

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

**PETITION FOR *INTER PARTES* REVIEW OF USPN 11,674,774
UNDER 35 U.S.C. §§ 311 *ET SEQ.* AND
37 C.F.R. § 42.100 *ET SEQ.***

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LIST OF EXHIBITS

Exhibit 1001	U.S. Patent No. 11,674,774 (“the ’774 patent”)
Exhibit 1002	Declaration of Dr. Barry Kudrowitz
Exhibit 1003	CV for Dr. Barry Kudrowitz
Exhibit 1004	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”)
Exhibit 1005	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”)
Exhibit 1006	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”)
Exhibit 1007	Scorch Works, String Shooter, YouTube video, July 4, 2018 (available at https://www.youtube.com/watch?v=IGIDy-IJxmo) (“Scorch”)
Exhibit 1008	U.S. Patent No. 6,537,126 to Wagner (“Wagner”)
Exhibit 1009	C.C.L. Gregory, Theory of a loop revolving in air, with observations on the skin-friction, Q. J. Mech. Appl. Math. 2 (1949) (“Gregory”)
Exhibit 1010	Sunita Sharma, <i>et. al.</i> , <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”)
Exhibit 1011	Anderson, Fundamentals of Aerodynamics, Sixth Edition, published by McGraw-Hill Education, 2017 (“Anderson”)
Exhibit 1012	G. K. Tyagi, <i>Yarn structure and properties from different spinning techniques</i> , Chapter 5 of Advances in Yarn Spinning Technology, pages 119-154, published by Woodhead Publishing Limited, 2010 (“Tyagi”)

Exhibit 1013	Screen shot taken at 6 minutes and 54 seconds into video from d’Art of Science, How to make a String Shooter? DIY String <i>Shooter</i> <i>dArtofScience</i> , YouTube video, June 29, 2018 (available at https://www.youtube.com/watch?v=bsZ93j_nUVc&t=283s) (“d’Art of Science”)
Exhibit 1014	Print out of Yeany Youtube webpage (printed from https://www.youtube.com/watch?v=rffAjZPmkuU)
Exhibit 1015	Print out of Scorch Youtube webpage (printed from https://www.youtube.com/watch?v=IGIDy-IJxmo)
Exhibit 1016	Print out of d’Art of Science Youtube webpage (printed from https://www.youtube.com/watch?v=bsZ93j_nUVc&t=283s)
Exhibit 1017	First Amended Complaint in <i>ZipString, LLC v NxtGen Toys, LLC</i> , case 1:24-cv-00136-TCB, filed on April 8, 2024
Exhibit 1018	Prosecution history of the ’774 patent
Exhibit 1019	Copy of ZipString Youtube webpage, <i>The Science of ZipString</i> , YouTube video, January 3, 2023 (available at https://www.youtube.com/watch?v=9MtrcXZbHh8))
Exhibit 1020	Print out of ZipString’s FAQ webpage (printed from https://zipstring.com/pages/faqs)
Exhibit 1021	Print out of Google support website (printed from https://support.google.com/youtube/answer/57407?hl=en&ref_topic=9257439&sjid=7169604476855613924-NC)
Exhibit 1022	Print out of ZipString Patents webpage (printed from https://zipstring.com/pages/patents)

I. Introduction

NxtGen Toys, LLC. (“Petitioner”), hereby requests *Inter Partes* Review pursuant to 35 U.S.C. §§ 311 *et seq.* and 37 C.F.R. §§ 42.100 *et seq.*, of claims 1-4, 12, and 15-17 (the “Challenged Claims”) of U.S. Patent No. 11,674,774 (“the ’774 Patent”) issued on June 13, 2023 to Fazio *et al.* See Ex.1001.

The alleged invention of the ’774 Patent is “designed to be used with toys or gadgets that propel a continuous loop of string around a mechanically driven drive wheel at a fast rate,” particularly with a “fuzzy” string having radiating threads that “may extend at any angle relative to the string.” Ex.1001, 4:9-17. The Challenged Claims of the ’774 Patent broadly recite basic structural features used string shooter devices for decades including a body, a housing, a driven wheel, and a string. Ex.1001, 12:18-22. The limitation that ostensibly led to allowance recites “the string comprises a plurality of fibers extending away from the axis.” Ex.1001, 12:22-28. However, string shooters with fibers that extended away from the string’s axis were also disclosed before the priority date of the ’774 Patent.

Perhaps most relevant is a YouTube video posted by a science teacher named Bruce Yeany. See Ex. 1004. Patent Owner admits in multiple sources that the Yeany video was the inspiration behind the ’774 Patent. Ex.1019 (Patent Owner YouTube webpage stating “Check out Bruce Yeany’s video. He is the one that inspired it all!”); Ex.1020, 2 (FAQ on Patent Owner website stating, “Where did you get your

inspiration? 8 years ago a high school teacher named Bruce Yaney [sic] shared a Youtube video where he built a table top machine that launched string...”).

Yet, the very same Yeany video that inspired the '774 Patent already disclosed a string shooter with fibers extending away from the axis of the string as shown in the screen shot below:



Ex.1004, 1:16

Moreover, using a rough string surface, such as Yeany’s string, to increase air friction to generate lift on the string was well-known to persons of skill in the art and would have been an obvious modification a string shooter device at the time of the invention. See Ex.1002, ¶38-¶53. Indeed, prior to the '774 Patent, multiple papers had been published on the physics of string shooter devices and highlighted the importance of drag produced by air friction on performance. Ex.1005, 8 (“This made

us realise the role that air drag plays in the String Shooter's physical behaviour and motivated us to study it in depth,..."); Ex.1006, 877 ("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."); Ex.1009, 30 ("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.").

Despite the multitude of string shooter references existing in the prior art, the Patent Owner failed to submit any of them for consideration by the Examiner (including the Yeany video which was the inventor's inspiration). Instead, during prosecution of the '774 Patent the Examiner issued rejections over a rubber band gun and a projectile disc toy. Thus, this IPR will be the first instance for the Office to address the Challenged Claims in view of prior art string shooter devices instead of other projectile toys.

As explained in detail below, the Challenged Claims are unpatentable in view of the prior art cited herein. Therefore, the Board should institute an *inter partes* review of claims 1-4, 12, and 15-17 of the '774 Patent.

II. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

Petitioner satisfies each requirement for *Inter Partes* Review of the '774 patent pursuant to 37 C.F.R. § 42.8(a)(1).

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

The Petitioner and real party in interest is NxtGen Toys, LLC incorporated in Arizona with registered address of 1846 E. Innovation Park Dr., Suite 100, Oro Valley, AZ, 85755, USA.

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

The '774 Patent is presently asserted by the Patent Owner against Petitioner in ZipString, LLC v NxtGen Toys, LLC, case 1:24-cv-00136-TCB, filed on January 10, 2024. *See* Ex.1017, 11-14 (amended complaint filed by Patent Owner alleging infringement of the '774 Patent).

To the best of Petitioners' knowledge, the '774 Patent has not been challenged in any IPR before this Petition.

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

Petitioner is represented by the following counsel:

Lead Counsel	Backup Counsel
James P. Murphy Reg. No. 55,474 Polsinelli PC 1000 Louisiana Street Suite 6400 Houston, Texas 77002 Tel: (713) 374-1631 jpmurphy@polsinelli.com	Jeffrey Kuo Reg. No. 73,071 Polsinelli PC 1000 Louisiana Street Suite 6400 Houston, Texas 77002 Tel: (713) 374-1618 jkuo@polsinelli.com

Pursuant to 37 C.F.R. § 42.10(b), Powers of Attorney have been filed with this Petition.

D. Service Information Under 37 C.F.R. § 42.8(b)(4)

Physical mailing service information for lead and back-up counsel is as follows:

James Murphy
Polsinelli PC
1000 Louisiana Street
Suite 6400
Houston, Texas 77002

Petitioner also consents to service by e-mail at the above e-mail addresses provided for lead and backup counsel.

E. Payment of Fees Under 37 C.F.R. § 42.15

All required fees have been paid with the filing of this Petition. Petitioner further authorizes the U.S. Patent & Trademark Office to charge Deposit Account

No. 50-1662 for any fees, including the fee set forth in 37 C.F.R. § 42.15(a) for this Petition.

F. Certification of Word Count Under 37 C.F.R. § 42.24(d)

Petitioner certifies that the word count in this Petition, including all footnotes and annotations, is 13,993 words as counted by the word-processing program (Microsoft Word for Office 365) used to generate this Petition, where such word count excludes the table of contents, mandatory notices, certificate of service, list of exhibits, and this certificate of word count. This Petition is in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24(a)(1)(i).

III. GROUNDS FOR STANDING UNDER 37 C.F.R. § 42.104(a)

Petitioner certifies that the '774 patent is available for *inter partes* review. Petitioner is not barred or estopped from requesting an *inter partes* review of the '774 patent claims on the grounds identified in this Petition. 37 C.F.R. § 42.104(a).

IV. IDENTIFICATION OF GROUNDS FOR WHICH REVIEW IS REQUESTED UNDER 37 C.F.R. § 42.104(b)(1)

Petitioner asserts that claims 1-4, 12, and 15-17 (the “Challenged Claims”) of the '774 patent are unpatentable based on the following grounds:

Ground 1: Claims 1-3, 12, and 15 are anticipated under 35 U.S.C. § 102 by Yeany.

Ground 2: Claims 1-3, 12, and 15-17 are rendered obvious under 35 U.S.C. § 103 by Abello in view of Yeany.

Ground 3: Claims 1-3, 12, and 15 are rendered obvious under 35 U.S.C. § 103 by Wagner in view of Yeany.

Ground 4: Claims 4, 16 and 17 are rendered obvious under 35 U.S.C. § 103 by Wagner in view of Yeany and Scorch.

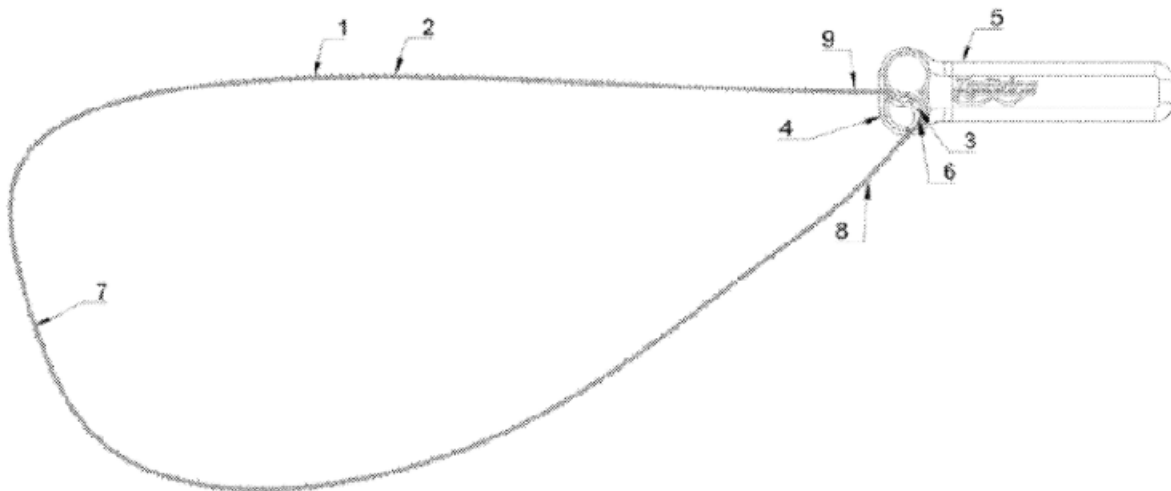
V. HOW THE CHALLENGED CLAIMS ARE TO BE CONSTRUED UNDER 37 C.F.R. § 42.104(b)(3)

In an IPR, claim terms need only be construed “to the extent necessary to resolve the controversy.” *Vivid Techs., Inc. v. Am Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed.Cir.1999). Here, Petitioner does not believe that any term requires construction to resolve the invalidity grounds presented in this Petition since the prior art renders claims 1-4, 12, and 15-17 unpatentable under any reasonable interpretation of the claims.

VI. OVERVIEW OF THE ’774 PATENT

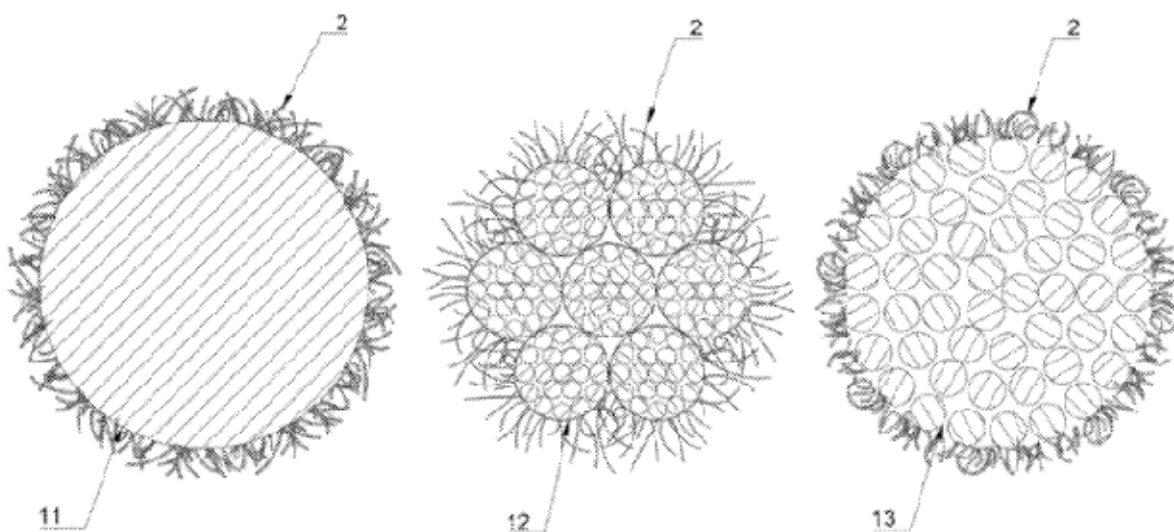
A. Summary of the ’774 Specification

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.” Ex.1001, 1:14-19; Ex.1002, ¶28.



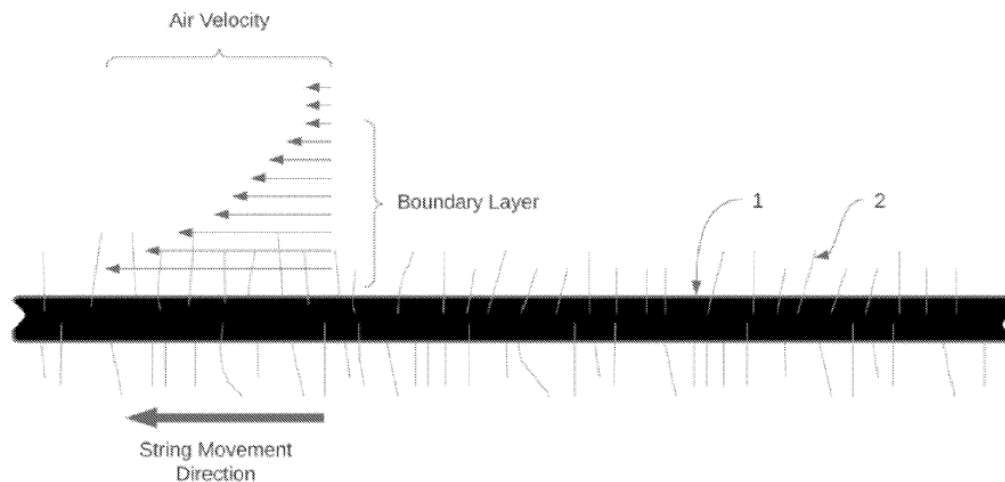
Ex.1001, FIG. 1

The '774 Patent states 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. Ex.1001, 4:13-16, 5:6-10, FIG. 2; Ex.1002, ¶31.



Ex.1001, FIG. 2

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.” Ex.1001, 5:14-16; Ex.1002, ¶32. According to the '774 Patent, the “threads increase a surface area of the string, and impart turbulence around the string.... [and] 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” Ex.1001, 5:24-29; Ex.1002, ¶32.



Ex.1001, FIG. 5

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). Ex.1001, 5:10-19, 6:1-13, 6:23-33; Ex.1002, ¶33.

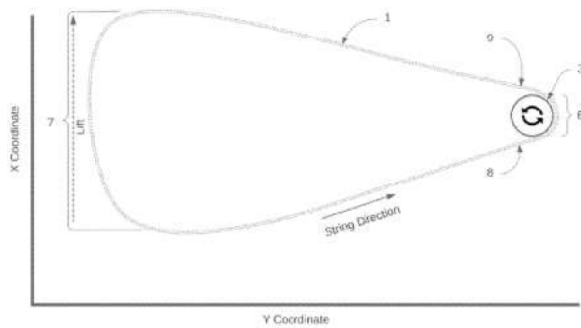


FIG. 3

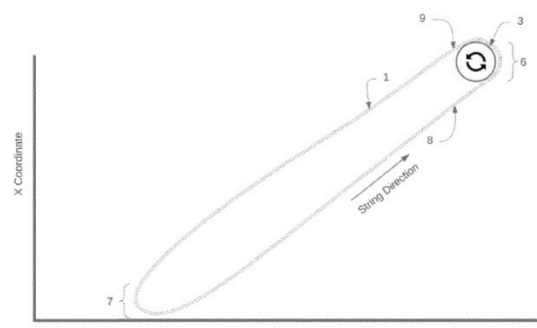


FIG. 4

B. Summary of the Prosecution of U.S. Patent No. 10,707,774

On November 17, 2022, the Applicants filed Application No. 18/056,567 (“the ‘567 Application”) which issued as 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”). Ex.1018, (NFOA, p. 3 and 6); Ex.1002, ¶34.

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.” Ex.1018, (Response to NFOA, p. 7); Ex.1002, ¶35. 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.” Ex.1018, (Response to NFOA p. 7); Ex.1002, ¶35. Applicant also amended pending independent claims 1

and 11 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”. Ex.1018, (Response to NFOA, p. 7); Ex.1002, ¶36.

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. Thus, the references cited herein are substantially more material than what was considered during prosecution – none of which were related to string in any way. Ex.1002, ¶37. The Examiner did not consider any of these references during prosecution because Patent Owner did not submit them despite its duty to disclose material references it was aware of, such as Yeany. 37 CFR §1.56; see Ex.1019; Ex.1020, 2 (acknowledging the ’774 inventors were aware of Yeany).

VII. BACKGROUND OF TECHNOLOGY¹

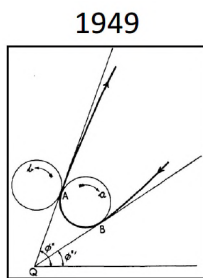
String shooter devices predate the ’774 Patent with numerous examples in the prior art in YouTube videos, online tutorials, conventions such as a Maker Faire, journal articles, and patents as shown below. Ex.1002, ¶38. In addition, the general

¹ Cited references not named in a ground of rejection are cited for the purpose of showing the state of the art and the background knowledge of a POSITA. *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362-63 (Fed. Cir. 2013).

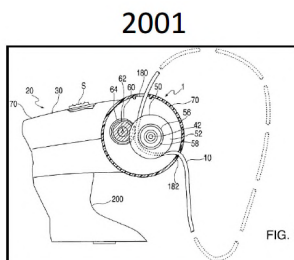
physics of solid objects moving through fluids (e.g., air) and the physics of string shooters specifically were well-known prior to the '774 Patent. *Id.* The history of string shooter devices and their physics of how they operate would have been a part of the background knowledge of a POSITA. *Id.*

A. History of String Shooter Devices

String shooter devices have existed since at least the late 1940's with the below illustrations providing comparative examples of these devices through the decades up through 2021 when the provisional application for the '774 Patent was filed. Ex.1002, ¶39.



Ex. 1009



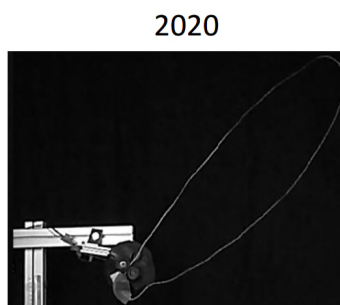
Ex. 1008



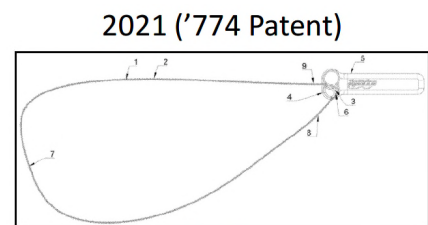
Ex. 1004



Ex. 1007



Ex. 1005



Ex. 1001

One of the first written studies 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.” Ex.1009,

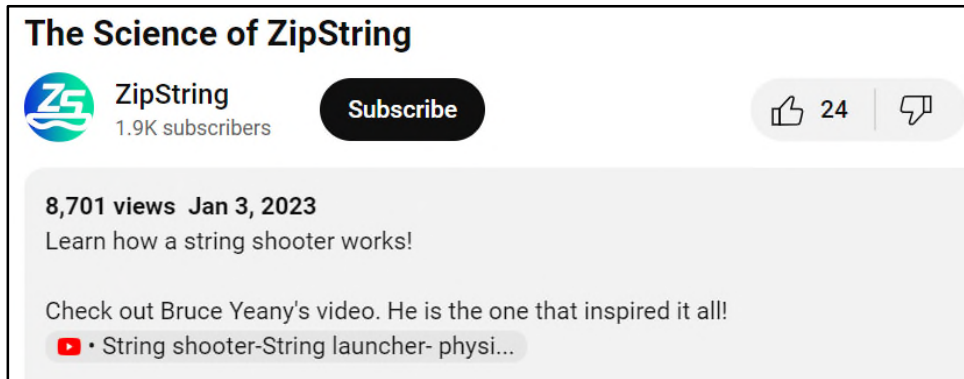
1; *see also* Ex.1005, 8 (stating that Gregory “first theorised the behaviour of the String Shooter in 1949.”); Ex.1002, ¶39. Gregory would explain much of the physics involved including that a loop becomes air-borne “when the air-friction is greater than the weight of the loop” – substantially the same principal disclosed on in the ’774 Patent. Ex.1009, 1; *compare with* Ex.1001, 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.”); Ex.1002, ¶39.

By at least the early 2000’s, the string shooter concept was utilized as a toy or amusement device. Ex.1002, ¶40. For example, a patent was filed in 2001 by Clifford Wagner describes an “amusement device comprising an endless flexible loop and an inline traction drive unit to rotate the loop.” Ex.1008, 1:12-13; Ex.1002, ¶40.

In 2014, science teacher Bruce Yeany uploaded a video of his homemade string shooter. Ex.1002, ¶41. In the video, Yeany discusses how a string shooter operates and interesting properties of the string during operation. *See* Ex.1004; Ex.1002, ¶41. Following Yeany’s video a plethora of other YouTube videos about homemade string shooters were published, including the Scorch video cited in this IPR. *See* Ex.1007; Ex.1002, ¶41. These videos enlightened a new generation about this old technology, including the inventors of the ’774 Patent. Ex.1006, 877 (“This toy was popularised online by Yeany”); Ex.1005, 1, 8 (citing Yeany and Scorch

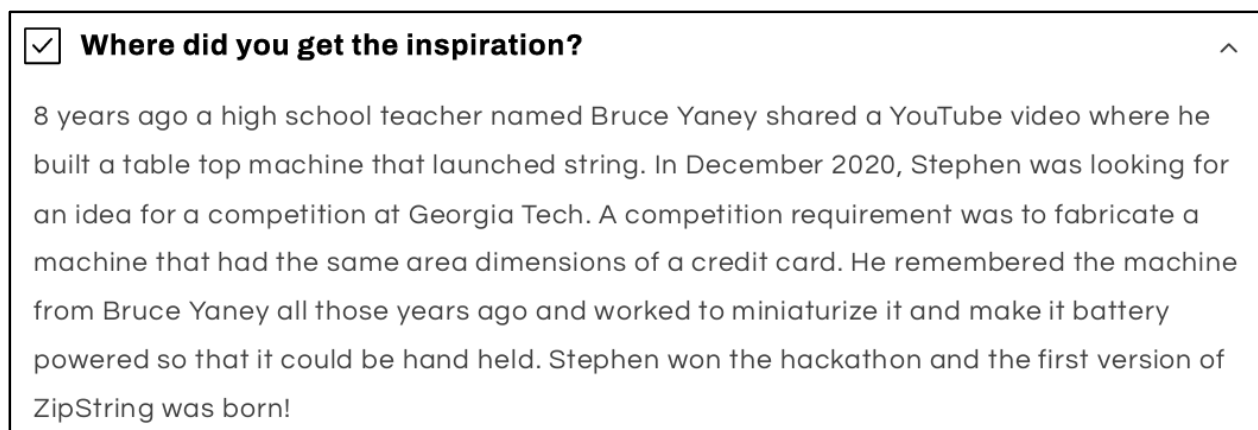
when stating “The concept of our setup takes inspiration from YouTube videos.”); Ex.1002, ¶41.

Even Patent Owner admits on its own YouTube channel that Yeany was “the one that inspired it all!”, suggesting others should check out the Yeany video:



Ex.1019.

Patent Owner’s FAQ webpage notes that “the inspiration” for the ZipString product, which allegedly embodies the ’774 Patent, was the Yeany video:



Ex.1020, 2;² *see* Ex.1022, 1 (Patent Owner webpage identifying the ZipString product as allegedly embodying the '774 Patent).

As discussed below, the claims of the '774 Patent encompass these earlier string shooter devices and are unpatentable.

B. Background Knowledge of Physics of String Shooter Devices

The Challenged Claims recite certain physical properties related to aerodynamics, including “air friction,”³ “turbulent air boundary layer,” and “lift.” *See e.g.*, Ex.1001, 12:18-37; Ex.1002, ¶42. These are well-known properties discussed in college level textbooks on physics, fluid mechanics or aerodynamics. Ex.1002, ¶43. One such textbook explains the relationship 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

² The supposed improvements over Yeany mentioned in the FAQ to “miniaturize it and make it battery powered so that it could be hand held” are not recited in the claims of the '774 Patent. Moreover, the Yeany video discloses a battery powered and a handheld device so these features would not be patentable over Yeany even if claimed.

³ In textbooks and scientific papers, air friction is often described using the more generalized term of skin friction or surface 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 synonymous with air friction.

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.

Ex.1011, 342 (emphasis added)⁴; Ex.1002, ¶43. “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.” Ex.1011, 73, 1051; Ex.1002, ¶44. As such, when the ’774 Patent recites a friction inducing surface generates a turbulent boundary layer or lift (see claims 2, 3, 12 and 16), it is merely reciting physical properties well-known to a POSITA. Ex.1002, ¶44.

In addition to the 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 making a looped string air borne requires air friction or drag to overcome the effect of gravity on 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

⁴ Emphasis always added by Petitioner unless otherwise noted.

sufficient to cause the loop to become air-borne. It does this when the air-friction is greater than the weight of the loop.

Ex.1009, 1; Ex.1002, ¶45.

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.

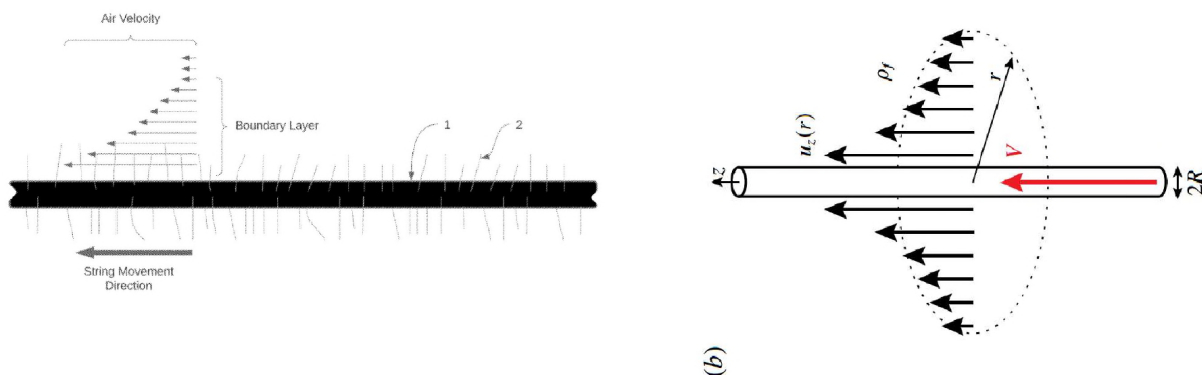
Ex.1005, 5; Ex.1002, ¶45.

[T]he 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.

Ex.1006, 877; *see also id.* (“rough surface structures” on the string correspond to regions of hydrodynamic roughness which denotes a turbulent boundary layer);

Ex.1002, ¶45.

In fact, Figure 5 of the '774 Patent which purportedly illustrates the aerodynamics of the string of the claimed invention, including the turbulent boundary layer, is substantially the same as illustrations provided in the prior art, shown below. Ex.1002, ¶46.



'774 Patent (Left) and Prior Art (Right)

These publications demonstrate background knowledge a POSITA would have been aware of the underlying physics of a string shooter device where friction produces a turbulent boundary layer and drag to generate sufficient lift to overcome the weight of the string. Ex.1002, ¶47.

C. Background Knowledge of Fibers Extending From String

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.” Ex.1018, (Response to NFOA, p. 7); Ex.1002, ¶48. The existence of such strings was ubiquitous. Ex.1002, ¶48. As a POSITA would know, most strings made with natural fibers would have fibers extending from the string axis. *Id.* This property is so common it has a term of art in the field of textiles known as “hairiness.” *Id.* 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.

Ex.1012, 124; see Ex.1010, 1 (“Yarn is a generic term use for continuous strands of textile fibre, filaments or material”); Ex.1002, ¶49. A graphical depiction of yarn hairiness showing protruding fibers extending from the core axis is provided in these background references as shown below:

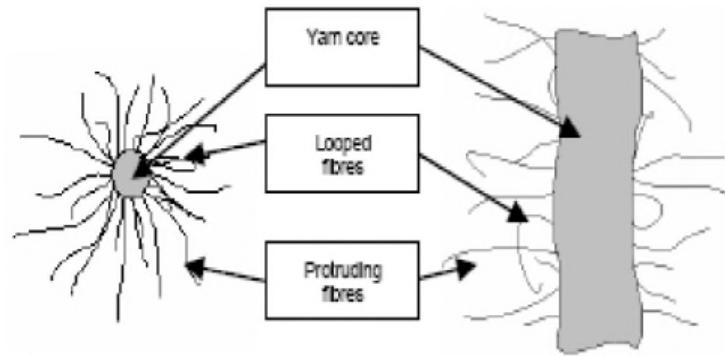


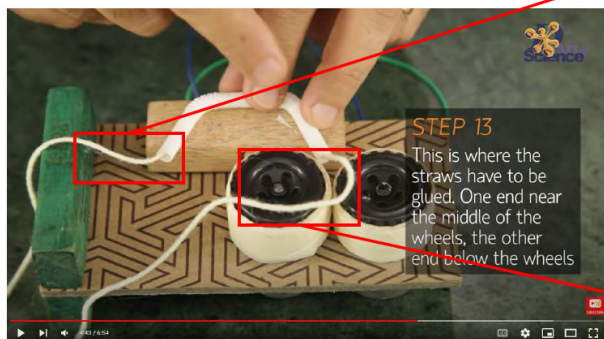
Fig1. Identification of yarn core and yarn hairiness (looped fibres and protruding fibres)

Ex.1010, Fig. 1; Ex.1002, ¶50

Yarns can be manufactured to produce strands with varying levels of hairiness. Ex.1012, 125; Ex.1002, ¶51. For string shooter devices, hairiness would be a desirable property for the reasons described above since the hairiness would increase air friction and drag to produce a turbulent boundary layer that generates lift. Ex.1002, ¶51. Unsurprisingly, multiple YouTube videos of string shooter devices before '774 Patent use a string with fibers extending from the string axis. Ex.1002, ¶52.



Ex.1004, 1:16



Ex.1013, 6:54; Ex. 1016 (publication of video on June 29, 2018)

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. Ex.1002, ¶53.

VIII. OVERVIEW OF THE PRIOR ART

A. Summary of Yeany

1. Yeany is available as prior art in this IPR

Yeany is a true and correct copy of a YouTube video published and publicly accessible on June 11, 2014. See Ex.1004; Ex.1014; Ex.1002, ¶55. 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. Ex.1021; Ex.1002, ¶56.

Learn the difference between “upload” and “publish”

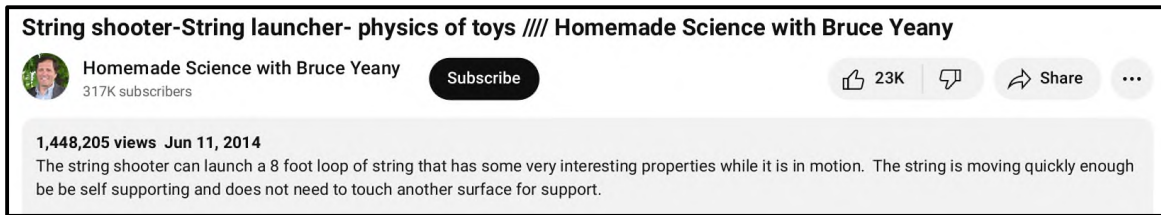
When you **upload** a video, the video file is imported to YouTube.

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

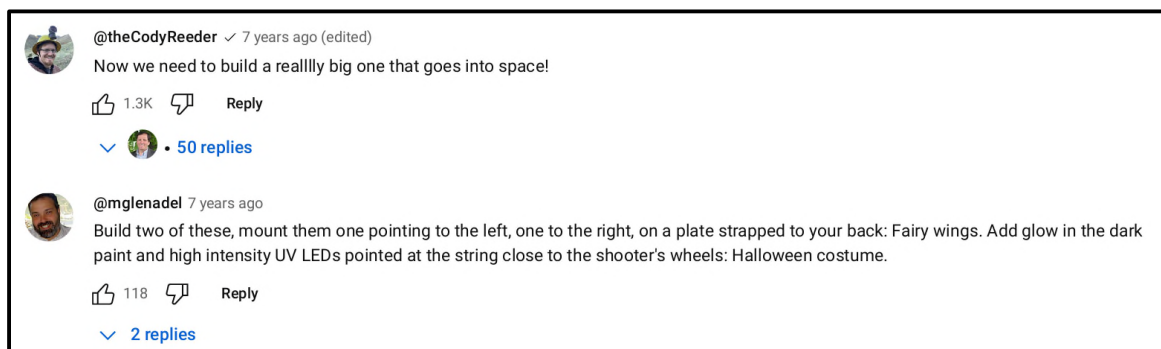
Figure out why your video’s upload date and publish date are different

- **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).

Here, the published date shown beneath the Yeany video is June 11, 2014, and the video has been viewed over 1 million times. Ex.1014 Ex.1002, ¶55.



Additionally, the YouTube webpage for the Yeany video includes thousands of comments dated prior to Nov. 21, 2021. Ex.1014; Ex.1002, ¶57. For example, as shown below the comments posted 7 years before the date the Yeany video webpage was accessed by Petitioner’s counsel on May 13, 2024 (i.e., posted by May 13, 2017).



Ex.1014.

As such, the Yeany video, including all images and audio, was publicly accessible as of June 11, 2014 and is a printed publication available as prior art for this IPR under 35 U.S.C §311(b). Ex.1002, ¶58; *In re Wyer*, 655 F.2d 221, 226 (CCPA 1981) (printed publication can be “in whatever form it may have been recorded”); *see also* IPR2018-00494, *MerchSource, LLC v. DODOCase VR, Inc.*, Paper No. 12, Institution Decision at 9, FN3 (PTAB Aug. 22, 2018) (instituting IPR review based on prior art YouTube video).

As explained by Dr. Kudrowitz, 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. Ex.1002, ¶59. Additionally, a POSITA would look at comments from YouTube videos and social media posts to gauge consumer sentiment about a particular product. *Id.* 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. *Id.*

Additionally, a POSITA would consider scientific journal articles about string shooter devices that directly reference the Yeany video, including Daerr and Abello. Ex.1002, ¶60.

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). Ex.1006, 877; see Ex.1005, 1, 8 (citing Yeany video when stating "The concept of our setup takes inspiration from YouTube videos."); Ex.1002, ¶60.

As such, a POSITA performing a reasonable diligent search would have discovered experimental physics YouTube videos related to string shooters,

including Yeany, and would have identified it as material to the '774 Patent as of the time of the invention. Ex.1002, ¶61.

Accordingly, the Yeany video is a printed publication and prior art to the '774 Patent under at least 35 U.S.C. §§ 102(a) and 103. *See* 35 U.S.C §311(b) (IPR grounds encompass “printed publications” that can be raised under Section 102 or 103).

2. Yeany discloses a string shooter device

Yeany is a YouTube video where Bruce Yeany discusses a string shooter device he created. Ex.1002, ¶62. The device is constructed from a length of string, two driven wheels, a housing tube, motors, batteries, an on/off switch, wires, and a body comprised of wooden blocks. *Id.* When the device is turned on, the motors drive the wheels to propel the continuous loop of string that appears to float in air as seen in the images below. *Id.*



Ex.1004, 1:05 and 1:30

Notably, the string used by Yeany has a surface texture configured to increase air friction as seen in the visible fibers extending from the string's surface in the below screenshot. Ex.1002, ¶63.



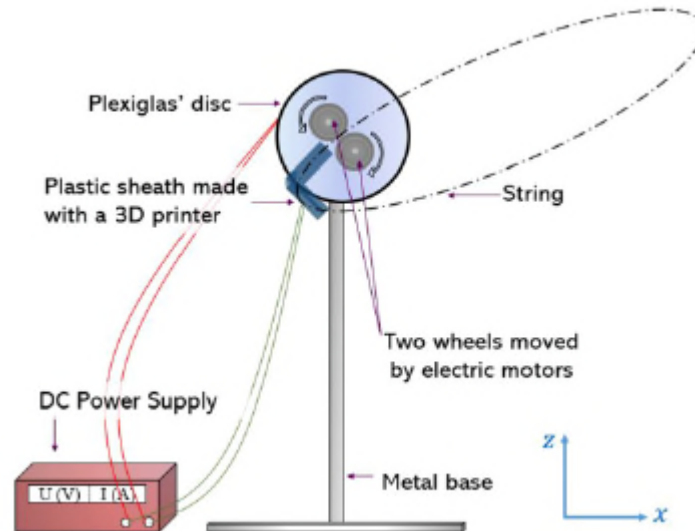
Ex.1004, 1:16

B. Summary of Abello

Abello is a research article published by the Emergent Scientist on January 14, 2020. *See* Ex. 1005. Therefore, Abello constitutes prior art to the '774 Patent under 35 U.S.C. § 102(a) and § 103.

Abello analyzed “an experimental setup wherein a closed string loop is propelled through the air using two motorized wheels spinning in opposite

directions.” Ex.1005, 1; Ex.1002, ¶64. Figure 2 of Abello illustrates the experimental setup. Ex.1005, FIG. 2; Ex.1002, ¶64.



Ex.1005, FIG. 2

Abello discloses that “as soon [as] the SSh [looped string] reaches the threshold speed, air drag dominates over the weight and begins to lift the SSh [looped string].” Ex.1005, 5; Ex.1002, ¶65. Abello tested multiple strings of different nature and determined the most dense and smoothest strings had the highest takeoff speeds requiring higher speeds to create lift. Ex.1005, 5, Table 2; Ex.1002, ¶66. Abello further describes that strings that are more worn out “may have induced more air drag.” Ex.1005, 5; Ex.1002, ¶67

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 $\mu_6 = 2.85 \pm 0.04$	–	–

Ex.1005, 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

Ex.1005, Table 2

C. Summary of Wagner

Wagner is a U.S. Patent filed on July 18, 2001, making it prior art to the ‘774 Patent under 35 U.S.C. §102(a) and §103. See Ex.1008.

Wagner discloses an “amusement device comprising an endless flexible loop and an inline traction drive unit.” Ex.1008, 1:12-13; Ex.1002, ¶68. 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. Ex.1008, 2:13-16; Ex.1002, ¶68. The “drive unit” 20 comprises a pair of circumferentially opposed drive wheels 50 and 60 and a housing

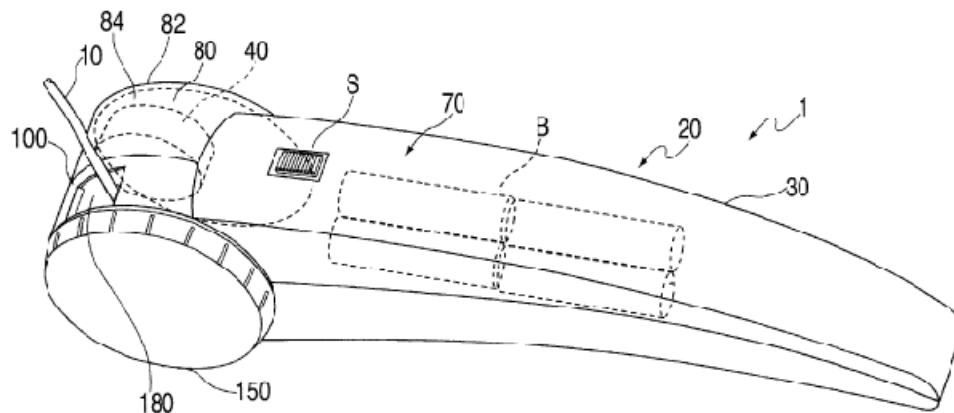


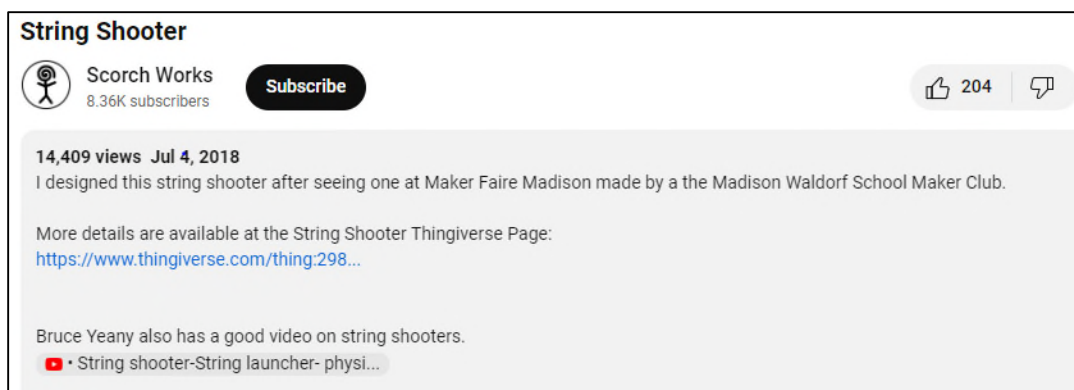
FIG. 3

Ex.1008, FIG. 3

The string of Wagner is loaded in the amusement device and propelled. Ex.1008, 3:57-62, 4:57-64; Ex.1002, ¶70. As shown in Figure 1 of Wagner, the looped string 10 is received between the drive wheel 50 and the backup wheel 60. Ex.1008, 2:37-40, FIG. 1; Ex.1002, ¶70. The wheels 50, 60 are within the cover 150 and the rotatable cup 100 (e.g., housing). Ex.1008, 4:22-38, FIG. 3; Ex.1002, ¶70. 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 the cover 150 and the rotatable cup 100 through a take-up aperture 182 to the wheels 50, 60. Ex.1008, 4:22-38; Ex.1002, ¶70.

D. Summary of Scorch

Scorch is a true and correct copy of a YouTube video published and publicly accessible on July 4, 2018. Ex.1002, ¶71.

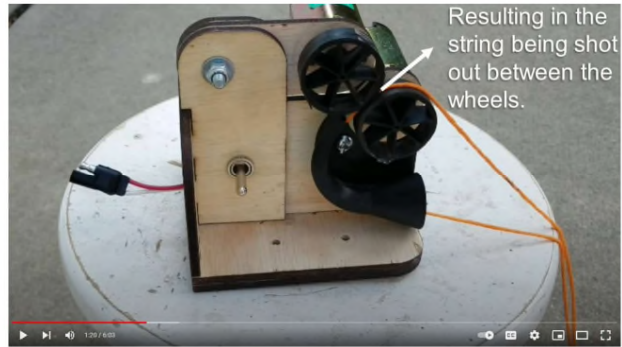


Ex.1015

As explained for Yeany, YouTube videos are publicly accessible as of this listed publication date and available as prior art in this IPR. *In re Wyer*, 655 F.2d at 226.

Like Yeany, Scorch was also cited as a relevant video by Abello. Ex.1005, 1, 8 (Scorch is listed in cited references as number 4); Ex.1002, ¶74. Given this and Scorch's material content to string shooters, a POSITA performing a reasonable diligent search would have discovered experimental physics YouTube videos related to string shooters, including Scorch, and would have identified it as material to the '774 Patent as of November 18, 2021. Ex.1002, ¶72-¶75.

Like the previous references, Scorch discloses a string shooter device that uses two wheels to propel a loop of string. Ex.1002, ¶76.



Ex.1007, 0:05 and 1:20

Perhaps most relevant to this IPR is that Scorch also teaches the housing for a string shooter can include a loading slot on the side, as shown by the slot in the funnel that houses the string. Ex.1002, ¶77. Using the loading slot, one can easily put a new string on the device. Ex.1007, 5:23-29; Ex.1002, ¶77.



Ex.1007, 3:16

IX. HOW THE CLAIMS ARE UNPATENTABLE UNDER 37 C.F.R. § 42.104(b)(4)

A. Level of Skill in the Art

In view of the subject matter of the '774 patent, a POSITA was typically 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. Ex.1002, ¶2-¶6, ¶22-¶26.

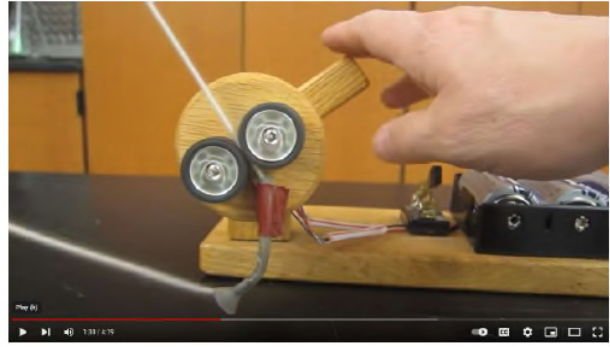
B. Ground 1 – Yeany anticipates claims 1-3, 12 and 15-17 under 35 U.S.C. § 102

1. Claim 1

[1.0] – A string shooting device comprising:

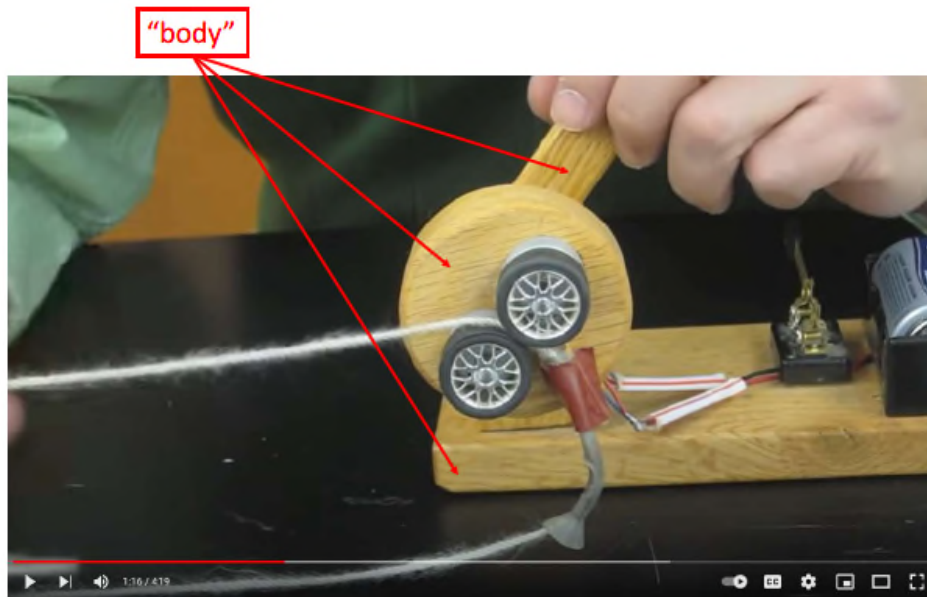
Yeany demonstrates “a device called a string shooter” that shoots a “long continuous string” in a loop. Ex.1004, 0:50-1:02; Ex.1002, ¶78.⁵ The device spins the two wheels to “push the string forward.” Ex.1004, 1:17-22; Ex.1002, ¶78.

⁵ Quotations of Yeany are taken from the audio portion of the Yeany video.



[1.1] – a body;

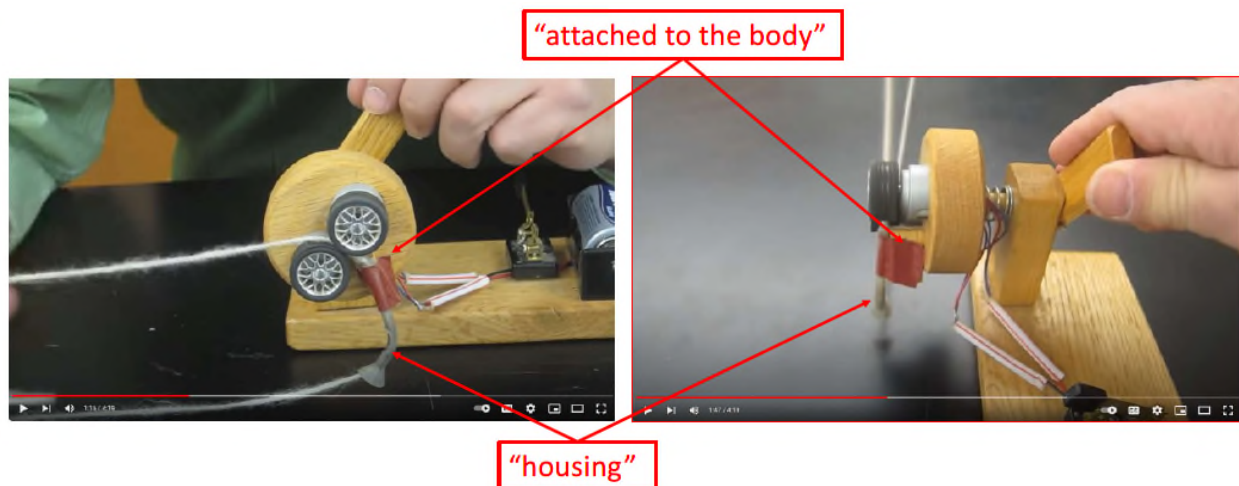
The Yeany string shooter has a body, which is comprised of wooden pieces, to which the other components, such as the wheels, tubing, on/off switch, and battery, are connected. Ex.1004, 1:13-1:47; Ex.1002, ¶79. The picture below depicts portions of the wooden body. Ex.1002, ¶79.



[1.2] – a housing attached to the body;

The Yeany string shooter has a hollow plastic tubing that houses a string attached to the wooden body via a piece of red tape. Ex.1004, 1:13-1:47; Ex.1002,

¶80. The tubing is a housing since it is used to house the string and “guides it [the string] back into place in between the wheels.” Ex.1004, 1:13:1:47; Ex.1002, ¶80. 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.” Ex.1001, 2:11-13; Ex.1002, ¶80. The red tape attaches the tubing (i.e., a housing) to the wooden pieces (i.e., the body). See e.g., Ex.1004, 1:40; Ex.1002, ¶80.



Although other housing embodiments described in the ’774 Patent have a housing that covers the wheels, have a loading slot, or have a guide slot, claim 1 does not recite such limitations for the housing. See *e.g.*, Ex.1001, 1:63-2:10 (describing these features of the housing as “example embodiments”), 12:38-56 (dependent claims 4-8 further limit the housing of independent claim 1).

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

The Yeany string shooter has two wheels (i.e., a pair of wheels) that propel the string forward. Ex.1002, ¶81. In Yeany, there are two motors, one for each wheel. Ex.1004, 1:38-1:48; Ex.1002, ¶81. A POSITA would understand 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.” Ex.1004, 1:17-1:22; Ex.1002, ¶81. 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.” Ex.1001, 4:52-54; Ex.1002, ¶81.

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* Ex.1004, 1:16 (wheels at rest) with 1:30 (driving the wheels); Ex.1002, ¶82.

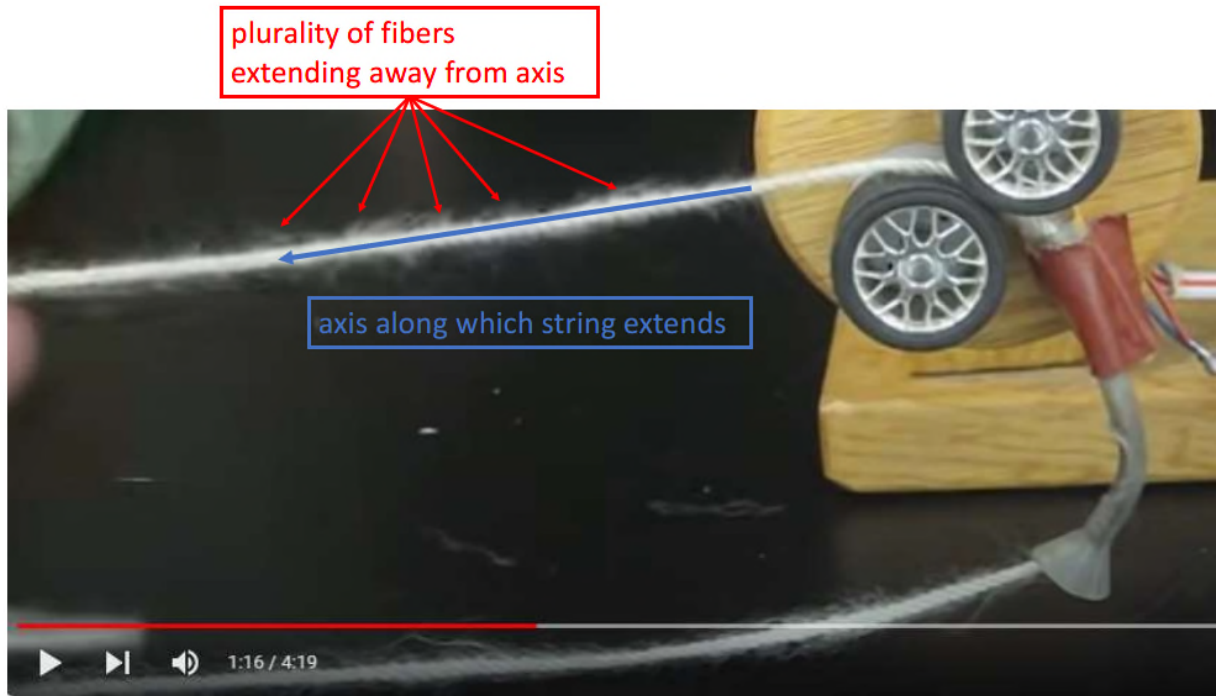


[1.4] – a string, wherein the string comprises a surface texture configured to increase air friction in response to the string being propelled

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.

Yeany discloses “a device called a string shooter” that shoots a “long continuous string” in a loop. Ex.1004, 0:50-1:02; Ex.1002, ¶83. Although not discussed in the narration, when the camera pans in on the string it is shown to have an axis of extension with fibers extending away from that axis creating a fuzzy surface texture that would increase air friction when propelled through the air. Ex.1004, 1:14-1:25; Ex.1002, ¶83. Examples of this surface texture and plurality of extending fibers on the string surface can be seen in the below screenshots. Ex.1002, ¶83.





This disclosure in Yeany falls squarely within the '774 Patent's description for how a radiating fiber string surface would appear fuzzy:

Embodiments 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. When viewed closely the string could be described as “fuzzy”.

Ex.1001, 4:13-17; Ex.1002, ¶84. As admitted in the '774 Patent the “effect of the ‘fuzzy’ surface of the string magnifies the air friction thereby magnifying the positive lift against gravity.” Ex.1001, 5:14-16; Ex.1002, ¶85. This occurs regardless of the angle or orientation of the fibers extending from the string axis. Ex.1001, 5:21-29; Ex.1002, ¶85. The '775 Patent's disclosure merely describes a law of nature that

would likewise apply to Yeany's string that having extending fibers producing a fuzzy surface texture or "hairiness". Ex.1002, ¶85.

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. Ex.1002, ¶86. Thus, the string surface shown in Yeany is an express or implicit disclosure of a "a surface texture configured to increase air friction in response to the string being propelled through air by the pair of wheels."

Finally, assuming Yeany's disclosure of a string surface configured to increase air friction was not express or implicit, then it would be inherent that a non-smooth string surface would increase friction when moving through air compared to a smooth string surface. Ex.1002, ¶87. This friction between the surface of an objection moving through a fluid is a well-studied physical property called skin friction. *Id.* When the fluid is air, this property can be referred to as air friction. *Id.* The radiating 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 resistance to movement of the string when traveling through a fluid. *Id.* 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 a smooth string surface. *Id.*

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.

Yeany discloses claim 1 as discussed above and claim 2 merely recites a well-known property of physics. Ex.1002, ¶88. 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. *Id.* A POSITA would understand these extending fibers disclosed in Yeany would generate a turbulent boundary layer around the string. *Id.*

It is well-known that friction between air and a solid body creates a viscous boundary layer that is generally turbulent for most practical applications. Ex.1002, ¶89. This 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.

Ex.1011, 342; Ex.1002, ¶89. Additionally, 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.” Ex.1011, 73, 1051; Ex.1002, ¶89.

A POSITA would understand the radiating 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. Ex.1002, ¶90. 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. *Id.* Additionally, 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. *Id.*

Moreover, the ’774 specification does not explain the detailed causation of turbulence due the presence of radiating extending threads on a string surface because it is a well-known physical phenomenon to a POSITA. Ex.1002, ¶91;

McRO, Inc. v. Bandai Namco Games America Inc., 959 F.3d 1091, 1102 (Fed. Cir. 2020) (“[A] patent need not teach, and preferably omits, what is well known in the art.”) (citation omitted). At most the ’774 Patent states “[t]he threads increase a surface area of the string, and impart turbulence around the string.” Ex.1001, 5:21-26; Ex.1002, ¶91. 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. Ex.1002, ¶91; *Lockwood v. American Airlines, Inc.*, 107 F.3d 1565, 1570 (Fed. Cir. 1997) (prior art does not need to disclose limitations in greater detail than the challenged 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.

Yeany discloses claim 2 as discussed above. Ex.1002, ¶92. Yeany discloses “a device called a string shooter” that shoots a “long continuous string” in a loop. Ex.1004, 0:50-1:02; Ex.1002, ¶92. 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. Ex.1001, Fig. 3, 5:10-19; Ex.1002, ¶92.

As discussed with respect to claims 1 and 2, Yeany's extending fibers produce friction that generates a turbulent boundary layer. Ex.1002, ¶93. It is well-known that "the presence of friction [which produces a boundary layer] is the very reason why we have lift." Ex.1011, 342; Ex.1002, ¶93. Since the fibers extend away from the surface throughout Yeany's string, a POSITA understands that Yeany's looped string generates lift from the turbulent boundary layer to counteract gravity and stay aloft in the air, including the distal end. Ex.1002, ¶93. Even if one assumes that only a small section of Yeany's string has the extending fibers then lift would be still generated at the distal portion when the section of the string with the extending fibers was at the distal portion. *Id.*

Additionally, 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. Ex.1004, 2:10; Ex.1002, ¶94.



If there were no lift, then downward redirection of the string would decrease the speed and momentum of the string propelling through the air, causing the string to continue in the path of the redirection and ultimately hit the table. Ex.1002, ¶95. 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. *Id.*

The downward redirection of the string by the hand eliminates any potential argument that the upward force on the Yeany string is solely due to momentum in the direction the string is initially propelled. See Ex.1001, 7:9-8:4 (distinguishing '774 invention from string shooters that rely on momentum alone); Ex.1002, ¶96. Hence, the upward force on the distal portion of the looped string counteracting gravity is lift and not just momentum. Ex.1002, ¶96.

Additionally, in Yeany, the shape of the loop where the distal end does not fall down due to the force of gravity shows that lift is generated at the distal end. Ex.1002, ¶97. 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). Ex.1002, ¶97.

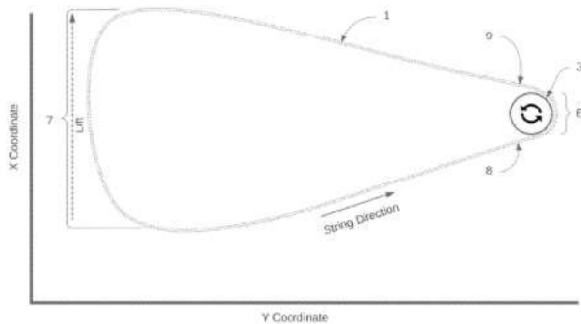


FIG. 3

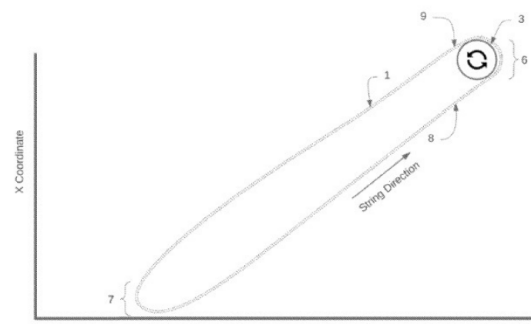


FIG. 4

The looped string in Yeany has a loop shape substantially the same as shown in Figure 3 above and does not depict a loop as shown in Figure 4. Ex.1004, 2:12 and 2:52; Ex.1002, ¶98.

“distal portion furthest from the body, generates lift from the turbulent air boundary layer”



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.

Ex.1001, 4:14-19; Ex.1002, ¶99. 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.*, Ex.1004, 2:09-2:31; Ex.1002, ¶99.

As previously discussed, this lift disclosed in Yeany is generated by the turbulent boundary layer produced by the extending fibers on Yeany’s string. Ex.1002, ¶100. Likewise, the alleged invention of the '774 Patent “generate[s] a lift force for a rapidly moving looped string by expanding a boundary layer of turbulent air around the string. *Id.* 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.” Ex.1001, 4:27-33; Ex.1002, ¶100. Thus, Yeany expressly or inherently discloses the exact same method of generating lift from a turbulent boundary layer as the '774 Patent does since the same laws of physics apply to Yeany as the '774 Patent. *See* Ex.1011, 73, 342, 105; *Lockwood*, 107 F.3d at 1570 (prior art does not need to disclose limitations in greater detail than the challenged patent); Ex.1002, ¶100.

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. Ex.1002, ¶101.

4. Claim 12

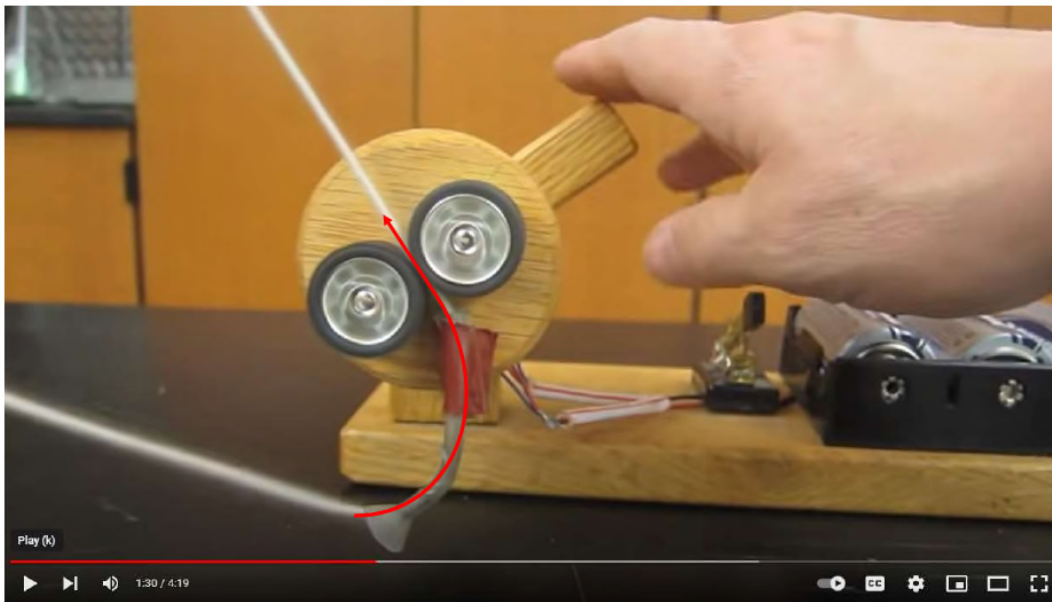
[12.0] – A method of propelling a looped string through air comprising:

Limitation [12.0] is disclosed by Yeany for the reasons previously provided for limitation [1.0]. See Section IX(B)(1); Ex.1002, ¶102.

[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,

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). Ex.1002, ¶103. 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. *Id.*

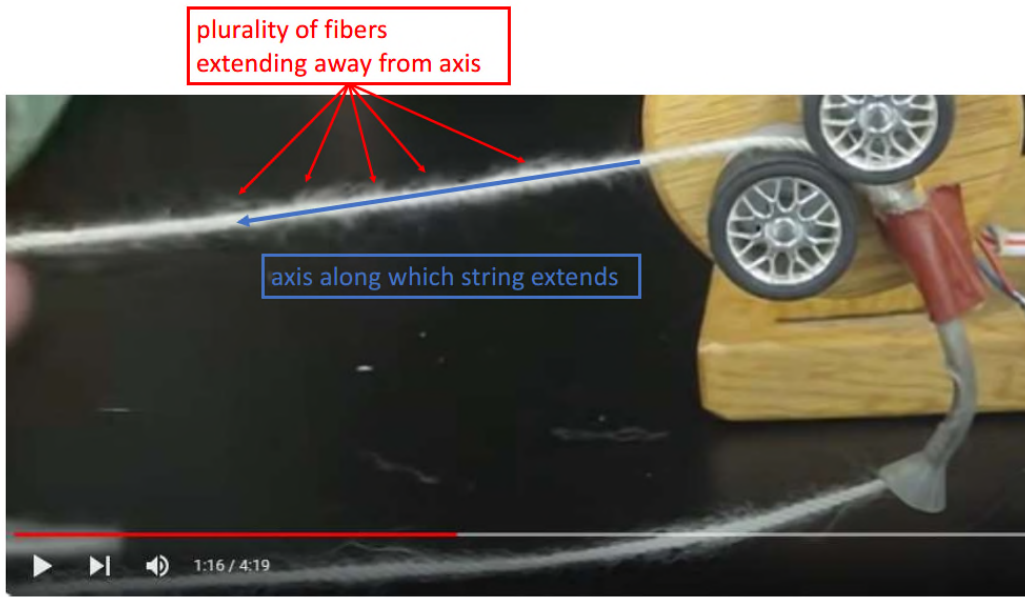
“receiving a looped string into a housing between a pair of wheels”



Ex.1004, 1:30

[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;

Limitation [12.2] is disclosed by Yeany for the reasons previously provided for limitation [1.4]. Ex.1002, ¶104.



Ex.1004, 1:16

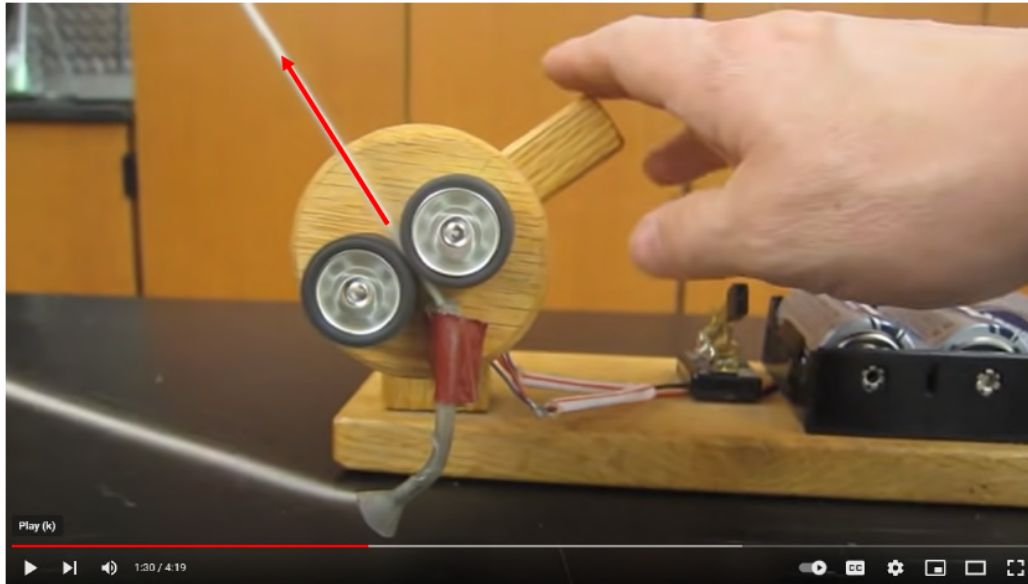
[12.3] – driving the at least one driven wheel;

Limitation [12.3] is disclosed by Yeany for the reasons previously provided for limitation [1.3]. Ex.1002, ¶105.



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

Limitation [12.4] is disclosed by Yeany for the reasons previously provided for limitation [1.3] (discussing how driving the wheels propels the string). Ex.1002, ¶106.



[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.

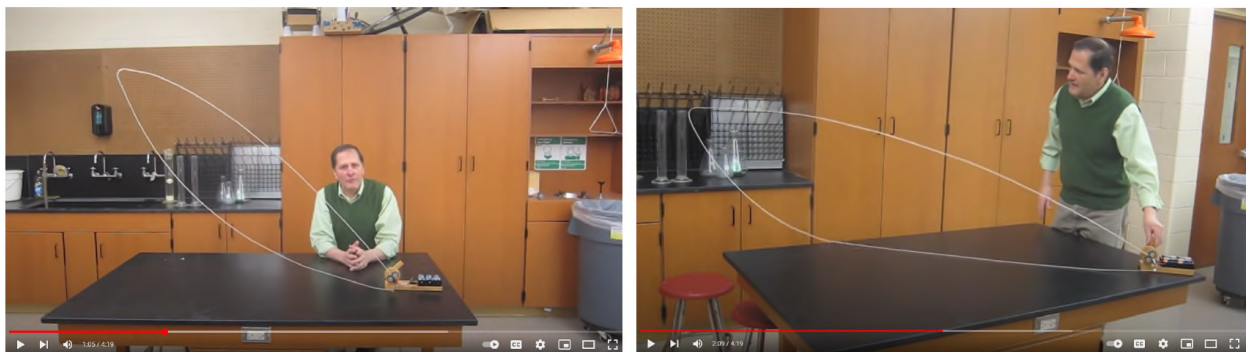
Limitation [12.5] is disclosed by Yeany for the reasons previously provided for claims 2-3 (discussing how Yeany generates lift at the distal end of the looped string based on the fuzzy extending string threads producing a turbulent boundary layer) and limitation [1.4] (discussing how the fuzzy extending string threads are a surface texture configured to increase air friction in response to the looped string being propelled). Ex.1002, ¶107.

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.

Ex.1002, ¶108; Ex.1004, 1:16.



Additionally, limitation [12.5] is further shown in the below screenshots of Yeany disclosing the generating lift at the distal end based on the fuzzy threads extending from the string axis that increase air friction. Ex.1002, ¶109.

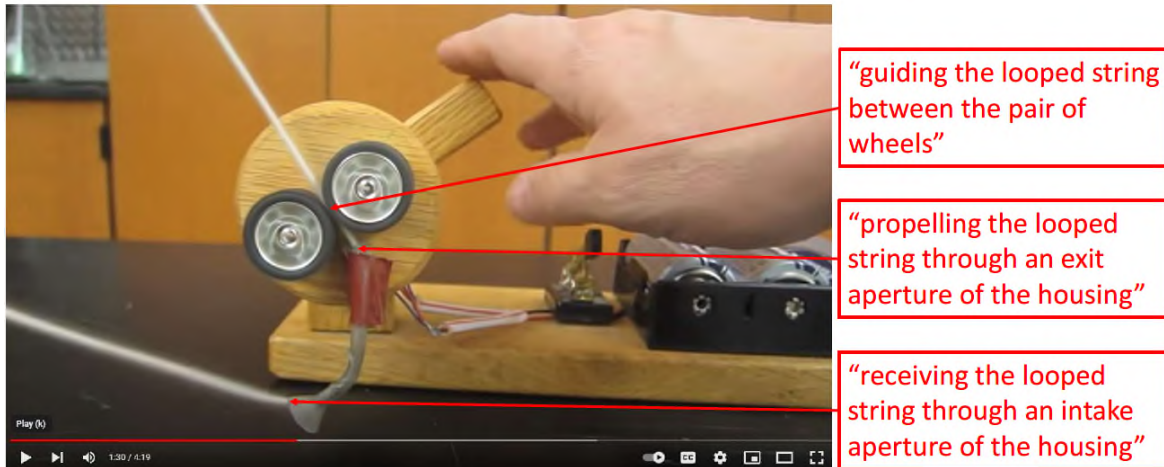


Ex.1004, 1:01, 2:09

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.

Yeany discloses claim 12 as discussed above. Ex.1002, ¶110. As previously discussed, Yeany discloses the tubing is a housing for the looped string. See limitation [1.2]; Ex.1002, ¶110. This tubing “guides [the string] back into place in between the wheels.” Ex.1004, 1:13-1:47; Ex.1002, ¶110. 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 string is continuously looped through Yeany’s string shooter device. Ex.1002, ¶110.



Notably, claim 15 does not recite any specified order of steps of the claimed method. *Interactive Gift Express, Inc. v. Compuserve Inc.*, 256 F.3d 1323, 1342 (Fed. Cir. 2001) (“Unless the steps of a method actually recite an order, the steps are not ordinarily construed to require one.”) Indeed, the claims recite a “looped string,” which has no defined beginning or end, so it is not clear how these steps would be performed on a “looped string” in a particular order.

C. Ground 2 –Abello in view of Yeany renders obvious claims 1-3, 12, and 15-17 under 35 U.S.C. § 102

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. Ex.1002, ¶111. However, in view of Abello’s disclosure that drag must overcome weight in order to lift the string, a POSITA would have looked for ways to increase the air drag. *Id.* Increasing the drag on the string reduces the takeoff velocity required to lift the string, which provides a number of benefits. Ex.1002, ¶112. 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 the batteries needed. *Id.* Additionally, slower spinning wheels would reduce the noise created by the spinning wheels leading to a more pleasing operating environment to a user. *Id.* Furthermore, reduced takeoff speeds would be achieved by smaller motors. *Id.* These benefits would work together to improve the operating of Abello's string shooter while decreasing cost and size given the less powerful components needed. *Id.*

Abello suggests one approach to achieve increased drag is to increase roughness of the string surface. Ex.1005, 7; Ex.1002, ¶113-114. Abello also notes that Yeany was an inspiration and directly cites to Yeany. Ex.1005, 1, 8; Ex.1002, ¶114. Therefore, a POSITA looking to increase drag on a string shooter based on the teachings of Abello would have been aware of the Yeany video and been motivated to use a fuzzy string with radiating extending fibers on the string surface as used in Yeany. *Id.* 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. *Id.* Moreover, a POSITA would have a reasonable expectation of success since Abello teaches using a string with a rough surface like that taught by Yeany and the underlying physics of Yeany's fuzzy string operate the same when used in Abello's string shooter device. Ex.1002, ¶125-¶126.

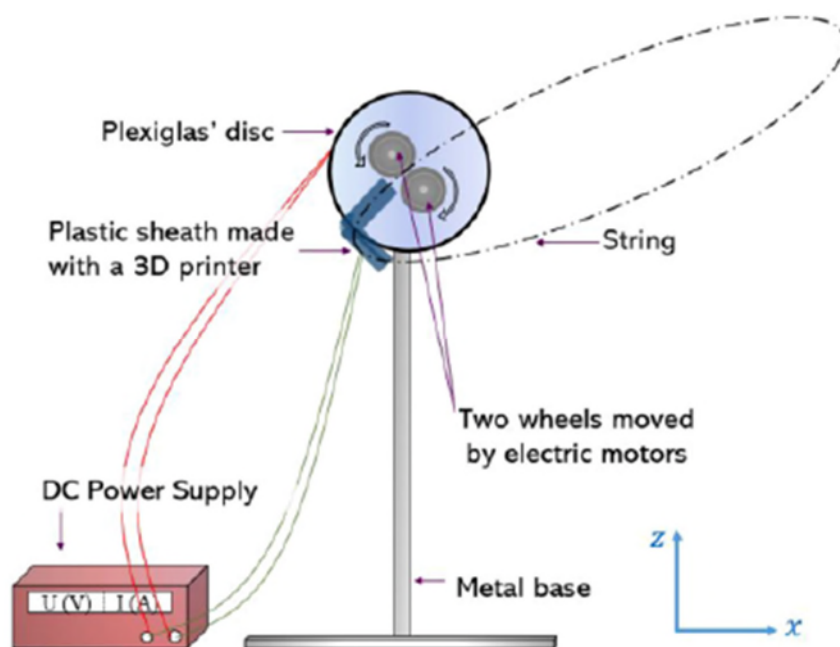
1. Claim 1

[1.0] – A string shooting device comprising:

Abello discusses a “String Shooter.” Ex.1005, 1; Ex.1002, ¶115. 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.” Ex.1005, 1-3; Ex.1002, ¶115.

[1.1] – a body;

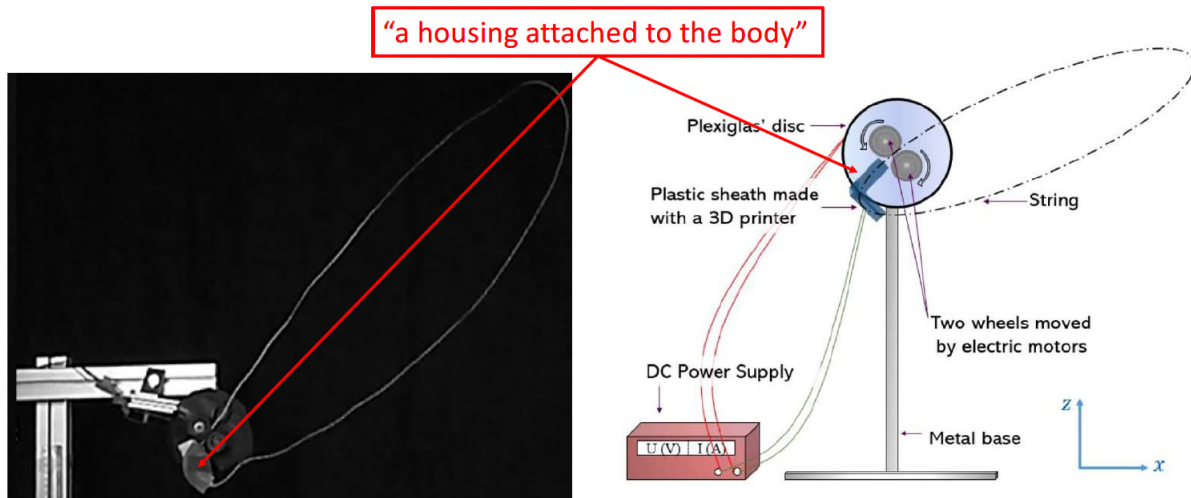
Abello discloses a body for the string shooter comprised of “a Plexiglas disk” and a metal base. Ex.1005, 2; Ex.1002, ¶116. Figure 2 of Abello, reproduced below, illustrates how the components of the string shooter are connected. Ex.1002, ¶116.



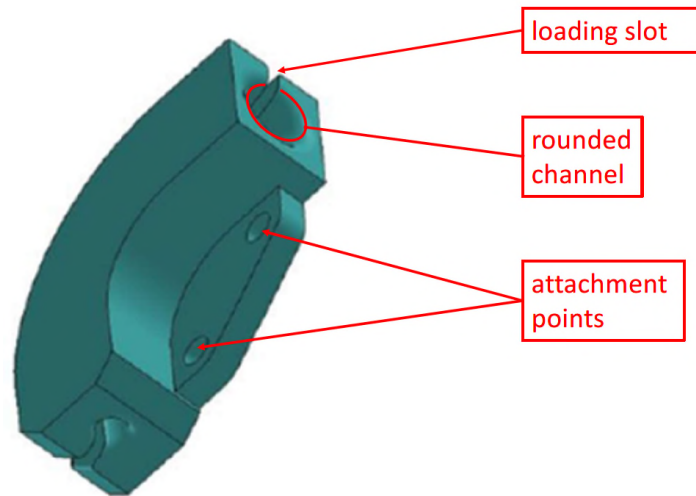
Ex.1005, Figure 2

[1.2] – a housing attached to the body;

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.” Ex.1005, 2; Ex.1002, ¶117. The plastic sheath is a housing since it houses the string to guide it back to the wheels. *Id.* This plastic sheath (i.e., the housing) can be seen attached to the plexiglass wheel (i.e., the body) in Figures 1 and 2. Ex.1002, ¶117



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. Ex.1002, ¶118.



Scheme δ

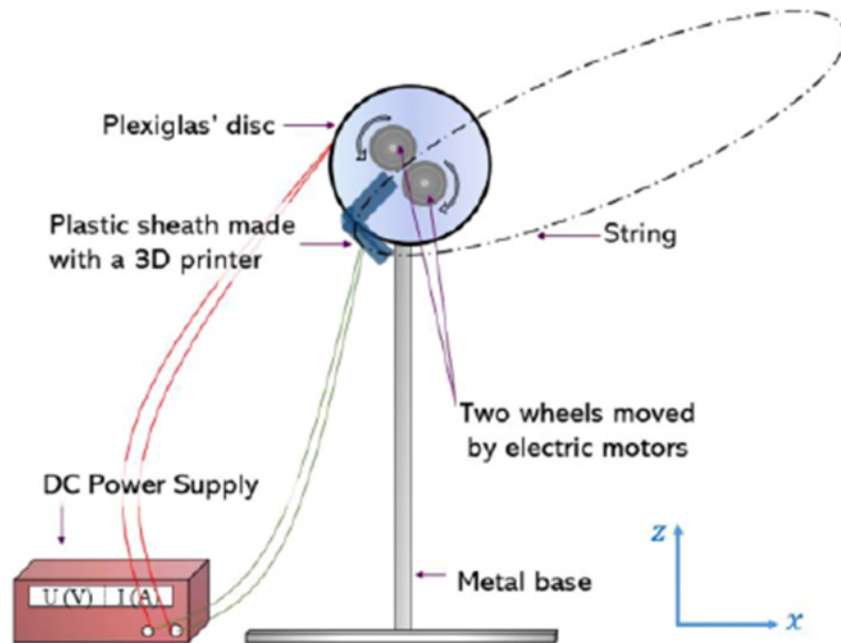
A portion of Figure 3 of Ex.1005

A POSITA understands 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 slots. Ex.1002, ¶119. As the string shooter operates, the sheath would house the string within the rounded channel while the string traveled in a continuous loop. *Id.*

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

Abello discloses that the string loop is ejected into the air “using two motorized wheels spinning at high speed.” Ex.1005, 1-2; Ex.1002, ¶120. Specifically, Abello utilized wheels as “rubber tyres, ensuring an optimal grip on the string. Each wheel was mounted on an MFA RE385 motor.” Ex.1005, 2; *see also id.*

at Figs. 1 and 2 (showing a string being propelled into the air by a pair of wheels);
Ex.1002, ¶120.



Ex.1005, Figure 2

[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.

Abello discloses the use of a string “made into a loop by making a thin knot or using strong glue.” Ex.1005, 1-2; Ex.1002, ¶121. The string is propelled by the wheels so that the string reaches an air-lifted stationary state. Ex.1005, 2-5; Ex.1002, ¶121. 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.” Ex.1005, 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.”); Ex.1002, ¶121.

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.” Ex.1005, 2; Ex.1002, ¶122. Abello discloses that string texture can influence the linear drag force applied on the string. Ex.1005, 4; Ex.1002, ¶122. The string texture can include roughness, fibre material, diameter, etc. to affect the air friction, or air drag, and subsequently the lift for the string. Ex.1005, 4-7; Ex.1002, ¶122.

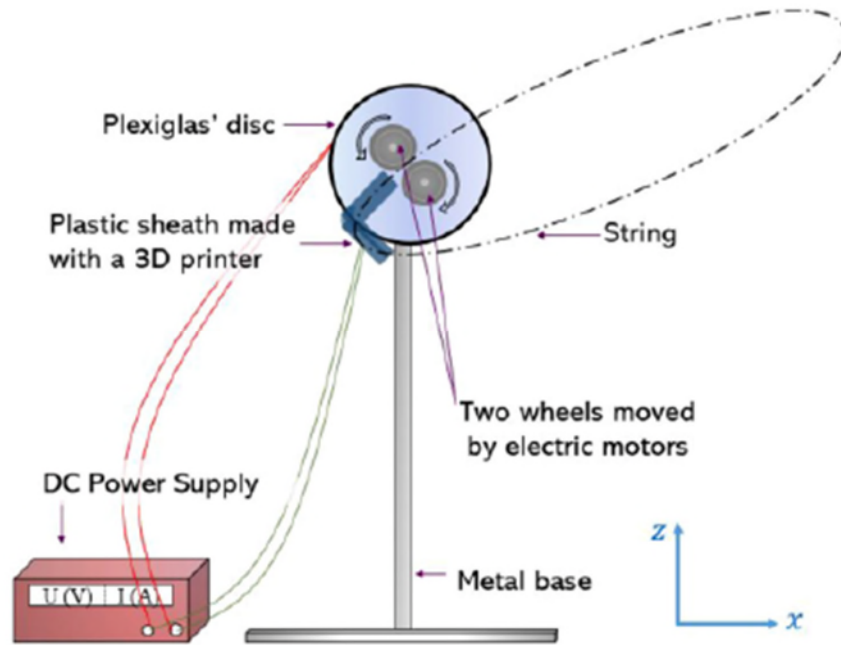
Although Abello does not provide explicit details on the string’s surface texture, Abello discloses testing strings having different surface smoothness. Ex.1005, 2 (“for instance the polyester strings are in general smoother than wool strings on their surface”); Ex.1002, ¶123. Additionally, Abello teaches that “the smoothest strings were the ones to have the highest takeoff speeds.” Ex.1005, 4-5; Ex.1002, ¶123. Abello also notes that “[t]he most severe issue however was wear, especially at higher speeds.” Ex.1005, 7; Ex.1002, ¶124. 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 and thereby reduce the wear on the string, motors, wheels, and sheath. Ex.1002, ¶124.

One such string with a non-smooth surface is disclosed in Yeany, which Abello specifically references as an inspiration for his paper. Ex.1005, 1, 8 (Yeany is listed as the first reference); Ex.1002, ¶125. 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. Ex.1002, ¶125. 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. See Section IX(B)(1)(discussion of limitation [1.4]); see Ex.1004, 1:16.

The underlying physics of drag, lift, and turbulent boundary layers for Yeany's fuzzy string travelling through air would be the same when used in Abello's string shooter, resulting in a similar creation of lift as discussed with respect to Yeany alone. Ex.1002, ¶126; See Section IX(B)(1)(discussion of limitation [1.4]).

The string of Abello defines a longitudinal central axis and is driven generally in line with the longitudinal central axis of the string. Ex.1005, 2-3; Ex.1002, ¶126.



Ex.1005, Figure 2

Abello utilized strings of different natures (cotton, wool, and polyester) in the string shooter. Ex.1005, 2; Ex.1002, ¶122. As noted above, a POSITA would have been motivated to use the non-smooth string of Yeany in the Abello device in order to improve performance of the string shooter. Ex.1002, ¶122-126. 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." *Id.*; See Section IX(B)(1) (discussion of limitation [1.4]).

Therefore, Abello in view of Yeany teaches utilizing a string that has a plurality of fibers extending away from the axis to increase the air friction, or air drag, so that the looped string can be in an air-lifted stationary state.

2. Claim 2

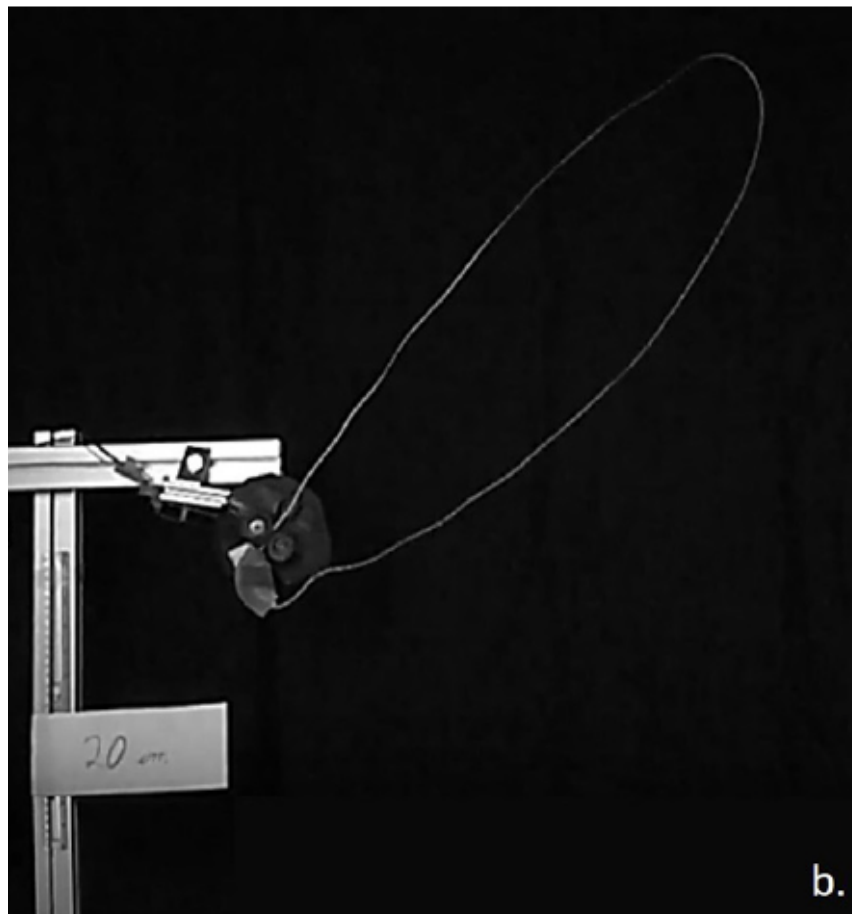
The string shooting device of claim 1, wherein the plurality of fibers extending away from the axis generate a turbulent air boundary layer around the string in response to the string being propelled through the air by the pair of wheels.

Abello discloses that “air flow along the string is neither perfectly laminar ($k=1$) nor totally turbulent ($k=2$) but intermediate.” Ex.1005, 5; Ex.1002, ¶127. 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. Ex.1002, ¶127. 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. *Id.* When the string of Yeany is used in the device of Abello, the non-smooth surface textures would include the fibers extending from the surface of Yeany’s string. Ex.1002, ¶128; see Section IX(B)(2). As such, Abello and Yeany teach “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.” *Id.*

3. Claim 3

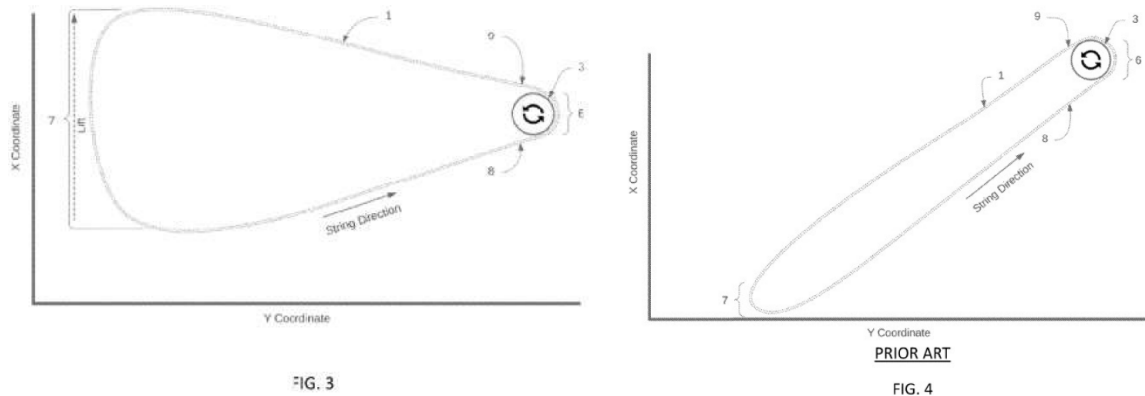
The string shooting device of claim 2, wherein the string is a looped string, wherein the looped string, at a distal portion furthest from the body, generates lift from the turbulent air boundary layer.

Abello and Yeany disclose a string shooter where the distal portion of the looped string is lifted against gravity. Ex.1002, ¶129.



Ex.1005, 1

This is consistent with the '774 Patent illustrations below 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). Ex.1002, ¶130.



Moreover, when Abello is combined with the looped string of Yeany, the combination 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 with respect to Yeany’s string. Ex.1002, ¶131; See Section IX(B)(3).

4. Claim 12

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

Limitation [12.0] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.0]. See Section IX(C)(1); Ex.1002, ¶132.

[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,

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). *See* Section IX(C)(1); Ex.1002, ¶133.

[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;

Limitation [12.2] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.4]. *See* Section IX(C)(1); Ex.1002, ¶134.

[12.3] – driving the at least one driven wheel;

Limitation [12.3] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.3]. See Section IX(C)(1); Ex.1002, ¶135.

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

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). See Section IX(C)(1); Ex.1002, ¶136.

[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.

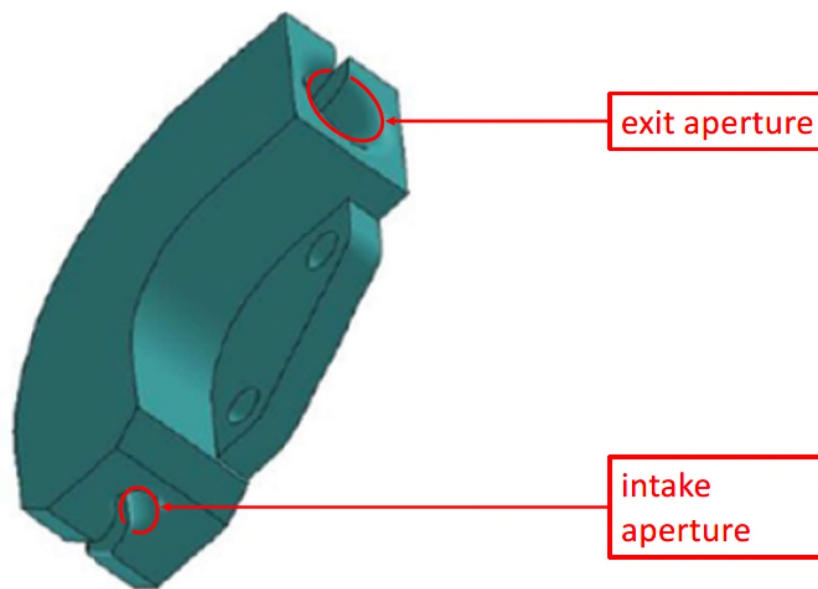
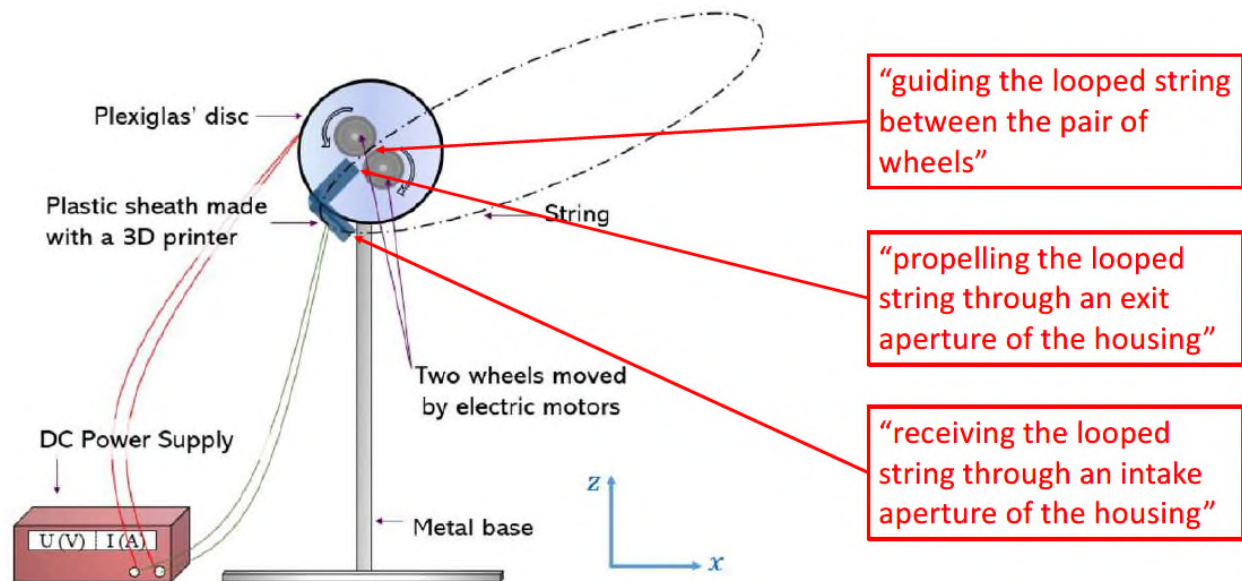
Limitation [12.5] is disclosed by Abello in view of Yeany for the reasons previously provided for claims 2-3 (discussing how the combination of Abello in view of Yeany generates lift at the distal end of the looped string based on the fuzzy extending string threads producing a turbulent boundary layer) 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). See Section IX(C)(1-3); Ex.1002, ¶137.

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.

Abello and Yeany disclose claim 12 as discussed above. Ex.1002, ¶138. As previously discussed, Abbelo discloses a sheath is a housing for the looped string. See limitation [1.2]; Ex.1002, ¶138. This sheath “guides [the string] back into place in between the wheels.” Ex.1005, 2; Ex.1002, ¶138. 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. Ex.1005, Fig. 1b, 2; Ex.1002, ¶138. Since the string is a loop, all three steps are occurring simultaneously as the string is continuously looped through string shooter device. Ex.1002, ¶138.



Scheme 8

Notably, claim 15 does not recite any specified order of steps of the claimed method. *Interactive Gift*, 256 F.3d at 1342.

6. Claim 16

[16.0] – A string shooting device comprising:

Limitation [16.0] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.0]. *See* Section IX(C)(1); Ex.1002, ¶139.

[16.1] – a body;

Limitation [16.1] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.1]. *See* Section IX(C)(1); Ex.1002, ¶140.

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

Limitation [16.2] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.2]. *See* Section IX(C)(1); Ex.1002, ¶141.

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

Limitation [16.3] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.3]. *See* Section IX(C)(1); Ex.1002, ¶142.

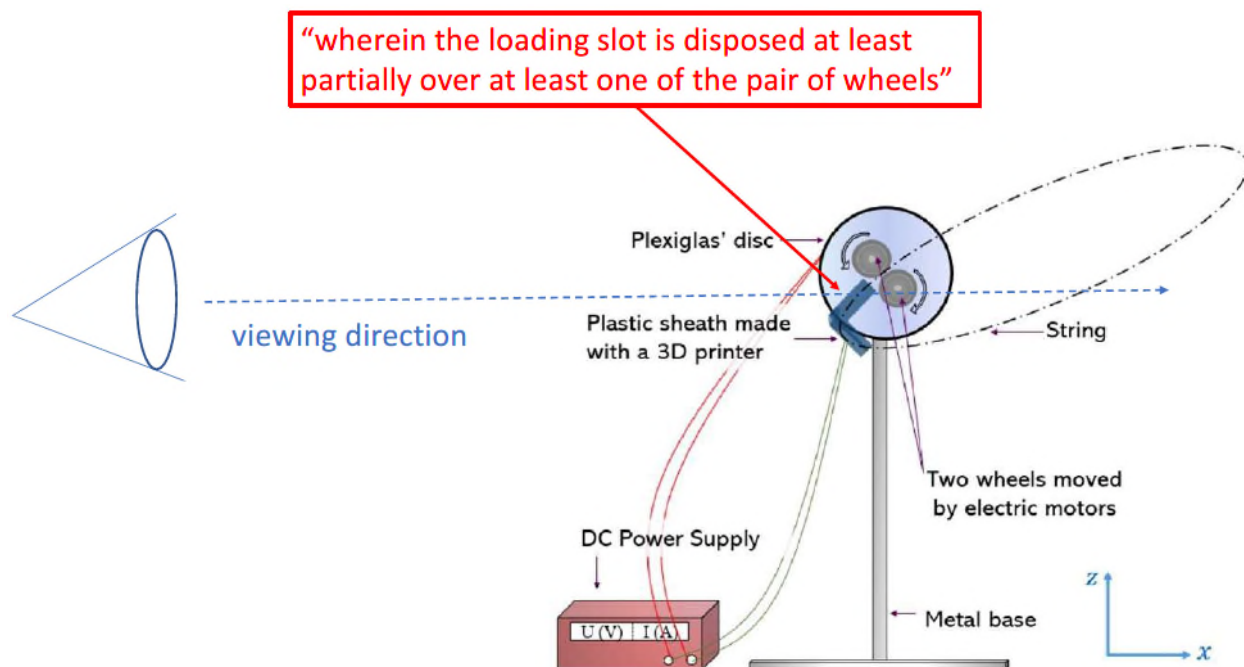
[16.4] – wherein the loading slot is disposed at least partially over at least one of the pair of wheels; and

As previously discussed, Abello’s sheath has a loading slot. Ex.1002, ¶143. The sheath comprising the loading slot partially surrounds the lower wheel and is “over” the wheel depending on a viewer’s perspective. *Id.* 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. Ex.1002, ¶144.

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.

Ex.1002, ¶145.



Therefore, Abello's loading slot is disposed at least partially over at least one of the pair of wheels. Ex.1005, Fig. 3. Ex.1002, ¶146.

[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.

Limitation [16.5] is disclosed by Abello in view of Yeany for the reasons previously provided for limitation [1.4]. See Section IX(C)(1); Ex.1002, ¶147.

7. 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.

Claim 17 is disclosed by Abello in view of Yeany for the reasons previously provided for Claim 2. *See* Section IX(C)(2); Ex.1002, ¶148.

D. Ground 3 –Wagner in view of Yeany renders obvious claims 1-3, 12 and 15 under 35 U.S.C. § 103

Wagner discloses all of the limitations of the claims except it does not expressly state the string has fibers extending away from the axis. Ex.1002, ¶149. 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. Ex.1008, Abstract, 1:63-2:12, 5:50-56; Ex.1002, ¶149. A POSITA would have been motivated to look for ways to reduce the velocity required to lift the unsupported loop portions to form various configuration, which provides a number of benefits. Ex.1002, ¶149. 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. *Id.* Additionally, reduced operating speeds reduces the wear on the string, wheels, and motors prolonging the useable life of these components. *Id.* Furthermore, slower spinning wheels would reduce the noise created by the spinning wheels leading to a more pleasing operating environment to a user. *Id.* Lastly, reduced takeoff speeds would be achieved by smaller motors. *Id.* 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. *Id.*

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. Ex.1002, ¶150. Wagner teaches that its loop can be any flexible strand and gives one example as a woven string-like material. *Id.* 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. *Id.* 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. *Id.* Doing so would have provided the benefits discussed above for improved operating with decreased cost and size. *Id.* Moreover, a POSITA would have a reasonable expectation of success since the underlying physics of Yeany's fuzzy string operate the same when used in Wagner's string shooter device as in Yeany's string shooter device. Ex.1002, ¶159.

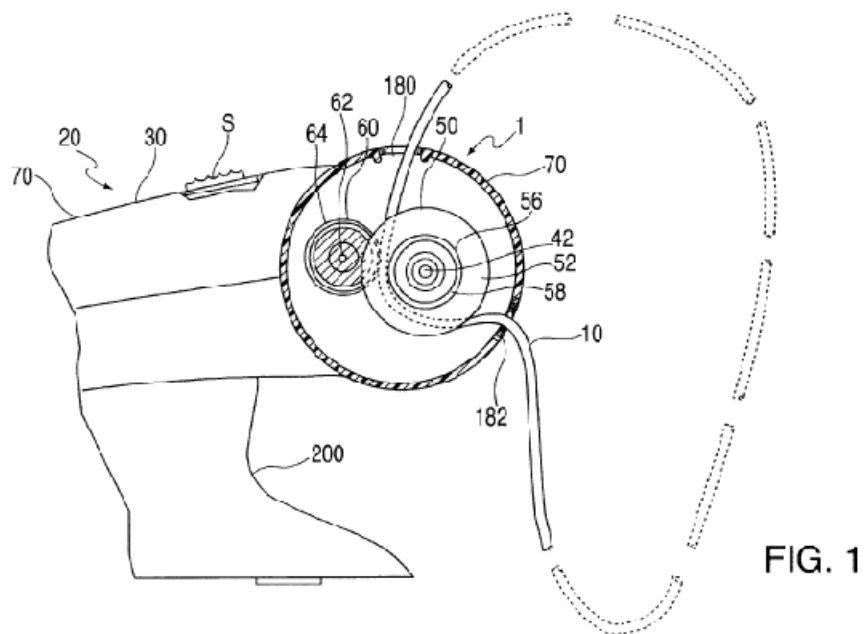
1. Claim 1

[1.0] – A string shooting device comprising:

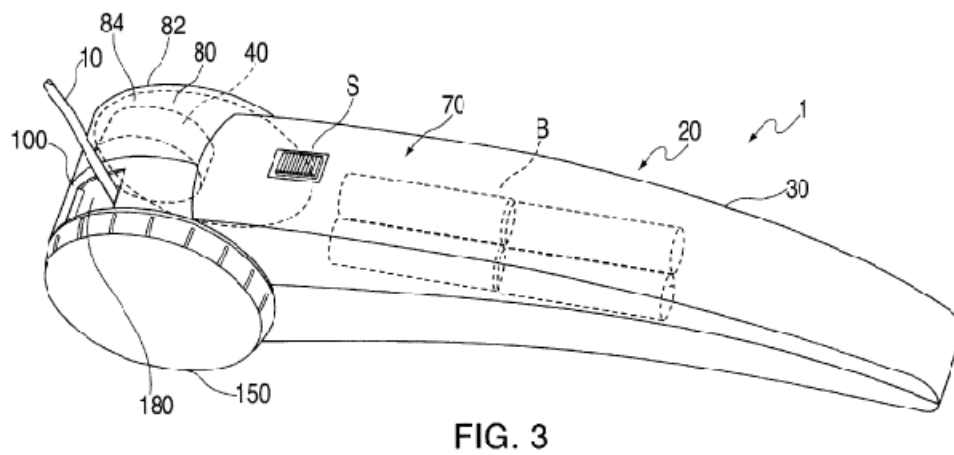
Wagner relates to “[a]n amusement device comprising an endless flexible loop and an inline traction drive unit to rotate the loop.” Ex.1008, 1:13-14; Ex.1002, ¶151. Wagner discloses “an amusement device” with an inline traction drive unit that positively drives the loop such that when the unsupported portion of the loop is driven or “thrown” by the drive unit, it assumes a “metastable” configuration. Ex.1008, 1:62-2:12, FIGS. 1-3; Ex.1002, ¶151.

[1.1] – a body;

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. Ex.1008, 2:23-27, 2:60-64; Ex.1002, ¶152. Wagner’s body encloses the electric motor and batteries. *Id.*



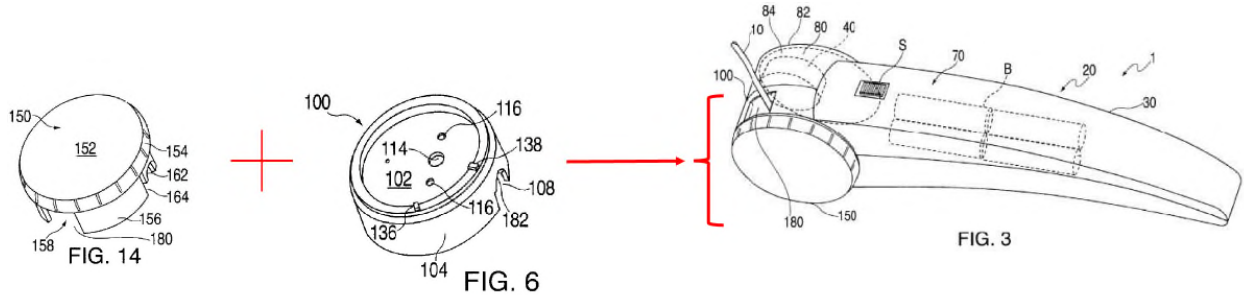
Ex.1008, FIG. 1



Ex.1008, FIG. 3

[1.2] – a housing attached to the body;

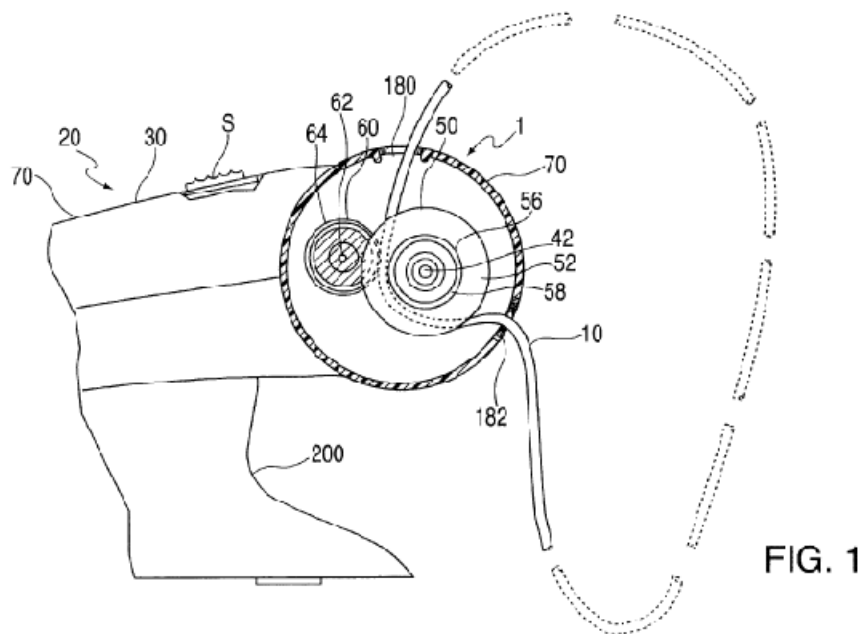
Wagner also discloses a housing comprised of “a rotatable cup 100, and a cover 150.” Ex.1008, 2:60-64; Ex.1002, ¶153. The rotatable cup is attached to the body where “[a]ttachment may be by a pair of fasteners passing through spaced apertures 116 and 118.” Ex.1008, 2:65-3:15; *see also id.* at 2:62-64 (body includes “electric motor 40 attached to the rotatable cup 100”); Ex.1002, ¶153. The cover is further attached to the rotatable cup using a “friction fit.” Ex.1008, 3:47-62; Ex.1002, ¶153.



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;

The drive motor of Wagner includes a drive motor and “a pair of circumferentially opposed drive wheels 50 and 60.” Ex.1008, 2:23-59, 3:15-21; Ex.1002, ¶154. The drive motor includes a drive shaft 42 that drives one of the drive wheels. Ex.1008, 2:28-36; Ex.1002, ¶154. During operation, “the drive wheel 50 rotates, in turn driving the loop 10 in line and in cooperation with the backup wheel 60.” Ex.1008, 4:57-59; Ex.1002, ¶154.



Ex.1008, 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.

Wagner discloses string formed into a loop. Ex.1008, 1:62-2:23, FIG. 1; Ex.1002, ¶155. 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.” Ex.1008, 2:37-59; 4:53-5:21; Ex.1002, ¶155.

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 hat 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. Ex.1002, ¶156. 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. Ex.1008, 5:12-15; Ex.1002, ¶157. 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 as known from a POSITA’s background knowledge. Ex.1002, ¶157; *see* Ex.1005, 5 (“as soon the SSh reaches the threshold speed v_{takeoff} , air drag dominates over the weight and begins to lift the SSh.”); Ex. 1009, 1 (“...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.”); Ex.1006, 877 (“the hydrodynamic drag of air is a crucial ingredient in the dynamics of the string shooter”).

One such string with a non-smooth surface is disclosed in Yeany. Ex.1002, ¶158. A POSITA looking at Yeany would understand that the fibers extending from the surface of Yeany's string would cause air friction and reduce the velocity Wagner's drive unit needs to impart to the string. *Id.* 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. *Id.*; see Section XI(B)(1).

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 string shooter since those properties depend on the physical characteristics of the string itself (such as surface texture, weight, velocity) when the string travels through the fluid, like air. Ex.1002, ¶159; see Section XI(B)(1).

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." Ex.1002, ¶160; see Section XI(B)(1). Therefore, when using the string of Yeany in Wagner's device, the combination teaches utilizing a string that has a plurality of fibers extending away from the axis to increase the air friction.

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.

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. Ex.1002, ¶161; *see* Section XI(B)(2).

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.

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. Ex.1002, ¶162; *see* Section XI(B)(3).

4. Claim 12

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

Limitation [12.0] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.0]. *See* Section IX(D)(1); Ex.1002, ¶163.

[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,

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). *See* Section IX(D)(1); Ex.1002, ¶164.

[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;

Limitation [12.2] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.4]. *See* Section IX(D)(1); Ex.1002, ¶165.

[12.3] – driving the at least one driven wheel;

Limitation [12.3] is disclosed by Wagner in view of Yeany for the reasons previously provided for limitation [1.3]. *See* Section IX(D)(1); Ex.1002, ¶166.

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

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). *See* Section IX(D)(1); Ex.1002, ¶167.

[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.

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). See Section IX(D)(1-3); Ex.1002, ¶168.

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.

Wagner and Yeany discloses claim 12 as discussed above. Ex.1002, ¶169. 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. Ex.1008, 4:21-37; Ex.1002, ¶169. Thus, during operation, 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.*

E. Ground 4 –Wagner in view of Yeany and Scorch renders obvious claims 4 and 16-17 under 35 U.S.C. § 103

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. Ex.1002, ¶170. Dependent claim 4 and independent claim 16 add limitations for a “loading slot” that are not expressly taught by Wagner or Yeany. *Id.* However, Scorch, a YouTube video prior to the time of the invention, teaches a string shooter device with a loading slot on the side. *Id.* 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. *Id.* Moreover, a POSITA would have a reasonable expectation of success given that Wagner already teaches loading new strings on the side of the device and flange structures around the wheels to keep the string in place if a loading slot on the side were present. Ex.1002, ¶174-¶176.

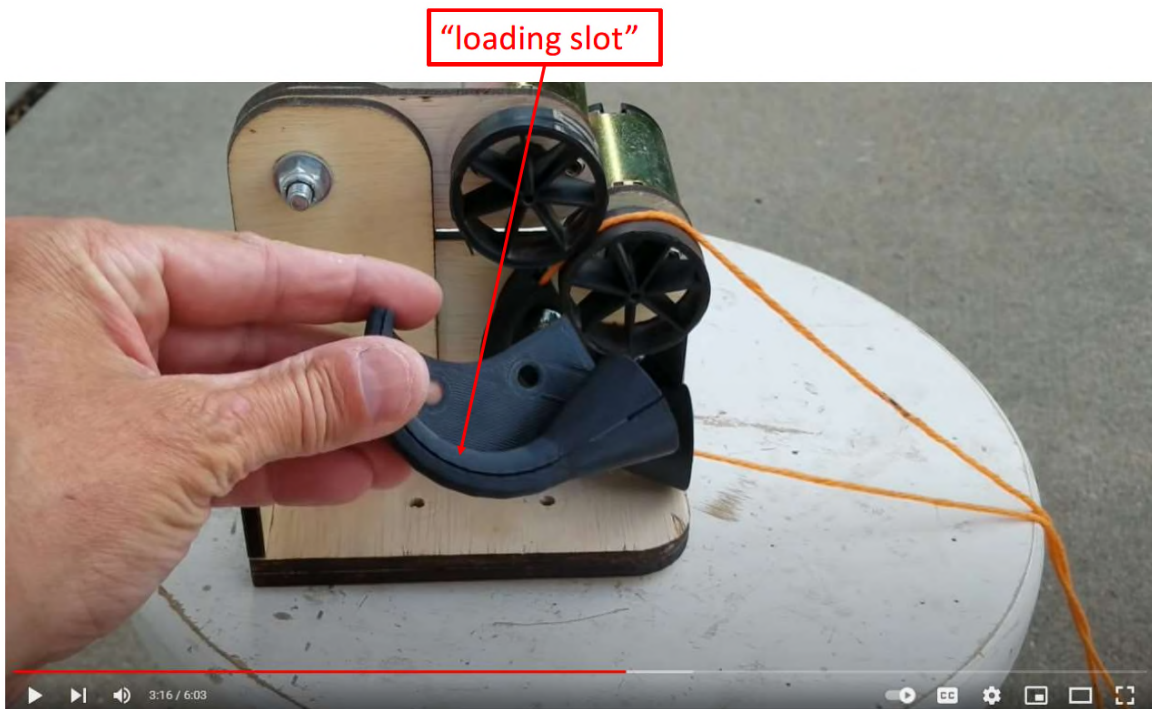
1. Claim 4

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:

Claim 1 is taught by Wagner and Yeany for the reasons previously provided for the combination of Wagner and Yeany for claim 1. Ex.1002, ¶171. 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.” Ex.1008, 2:60-64, 3: 3:13-21; Ex.1002,

¶171. This housing at least partially covers wheels 50 and 60. Ex.1008, Fig. 1, Fig. 3, 3:13-21, 3:47-62; Ex.1002, ¶171.

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 the housing between the pair of wheels. Ex.1007, 1:13:1:47; *see* Ex.1001, 2:11-13 (embodiment in ’774 Patent “receiv[es] a looped string into a housing between a pair of wheels.”); Ex.1002, ¶172. Scorch also discloses that the housing can have “a slot in the side” so one can put a loop of string around the wheels through the housing. Ex.1007, 3:00-3:30; Ex.1002, ¶172. This loading slot is shown in the screen shot below. Ex.1002, ¶172.



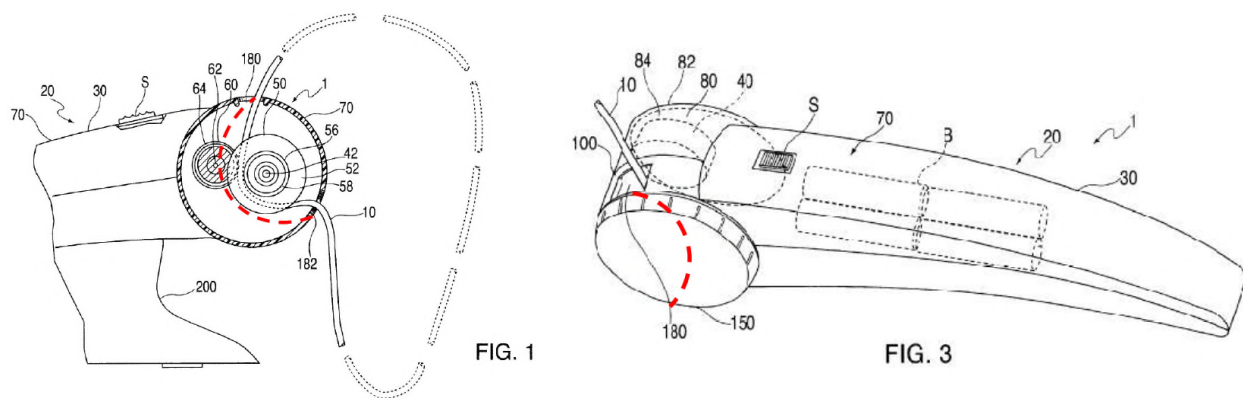
This loading slot allows one to “swap them [the strings] out really quick.” Ex.1007, 3:30-3:53; Ex.1002, ¶173. An example of how a loop of string is inserted into this type of loading slot is shown below (with the red string being inserted into the loading slot). Ex.1002, ¶173.



A POSITA would apply the teaching of a side loading slot from Scorch to the Wagner device to improve the convenience of replacing a loop of string. Ex.1002, ¶174. Wagner already teaches that a loop of string may need to be “removed from the device 1 or reinstalled between the” wheels. Ex.1008, 3:58-62; Ex.1002, ¶174. However, Wagner teaches doing so by removing the cover and then reinstalling the cover after the loop of string has been replaced. Ex.1008, 3:46-4:45; Ex.1002, ¶174. 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 is easier and quicker for a user. Ex.1002, ¶174.

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. Ex.1002, ¶175. An illustration of one obvious path to a POSITA for the loading slot is provided below as a dashed red line in the embodiments of Figure 1 and 3. *Id.* A loading slot that follows this path allows for quick replacement of the loop of string in the Wagner device. *Id.*



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 Ex.1007, 4:00-4:30; Ex.1008, 2:49-

52; Ex.1002, ¶176. 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. Ex.1002, ¶176. 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* Ex.1007, 4:00-4:30; Ex.1002, ¶176. 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. Ex.1007, 5:00-5:20; Ex.1002, ¶176.

2. Claim 16

[16.0] – A string shooting device comprising:

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]. *See* Section IX(D)(1); Ex.1002, ¶177.

[16.1] – a body;

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]. *See* Section IX(D)(1); Ex.1002, ¶178.

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

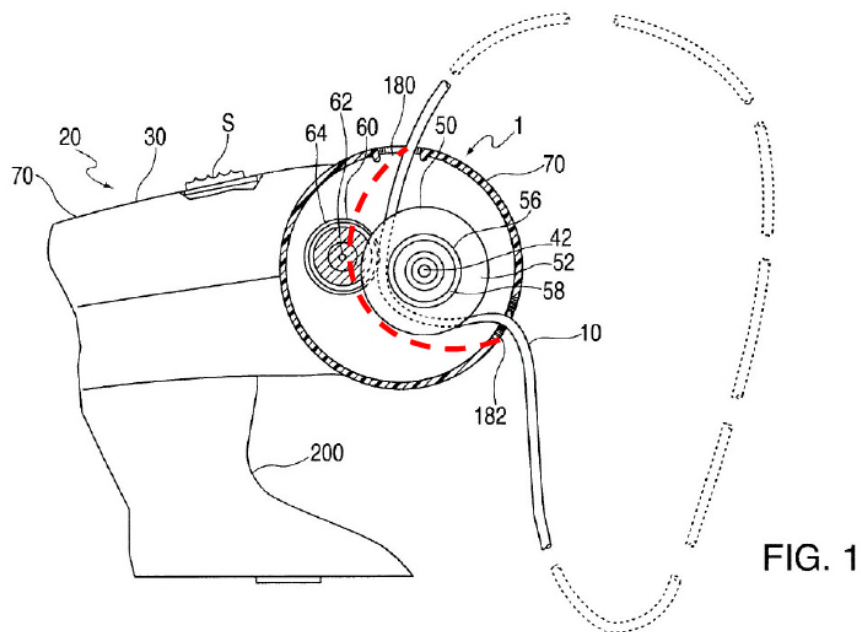
Limitation [16.2] is taught by Wagner, Yeany and Scorch for the reasons previously provided for the combination of Wagner, Yeany, and Scorch for claim 4. *see also* analysis of Wagner in view of Yeany for limitation [1.2] (discussing housing attached to the body). *See* Section IX(D)(1); Ex.1002, ¶179.

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

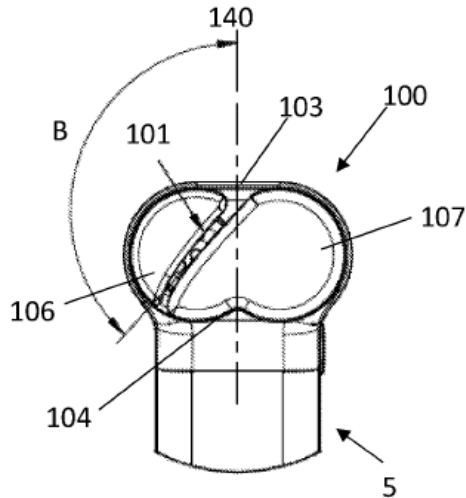
Limitation [16.3] is disclosed by Scorch for the reasons previously provided for the combination of Wagner and Yeany for limitation [1.3]. *See* Section IX(D)(1); Ex.1002, ¶180.

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

As previously discussed, a POSITA would apply the teaching of a slot in the side from Scorch to the Wagner device. *See* Section IX(E)(1); Ex.1002, ¶181. 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. Ex.1008, Fig. 1, Fig. 3; Ex.1002, ¶181.



Notably, 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. Ex.1002, ¶182. 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. Ex.1002, ¶182.



Ex.1001, Fig. 11

Therefore, the loading slot taught Wagner, Yeany, and Scorch is disposed at least partially over at least one of the pair of wheels. Ex.1002, ¶183.

[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.

Limitation [16.5] is disclosed by Scorch for the reasons previously provided for the combination of Wagner and Yeany for limitation [1.4]. See Section IX(D)(1); Ex.1002, ¶184.

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.

Claim 17 is disclosed by Scorch for the reasons previously provided for the combination of Wagner and Yeany on Claim 2. See Section IX(D)(1); Ex.1002, ¶185.

X. CONCLUSION

Claims 1-4, 12 and 15-17 of the '774 patent are not patentable and Petitioner requests that IPR be instituted and claims 1-4, 12 and 15-17 of the '774 patent be canceled.

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CERTIFICATE OF SERVICE UNDER 37 CFR § 42.6(e)(4)

The undersigned hereby certifies that a copy of the accompanying Petition for *inter partes* review, all accompanying exhibits, and the Power of Attorney is being served via Federal Express to the correspondence address of record for U.S. Patent No. 11,674,774 on July 25, 2024 upon the following:

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