received a master's degree in mechanical engineering from MIT and a Bachelor of Science in mechanical engineering from the University of Central Florida, graduating Summa Cum Laude. As part of my coursework in mechanical engineering, I became familiar with general principles of physics, including the concepts of friction, drag, boundary layers, and lift.

4. My master's thesis, entitled *An Exploration of Concepts for Projectile Toys*, was on the process of designing projectile toys. This work specifically included the design of a hand-held string projectile toy concept. In this master's work from 2004-2006, I collaborated with Hasbro Inc. developing new technologies that could be used in the Nerf brand and Super Soaker brand products. As a result of this work, I am listed as an inventor on U.S. Patent No. 7,673,625, "Toy Projectile Launching Device." This technology was implemented in the Nerf Atom Blaster toy, which was on the market in 2006 until it was discontinued after five years. I am also a listed inventor on an unrelated patent application for an Endoscopic Biopsy Needle Design.

5. I have developed a course called *Toy Product Design*, which I have taught for six years at the Massachusetts Institute of Technology (2005-2010) and nine years at the University of Minnesota (2011-2019). In this class, I taught a toy design process to students in engineering, design, and business disciplines. A different industry partner sponsors this course each year and students develop toy product concepts for that partner. I regularly speak nationally and internationally about creative product design and designing for play. My book entitled "Sparkling Creativity: How Play and Humor Fuel Innovation and Design" was released in May 2023 through Routledge. Additionally, I have published two book chapters related to toy design: "Designing Developmentally Appropriate Toys" in *The Handbook to*

Developmentally Appropriate Toys and “Emerging Technology in Toy Design” in “*Designing for Emerging Technologies.*” I was also a judge for the Toy of the Year Awards (i.e., TOTY) from 2011-2015.

6. I was the founding director of the Product Design Program at the University of Minnesota College of Design in 2011. I am currently a Professor of Product Design, Affiliate Professor of Human Factors and Ergonomics, Affiliate Professor of User Experience Design, and the Department Head of the College of Design’s Department of Graphic Design, Apparel Design, Retail Merchandising, and Product Design. A copy of my curriculum vitae is attached.

II. MATERIALS REVIEWED

7. In forming my opinions provided in this declaration, I have read and considered the following. I have also relied on my education, knowledge, and experience in mechanical engineering and consumer products.

Materials Reviewed
U.S. Patent No. 11,674,774 (“the ’774 patent”)
Prosecution history of the ’774 patent
B. Yeany, String shooter-String launcher – physics of toys – Homemade Science with Bruce Yeany, YouTube video, June 11, 2014 (available at https://www.youtube.com/watch?v=rffAjZPmkuU) (“Yeany”)
Abello, Margaux, <i>et al.</i> , String Shooter’s Overall Shape in Ambient Air, Volume 4, <i>Emergent Scientist</i> , 1-8, January 14, 2020 (“Abello”)

Materials Reviewed
Daerr, Adrian, <i>et al.</i> , The Charmed String: Self-Supporting Loops Through Air Drag, Volume 877, <i>Journal of Fluid Mechanics</i> , 1-12, August 20, 2019 (“Daerr”)
Scorch Works, String Shooter, YouTube video, July 4, 2018 (available at https://www.youtube.com/watch?v=IGIDy-IJxmo) (“Scorch”)
U.S. Patent No. 6,537,126 to Wagner (“Wagner”)
C.C.L. Gregory, Theory of a loop revolving in air, with observations on the skin-friction, <i>Q. J. Mech. Appl. Math.</i> 2 (1949) (“Gregory”)
Anderson, Fundamentals of Aerodynamics, Sixth Edition, published by McGraw-Hill Education, 2017 (“Anderson”)
Sunita Sharma, et. al., <i>Yarn Hairiness Determination Using Image Processing</i> , IOSR Journal of Electronics and Communication Engineering, Volume 11, Issue 5, Ver. II (Sep.-Oct. 2016), pages 48-52 (“Sharma”)
G. K. Tyagi, <i>Yarn structure and properties from different spinning techniques</i> , Chapter 5 of <i>Advances in Yarn Spinning Technology</i> , pages 119-154, published by Woodhead Publishing Limited, 2010 (“Tyagi”)
d’Art of Science, How to make a String Shooter? DIY String Shooter dArtofScience, YouTube video, June 29, 2018 (available at https://www.youtube.com/watch?v=bsZ93j_nUVc&t=283s) (“d’Art of Science”)
Print out of Yeany Youtube webpage (printed from https://www.youtube.com/watch?v=rffAjZPmkuU)
Print out of Scorch Youtube webpage (printed from https://www.youtube.com/watch?v=IGIDy-IJxmo)
Print out of d’Art of Science Youtube webpage (printed from https://www.youtube.com/watch?v=bsZ93j_nUVc&t=283s)

III. SUMMARY OF MY OPINIONS

8. I understand the following table summarizes the grounds of invalidity to be raised in an IPR Petition that I have been requested to provide my opinions on:

Ground	Prior Art	Basis	Claims Challenged
1	Yeany	§102	1-3, 12, and 15
2	Abello in view of Yeany	§103	1-3, 12, and 15-17
3	Wagner in view of Yeany	§103	1-3, 12, and 15
4	Wagner in view of Yeany and Scorch	§103	4, 16 and 17

9. It is my opinion that a person of skill in the art (defined below) would find at least claims 1-4, 12, and 15-17 invalid under the grounds proposed above. My opinions, and the bases therefor, are detailed throughout this Declaration.

IV. LEGAL PRINCIPLES

A. Understanding of Patent Law

10. I am not an attorney and will not be offering legal conclusions. However, I have been informed of several principles concerning legal issues relevant to my analysis of the Challenges to the claims of the '774 Patent, and I relied on these principles to arrive at my conclusions.

11. I understand a claim is anticipated if all limitations are found in a single prior art reference, arranged as in the claim. The identical invention must be shown in complete detail as is contained in the patent claim.

12. I understand a prior art reference can disclose an element not expressly identified in a reference if the element is “inherently present” in the reference. To be

“inherent,” I understand the missing element must necessarily be present in the reference. An element is not “inherent” if the missing element is only probably present or if there is merely a possibility it is present.

13. I understand a claim is invalid as obvious under 35 U.S.C. § 103 if the differences between the subject matter sought to be patented and the prior art are such that the subject matter of the claim as a whole would have been obvious at the time of the patent’s filing date to a Person of Ordinary Skill in The Art (POSITA). It is my understanding that the following factors are used to determine whether or not the claimed subject matter would have been obvious: (i) the scope and content of the prior art; (ii) the differences between the prior art and the claimed invention; (iii) the level of ordinary skill in the field of the invention; and (iv) any relevant objective considerations of non-obviousness.

14. I understand a party asserting obviousness based on a combination of prior art references must demonstrate that one of ordinary skill in the art would have been motivated to combine the teachings of those references to achieve the claimed invention with a reasonable expectation of success. It is my understanding that it is not sufficient to show that one of ordinary skill in the art *could* combine elements of multiple references. Instead, there must be a rational reason that would have prompted a POSITA to combine the elements in the way the claimed invention does; and the reason should be explained or articulated.

15. I understand a combination of references would not have been obvious if the alleged modification(s) to be made to the reference(s) are inconsistent with the stated goals of the reference(s). I understand a combination of references would not have been obvious if the modification of the reference(s) to derive what is claimed would render the reference(s) unsatisfactory or inoperable for their intended purpose. I further understand the party asserting obviousness must explain why a POSITA would have selected components for combination in the manner claimed.

16. It is my further understanding that an invention would not have necessarily been obvious simply because all the elements of the invention may have been known separately in the prior art; there must be a reason to combine the separately known elements. Obviousness cannot be based on a hindsight combination of components selectively picked from the art using the claims as guide.

B. Claim Construction

17. I understand that claim construction in an IPR proceeding is a legal question for the Patent Trial and Appeal Board (PTAB or Board) to decide. In general, I understand that claim terms are to be given their ordinary and customary meaning to a POSITA in the context of the patent at the time the patent was filed.

18. I also understand that in construing claim terms, the Board asks what the claim terms would mean to a person of ordinary skill in the relevant art in view of the plain claim language and the disclosures of the patent and prosecution history.

I understand that the Board may also consider other external evidence, such as dictionaries, however the disclosures in the patent and prosecution history carry more weight than external evidence.

19. As such, any claim term not construed should be given its ordinary and customary meaning as would be understood by one of ordinary skill in the art.

20. I understand that the best source for determining the meaning of a claim is intrinsic evidence—the claims themselves, the written description, and the prosecution history. I also understand that extrinsic evidence, which consists of all evidence external to the patent and prosecution history, may be considered to determine the meaning of a claim term.

21. In view of the principles described above and the materials I have reviewed, I do not believe any limitations in the claims addressed herein require a specific construction to support the opinions I provide in this declaration.

C. Level of Ordinary Skill in the Art

22. I understand that certain issues in an IPR, such as claim construction and whether a claim is invalid as obvious, are assessed from the view of a hypothetical person of ordinary skill in the relevant art at the time of the invention. I understand there are multiple factors relevant to determining the level of ordinary skill in the art, including: (1) the level of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the

technology; (3) the types of problems encountered in the field; and (4) the prior art solutions to those problems.

23. In order to determine the characteristics of a hypothetical POSITA at the time of the claimed invention, I have considered a variety of factors. I have considered the prior art (referred to in the “Materials Considered” section of this declaration) and the various approaches to address the design of string shooting devices disclosed in those prior art documents, the types of problems encountered in the art and the solutions to those problems, the alleged problems encountered by the inventor as described in the ’774 patent, the sophistication of the technology involved, and the educational background and experience of those actively working in the relevant field at the time of the invention.

24. I have been asked by counsel to assume the date of invention for the ’774 Patent is Nov. 18, 2021, as that is when the earliest provisional application was filed. I considered the technology available at that time and the knowledge of professionals with whom I worked during that time, including their levels of education, sophistication, and activities in professional associations. I am informed that such considerations are in accordance with factors identified in case law and typically considered to determine the level of skill in the art.

25. My understanding is that field of art for the ’774 patent is the field of toy or amusement devices.

26. In view of the above and based on my experience and knowledge, I believe a hypothetical Person of Ordinary Skill in The Art (POSITA) with regard to the '774 patent would be a person with a bachelor's degree in mechanical engineering, aerospace engineering, physics, or other science or engineering based degree that are familiar with general principles of mechanics and aerodynamics with at least two years of experience in product design and development in the field of toys or other amusement type devices.

V. THE '774 PATENT

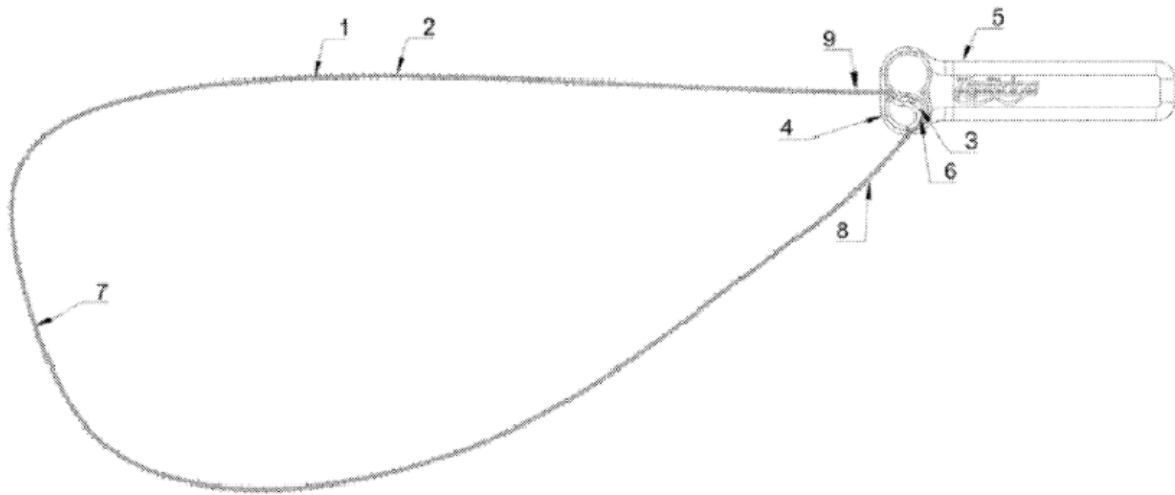
A. Priority of '774 Patent

27. The '774 patent claims priority to U.S. provisional application no. 63/280,810 filed on Nov. 18, 2021. *See* '774 Patent.

B. Summary of the '774 Patent

28. The '774 Patent relates “generally to a string shooting device, and more particularly, to a string shooting device having a string capable of generating lift when propelled from the string shooting device and a guide to readily attach and detach the string from the string shooting device.” '774 Patent at 1:14-19.

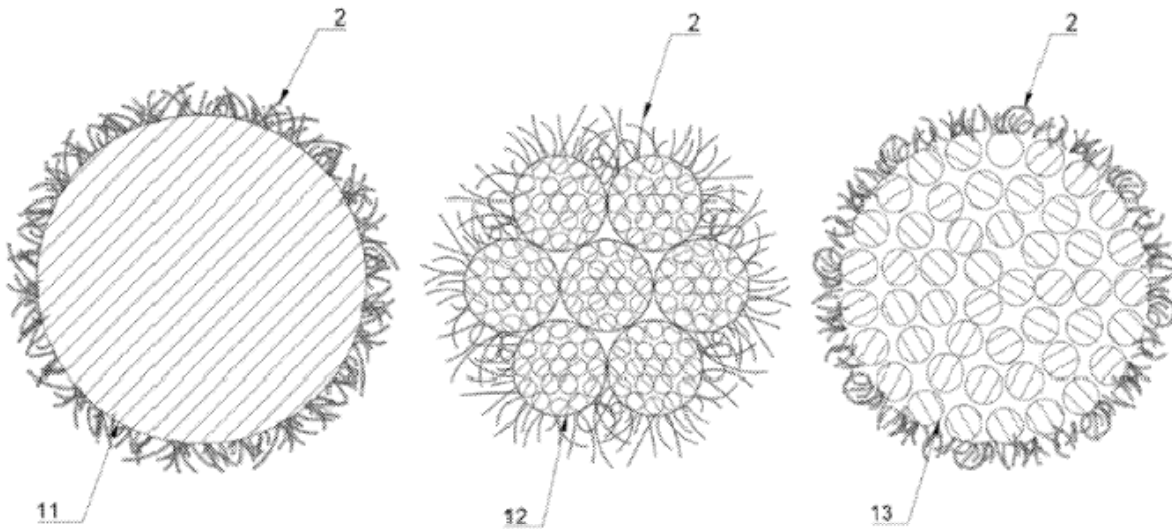
29. Figure 1, reproduced below, depicts an embodiment of the string shooting device with string 1, drive wheel 3, and body 5. *Id.* at 4:52-53.



'774 Patent at Fig. 1

30. The '774 Patent states that “[p]ropelling a flexible member such as a rope, string, or chain, is challenging as the inherent flexibility of such a member tends to allow a distal portion to succumb to gravity resulting in a short distance traveled by the member before dropping.” *Id.* at 1:21-26. The '774 Patent thus describes to “propel a flexible member further, increased air friction and greater speed is used in an effort to extend an arc of the flexible member, resulting in the flexible member traveling a greater distance before succumbing to gravity.” *Id.* at 1:26-29.

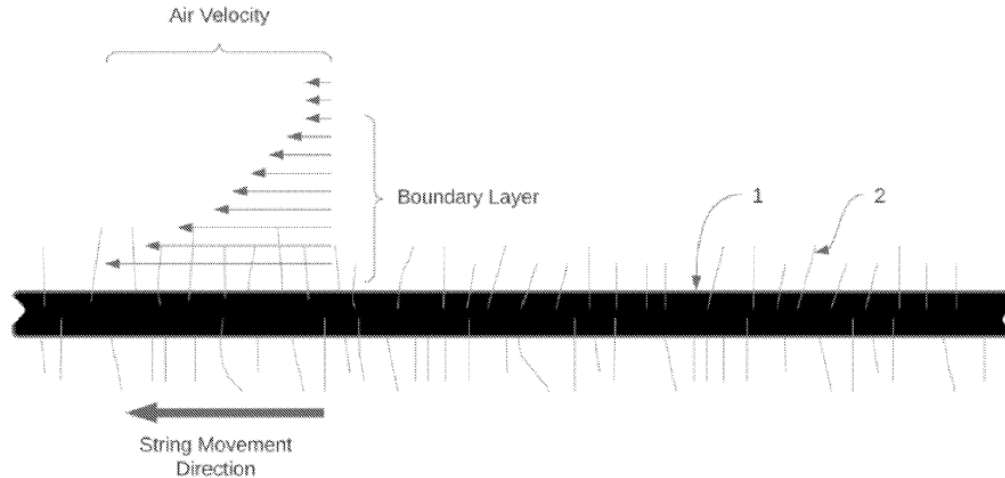
31. The '774 Patent further describes that “[e]mbodiments of the present disclosure employ the use of a string that has high surface area derived from threads, fibers or texture which radiate out from the surface of the string” with some examples shown in Figure 2. *Id.* at 4:13-16 and 5:6-10, FIG. 2.



'774 Patent at Fig. 2

32. The '774 Patent describes that “[t]he effect of the ‘fuzzy’ surface of the string magnifies the air friction thereby magnifying the positive lift against gravity.” *Id.* at 5:14-16. According to the '774 Patent, the “threads increase a surface area of the string, and impart turbulence around the string.” *Id.* at 5:24-26. The '774 Patent further states that “the orientation of the threads is not necessarily critical; however, the more they extend away from the string, the greater potential effect the threads can impart on the air around the string.” *Id.* at 5:26-29. According to the '774 Patent, “[e]mbodiments dynamically change the path of a moving string due to the enhanced turbulence of the boundary layer, which provides a lifting effect on the string as it is driven away from the drive wheel to lift a distal end of the looped string to counter

a weight of the string,” which is shown in Figure 5. *Id.* at 5:30-36, 5:57-61, *see also id.* at 6:53-56.



'774 Patent at FIG. 5

33. Finally, the '774 Patent contrasts how “the effect of lift on the looped string 1 ...give the appearance that the looped string 1 is weightless” (as shown in Figure 3 on left) with a looped string 1 having a smooth profile where “the gravitational effects weigh down the distal end 7 since there is little-to-no lift on the string” (as shown in Figure 4 on right). *Id.* at 5:10-19, 6:1-13, 6:23-33.

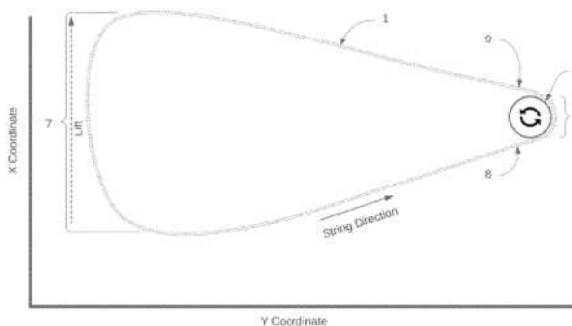
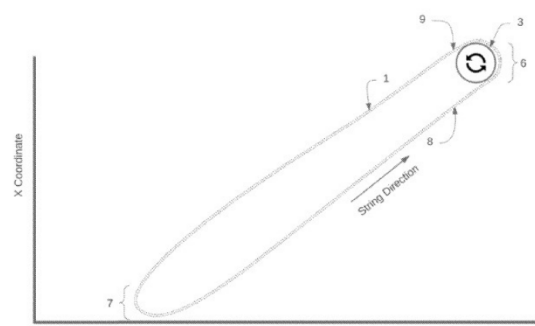


FIG. 3



PRIOR ART
FIG. 4

C. Summary of the Prosecution of the '774 Patent

34. During prosecution of the application that became the '774 Patent, the Examiner rejected the original independent claims in a single Office Action as being anticipated by U.S. Patent No. 5,205,266 to Kilby, Jr. ("Kilby") and alternatively as being anticipated by U.S. Patent No. 5,471,967 to Matsuzaki, *et al* ("Matsuzaki"). '774 Prosecution History at (NFOA, p. 3 and 6).

35. The Applicants argued that Kilby "is directed to a rubber band shooting device, and the alleged 'driven wheel 26' of Kilby does not 'propel' the rubber band, but merely releases the rubber band." *Id.* at (Response to NFOA, p. 7). Similarly, the Applicants argued that "Matsuzaki fails to relate to a string shooting device in any manner" as "the device of Matsuzaki is configured to 'discharge discs' and is incapable of propelling a string." *Id.* at (Response to NFOA p. 7).

36. Applicant amended pending claim 1 to incorporate the features of dependent claim 2 which recited "wherein the string defines an axis along which the string extends, and wherein the string comprises a plurality of fibers extending away from the axis" and made a similar amendment to independent claim 11 (which issued as independent claim 12). *Id.* at (Response to NFOA, p. 7).

37. As discussed below, the prior art relied on for the Grounds of Rejection all disclose string shooter devices that propel loops of string as well as all the limitations of the Challenged Claims. In my opinion, the references cited herein are

substantially more material than what the Examiner considered during prosecution – none of which were related to string in any way.

VI. BACKGROUND OF THE TECHNOLOGY

38. String shooter devices predate the '774 Patent with numerous examples in the prior art in YouTube videos, online tutorials, conventions such as a Maker Faire, journal articles, and patents as shown below. In addition, the general physics of solid objects moving through fluids (e.g., air) and the physics of string shooters specifically were well-known prior to the '774 Patent. The history of string shooter devices and the physics of how they operate would have been a part of the background knowledge of a POSITA.

A. History of String Shooter Devices

39. The first written study of a string shooter type device appears to be in 1949 when Gregory published a paper where an “investigation is made of the dynamics of a flexible loop, driven by a small pulley at a constant speed.” Gregory at 1; *see* Abello at 8 (stating that Gregory “first theorised the behaviour of the String Shooter in 1949.”). Gregory would explain much of the physics involved including the finding that a loop becomes air-borne “when the air-friction is greater than the weight of the loop” which is substantially the same principal disclosed on in the '774 Patent. Gregory at 1; *compare with* '774 Patent at 6:29-31 (“When sufficient lift in

the moving string overcomes the weight of the string, the string begins to hover or float in the air.”).

40. By at least the early 2000’s, the string shooter was conceived of for use as a toy or amusement device. For example, a patent was filed in 2001 by Clifford Wagner describing an “amusement device comprising an endless flexible loop and an inline traction drive unit to rotate the loop.” Wagner at 1:12-13.

41. Then in 2014, science teacher Bruce Yeany uploaded a video of his homemade string shooter. In the video, Yeany discusses how a string shooter operates and some of the interesting properties of the string during operation. *See* Yeany. Following Yeany’s video a plethora of other YouTube videos about homemade string shooters were published, including the Scorch video cited in this declaration. *See* Scorch; *see also* Abello at 1 and 8 (citing Yeany and Scorch when stating “The concept of our setup takes inspiration from YouTube videos.”).

B. Background Knowledge of Physics of String Shooter Devices

42. The challenged claims recite certain physical properties related to aerodynamics, including “air friction,” “turbulent air boundary layer,” and “lift.” *See e.g.*, ’774 Patent at 12:18-37. In textbooks and scientific papers, air friction is often described using the more generalized term of “skin friction,” which refers to the friction between the surface of a solid body and a fluid the solid body is moving through. When the fluid is air, the skin friction is the same as air friction.

43. These are well-known properties discussed in college level textbooks on physics, fluid mechanics, or aerodynamics. One such textbook explains the relationship between these as air friction causes a viscous boundary layer to stay attached to the surface of a solid body which produces lift on that body:

Indeed, the presence of friction is the very reason why we have lift. These sound like strange, even contradictory statements to our discussion in the preceding paragraph. What is going on here? The answer is that in real life, the way that nature insures that the flow will leave smoothly at the trailing edge, that is, the mechanism that nature uses to choose the flow shown in Figure 4.18c, is that the viscous boundary layer remains attached to the surface all the way to the trailing edge. Nature enforces the Kutta condition by means of friction. If there were no boundary layer (i.e., no friction), there would be no physical mechanism in the real world to achieve the Kutta condition.

Anderson at 342.

44. “There are two basic types of viscous flow: laminar flow...[and] turbulent flow” but “[f]or most practical applications in aerodynamics, the flow in boundary layers is predominantly turbulent.” Anderson at 73, 1051. As such, when the ’774 Patent recites that a friction increasing surface generates a turbulent boundary layer or lift, it is merely reciting physical properties well-known to a POSITA.

45. In addition to the more general teachings of aerodynamics in textbooks, there are numerous papers published prior to the '774 Patent that specifically explore the physics underlying string shooter devices, and they find that to make a looped string air-borne requires air friction or drag to overcome the effect of gravity on the weight of the string:

An investigation is made of the dynamics of a flexible loop, driven by a small pulley at a constant speed, for the case when the speed is sufficient to cause the loop to become air-borne. It does this when the air-friction is greater than the weight of the loop.

Gregory at 1.

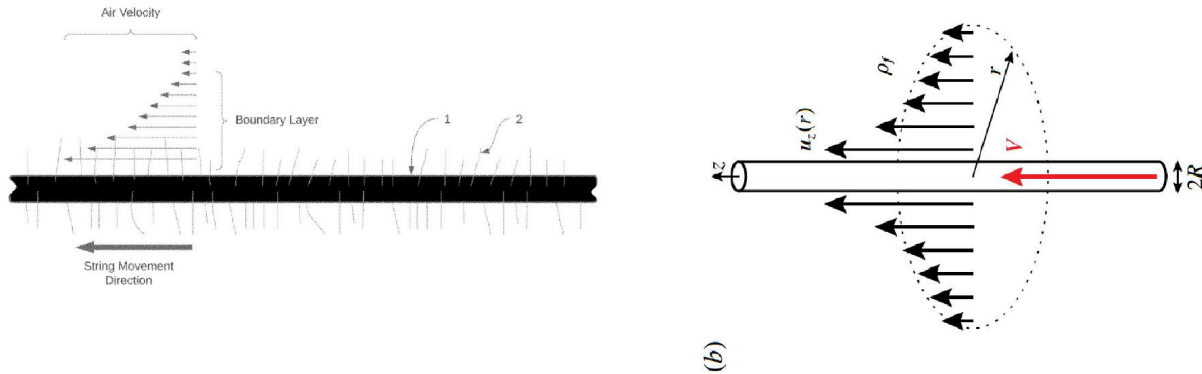
However, as soon the SSh [string shooter] reaches the threshold speed $v_{takeoff}$, air drag dominates over the weight and begins to lift the SSh.

Abello at 5.

Here we show that the hydrodynamic drag of air is a crucial ingredient in the dynamics of the string shooter, a physics toy in which a closed loop of flexible string is longitudinally entrained.

Daerr at 2; *see also id.* at 5 (“rough surface structures” on the string correspond to regions of hydrodynamic roughness which denotes a turbulent boundary layer).

46. Figure 2 of Daerr shows substantially the same aerodynamics of a string for a string shooter (including friction, drag and turbulent boundary layer) as shown in Figure 5 of the '774 Patent that purportedly illustrates the aerodynamics of the string of the claimed invention:



'774 Patent FIG. 5 (Left) and Daerr Fig. 2 (Right)

47. These papers demonstrate that a POSITA would have been aware of the underlying physics of a string shooter where friction produces a turbulent boundary layer and drag to generate sufficient lift to overcome the weight of the string.

C. Background Knowledge of Fibers Extending From String

48. As discussed in the prosecution history section, the apparent reason for allowance is based on the limitation reciting “the string comprises a plurality of fibers extending away from the axis.” ’774 Prosecution History at 114. The existence of such strings was ubiquitous. As a POSITA would know, most strings made with spun natural fibers would be expected to have fibers that extend from the string axis. This property is so common that there is a term used in the field of textiles - “hairiness”.

49. A description of hairiness is provided below:

Hairiness is a property which indicates the amount and length of fibre ends and loops protruding from the body of the yarn. *It is a desirable*

property in certain situations and undesirable in other circumstances, depending upon the type of end-use and application of the resultant fabric.

Tyagi at 124 (emphasis added); *see* Sharma at 1 (“Yarn is a generic term use for continuous strands of textile fibre, filaments or material”).

50. A graphical depiction of yarn hairiness showing protruding fibers extending from the core axis is provided in the background references as shown below:

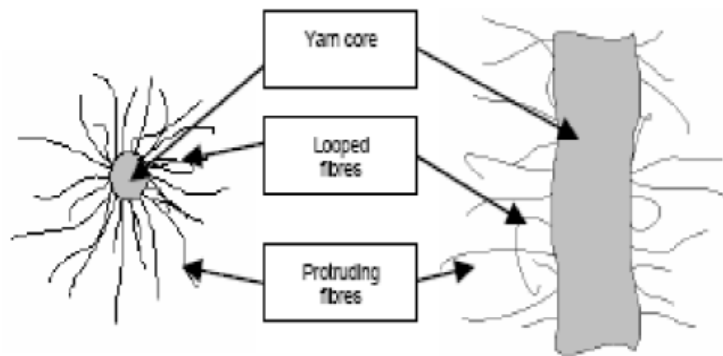


Fig1. Identification of yarn core and yarn hairiness (looped fibres and protruding fibres)

Sharma at Fig. 1

51. Yarns can be manufactured to produce strands with varying levels of hairiness. Tyagi at 125 (“Yarn hairiness can be regulated by [listing various factors].”) For the application in string shooter devices, hairiness would be a desirable property for the string for the reasons described above on the physics of string shooter devices since the hairiness would increase air drag to produce a turbulent boundary layer that generates lift.

52. There are multiple YouTube videos of string shooter devices before '774 Patent that use a string with fibers extending from the string axis as shown below.



Yeany at 1:16



D'Art of Science at 4:43

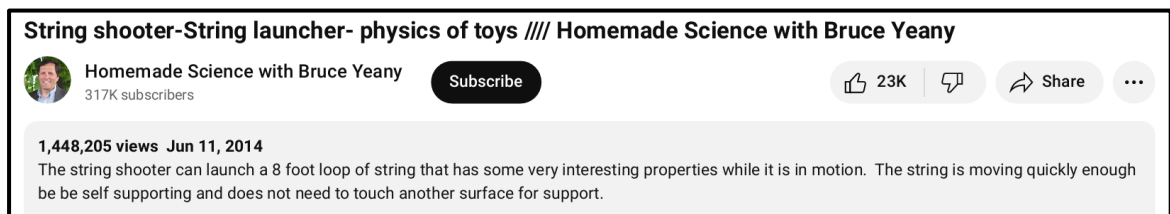
53. These papers and videos demonstrate background knowledge that a POSITA would have been aware of the availability of strings with fibers extending from the string axis and their usage in string shooter devices.

VII. OVERVIEW OF THE PRIOR ART

54. Before providing a detailed analysis of how the prior art discloses or teaches the limitations of the challenged claims, I will provide a brief summary of the individual prior art references I rely on for my opinions.

B. Summary of Yeany

55. The Yeany video YouTube webpage indicates it was published on June 12, 2014 (available at <https://www.youtube.com/watch?v=rffAjZPmkuU>). *See* Yeany YouTube webpage printout.



56. As explained by YouTube’s support webpage, “[w]hen you publish a video, the video is made available for anyone to watch,” and the “Publish date” is the shown “beneath your live video,” reproduced below. *See* YouTube Support webpage.

Learn the difference between “upload” and “publish”

When you **upload** a video, the video file is imported to YouTube.

When you **publish** a video, the video is made available for anyone to watch.

Figure out why your video’s upload date and publish date are different

- **Upload date:** The date you uploaded your video. Shows next to your private or unlisted video on your [Content page](#).
- **Publish date:** The date your video became public. Shows beneath your live video and is set to Pacific Standard Time (PST).

57. In addition, the YouTube webpage for the Yeany video indicates it has been viewed over one million times and has comments from viewers of the video dated prior to Nov. 21, 2021. *See Yeany YouTube webpage printout.*

58. Based on the publication information on the YouTube webpage for the Yeany video and YouTube’s support pages, it is my opinion that Yeany was publicly accessible to a POSITA as of June 11, 2014.

59. A POSITA in the field of toy or amusement devices at the time of the invention of the ’774 Patent would regularly review videos on YouTube and posts on other social media platforms for information related to new product ideas and designs. In addition, a POSITA would look at the comments from other users about YouTube videos and social media posts to gauge consumer sentiment about a particular product. Fascinating physics experiments are a common source of inspiration for new toy and amusement devices which are regularly posted on YouTube given their entertaining nature.

60. In addition, journal articles about string shooter devices published before the date of the '774 Patent that would be considered by a POSITA directly reference the Yeany video, including Daerr and Abello:

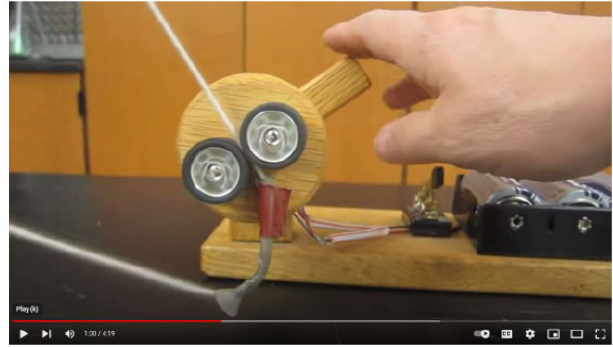
Here we show that the hydrodynamic drag of air is a crucial ingredient in the dynamics of the string shooter, a physics toy in which a closed loop of flexible string is longitudinally entrained. This toy was popularised online by Yeany (2014), and its understanding was one of the problems of 2019's International Physicists' Tournament (Collomb et al. 2019).

Daerr at 877; *see* Abello at 1 and 8 (citing Yeany video when stating “The concept of our setup takes inspiration from YouTube videos.”).

61. Given the above, a POSITA performing a reasonable diligent search for toys or amusement devices, particularly on string shooter devices, at the time of the invention of the '774 Patent would have discovered YouTube videos related to string shooters, including Yeany. A POSITA would have found Yeany's YouTube webpage through a general internet search or through citations from published journal articles.

62. Yeany is a YouTube video featuring Professor Bruce Yeany as he discusses a string shooter device he created. As shown in Yeany, the device is constructed from a length of string, two driven wheels, a housing tube, motors, batteries, an on/off switch, some wires, and the body of the device comprised of wooden blocks. When the device is turned on, the motors drive the wheels to propel

the string as a continuous loop that appears to float in air as seen in the images from Yeany below:



Yeany at 1:05 and 1:30

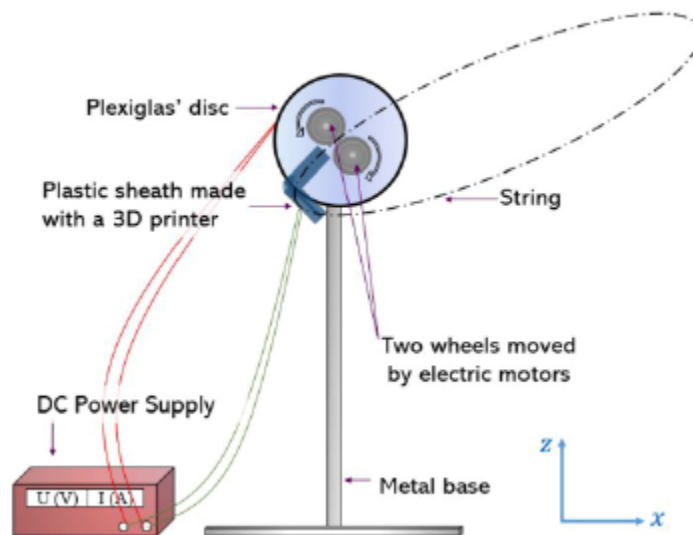
63. Notable, the string used by Yeany has a surface texture configured to increase air friction, as seen by the visible fibers extending from the string's surface in the below screenshot.



Yeany at 1:16

C. Summary of Abello

64. Abello relates to “an experimental setup wherein a closed string loop is propelled through the air using two motorized wheels spinning in opposite directions.” Abello at 1. Figure 2 of Abello illustrates the experimental setup. Abello at FIG. 2.



Abello at FIG. 2

65. Abello defines a “takeoff speed” as the threshold between a pulley state where the loop of string “dangles from the shooter,” and an air-lifted state “where the loop starts rising in the air.” Abello at 4. Abello further discloses that “as soon

[as] the SSh [string shooter] reaches the threshold speed, air drag dominates over the weight and begins to lift the SSh.” Abello at 5.

66. Abello tested multiple strings of different nature including “cotton, wool and polyester” strings. Abello at 2. Abello determined that the takeoff speed is influenced by the density and smoothness of the strings. Abello at 4-5. For example, the most dense and smoothest strings had the highest takeoff speeds requiring higher speeds to create lift. Abello at 5, Table 2. Table 1 illustrates the linear mass of the strings used in the experiment, while Table 2 illustrates the takeoff speeds measured by Abello for each string, both tables are reproduced below.

Linear mass μ (in $\text{g} \cdot \text{m}^{-1}$)		
Polyester	Wool	Cotton
p₄ $\mu_4 = 0.275 \pm 0.004$	w₂ $\mu_2 = 0.221 \pm 0.004$	c₁ $\mu_1 = 0.275 \pm 0.004$
p₅ $\mu_5 = 0.395 \pm 0.006$	w₃ $\mu_3 = 0.283 \pm 0.005$	–
p₆ $\mu_6 = 2.85 \pm 0.04$	–	–

Abello at Table 1

String used	v_{takeoff} (m s^{-1})
<i>c₁</i>	6.3 ± 0.4
<i>w₂</i>	2.6 ± 0.2
<i>w₃</i>	4.6 ± 0.3
<i>p₄</i>	4.6 ± 0.3
<i>p₅</i>	5.6 ± 0.5
<i>p₆</i>	10.7 ± 1.1

Abello at Table 2

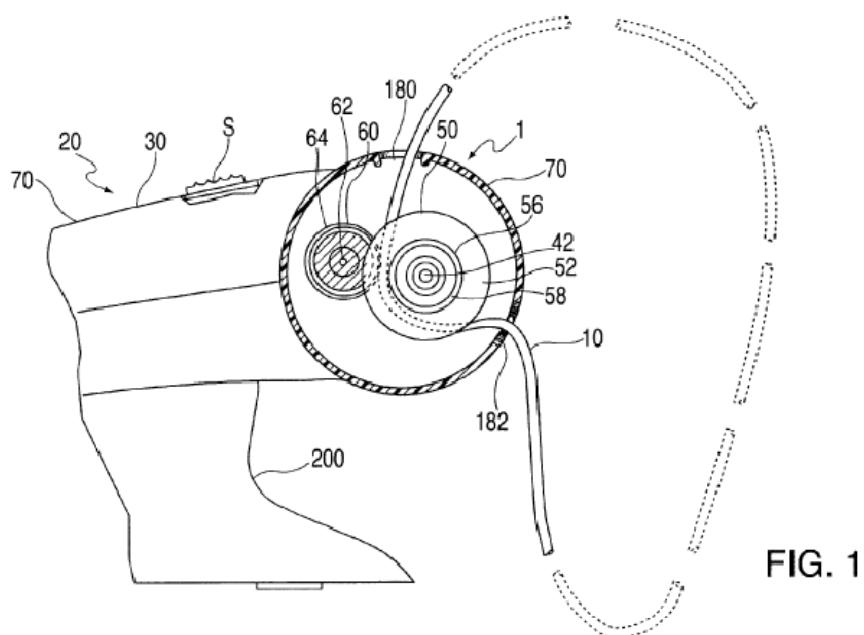
67. Abello describes that “polyester strings are in general smoother than wool strings on their surface.” Abello at 2. Abello further discloses that “the strings of w_3 and p_4 have the same $v_{takeoff}$ despite having different linear mass μ , which proves that there must be other parameters specific to each string (such as diameter, its material, etc.) that can influence their properties.” Abello at 5. Abello further describes that strings that are more worn out “may have induced more air drag and thus facilitated its takeoff.” Abello at 5.

D. Summary of Wagner

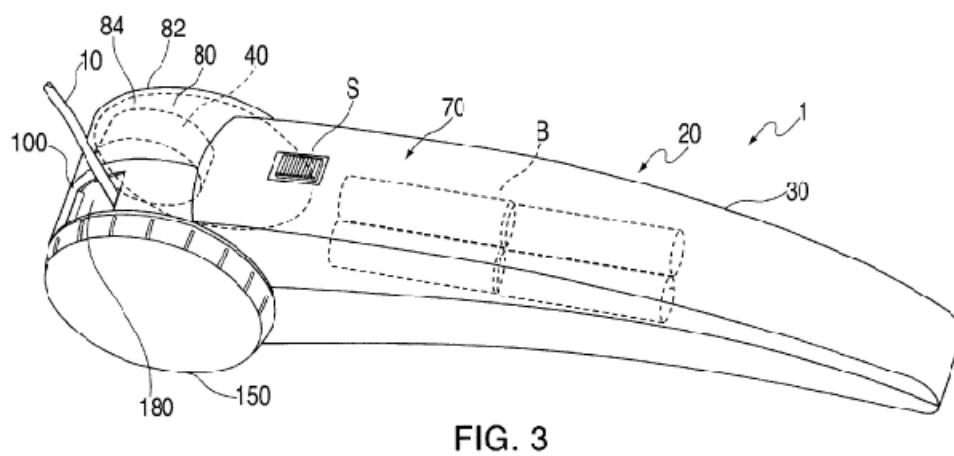
68. Wagner discloses an “amusement device comprising an endless flexible loop and an inline traction drive unit.” Wagner at 1:12-13. The loop 10 can be a highly flexible, limp, strand, or length of fabric or filaments without ends and may, for example, be formed by stitching or otherwise joining the ends of a length of woven string-like material. Wagner at 2:13-16. The “drive unit” 20 comprises a pair of circumferentially opposed drive wheels 50 and 60 and a housing 70, where at least one of the wheels is driven by a motor. Wagner at 2:23-27, 2:28-32. Wagner further discloses that the looped string 10 is positively driven by the inline traction drive unit 20 “generally in line with the longitudinal central axis of the loop 10.” Wagner at 1:65-2:4, 2:13-18.

69. Wagner further discloses a body (e.g., housing 70) which can include a base 80 and a handle 30. Wagner, 2:60-61. Wagner has a housing (e.g., rotatable cup

100 and/or cover 150) coupled to the body (e.g., base 80 and/or handle 30). Wagner at 2:60-3:3, 3:47-4:38. The relevant amusement device arrangement is shown in Figures 1 and 3, both reproduced below.



Wagner at Fig. 1

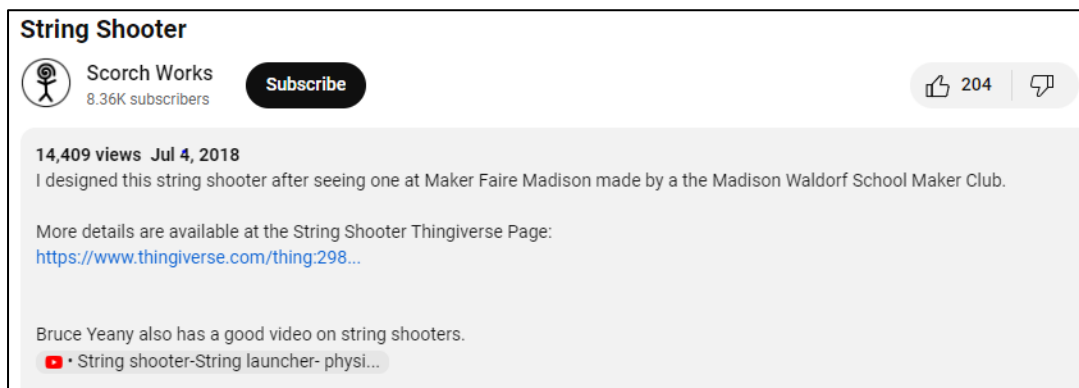


Wagner at Fig. 3

70. Wagner further discloses loading the string in the amusement device and propelling the looped string. Wagner at 3:57-62, 4:57-64. As shown in Figure 1 of Wagner, the looped string 10 is received between the drive wheel 50 and the backup wheel 60. Wagner at 2:37-40, FIG. 1. The wheels 50, 60 are within the cover 150 and the rotatable cup 100 (e.g., housing). Wagner at 4:22-38, FIG. 3. The looped string is propelled out of the cover 150 and rotatable cup 100 by the wheels 50, 60 through an ejection aperture 180 and enters into the cover 150 and the rotatable cup 100 to the wheels 50, 60 through a take-up aperture 182. Wagner at 4:22-38.

E. Summary of Scorch

71. The Scorch video YouTube webpage indicates it was published on July 4, 2018 (available at <https://www.youtube.com/watch?v=IGIDy-IJxmo>). *See* Scorch YouTube webpage printout.



72. Based on the publication information on the YouTube webpage for the Scorch video, and YouTube's support pages previously discusses, it is my opinion that Scorch was publicly accessible to a POSITA as of July 4, 2018.

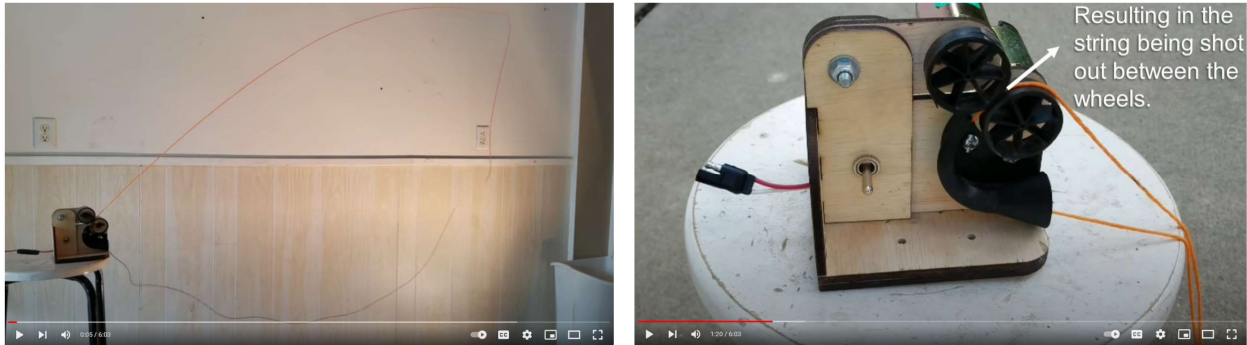
73. A POSITA in the field of toy or amusement devices at the time of the invention of the '774 Patent would regularly review videos on YouTube and posts on other social media platforms for information related to new product ideas and designs. In addition, a POSITA would look at the comments from other users about YouTube videos and social media posts to gauge consumer sentiment about a particular product. Fascinating physics experiments are a common source of inspiration for new toy and amusement devices which are regularly posted on YouTube given their entertaining nature.

74. In addition, a journal articles about string shooter devices published before the date of the '774 Patent that would be considered by a POSITA directly references the Scorch video. *See* Abello at 1 and 8 (citing Scorch video when stating "The concept of our setup takes inspiration from YouTube videos.").

75. Given the above, a POSITA performing a reasonable diligent search for toys or amusement devices, particularly on string shooter devices, at the time of the invention of the '774 Patent would have discovered YouTube videos related to string shooters, including Scorch. A POSITA would have found the Scorch YouTube

webpage through a general internet search or through citations from published journal articles.

76. Like the previous references, Scorch discloses a string shooter device that uses two wheels to shoot a loop of string.



Scorch at 0:05 and 1:20

77. Scorch also teaches the housing for a string shooter can include a loading slot on the side, as shown by the slot in the black funnel that houses the string. The narrator of Scorch says that, with the housing including the loading slot, “you can put a new string on, without having to disconnect the string or bond the string that’s in there.” Scorch at 5:23-29.



Scorch at 3:16

VIII. REASONS THE CHALLENGED CLAIMS OF THE ‘774 PATENT ARE UNPATENTABLE

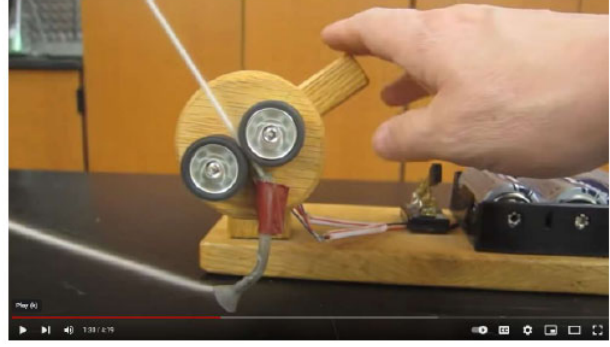
A. Yeany anticipates claims 1-3, 12 and 15-17

1. Claim 1

[1.0] A string shooting device comprising:

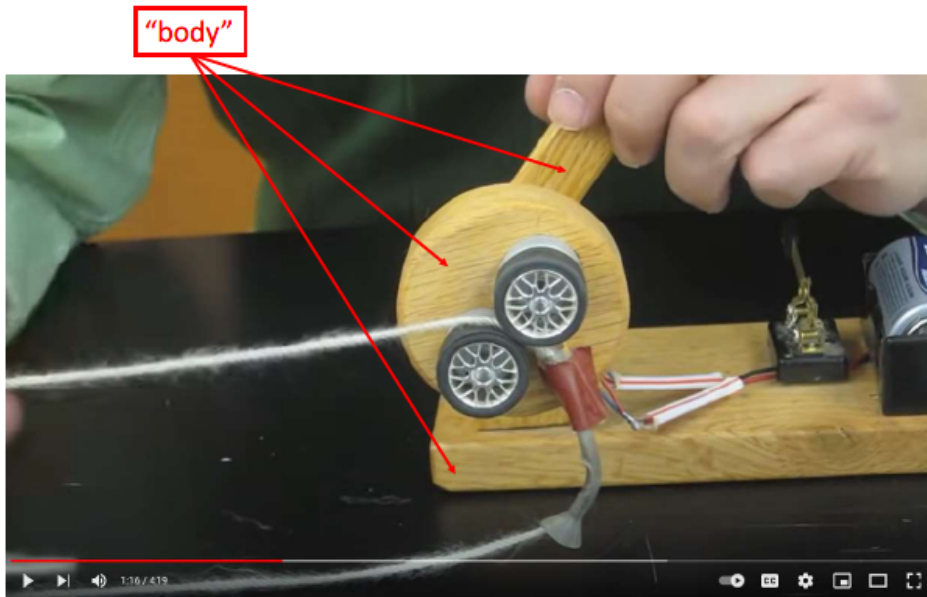
78. Yeany is a YouTube video where science teacher Bruce Yeany demonstrates “a device called a string shooter” that shoots a “long continuous string” in a loop. Yeany at 0:50-1:02.¹ The device spins the two wheels to “push the string forward.” Yeany at 1:17-22.

¹ Quotations of Yeany are taken from the audio portion of the Yeany video.



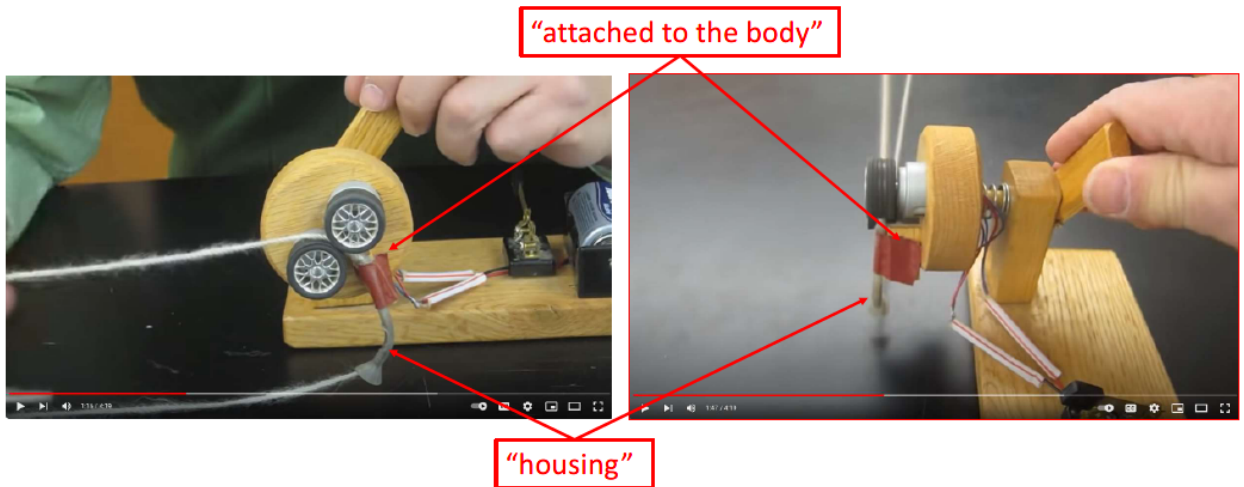
[1.1] a body:

79. The Yeany string shooter has a body, which is comprised of wooden pieces to which the other components are connected such as the wheels, tubing, on/off switch and battery. Yeany at 1:13:1:47. The picture below depicts portions of the wooden body (note that some portions of the body are hidden due to the angle of the picture).



[1.2] a housing attached to the body;

80. The Yeany string shooter has a hollow plastic tubing attached to the wooden body via a piece of red tape. Yeany at 1:13 to 1:47. As the video camera rotates around the body the red tape can be seen attaching the tubing (i.e., a housing) to the wooden pieces (i.e., the body). *See e.g., Yeany at 1:40.* The tubing is used to house the string and “guides it [the string] back into place in between the wheels.” Yeany at 1:13:1:47. This description of Yeany’s housing is commensurate with an embodiment in the ’774 Patent that “receiv[es] a looped string into a housing between a pair of wheels.” ’774 Patent at 2:11-13.

**[1.3] a pair of wheels, wherein at least one of the pair of wheels is a driven wheel;**

81. The Yeany string shooter has two wheels (i.e., a pair of wheels) that propel the string forward. As shown in the video there are two motors, one for each wheel. Yeany at 1:38-1:48. A POSITA understands that least one of the wheels is a driven wheel since “the two wheels will turn [via the motors] and that will push the

string forward.” Yeany at 1:17-1:22. This disclosure in Yeany is substantively identical to an embodiment in the ’774 Patent where the string is “propelled by a drive wheel 3 driven by a motor 4.” ’774 Patent at 4:52-54.

82. To further illustrate this, Yeany discloses the wheels at rest with the string not moving and conversely discloses driving the wheels with the string being propelled forward, as shown below. *Compare* Yeany at 1:16 (wheels at rest) *with* 1:30 (driving the wheels).

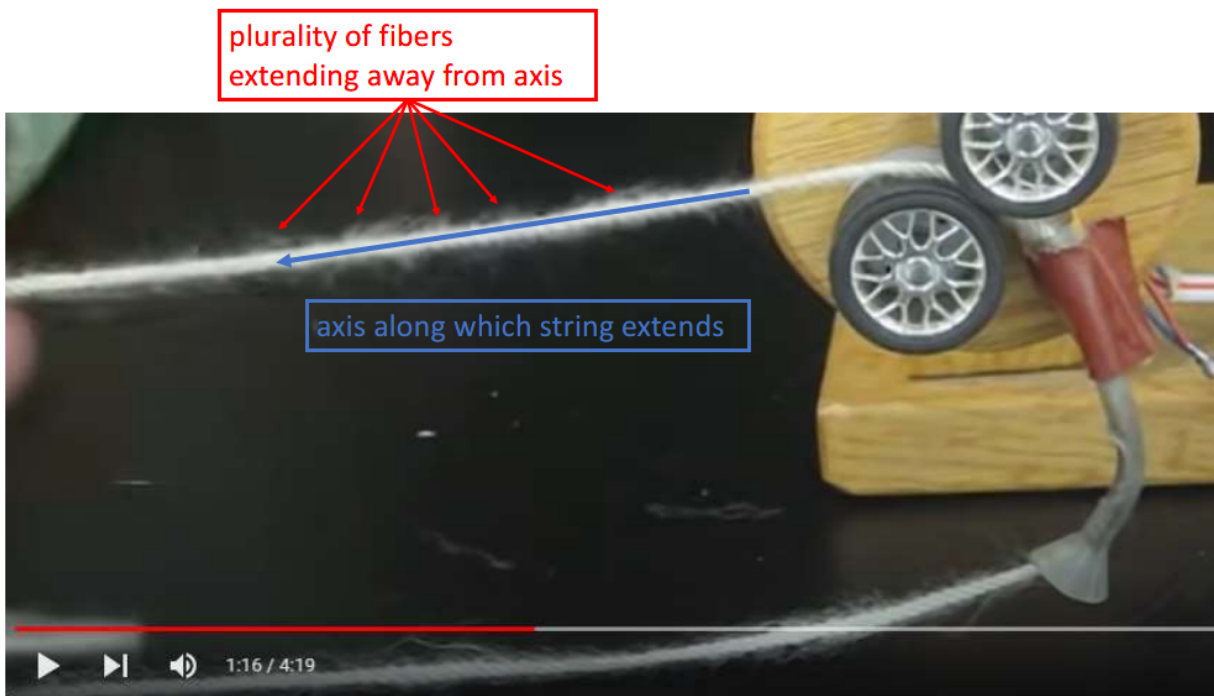


[1.4] a string, wherein the string comprises a surface texture configured to increase air friction in response to the string being propelled through air by the pair of wheels, wherein the string defines an axis along which the string extends, and wherein the string comprises a plurality of fibers extending away from the axis.

83. Yeany discloses “a device called a string shooter” that shoots a “long continuous string” in a loop. Yeany at 0:50-1:02. Although not verbally discussed in the narration, when the camera pans in on the string, it is visually shown to have fiber threads extending away from axis of the string creating a fuzzy surface texture

that would increase air friction when propelled through the air. Yeany at 1:14-1:25.

Examples of this surface texture and plurality of extending fibers on the string surface can be seen in the below screenshots:



84. This disclosure in Yeany is the same as the '774 Patent's description for how an extending fibers would appear fuzzy:

Embodiments of the present disclosure employ the use of a string that has high surface area derived from 15 threads, fibers or texture which radiate out from the surface of the string. When viewed closely the string could be described as "fuzzy".

Ex. 1001 at 4:13-17.

85. As stated in the '774 Patent the "effect of the 'fuzzy' surface of the string magnifies the air friction thereby magnifying the positive lift against gravity." '774 Patent at 5:14-16. This occurs regardless of the angle or orientation of the fibers extending from the string axis. '774 Patent at 5:21-29. This merely describes principals of physics that would likewise apply to Yeany's string having radiating extending surface fibers producing a fuzzy surface texture or "hairiness" to use fiber science terminology.

86. A POSITA would understand that the fuzzy surface texture of Yeany's string would increase the air friction relative to a string with a smoother surface texture because the fibers extending from the surface of the string would impede the movement of air near the string surface thereby increasing the friction between the string and the air.

87. Finally, a non-smooth string surface would increase friction when moving through air compared to a smooth string surface. This friction between the

surface of an object moving through a fluid is a well-studied physical property called skin friction. When the fluid is air, this property can be referred to as air friction. The extending fibers on the Yeany string must have some volume, mass, and surface area which would increase skin friction relative to a smooth string surface by increasing the string's resistance to movement when traveling through a fluid like air. As such, when the string is moving through air as shown in Yeany, a POSITA would know that the fibers extending from Yeany's string surface would necessarily increase the air friction between the string and the air relative to the same string surface without such extending fibers.

2. Claim 2

The string shooting device of claim 1, wherein the plurality of fibers extending away from the axis generate a turbulent air boundary layer around the string in response to the string being propelled through the air by the pair of wheels

88. Yeany discloses claim 1 as discussed above and claim 2 merely recites a well-known property of physics. As previously discussed for claim 1, Yeany discloses the string has loose fibers extending away from the longitudinal string axis creating a fuzzy surface texture that would increase the air friction relative to a string with a smoother surface texture. A POSITA would understand these extending fibers disclosed in Yeany would generate a turbulent boundary layer around the string.

89. It is well-known that friction between air and a solid body creates a viscous boundary layer that is turbulent for most practical applications. This is

explained in college textbooks as discussed in the Background of the Technology section:

Indeed, the presence of friction is the very reason why we have lift. ... the viscous boundary layer remains attached to the surface all the way to the trailing edge. Nature enforces the Kutta condition by means of friction. If there were no boundary layer (i.e., no friction), there would be no physical mechanism in the real world to achieve the Kutta condition.

Anderson at 342 (emphasis added). In addition, there “are two basic types of viscous flow: laminar flow...[and] turbulent flow” but “[f]or most practical applications in aerodynamics, the flow in boundary layers is predominantly turbulent.” Anderson at 73 and 1051.

90. A POSITA would understand the extending fibers on the Yeany string surface have some volume, mass, and surface area increasing the string surface area and, when the string is moving through air, cause collisions with the fluid particles comprising air. These collisions between the extending fibers on the string and the air would cause a viscous boundary layer near the string surface where the air flow of near the string surface is different than the air flow further from the string surface. In addition, because these extending fibers on Yeany’s string are not in a symmetrical distribution, the disruptions to the flow of air across the surface of the string surface created by the extending fibers would result in a turbulent boundary layer instead of a laminar boundary layer.

91. Moreover, the '774 specification does not explain the detailed causation of turbulence due the presence of extending threads on a string surface because it is a well-known physical phenomenon to a POSITA. At most the '774 Patent states “[t]he threads increase a surface area of the string, and impart turbulence around the string.” ’774 Patent at 5:21-26. Yeany discloses threads that increase the surface area of a string and thus disclose a turbulent boundary layer in as much detail as the ’774 Patent.

3. Claim 3

The string shooting device of claim 2, wherein the string is a looped string, wherein the looped string, at a distal portion furthest from the body, generates lift from the turbulent air boundary layer

92. Yeany discloses claim 2 as discussed above. Yeany discloses “a device called a string shooter” that shoots a “long continuous string” in a loop. Yeany at 0:50-1:02. Lift is a force that acts perpendicular to the movement of an object through fluid and in the context of the ’774 Patent is used to describe an upward force on the string that can counteract gravity’s effect on the weight of the string. ’774 Patent at Fig. 3 and 5:10-19.

93. As discussed with respect to claims 1 and 2, Yeany’s extending fibers produce friction that generates a turbulent boundary layer. It is well-known that “the presence of friction [which produces a boundary layer] is the very reason why we have lift.” Anderson at 342. Since the fibers extend away from the surface for the

entire length of Yeany's string, a POSITA understands that substantially the entire length of Yeany's looped string generates lift from the turbulent boundary layer to counteract gravity and stay aloft in the air, including the distal end. Yet, even if one assumes that only a small section of Yeany's string has the extending fibers then the lift would be still generated at the distal portion when the section of the string with the extending fibers was at the distal portion.

94. In addition, Yeany discloses lift generated along the string when the presenter taps his hand down on the looped string creating an intentional downward redirection of the string but then the string re-establishes its upward trajectory due to the force of lift acting on the string.



95. If there were no lift, then downward redirection of the string would cause the string to continue in the path of the redirection and ultimately hit the table. Instead, Yeany shows an upward force of lift along the entire length of the string

since after the deflection the entire loop of string is lifted all the way to the distal most portion.

96. The redirection of the string downward by the hand shows that the upward force on the Yeany string is not solely due to momentum in the direction the string is initially propelled. *See* '774 Patent at 7:9-8:4 (distinguishing '774 invention from string shooters that rely on momentum alone). Hence, the upward force on the distal portion of the looped string counteracting gravity is lift and not just momentum.

97. Additionally, the shape of the loop formed in Yeany discloses that lift is generated at the distal end, as the distal end does not fall down due to the force of gravity. For instance, the '774 Patent gives the below comparison of loops from its alleged invention that has “positive lift against gravity” (shown on left) compared to those in prior art where “the gravitational effects weigh down the distal end 7 since there is little-to-no lift on the string” (shown on right).

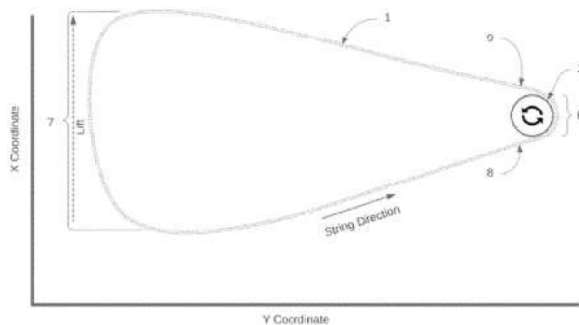
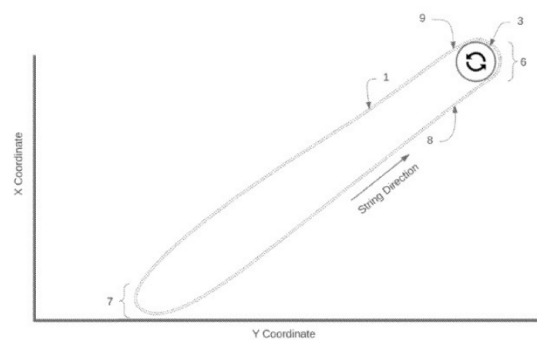


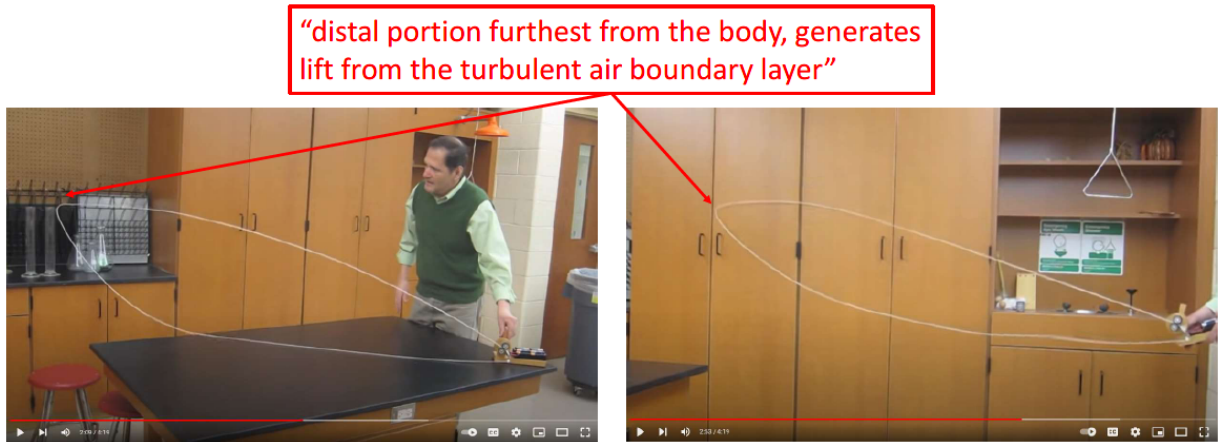
FIG. 3



PRIOR ART

FIG. 4

98. The looped string in Yeany has a loop shape substantially the same as shown in Figure 3 and does not depict a loop as shown in Figure 4.



99. Finally, the '774 Patent states:

With sufficient lift, the modified string overcome gravitational forces on the distal end 7 of the looped string 1 and give the appearance that the looped string 1 is weightless.

'774 Patent at 4:14-19. A “weightless” appearance for the distal end of the looped string is precisely what a POSITA observes with the fuzzy string used in the string shooter of the Yeany video. *See e.g.*, Yeany at 2:09-2:31.

100. As previously discussed, this lift disclosed in Yeany is generated by the turbulent boundary layer produced by the extending fibers on the Yeany’s string. Likewise, the alleged invention “generate[s] a lift force for a rapidly moving looped string by expanding a boundary layer of turbulent air around the string. This expansion of the boundary layer is achieved by threads radiating out from an axis

along which the string extends creating friction with the air or ‘drag’ as the string moves through the air.” ’774 Patent at 4:27-33. Thus, Yeany discloses the same method of generating lift from a turbulent boundary layer as in the ’774 Patent since the same laws of physics apply to Yeany as the ’774 Patent. *See* Anderson at 73, 342 and 105.

101. In sum, Yeany discloses its “string is a looped string, wherein the looped string, at a distal portion furthest from the body, generates lift from the turbulent air boundary layer” to a POSITA, who would have background knowledge of the physics involved in a string shooter including how lift is generated.

4. Claim 12

[12.0] A method of propelling a looped string through air comprising:

102. Limitation [12.0] is disclosed by Yeany for the reasons previously provided for limitation [1.0].

[12.1] receiving a looped string into a housing between a pair of wheels, wherein at least one of the pair of wheels is a driven wheel,

103. Limitation [12.1] is disclosed by Yeany for the reasons previously provided for limitations [1.2] (discussing receiving a looped string into a housing between a pair of wheels) and [1.3] (discussing wherein at least one of the pair of wheels is a driven wheel). Limitation [12.1] is further shown in the below annotations of Yeany where the looped string is received into the tubing (i.e., a

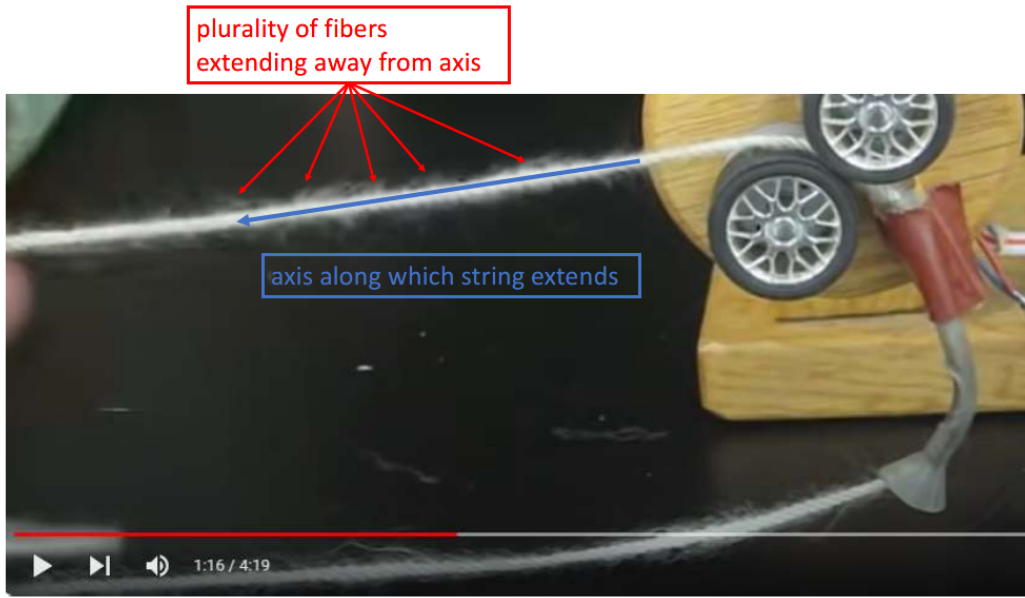
housing) between a pair of wheels that are both being driven by motors to propel the string:

“receiving a looped string into a housing between a pair of wheels”



[12.2] wherein the looped string defines an axis along which the string extends, and wherein the looped string comprises a plurality of fibers extending away from the axis;

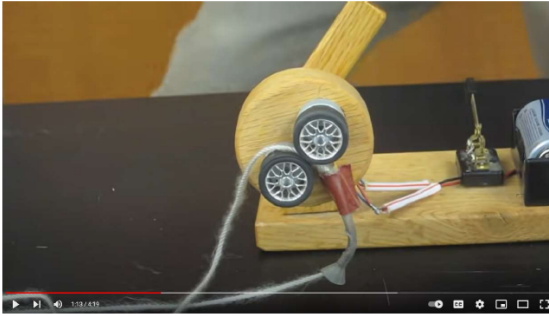
104. Limitation [12.2] is disclosed by Yeany for the reasons previously provided for limitation [1.4]. Limitation [12.2] is further shown in the below annotations of Yeany identifying the string axis and the fibers extending away from the axis:



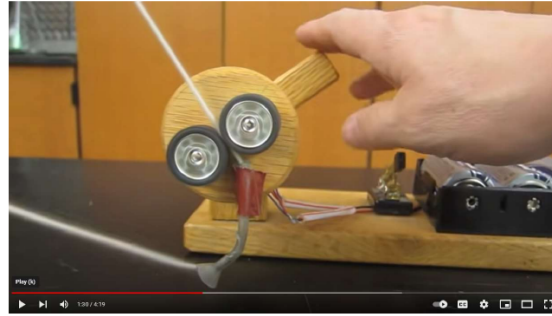
[12.3] driving the at least one driven wheel;

105. Limitation [12.3] is disclosed by Yeany for the reasons previously provided for limitation [1.3]. Limitation [12.3] is further shown in the below annotations of Yeany comparing on off state to an on state where the motors are driving both wheels:

wheels at rest



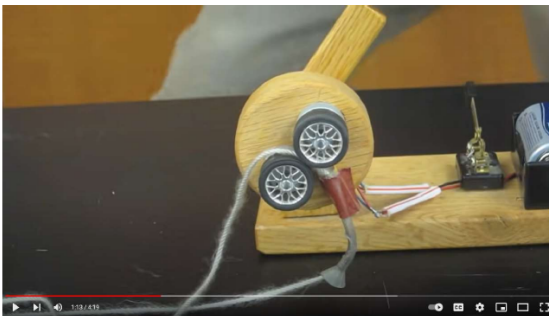
driving both wheels



[12.4] propelling the looped string from the at least one driven wheel; and

106. Limitation [12.4] is disclosed by Yeany for the reasons previously provided for limitation [1.3] (discussing how driving the wheels propels the string). Limitation [12.4] is further shown in the below annotations of Yeany disclosing the looped string being propelled from the pair of driven wheels:

wheels at rest



driving both wheels



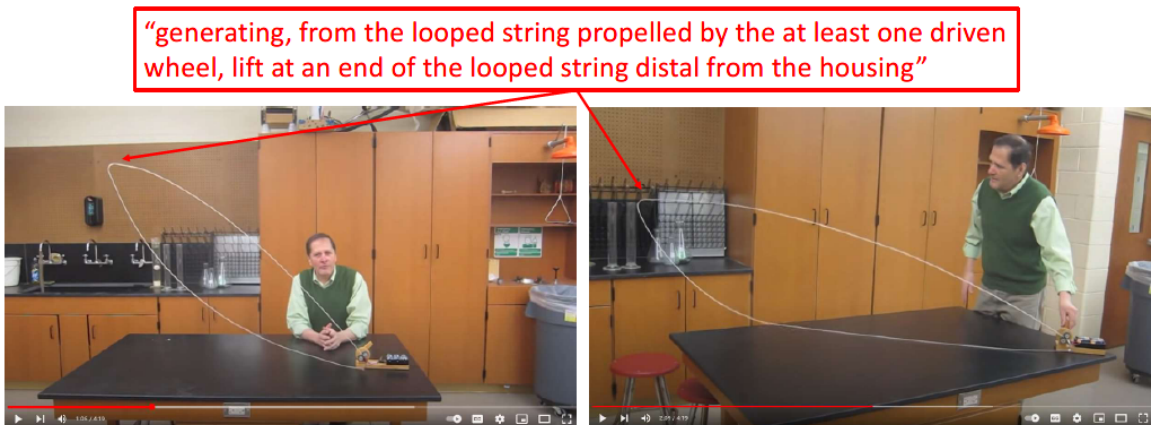
[12.5] generating, from the looped string propelled by the at least one driven wheel, lift at an end of the looped string distal from the housing based on a surface texture of string configured to increase air friction in response to the looped string being propelled.

107. Limitation [12.5] is disclosed by Yeany for the reasons previously provided for claims 2-3 (discussing how Yeany generates lift at the distal end of the looped string based on the fuzzy extending string threads producing a turbulent boundary layer) and limitation [1.4] (discussing how the fuzzy extending string threads are a surface texture configured to increase air friction in response to the looped string being propelled).

108. Limitation [12.5] is further shown in the below annotations of Yeany disclosing the fuzzy threads extending from the string axis that increase air friction:



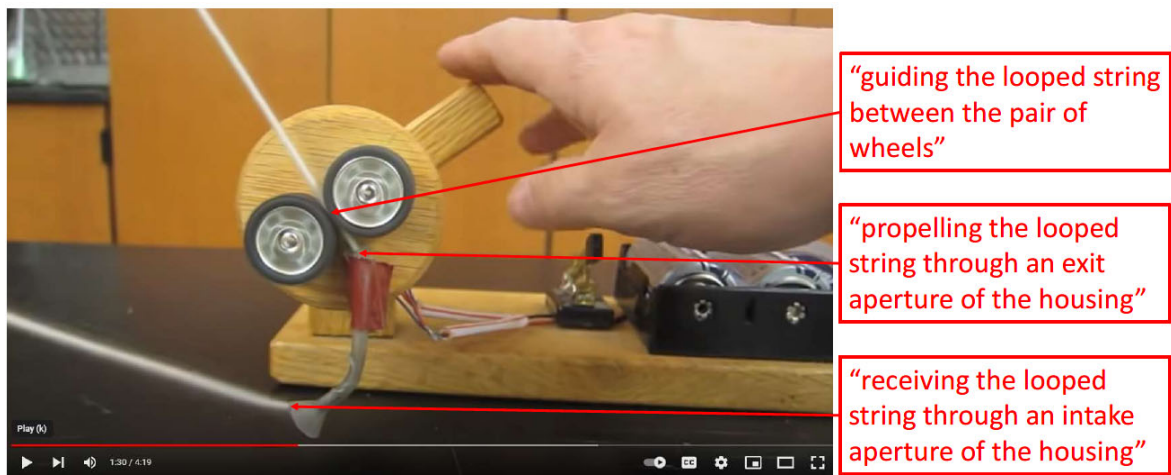
109. In addition, Limitation [12.5] is further shown in the below annotations of Yeany disclosing the generating lift at the distal end based on the fuzzy threads extending from the string axis that increase air friction:



5. Claim 15

The method of claim 12, wherein propelling the looped string from the at least one driven wheel comprises: receiving the looped string through an intake aperture of the housing; guiding the looped string between the pair of wheels; and propelling the looped string through an exit aperture of the housing.

110. Yeany discloses claim 12 as discussed above. As previously discussed, Yeany discloses a tube as a housing for the looped string. This tubing “guides [the string] back into place in between the wheels.” Yeany at 1:13-1:47. As shown below, the tubing includes an intake aperture where the string enters the tubing and an exit aperture where the string is propelled out of the tubing. *Id.* Since the string in Yeany is a loop, all three steps are occurring simultaneously as the loop of string is continuously moved while Yeany’s string shooter device is turned on.



B. Abello in view of Yeany renders obvious claims 1-3, 12, and 15-17

111. Abello discloses a string shooter device that discloses all of the limitations of the claims except it does not expressly state the string has fibers

extending away from the axis. However, in view of Abello's disclosure that air drag caused by the surface of the string must overcome weight in order to lift the string, a POSITA would have looked to ways to increase the air drag. Abello at 3 and 5.

112. Increasing the drag on the string reduces the takeoff velocity required to lift the string, which provides a number of benefits. For example, reducing the takeoff velocity would allow the string shooter to operate with slower spinning wheels reducing the amount of power consumed from the batteries leading to longer operation times or reducing the size and/or quantity of batteries needed. Additionally, slower spinning wheels would reduce the noise created by the spinning wheels leading to a more pleasing operating environment to a user. Furthermore, reduced takeoff speeds would be achieved by smaller motors. These benefits would work together to improve the operation of Abello's string shooter while decreasing cost and size given the less powerful components needed.

113. Abello suggests one approach to achieve increased drag is to increase roughness of the string surface. Abello at 7. Abello also notes that strings that are "more worn...may have induced more air drag and thus facilitated its takeoff." Abello at 5, FN 4.

114. Abello also notes that Yeany was an inspiration and directly cites to Yeany. Therefore, a POSITA looking to increase drag on a string shooter based on the teachings of Abello would have been aware of the rough string surface in the

Yeany video and been motivated to use a fuzzy string with extending fibers on the string surface as used in Yeany. Yeany's fuzzy string would have increased the drag on the string and provided the benefits discussed above for improved operating with decreased cost and size.

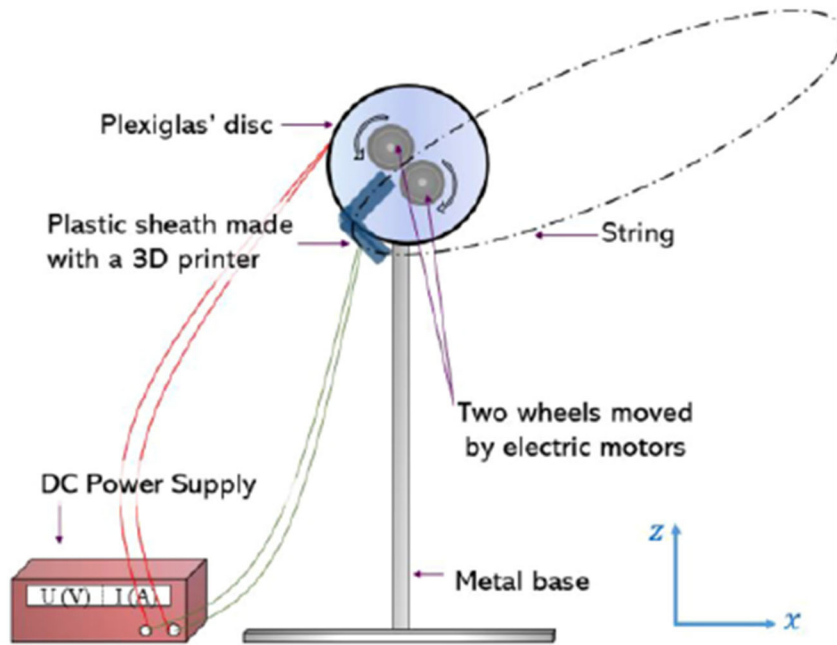
2. Claim 1

[1.0] A string shooting device comprising:

115. To the extent the preamble of claim 1 is limiting, it is taught by Abello. Abello discusses a "String Shooter." Abello at 1. Abello discloses that the "String Shooter is an experimental setup wherein a closed string loop is propelled through the air using two motorized wheels spinning in opposite directions." Abello at 1-3.

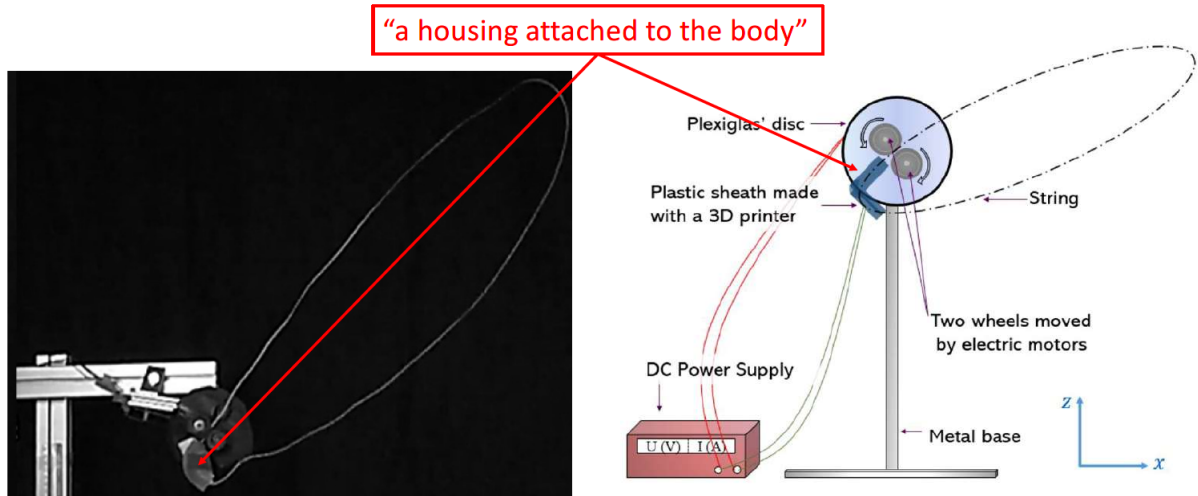
[1.1] a body:

116. Abello discloses a body for the string shooter comprised of "a Plexiglas disk" and a metal base. Abello at 2. Figure 2 of Abello, reproduced below, illustrates how the components of the string shooter are connected.

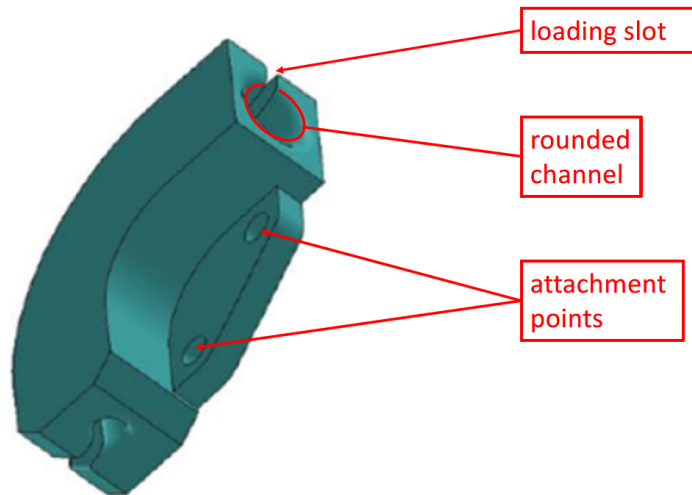


[1.2] a housing attached to the body;

117. Abello discloses a plastic sheath is “placed under the wheels in such a way that it guides the returning string back in between the wheels.” Abello at 2. The plastic sheath is a housing since it houses the string to guide it back to the wheels. Abello at 2. This plastic sheath (i.e., the housing) can be seen attached to the plexiglass wheel (i.e., the body) in Figures 1 and 2.



118. In addition, Figure 3 provides a three-dimension illustration of the sheath, depicting two circular attachment points, a loading slot to insert a string and a rounded channel where the string would be housed during use. Abello at 2.



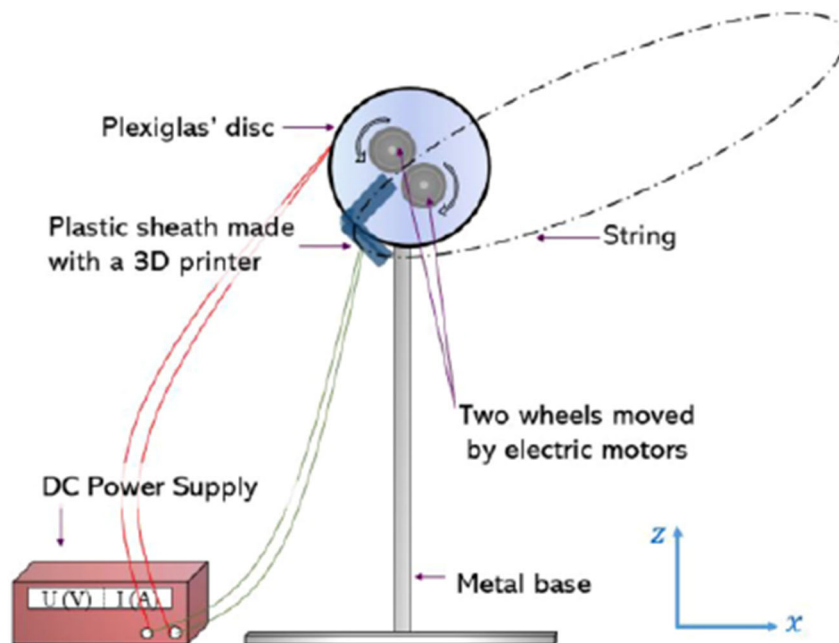
Scheme δ

119. A POSITA would understand that the attachment points indicated in Figure 3 above would be used to attach the sheath (i.e., housing) to the plexiglass disc using screws and that looped strings would be placed into the sheath using the

loading slot. As the string shooter operates, the sheath would house the string within the rounded channel while the string traveled in a continuous loop.

[1.3] a pair of wheels, wherein at least one of the pair of wheels is a driven wheel;

120. Abello discloses that the string loop is ejected into the air “using two motorized wheels spinning at high speed.” Abello at 1-2. Specifically, Abello utilized Solar-botics RW2-3MM wheels as “rubber tyres, ensuring an optimal grip on the string. Each wheel was mounted on an MFA RE385 motor.” Abello at 2; *see also id.* at Figs. 1 and 2 (showing a string being propelled into the air by a pair of wheels).



[1.4] a string, wherein the string comprises a surface texture configured to increase air friction in response to the string being propelled through air by the pair of wheels, wherein the string defines an axis along which the string extends, and wherein the string comprises a plurality of fibers extending away from the axis.

121. Abello discloses the use of a string “made into a loop by making a thin knot or using strong glue.” Abello at 1-2. The string is propelled by the wheels where until the string reaches an air-lifted stationary state. Abello at 2-5. In particular, Abello discloses that “as soon the SSh reaches the threshold speed v_{takeoff} , air drag dominates over the weight and begins to lift the SSh.” Abello at 5; *see also* id. at 8 (“Using a mathematical model, we have shown that a drag term is indeed necessary to describe an air-lifted state and that there indeed exists a threshold between these two states when the air drag equals the weight.”).

122. Abello studied “strings of different nature (cotton, wool and polyester), as for instance the polyester strings are in general smoother than wool strings on their surface.” Abello at 2. Abello also discloses that texture of the string is a factor that influences the linear drag force applied on the string. Abello at 4. The texture of the string can include roughness, fibre material, diameter, etc. to affect the air friction, or air drag, and subsequently the lift for the string. Abello at 4-7.

123. Although Abello does not provide explicit details on the surface texture of the string, it does disclose testing strings having different surface smoothness. Abello at 2 (“for instance the polyester strings are in general smoother than wool

strings on their surface”). Abello also notes that strings that are “more worn...may have induced more air drag and thus facilitated its takeoff.” Abello at 5, FN 4. A POSITA would understand that when natural fibers are worn, the fibers break and split away from the core increasing the hairiness of the fibers. In addition, Abello teaches that “the smoothest strings were the ones to have the highest takeoff speeds.” Abello at 4-5.

124. Abello also notes that “[t]he most severe issue however was wear, especially at higher speeds.” Abello at 7. Therefore, based on the teachings of Abello, a POSITA would be motivated to use a string with a non-smooth surface order to reduce the takeoff speed of the string which would thereby reduce the wear on the string, motors, wheels, and sheath.

125. One such string with a rough surface is disclosed in Yeany, which is one of the YouTube videos Abello specifically references as the inspiration for his paper. Abello at 1 and 8 (Yeany is listed as the first reference in the list of references). A POSITA looking at Yeany would understand that the fibers extending from the surface of Yeany’s string would cause air friction that produces air drag to achieve Abello’s finding that air drag must dominate over weight to achieve an air-lifted state for the string. A full explanation of how Yeany’s string “comprises a surface texture configured to increase air friction in response to the string being

propelled through air by the pair of wheels” was discussed above with respect to Yeany anticipation analysis and incorporated by herein.

126. The underlying physics of drag, lift, and turbulent boundary layers for Yeany’s fuzzy string travelling through air would be the same in Abello’s string shooter. Accordingly, if Yeany’s string was utilized in Abello’s device, the device would achieve a similar result as the properties to create lift of the string depend on the physical characteristics of the string itself (such as surface texture, weight, velocity) when the string travels through the same fluid, like air.

3. Claim 2

The string shooting device of claim 1, wherein the plurality of fibers extending away from the axis generate a turbulent air boundary layer around the string in response to the string being propelled through the air by the pair of wheels

127. Abello discloses that “air flow along the string is neither perfectly laminar ($k=1$) nor totally turbulent ($k=2$) but intermediate.” Abello at 5. Accordingly, Abello teaches that the texture of the string in a string shooter device creates a turbulent boundary layer when the string is being propelled through the air since the air along the string is not laminar. While Abello does not expressly state the source of this turbulent boundary layer, a POSITA would understand it is caused by non-smooth surface textures.

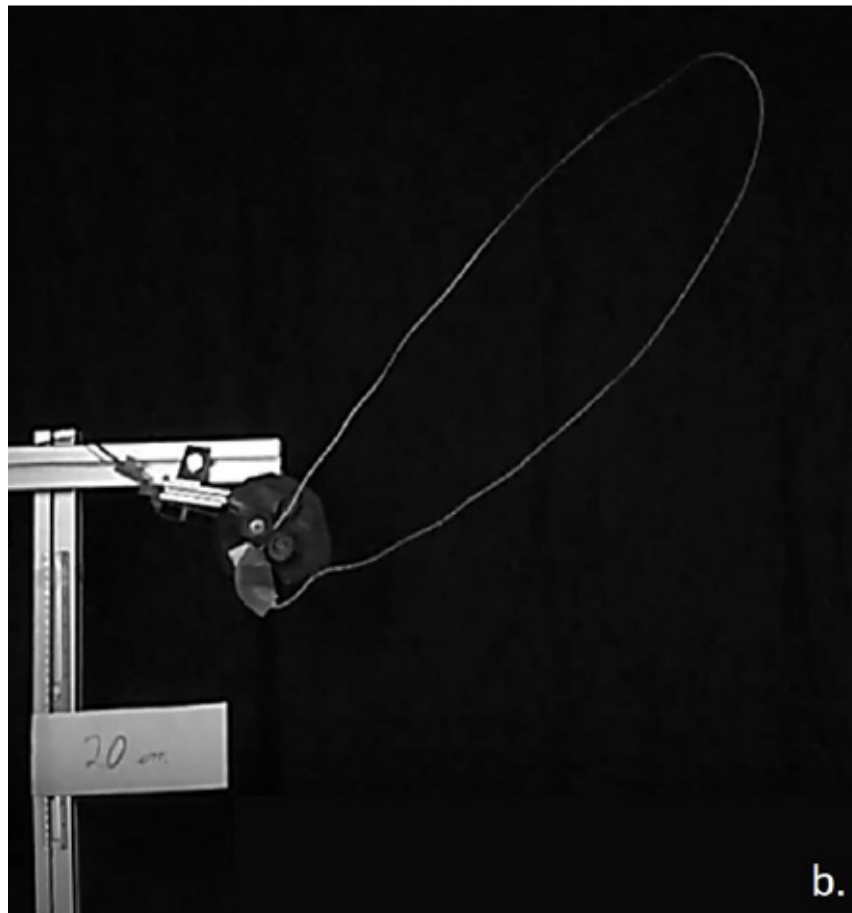
128. When the string of Yeany is used in the device of Abello, the non-smooth surface textures would be the fibers extending from the surface of Yeany’s

string. For the reasons previously discussed, Yeany's teaches "the plurality of fibers extending away from the axis generate a turbulent air boundary layer around the string in response to the string being propelled through the air by the pair of wheels."

4. Claim 3

The string shooting device of claim 2, wherein the string is a looped string, wherein the looped string, at a distal portion furthest from the body, generates lift from the turbulent air boundary layer

129. Abello and Yeany disclose claim 2 as discussed above. Abello discloses a string shooter where the distal portion of the looped string is lifted against gravity as seen in Figure 1b, reproduced below. Abello at 1.



130. This is consistent with the '774 Patent illustration of its invention (Fig. 3 on left) compared to the prior art string shooters where the distal end falls due to gravity (Fig. 4 on right).

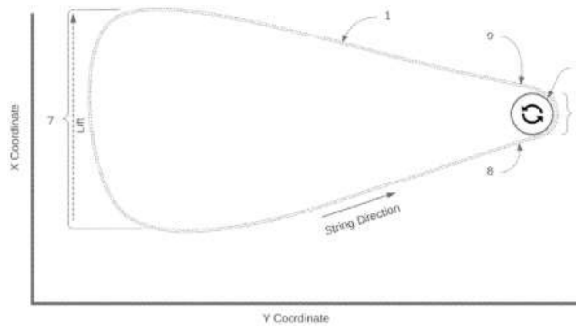


FIG. 3

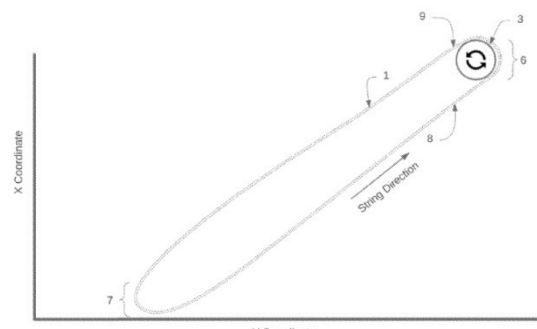


FIG. 4

131. Moreover, when Abello is combined with the looped string of Yeany, Yeany teaches “wherein the looped string, at a distal portion furthest from the body, generates lift from the turbulent air boundary layer” for the reasons previous discussed.

5. Claim 12

[12.0] A method of propelling a looped string through air comprising:

132. Limitation [12.0] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.0].

[12.1] receiving a looped string into a housing between a pair of wheels, wherein at least one of the pair of wheels is a driven wheel,

133. Limitation [12.1] is disclosed by Abello in view of Yeany for the reasons previously provided for limitations [1.2] (discussing receiving a looped string into a housing between a pair of wheels) and [1.3] (discussing wherein at least one of the pair of wheels is a driven wheel).

[12.2] wherein the looped string defines an axis along which the string extends, and wherein the looped string comprises a plurality of fibers extending away from the axis;

134. Limitation [12.2] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.4].

[12.3] driving the at least one driven wheel;

135. Limitation [12.3] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.3].

[12.4] propelling the looped string from the at least one driven wheel; and

136. Limitation [12.4] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.3] (discussing how driving the wheels propels the string).

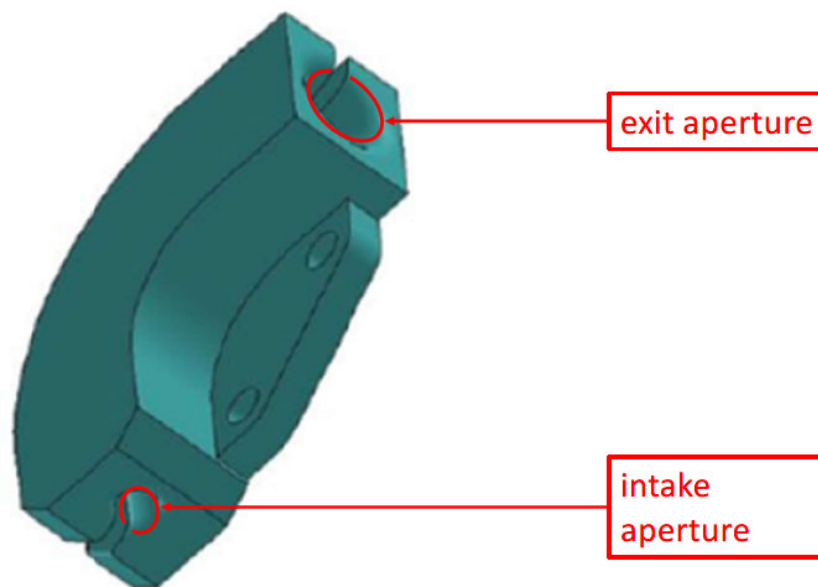
[12.5] generating, from the looped string propelled by the at least one driven wheel, lift at an end of the looped string distal from the housing based on a surface texture of string configured to increase air friction in response to the looped string being propelled.

137. Limitation [12.5] is disclosed by Abello in view of Yeany for the reasons previously provided for claims 2-3 (discussing how the combination of Abello in view of Yeany generates lift at the distal end of the looped string based on the fuzzy extending string threads producing a turbulent boundary layer) and limitation [1.4] (discussing how the fuzzy extending string threads are a surface texture configured to increase air friction in response to the looped string being propelled).

6. Claim 15

The method of claim 12, wherein propelling the looped string from the at least one driven wheel comprises: receiving the looped string through an intake aperture of the housing; guiding the looped string between the pair of wheels; and propelling the looped string through an exit aperture of the housing.

138. Abello and Yeany disclose claim 12 as discussed above. As previously discussed, Abello discloses a sheath as a housing for the looped string. *See* limitation [1.2]. This sheath “guides the returning string back in between the wheels.” Abello at 2. As shown below, the sheath includes an intake aperture where the string enters the sheath and an exit aperture where the string is propelled out of the sheath. *Id.*; *see also* Abello at Fig. 1b and 2 (both showing string going through sheath). Since the string is a loop, all three steps are occurring simultaneously as the string is continuously looped through string shooter device.



Scheme δ

7. Claim 16

[16.0] A string shooting device comprising:

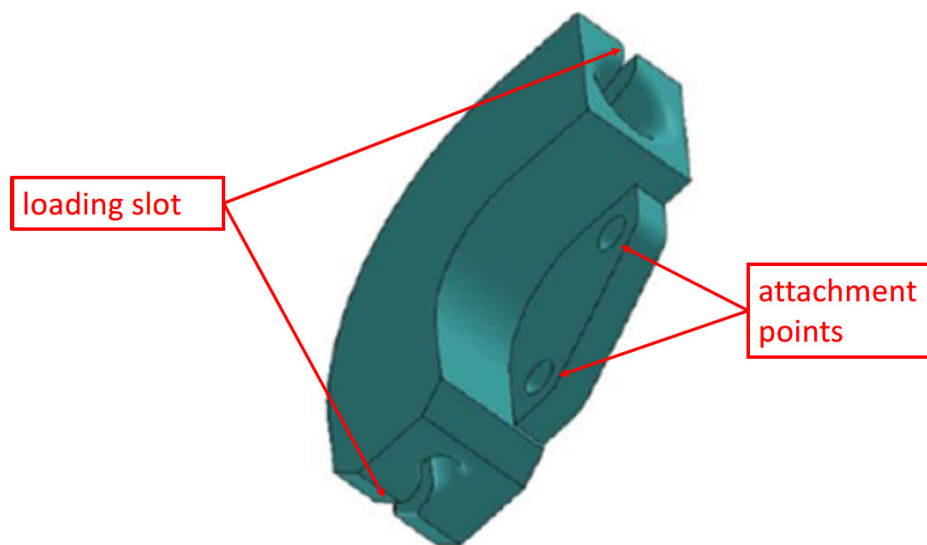
139. Limitation [16.0] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.0].

[16.1] a body,

140. Limitation [16.1] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.1].

[16.2] a housing attached to the body and defining a loading slot;

141. Limitation [16.2] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.2]. The housing with defined loading slot is illustrated below:



Scheme δ

[16.3] a pair of wheels, wherein at least one of the pair of wheels is a driven wheel,

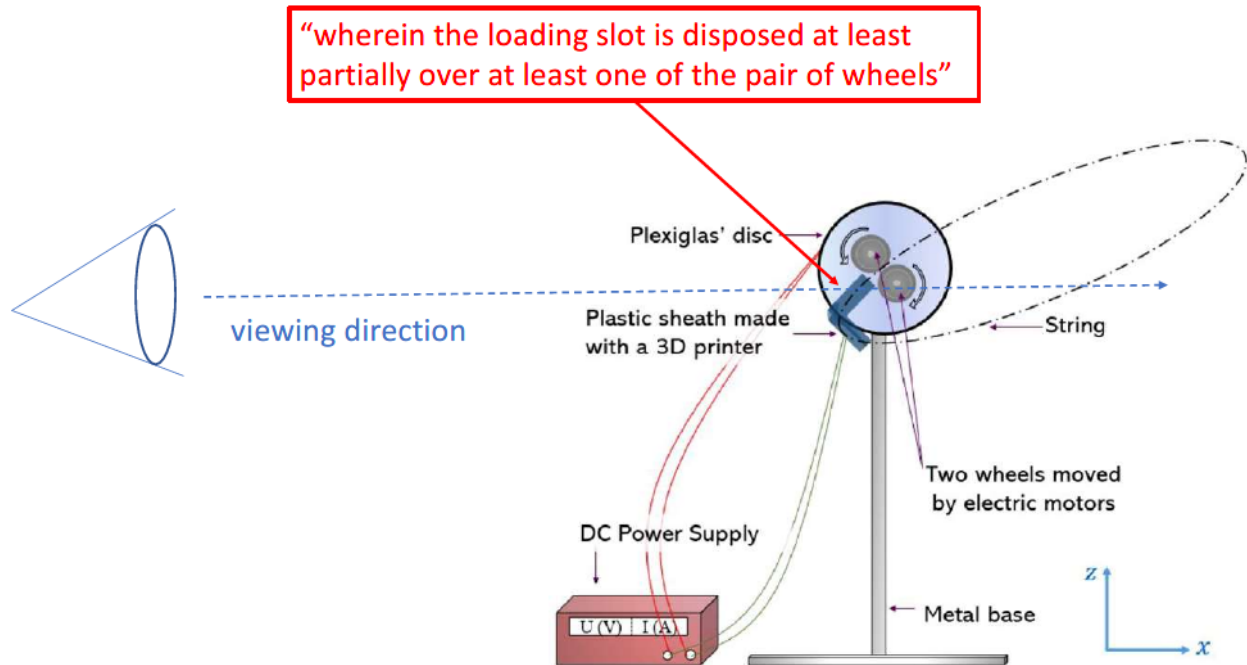
142. Limitation [16.3] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.3].

[16.4] wherein the loading slot is disposed at least partially over at least one of the pair of wheels; and

143. As previously discussed, Abello's sheath has a loading slot. Abello at 2. The sheath comprising the loading slot partially surrounds the lower wheel and is "over" the wheel depending on a viewer's perspective.

144. Claim 16 does not provide any point of reference for a POSITA to determine if the loading slot is "over" one of the wheels and thus the claim would encompass a loading slot disposed over one of the pair of wheels from any perspective.

145. For example, a natural position for a user of the string shooter is to be on the side of the device opposite the direction of the loop. From this position, the sheath of Abello would be at least partially over the lower wheel obscuring it from view.



146. Therefore, Abello's loading slot is disposed at least partially over at least one of the pair of wheels. Abello at Fig. 3

[16.5] a looped string, wherein the looped string comprises a surface texture configured to increase air friction in response to the looped string being propelled through air by the pair of wheels.

147. Limitation [16.5] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.4].

8. Claim 17

The string shooting device of claim 16, wherein the surface texture comprises a plurality of fibers extending away from an axis along which the looped string extends to generate a turbulent air boundary layer around the looped string in response to the looped string being propelled through the air by the pair of wheels.

148. Claim 17 is disclosed by Abello in view of Yeany for the reasons previously provided for Claim 2.

C. Wagner in view of Yeany renders obvious claims 1-3, 12 and 15

149. Wagner discloses a string shooter device that discloses all of the limitations of the claims except it does not expressly state the string has fibers extending away from the axis. However, Wagner teaches an amusement device where an inline drive unit “impart[s] linear velocity on to the strand to create an elongated loop extending from the drive unit” causing unsupported portions of the loop to form various configurations. Wagner at Abstract, 1:63-2:12 and 5:50-56. A POSITA would have been motivated to look to ways reduce the velocity required to lift the unsupported loop portions to form various configuration, which provides a number of benefits. For example, reducing the takeoff velocity would allow the string shooter to operate with slower spinning wheels reducing the amount of power consumed from the batteries leading to longer operation times and/or reducing the size and/or number of batteries needed. Additionally, reduced operating speeds reduces the wear on the string, wheels, and motors prolonging the useable life of

these components. Furthermore, slower spinning wheels would reduce the noise created by the spinning wheels leading to a more pleasing operating environment to a user. Lastly, reduced takeoff speeds would be achieved by smaller motors. These benefits would individually or in combination improve the operation of Wagner's string shooter while decreasing cost and size of the components that make up a string shooter.

150. The background knowledge of string shooters operation and physics known to a POSITA would have informed a POSITA that one way to decrease velocity of the string while still allowing it to form various configurations in air was to increase the friction between the surface of the string and the air. Wagner teaches that its loop can be any flexible strand and gives one example as a woven string-like material. Yeany was a popular string shooter video prior to the time of the invention that taught using a woven string like material with radiating extending fibers that increased air friction. Therefore, a POSITA looking to reduce string velocity needed for Wagner's device would have been motivated to use a woven string like material with radiating extending fibers on the string surface as used in Yeany. Doing so would have provided the benefits discussed above for improved operating with decreased cost and size.

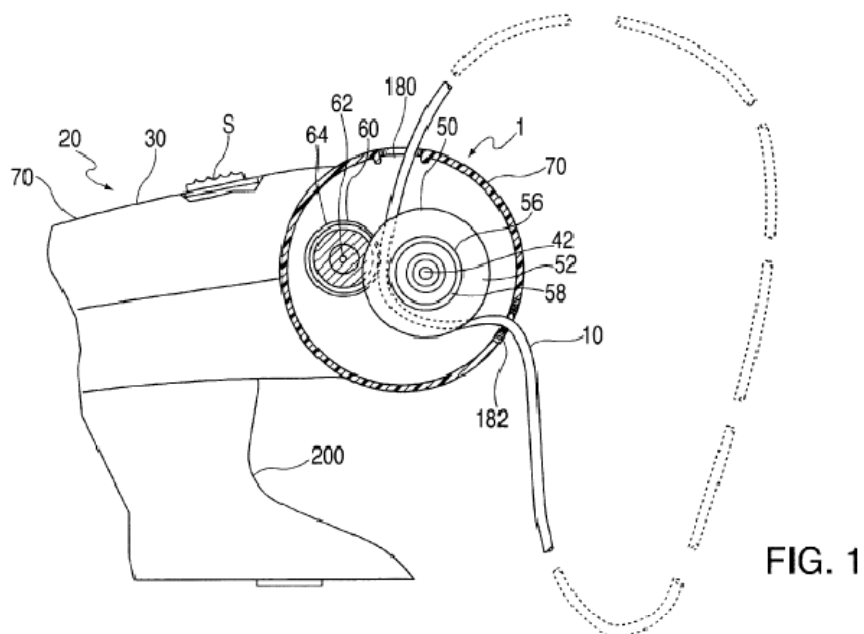
2. Claim 1

[1.0] A string shooting device comprising:

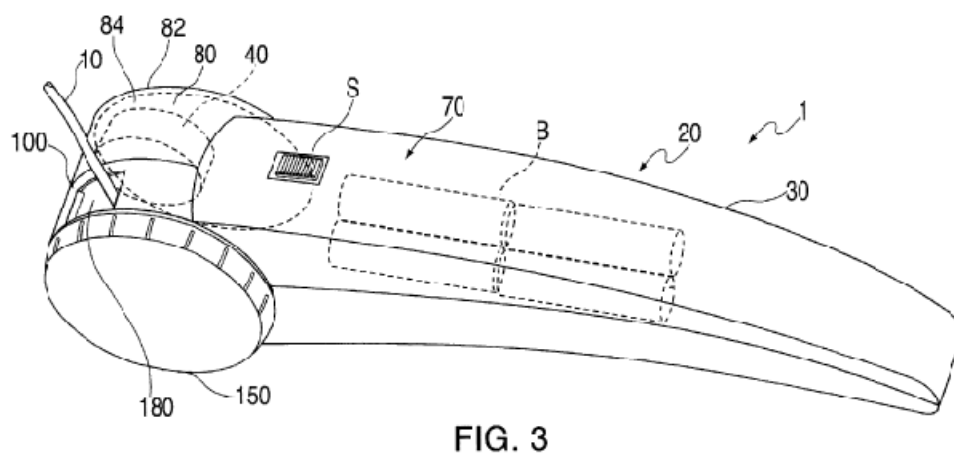
151. Wagner's invention relates generally to "[a]n amusement device comprising an endless flexible loop and an inline traction drive unit to rotate the loop." Wagner at 1:13-14. Wagner discloses "an amusement device" with an inline traction drive unit that positively drives the loop such that the unsupported portion of the loop is drive, or "thrown" by the drive unit, it assumes a "metastable" configuration. Wagner at 1:62-2:12, FIGS. 1-3.

[1.1] a body:

152. Wagner discloses a body which includes at least "a handle 30 for gripping the drive unit and for changing its orientation" and "a base 80 integrally extending from the handle 30" and an electric motor attached to a rotatable cup. Wagner at 2:23-27 and 2:60-64. Wagner's body encloses the electric motor and batteries. *Id.*



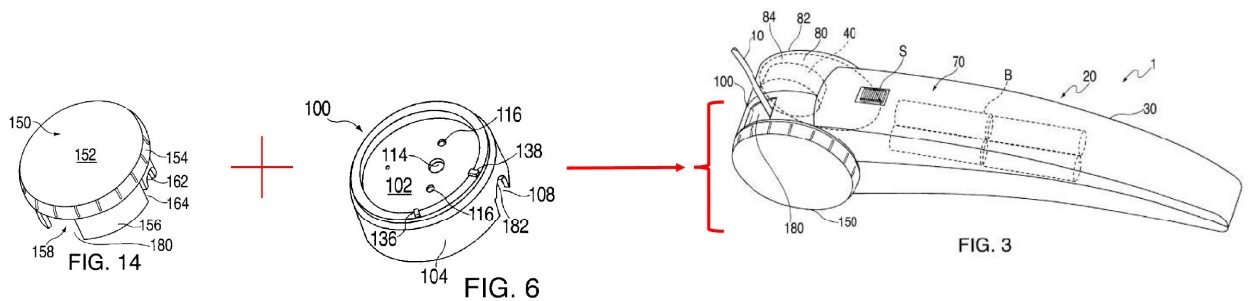
Wagner at Fig. 1



Wagner at Fig. 3

[1.2] a housing attached to the body;

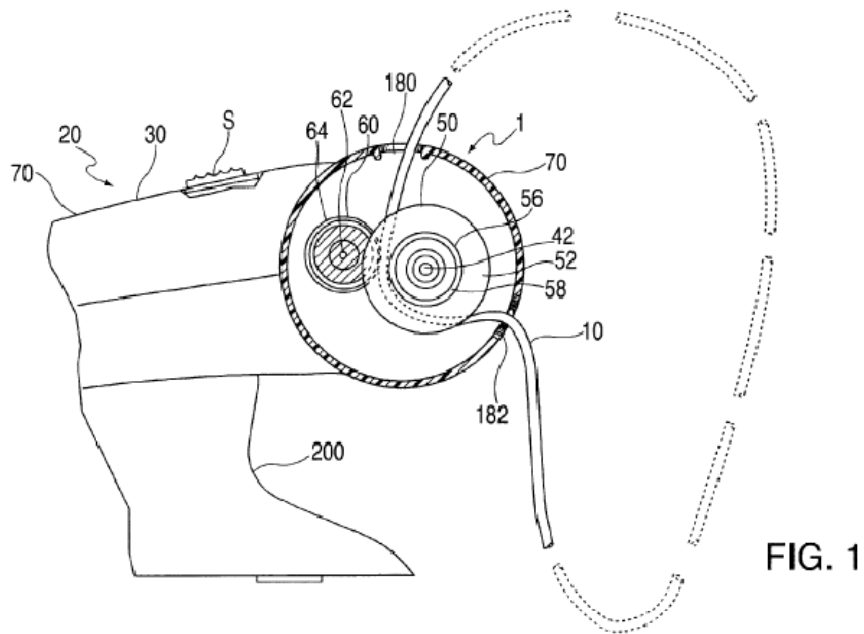
153. Wagner also discloses a housing comprised of “a rotatable cup 100, and a cover 150.” Wagner at 2:60-64. The rotatable cup is attached to the body where “[a]ttachment may be by a pair of fasteners passing through spaced apertures 116 and 118.” Wagner at 2:65-3:15; *see also id.* at 2:62-64 (body includes “electric motor 40 attached to the rotatable cup 100”). The cover is then attached to the rotatable cup using a “friction fit.” Wagner at 3:47-62.



a housing attached to a body

[1.3] a pair of wheels, wherein at least one of the pair of wheels is a driven wheel;

154. The drive motor of Wagner includes a drive motor and “a pair of circumferentially opposed drive wheels 50 and 60.” Wagner at 2:23-59, 3:15-21. The drive motor includes a drive shaft 42 that drives one of the drive wheels. Wagner at 2:28-36. During operation of the device, “the drive wheel 50 rotates, in turn driving the loop 10 in line and in cooperation with the backup wheel 60.” Wagner at 4:57-59.



Wagner at FIG. 1

[1.4] a string, wherein the string comprises a surface texture configured to increase air friction in response to the string being propelled through air by the pair of wheels, wherein the string defines an axis along which the string extends, and wherein the string comprises a plurality of fibers extending away from the axis.

155. Wagner discloses string formed into a loop. Wagner at 1:62-2:23, FIG.

1. The loop is made of a “highly flexible, limp, strand, or length of fabric of filaments without ends and may, for example be formed by stitching or otherwise joining the ends of a length of woven string-like material.” *Id.* The loop of Wagner is “driven by friction resulting from the action of the circumferentially opposed wheels 50 and 60, which comprise a drive wheel 50 and a backup wheel 60 that are spaced from each other.” Wagner at 2:37-59; 4:53-5:21.

156. While Wagner does not explicitly state that the surface texture of the string is configured to increase air friction in response to the string being propelled through air by the pair of wheels, a POSITA would be motivated to use a string with a surface that increased air friction in order to reduce the takeoff velocity of the string which provides the benefits discussed above for improved operating with decreased cost and size.

157. Indeed, Wagner notes that the speed of the loop at ejection from the wheels is determined in part by the rotational speed of the drive wheel and must achieve a minimum speed to overcome the density of the loop material. Wagner at 5:12-15. By using a string with increased air friction, it would reduce the minimum speed necessary for Wagner's device to overcome the density of the loop material based on a POSITA's background knowledge. *See* Abello at 5 (POSITA's background knowledge includes Abello's teaching that "as soon the SSh reaches the threshold speed v_{takeoff} , air drag dominates over the weight and begins to lift the SSh."); Gregory, 1 ("...when the speed is sufficient to cause the loop to become airborne. It does this when the air-friction is greater than the weight of the loop."); Daerr, 877 ("the hydrodynamic drag of air is a crucial ingredient in the dynamics of the string shooter").

158. One such string with a non-smooth surface is disclosed in Yeany. A POSITA looking at Yeany would understand that the fibers extending from the

surface of Yeany's string would cause air friction, creating drag and reducing the velocity Wagner's drive unit needs to impart to the string. A full explanation of how Yeany's string "comprises a surface texture configured to increase air friction in response to the string being propelled through air by the pair of wheels" was discussed above with respect to Yeany anticipation arguments and incorporated by herein.

159. The underlying physics of drag, lift, and turbulent boundary layers for Yeany's fuzzy string travelling through air would be the same in Wagner's string shooter as they are in Yeany's since those properties depend on the physical characteristics of the string itself (such as surface texture, weight, velocity) when the string travels through the same fluid, like air.

160. For the reasons previously stated, Yeany's string "defines an axis along which the string extends, and wherein the string comprises a plurality of fibers extending away from the axis."

3. Claim 2

The string shooting device of claim 1, wherein the plurality of fibers extending away from the axis generate a turbulent air boundary layer around the string in response to the string being propelled through the air by the pair of wheels

161. Claim 2 is rendered obvious by Wagner in view of Yeany for the reasons previously provided for why Yeany anticipates claim 2 since the combination relies on a using string as taught by Yeany.

4. Claim 3

The string shooting device of claim 2, wherein the string is a looped string, wherein the looped string, at a distal portion furthest from the body, generates lift from the turbulent air boundary layer

162. Claim 3 is rendered obvious by Wagner in view of Yeany for the reasons previously provided for why Yeany anticipates claim 3 since the combination relies on a using string as taught by Yeany.

5. Claim 12

[12.0] A method of propelling a looped string through air comprising:

163. Limitation [12.0] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.0].

[12.1] receiving a looped string into a housing between a pair of wheels, wherein at least one of the pair of wheels is a driven wheel,

164. Limitation [12.1] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitations [1.2] (discussing receiving a looped string into a housing between a pair of wheels) and [1.3] (discussing wherein at least one of the pair of wheels is a driven wheel).

[12.2] wherein the looped string defines an axis along which the string extends, and wherein the looped string comprises a plurality of fibers extending away from the axis;

165. Limitation [12.2] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.4].

[12.3] driving the at least one driven wheel;

166. Limitation [12.3] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.3].

[12.4] propelling the looped string from the at least one driven wheel; and

167. Limitation [12.4] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.3] (discussing how driving the wheels propels the string)

[12.5] generating, from the looped string propelled by the at least one driven wheel, lift at an end of the looped string distal from the housing based on a surface texture of string configured to increase air friction in response to the looped string being propelled.

168. Limitation [12.5] is disclosed by Wagner in view of Yeany for the reasons previously provided for claims 2-3 (discussing how the combination of Wagner in view of Yeany generates lift at the distal end of the looped string based

on the fuzzy extending string threads producing a turbulent boundary layer) and limitation [1.4] (discussing how the fuzzy extending string threads are a surface texture configured to increase air friction in response to the looped string being propelled).

6. Claim 15

The method of claim 12, wherein propelling the looped string from the at least one driven wheel comprises: receiving the looped string through an intake aperture of the housing; guiding the looped string between the pair of wheels; and propelling the looped string through an exit aperture of the housing.

169. Wagner and Yeany disclose claim 12 as discussed above. Wagner discloses the attached rotatable cup and cap (e.g., attached housing) has two apertures for the loop of string, “ejection aperture 180 through which the driven loop 10 exits” the drive unit having the pair of wheels and “takeup aperture 182 through which the loop 10 returns” to the drive unit having pair of wheels. Wagner at 4:21-37. Thus, during operation when the string is being propelled, the looped string is received through the takeup aperture (intake aperture of the housing), guided to the pair of wheels in the drive unit, and propelled through the ejection aperture (exit aperture of the housing) *Id.*

D. Wagner in view of Yeany and Scorch renders obvious claims 4, 16 and 17

170. As explained in Ground 3, the combination of Wagner in view of Yeany teaches all of the limitations of claims 1-3, 12 and 15. Dependent claim 4 and

independent claim 16 add limitations for a “loading slot” that are not expressly taught by Wagner or Yeany. However, Scorch, a string shooter video prior to the time of the invention, teaches a string shooter device with a loading slot on the side. A POSITA would be motivated to apply this teaching of a loading slot to the Wagner device to increase the convenience of loading a string into the device without having to remove a portion of the housing.

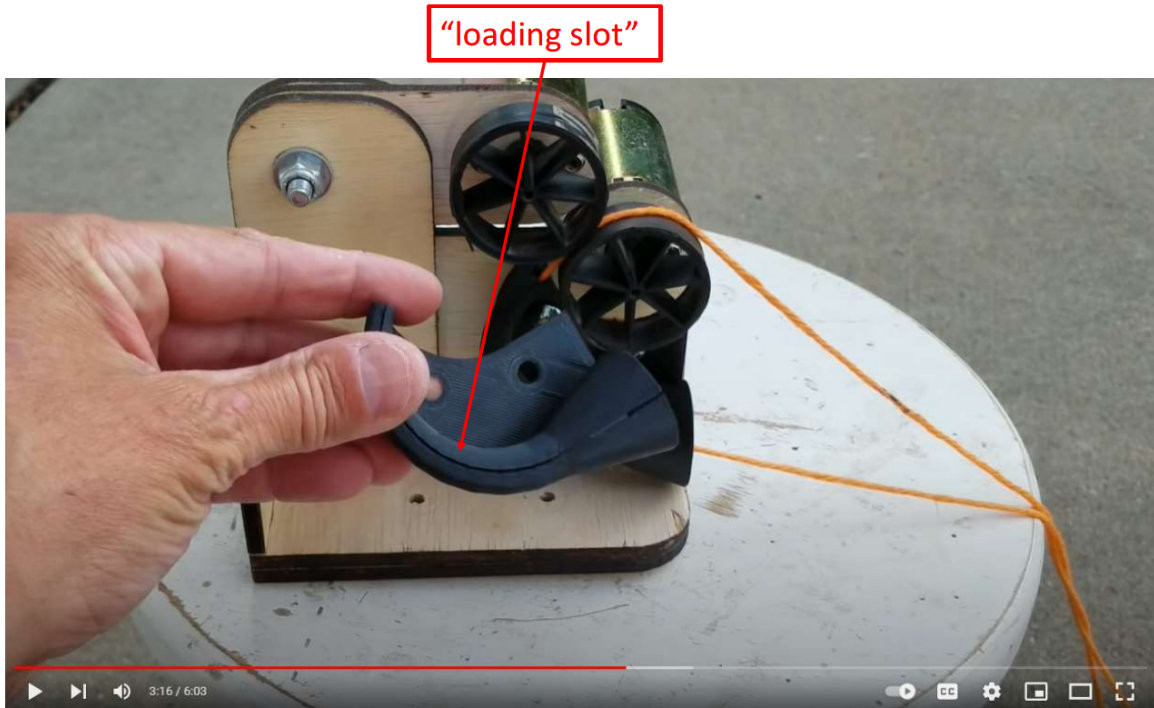
1. Claim 4

The string shooting device of claim 1, wherein the housing covers, at least partially, the pair of wheels, and wherein the housing defines a loading slot through which the string is loaded or removed from between the pair of wheels:

171. Claim 1 is taught by Wagner and Yeany for the reasons previously provided for the combination of Wagner and Yeany for claim 1. As explained with respect to claim 1, Wagner teaches a housing attached to the body comprised of “a rotatable cup 100, and a cover 150.” Wagner at 2:60-64 and 3: 3:13-21. This housing at least partially covers wheels 50 and 60. Wagner at Fig. 1, Fig. 3, 3:13-21, 3:47-62.

172. In addition, Scorch teaches a string shooter with a hollow tubular funnel, which houses the looped string, attached to a wooden body where “the string runs through this funnel” and exits this housing between the pair of wheels. Scorch at 1:13:1:47; *see* ’774 Patent at 2:11-13. (embodiment in ’774 Patent “receiv[es] a looped string into a housing between a pair of wheels.”). Scorch also discloses an

embodiment where this housing “has a slot in the side” so that one can put a loop of string around the wheels through the housing. Scorch at 3:00-3:30. This loading slot is shown in the screen shot below.



173. This loading slot allows one to “swap them [the strings] out really quick.” Scorch at 3:30-3:53. An example of how a loop of string is inserted into this type of loading slot is shown below (with the red string being inserted into the loading slot).



174. A POSITA would apply the teaching of a side loading slot from Scorch to the Wagner device in order to improve the convenience of replacing a loop of string. Wagner already teaches that a loop of string may need to be “removed from the device 1 or reinstalled between the” wheels. Wagner at 3:58-62. However, Wagner teaches doing so by removing the cover and then reinstalling the cover after the loop of string has been replaced. Wagner at 3:46-4:45. This is an inconvenient process that requires a user overcoming the “friction fit” to remove the cover and then lining up complementary structures on the cover and the cup to reattach the cover. *Id.* By using a loading slot to replace a loop of string instead of Wagner’s existing process, the replacement of string in Wagner’s string shooter device can be easier and quicker for a user.

175. By applying the teaching of a side slot to Wagner, a POSITA would understand that the slot would extend between the intake and exit apertures of

Wagner's housing while also going around wheel 50 so that user has sufficient access to load the string around the flanges of wheel 50. An illustration of one obvious path to a POSITA for the loading slot is provided below as a dashed redline in the embodiments of Figure 1 and 3. A loading slot that follows this path allows for quick replacement of the loop of string in the Wagner device.

housing defines a loading slot through which the string is loaded or removed from between the pair of wheels

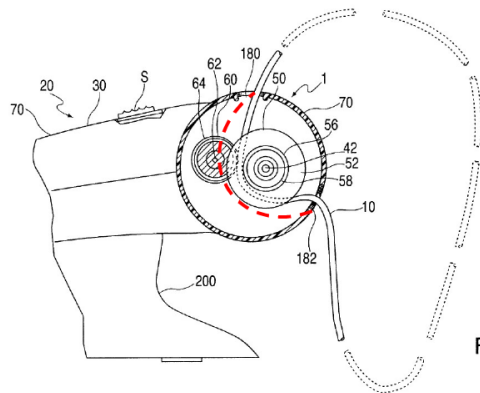


FIG. 1

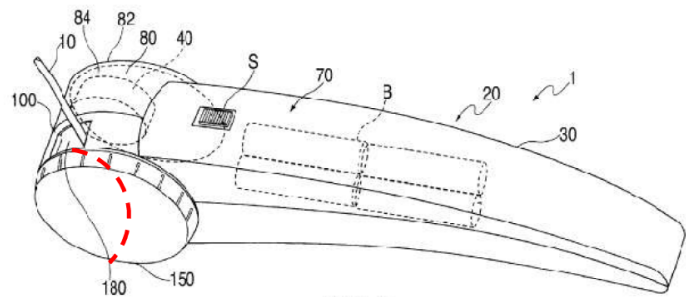


FIG. 3

176. Finally, while Scorch mentions using a loading slot can lead to the string inadvertently exiting through the loading slot this potential downside is already addressed in Wagner due the flanges 52 and 54 on the driven wheel that “form a channel for trapping and guiding loop 10.” See Scorch at 4:00-4:30; Wagner at 2:49-52. A POSITA would expect this channel to help keep the string contained between the wheels and within the housing even with the addition of a loading slot to the side of the housing. Additionally, Scorch teaches structural features can be added to help physically restrain the string when using a loading slot so a POSITA could add structures with a similar restraining effect in Wagner if desired to further

reduce the risk of a string inadvertently exiting the string shooter device. *See* Scorch at 4:00-4:30. For example, one could add a structure at the intake aperture of Wagner's device to wrap the string around during the loading to provide a similar function as the wire cone as disclosed in Scorch. Scorch at 5:00-5:20.

2. Claim 16

[16.0] – A string shooting device comprising:

177. Limitation [16.0] is taught by Wagner, Yeany and Scorch for the reasons previously provided for the combination of Wagner and Yeany for limitation [1.0].

[16.1] – a body;

178. Limitation [16.1] is taught by Wagner, Yeany and Scorch for the reasons previously provided for the combination of Wagner and Yeany for limitation [1.1].

[16.2] – a housing attached to the body and defining a loading slot;

179. Limitation [16.2] is taught by Wagner, Yeany and Scorch for the reasons previously provided for the combination of Wagner, Yeany and Scorch for claim 4. *see also* analysis of Wagner in view of Yeany for limitation [1.2] (discussing housing attached to the body).

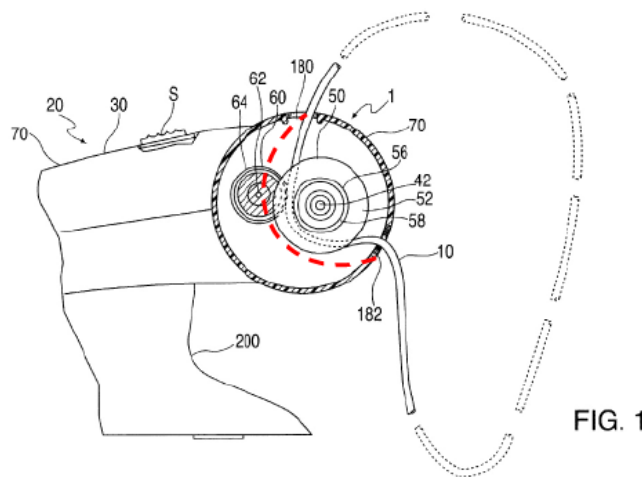
[16.3] – a pair of wheels, wherein at least one of the pair of wheels is a driven wheel,

180. Limitation [16.3] is disclosed by Scorch for the reasons previously provided for the combination of Wagner and Yeany for limitation [1.3].

[16.4] – wherein the loading slot is disposed at least partially over at least one of the pair of wheels; and

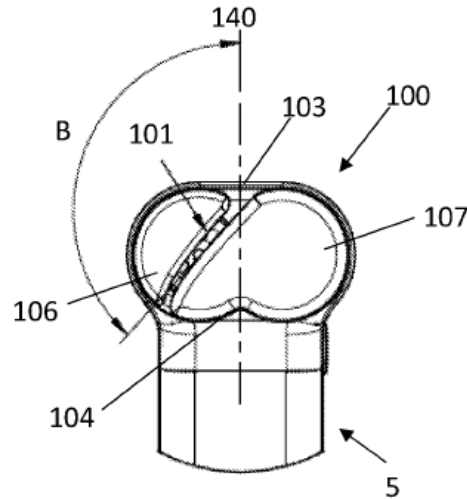
181. As previously discussed, a POSITA would apply the teaching of a slot in the side from Scorch to the Wagner device. This loading slot would be disposed at least partially over wheel 60 when viewing the device from the side perspective as shown by Wagner’s Figures 1 and 3. Wagner at Fig. 1 and Fig. 3.

loading slot is disposed at least partially over at least one of the pair of wheels



182. Notable, the claim does not provide any point of reference to determine if the loading slot is “over” one of the wheels and thus the claim would encompass a loading slot disposed over one of the wheels from any perspective. Nonetheless, it is noted that the loading slot taught by the combination of Wagner, Yeany, and

Scorch would be “over” a wheel in a manner substantially similar to the loading slot example shown in Figure 11 of the '774 Patent.



'774 Patent at Fig. 11

183. Therefore, the loading slot taught Wagner, Yeany, and Scorch is disposed at least partially over at least one of the pair of wheels.

[16.5] – a looped string, wherein the looped string comprises a surface texture configured to increase air friction in response to the looped string being propelled through air by the pair of wheels.

184. Limitation [16.5] is disclosed by Scorch for the reasons previously provided for the combination of Wagner and Yeany for limitation [1.4].

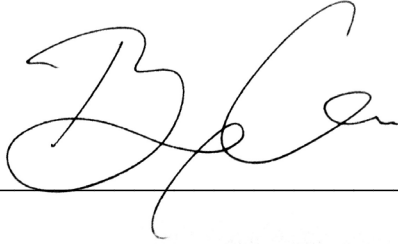
3. Claim 17

The string shooting device of claim 16, wherein the surface texture comprises a plurality of fibers extending away from an axis along which the looped string extends to generate a turbulent air boundary layer around the looped string in response to the looped string being propelled through the air by the pair of wheels.

185. Claim 17 is disclosed by Scorch for the reasons previously provided for the combination of Wagner and Yeany on Claim 2.

IX. OATH

I 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; and further 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 Title 18 of the United States Code.

Dated: 7/20/24 _____ By:  _____