

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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DECLARATION OF DR. SAMIR NAYFEH

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	<i>[1b] a mouthpiece defined at one of the two ends;.....</i>	<i>69</i>
	<i>[1c] an electrical power source arranged within the outer housing;.....</i>	<i>69</i>
	<i>[1d] an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source</i>	<i>70</i>
	<i>[1e] a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;</i>	<i>73</i>
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	<i>[1b] a mouthpiece defined at one of the two ends;</i>	<i>104</i>
	<i>[1c] an electrical power source arranged within the outer housing;</i>	<i>105</i>
	<i>[1d] an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source</i>	<i>107</i>

	<i>[1e] a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;</i>	<i>109</i>
	<i>[1f] an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and.....</i>	<i>111</i>
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I, Dr. Samir Nayfeh of Dunn Loring, VA, declare that:

I. INTRODUCTION

1. My name is Dr. Samir Nayfeh, and I have been retained by counsel for Shenzhen Kangvape Technology Co., Ltd. (“Petitioner” or “Kangvape”) as an expert witness to provide assistance regarding U.S. Patent No. 11,925,202 (“the ’202 Patent”). Specifically, I have been asked to consider the validity of claims 1, 3, 4, 8-13, and 15 of the ’202 Patent (the “Challenged Claims”).

2. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the Challenged Claims. I have no financial interest in the outcome of this matter or on related litigation involving the ’202 Patent.

3. My independent analysis here is based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those cited herein. I may rely upon these materials, my knowledge and experience, and/or additional materials to further explain and corroborate my analysis, and to respond to critiques of my analysis raised by the Patent Owner or the Patent Trial and Appeal Board (“Board”).

4. My analysis of the materials produced in this proceeding is ongoing and I will continue to review any new material as it is provided. This declaration represents my independent analysis of particular issues considered to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

II. BACKGROUND AND QUALIFICATIONS

5. I am over the age of 18 and am competent to provide this testimony. I have developed knowledge of the technologies addressed in this declaration based upon my education, training, experience, and my review of the '202 Patent, its file history, and the related prior art. I am well qualified to serve as a technical expert in this matter based upon my qualifications, discussed in detail below.

6. I earned a Bachelor of Science in Engineering Science and Mechanics from Virginia Tech in 1991; a Master of Science in Engineering Mechanics from Virginia Tech in 1993; and a Ph.D. in Mechanical Engineering in 1998 from the Massachusetts Institute of Technology (MIT).

7. I was an assistant professor and associate professor of Mechanical Engineering at MIT from July 1998 until July 2006. In these positions, I taught classes across the curricula and disciplines of mechanical engineering, including control systems. I also taught introductory courses on product design and

development, covering a variety of different types of mechanical products, including medical products, consumer products and industrial products.

8. For example, in my practice of teaching a Product Engineering Process class, I regularly supervise several groups in the exercise of designing consumer-based products and medical products, including products that include mechanical and control components used in thermal and fluid delivery devices. Similarly, in my Elements of Mechanical Design class, I taught others the engineering practice of designing consumer products in a manner that identifies and improves the user experience. One such product design resulted in a sophisticated car seat described in U.S. Patent No. 6,626,064. My experience in teaching engineering principles and mechanical design is also described in my curriculum vitae (“CV”), which is appended to this Declaration.

9. I have conducted research across a number of disciplines within the mechanical and electromechanical fields. This research culminated in various publications on, for example, medical instruments, fiber-reinforced materials, electromechanical system dynamics, fluid structure interactions, fluid delivery devices and flow in porous materials, and power generation and distribution. Many of these publications are listed in my CV.

10. In addition to my experience in academics, teaching, and research, I have also served as a professional engineering consultant with an emphasis on the

design of precision electromechanical systems, including several types of thermal and fluid delivery devices. During this experience, I have assisted in the development of a variety of medical, consumer, and industrial products, including those that provide controlled delivery of flowable material, so I have a meaningful understanding of the types of components and underlying technology used in such designs. For example, I have worked on many projects relating to fluid flow and thermal control in various products. These products have commonly included resistive heaters and other heaters and have involved convection, conduction, mixing, and radiation. Many of these projects require precise metering of liquids and gases and involve the use of porous media and thin gaps to meter gas flow, as well as capillary action to draw and retain liquids. These systems also commonly involve temperature and pressure sensors employed in conjunction with a controller to regulate heating or flow. Additionally, in my consulting experience, I performed CFD-based optimization of mixing of reagents and samples for medical diagnostics. I also developed new concepts for construction of various machines including magnetically-levitated stages, precision steering mirrors, high-temperature deposition systems, surgical tools, and microfluidic systems. I further developed models and design methods for control of friction and adhesion in air and vacuum, large porous aerostatic bearings, water and gas-flow systems, magnetic actuators and sensors, and nanometer-precision positioning systems, among other projects.

11. In addition to my consulting experience, I previously served as an expert witness in earlier patent proceedings related to smoking articles or other thermal and aerosol delivery devices. While much of this work was completed many years ago, I recall that some of those those earlier proceedings related to smoking articles having a heating element to vaporize an aerosol-forming substance, and I have experience in assessing the mechanical design of such devices and familiarity with the components and underlying technology used therein. *See, e.g.*, IPR2020-00920 (addressing U.S. Patent No. 8,314,591); IPR2020-01097 (addressing U.S. Patent No. 9,839,238).

12. I have over 30 years of experience in mechanical engineering and design. Much of that time was spent conducting research and teaching as a university-level mechanical engineering faculty member. I have extensive experience in mechanical design, flow control, consumer products, thermal and fluid delivery devices, and the types of components and underlying technology used in such designs. Taken as a whole, my academic and practical experience have given me a substantial basis upon which to evaluate the technology that is in question in the claims of the '202 patent.

III. LEVEL OF ORDINARY SKILL IN THE ART

13. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a person of ordinary

skill in the art at the time of the invention of the '202 Patent ("POSITA"), which I have assumed to be the earliest alleged filing date (October 18, 2006) for purposes of my analysis here. I have considered the factors in determining the level of skill for a POSITA, including the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art; and the sophistication of the technology at the time of the alleged invention. I understand that a POSITA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSITA also would have knowledge from the teachings of the prior art, including the art cited below. As previously described, I have reviewed and understand the '202 patent. Based on my above-described experience, I am familiar with and know of the capabilities of a POSITA in this field leading up to October 18, 2006. Indeed, in my experience, I taught and/or worked with many such mechanical engineers.

14. Based on these factors described above, a POSITA would have had a bachelor's degree in mechanical engineering, electrical engineering, or a related field, and three to four years of experience, or a master's degree in mechanical engineering, electrical engineering, or a related field, and one to two years of experience. Additionally, a higher level of education or skill might make up for less experience, and vice versa. Such experience would include, for example, a

familiarity with thermal and fluid delivery devices and/or the components and underlying technology used therein.

15. By October 18, 2006, my academic, research, and work experience was at least that of a POSITA. I have reviewed and understand the technology described in the '202 patent, and I am qualified to provide opinions concerning what a POSITA would have known and understood at that time. My analysis and conclusions herein are from the perspective of a POSITA as of that date.

IV. MATERIALS CONSIDERED AND RELIED UPON

16. In forming my opinions and reaching the conclusions described in this declaration, I have relied on the documents and materials cited herein as well as those identified in this declaration, including the '202 Patent, the prosecution history of the '202 Patent, and prior art references cited herein. These materials comprise patents, related documents, and printed publications. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions. I have also relied on my education, training, research, knowledge, and personal and professional experience in the relevant technologies and systems that were already in use prior to, and within the timeframe of the earliest effective filing date of the '202 Patent (October 18, 2006).

17. Accordingly, as part of my independent analysis of the '202 Patent, I have analyzed the following publications and materials:

<u>Exhibit</u>	<u>Description</u>
EX1001	U.S. Patent No. 11,925,202 to Robinson et al. (“the ’202 Patent”)
EX1002	Prosecution History of the ’202 Patent (“the Prosecution History”)
EX1004	U.S. Patent No. 5,249,586 (“Morgan”)
EX1005	U.S. Patent No. 4,510,950 (“Keritsis”)
EX1006	E.P. Patent No. 0845220 (“Susa”)
EX1007	U.S. Publication No. 2005/0205084 (“Gupta”)
EX1008	U.S. Patent No. 5,743,251 (“Howell”)
EX1009	U.S. Patent No. 6,155,268 (“Takeuchi”)
EX1010	Kevin Hatch, et al., Preliminary Evaluation of a Commercially Available Electric Aerosol Inhaler from China (Sep. 14, 2006) (“September 2006 Ruyan Product Evaluation”), available at https://www.industrydocuments.ucsf.edu/tobacco/docs/#id=jqyy0228
EX1011	U.S. Patent No. 7,726,320 (“the ’320 patent”)
EX1012	Final Written Decision in IPR2020-00921, Paper 32 (PTAB June 30, 2022)
EX1013	U.S. Patent No. 5,060,671 (“Counts”)
EX1014	Declaration of Dr. Robert Sturges, <i>RJ Reynolds Vapor Company et al v. Fontem Holdings 1 BV et al.</i> , IPR2018-00627, EX1002
EX1015	Patent Owner Response in IPR2020-01602, Paper 16 (PTAB July 2, 2021)
EX1016	Petition in IPR2018-00627, Paper 2 (PTAB March 1, 2018)
EX1017	U.S. Publication No. US2013/0306064 (“Thorens”)

<u>Exhibit</u>	<u>Description</u>
EX1018	U.S. Publication No. US2014/0000638 (“Sebastian”)

18. Although this declaration refers to selected portions of prior art publications, it should be understood that these cited portions are examples, and I recognize that a POSITA would have viewed the references cited herein in their entirety and in combination with other references cited herein or cited within the references themselves.

V. LEGAL STANDARDS

19. I am not a lawyer, but I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding meaning and validity of patent claims. I have applied the legal standards described below, which were provided to me by counsel for the Petitioners.

20. It is my understanding that assessing the validity of a U.S. patent based on a prior art analysis involves two steps. First, one construes the terms of the patent claims to understand what meaning one of ordinary skill in the art would have given the terms. Second, after the claim terms have been construed, one then assesses validity by comparing the patent claim properly construed to the “prior art.” I understand that the teaching of the prior art is viewed through the eyes of a POSITA as of the effective filing date of the ’202 Patent. My analysis as to what constitutes a POSITA is set forth above (§III).

A. Legal Standards for Prior Art

21. I understand that a patent or other publication must first qualify as prior art before it can be used to invalidate a patent claim. Counsel for Petitioners have informed me that Morgan (EX1004), Susa (EX1006), Gupta (EX1007) (incorporating by reference Howell (EX1008)), and Takeuchi (EX1009) all qualify as prior art to the '202 Patent. In particular, I was informed that each of these publications were published more than a year before the earliest alleged filing date of the '202 patent (October 18, 2006).

B. Legal Standard for Anticipation

22. I have been informed that a patent claim is unpatentable as anticipated under 35 U.S.C. § 102 if each and every element of a claim is found either explicitly or inherently in a single prior art reference. Under the principles of inherency, if the prior art necessarily functions in accordance with, or necessarily includes the claimed elements, it anticipates.

C. Legal Standard for Obviousness

23. I have been informed that a patent claim is invalid as “obvious” in light of one or more prior art references if it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention (“POSITA”), taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called

“secondary considerations” of non-obviousness (e.g., evidence of “long felt need” for the claimed invention, commercial success attributable to the claimed invention, unexpected results of the claimed invention, and “copying” of the claimed invention by others).

24. While I do not know the exact date that the alleged invention of the '202 patent was made, I do know that the '202 patent's earliest claimed priority date is October 18, 2006. For purposes of my obviousness analysis in the Grounds below, I have applied a date of October 18, 2006 as the date of the alleged invention, although in many cases the same analysis (explained below) would hold true even if the date of the alleged invention were earlier.

25. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason that would have prompted a POSITA to modify or supplement the single prior art reference, or to combine two or more references, in a manner that provides the elements of the claimed invention. This reason may come from a teaching, suggestion, or motivation to combine, or may come from the reference(s) themselves, the knowledge or “common sense” of a POSITA, or from the nature of the problem to be solved, and this reason may be explicit or implicit from the prior art as a whole. I have been informed that, under the law, the combination of familiar elements according to

known methods is likely to be obvious when it does no more than yield predictable results. I also understand it is improper to rely on hindsight in making the obviousness determination.

26. To the extent that a party presents any evidence of alleged “secondary considerations” of non-obviousness (refer to ¶23 above), the evidence must demonstrate a “nexus” between that secondary consideration and the invention recited in the patent claim.

VI. OVERVIEW OF THE '202 PATENT

A. Subject Matter Overview

27. The '202 Patent is directed to an “electrically powered aerosol generating device” that powers a heating device with the power source “for forming a thermally generated aerosol.” EX1001, 5:41-61, Abstract, 1:28-29, 4:30-5:61, FIGS. 1-3. Although the '202 Patent is titled “Tobacco-Containing Smoking Article” and describes embodiments that include tobacco therein, I noticed that the claims do not recite the term “tobacco.” EX1001, Cover, 8:66-19:24, 32:57-35:7. As described below, the claims were changed during prosecution of the '202 patent.

28. Another notable feature of the the smoking article of the '202 Patent is that the article can “produce aerosols *without experiencing any necessary burning of tobacco or other component materials*” because the smoking article uses electrically generated heat to produce aerosol instead of burning. EX1001, 4:35-67;

1:56-61. The claims of the '202 Patent likewise describe that a liquid aerosol-forming material is heated to produce aerosol. EX1001, 32:57-35:7. Three depicted embodiments of the smoking article described in the '202 Patent are shown below:

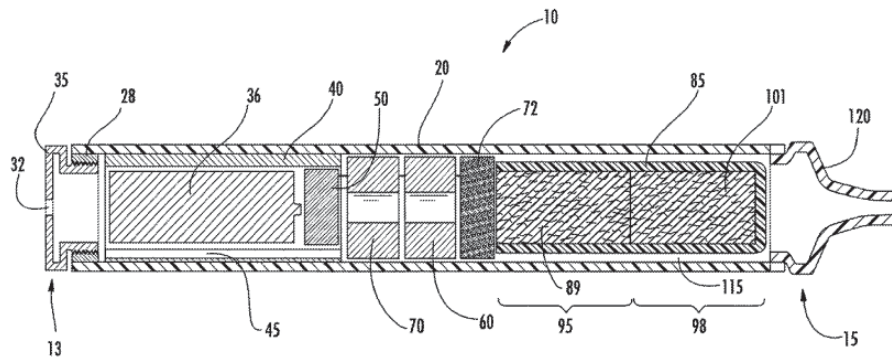


FIG. 1

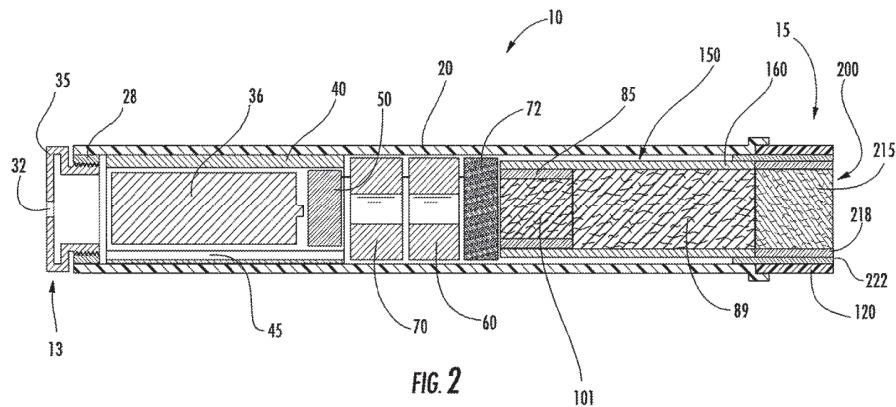


FIG. 2

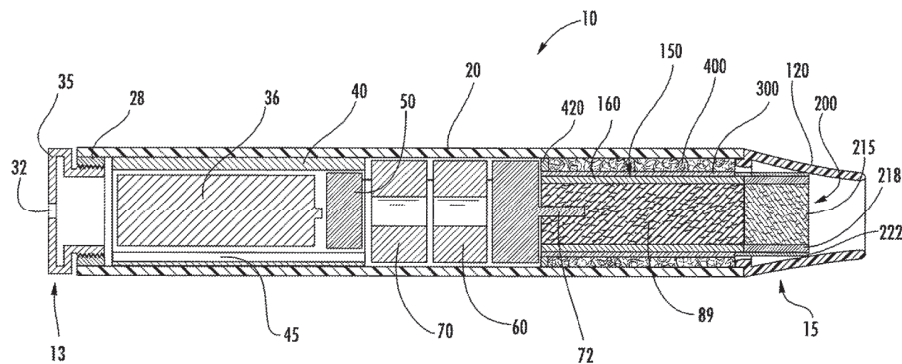


FIG. 3

EX1001, FIGS. 1-3.

29. According to the '202 patent, the smoking article 10 “has an overall shape that is generally rod-like or tubular in nature, generally akin to a cigarette-type or cigar-type smoking article.” EX1001, 19:53-57. The smoking article 10 described in the specification includes a set of structures that are also recited in claim 1; these structures are listed as items (a) through (g) below along with portions of the '202 patent specification describing each structure:

- a) an “outer housing” (outer container or housing 20, col. 19: 58-20:23),
- b) a “mouthpiece” (mouth-end 15 including a mouth piece 120, col. 20:4-23 and 24:15-59),
- c) an “electrical power source” (battery source 36, col. 20:24-44),
- d) an “electrical resistance heater” (heating element 72, col. 21:28-22:8),
- e) a “storage compartment” that is “configured for” storage of a liquid-aerosol forming material (cartridge 85, col. 22:9-36),
- f) an “air passageway” (passageway 45/115, col. 20:28-44, 22:40-45 and 24:34-41), and
- g) a “controller” (controller 50, col. 20:45-21:27).

30. I noticed that the '202 Patent concedes that each these above-listed structures were included in a competitor product referred to as the “Ruyan Atomizing Electronic Cigarette” that was “available” from “Ruyan SBT Technology and Development Co., Ltd.” before the earliest alleged filing date of the '202 Patent.

EX1001, 20:1-4, 20:20-24, 20:38-44, 20:55-59, 20:64-67, 21:58-61, 22:19-22, 24:20-23. This concession appears to be corroborated by those in the industry at the time, which obtained the “commercially available” Ruyan device and analyzed its contents no later than September 2006. EX1010, 1-3 (“commercially available electronic cigar” which “yields nicotine containing aerosol when puffed,” “rechargeable battery”, “cartridge containing [] aerosol generating material (propylene glycol)”), 4 (“cigar body,” “mouthpiece”), 5 (“heater elements,” “micro chip(s) controlling [] electronic circuitry”), 6 (“air channels”).

31. The '202 Patent plainly explains that the difference between its preferred embodiment of the claimed smoking article and the Ruyan device occurs in the contents of the “cartridge.” EX1001, 22:46-23:34. In particular, the '202 Patent states that the contents of the Ruyan device’s cartridge (which contained an aerosol-forming material and “fibrous” substrate) can be “replaced” with an aerosol-forming liquid *and a “tobacco” substrate* (tobacco cut filler, tobacco sheet, aqueous extracted tobacco cut filler pulp, or formed tobacco pieces or pellets). *Id.* This admission, along with the above-noted statements from the '202 Patent related to the structures known in the Ruyan device, are informative here regarding the state of the prior art. As described below, a variety of prior art publications disclosed similar structures. *Infra*, Grounds 1A-3.

B. File History and Effective Filing Date of the '202 Patent

32. As part of my preparation of this declaration, I reviewed the file history of the '202 Patent (EX1002). I understand that the '202 Patent was filed March 31, 2023, and claims priority to several prior patent applications including a prior patent application filed October 18, 2006. *See* EX1001, pp. 1-2. On the same date, the Patent Owner also filed an information disclosure statement that included a listing of prior art publications and other literature spanning more than fifty pages. EX1002, 71-128. Shortly after this filing, the Patent Owner then canceled all of the original claims and inserted a new set of claims, which no longer expressly recited a “tobacco” element in the claims. EX1002, 153-159.

33. In the first Office Action, the Examiner raised a “double patenting” ground of rejection. EX1002, 172-177. There were no anticipation (§102) or obviousness (§103) rejections based upon any references cited in the lengthy list from the Patent Owner. The Patent Owner replied with a “terminal disclaimer,” and then all of the claims were allowed. EX1002, 287-289, 305-310, 391-396.

C. Interpretation of the '202 Patent Claims at Issue

34. For purposes of my analysis in this IPR proceeding, I understand that the terms that appear in the claims of the '202 Patent should be interpreted according to their “ordinary and customary meaning,” which is sometimes called the *Phillips* standard. In determining the ordinary and customary meaning, I understand that the words of a claim are first given their plain meaning that those words would have had

to a POSITA at the time. I also understand that the structure of the claims, the specification and file history also may be used to better construe a claim insofar as the plain meaning of the claims cannot be understood. Moreover, I understand that even treatises and dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by a POSITA to a claim term at the time of filing. I have followed this approach in interpreting terms of the Challenged Claims herein.

35. I have been informed that the Board has previously construed a claim term from a related patent (IPR2020-01602, Paper 32, which analyzed claims of related U.S. Patent No. 9,901,123), and this same claim term also appears in claim 1 of the '202 Patent. In particular, I was informed that the Board previously construed the term “*wicked into contact*” to mean: “wicked into contact (1) with the heater, or (2) with an area in close proximity to, and exposed by the heat produced by, the heater.” Also, I was informed that the Board supported its analysis of this term by citing to text in U.S. Patent No. 9,901,123. This same text appears in the '202 Patent. *See* EX1001, 21:44-61 (“in close proximity to”), 24:41-59. I have considered these cited portions of the '202 Patent specification, and I have therefore applied the Board’s formal construction the term “*wicked into contact*” for purposes of my analysis in the present IPR proceeding.

36. For purposes of addressing the prior art comparison here and in light of the remarkable similarities between the components of the preferred embodiment of

the '202 Patent and the prior art/predictable combinations articulated below in Grounds 1A-3, the plain meaning of the remaining elements of the challenged claims of the '202 Patent is sufficiently clear without the need for a substitution of other words or phrases. As such, I have not proposed any further claim constructions for use in this IPR proceeding. To the extent other proposals are subsequently raised, I reserve the opportunity to address such proposals based on any new information and on my continuing analysis of the materials already provided.

VII. OVERVIEW OF THE CITED REFERENCES

A. Morgan (EX1004)

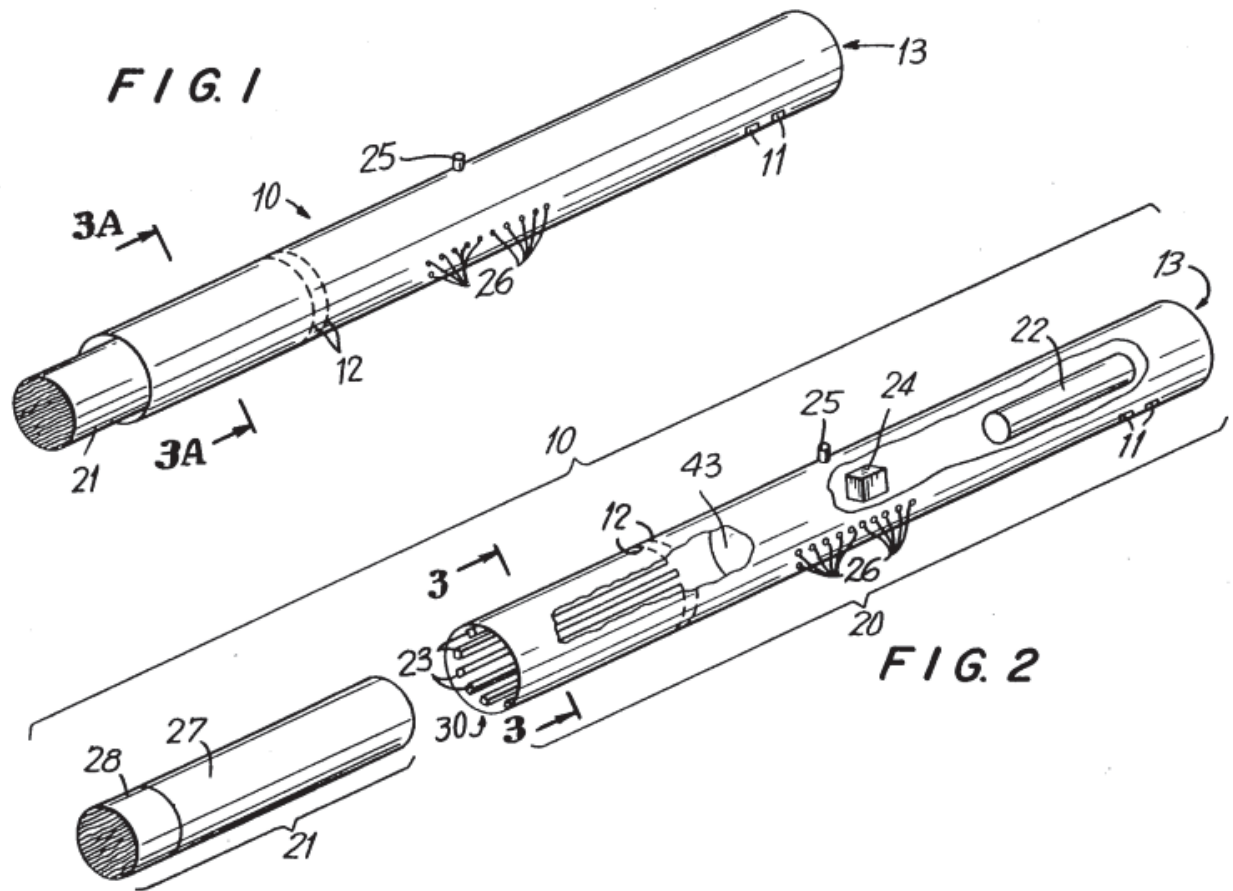
37. Similar to the disclosure of the '202 Patent, Morgan discloses an electrical smoking article. EX1004, 1:11-15, 3:9-25, 4:40-47, 7:11-21. Morgan teaches an aerosol-producing smoking article that resembles a cigarette—much like the smoking article of the '202 Patent. EX1004, 2:6-33, 3:9-37, FIGS. 1-2. Notably, Morgan's electrical smoking article achieves some of the same benefits touted by the teaching of the '202 Patent, including electrical resistance heaters that heat (but do not burn) an aerosol precursor contained within a porous tobacco material so as to produce aerosol that mimics the appearance of cigarette smoke. EX1004, 1:11-15, 2:6-33, 5:21-65, FIGS. 1-2. Morgan teaches that the article 10 achieves a user experience that is similar to conventional cigarette smoking but does not involve the user inhaling smoke from burning tobacco. As described in more detail below,

Morgan includes all of the features of Claim 1, including features that the the '202 Patent alleges are “replaced” from the Ruyan device (refer to ¶¶30-31 above).

38. Additionally, I have been informed that the Board previously analyzed Morgan’s teachings in comparison to claims of an earlier patent related to the '202 Patent. *See* EX1012 (Final Written Decision in IPR2020-00921, which addressed the claims of related U.S. Patent No. 9,814,268 in comparison to Morgan’s teachings). I have reviewed the Board’s analysis of Morgan, and I believe that its is consistent with my independent analysis here. I have attempted to note this consistency below by citing to EX1012, but I note that my independent analysis of Morgan (and its comparison to the claim elements below) provides further detail and support for Grounds 1A-1B in this proceeding.

39. The electrical smoking article of Morgan includes a “reusable portion,” which includes an outer housing that contains heating elements, a power source, control circuitry, and a cavity configured to receive a “disposable portion.” EX1004, 3:9-37, 4:42-67, FIG. 2. The disposable portion includes a porous structure and contains an aerosol precursor that produces aerosol when heated by the heating elements. EX1004, 5:34-46. Morgan explains that the disposable portion can be slidably inserted into the reusable portion so as to contact the heating elements of the reusable portion. EX1004, 3:9-37. One embodiment of Morgan’s electrical smoking article is shown below in FIGS. 1-4, including an example where the

disposable portion is inserted into the reusable portion (FIG. 1) and an example where the disposable portion is separated from the reusable portion (FIG. 2):



EX1004, FIGS. 1-2.

40. Morgan also teaches that, when the disposable portion 21 is received the reusable portion 20, a flavor segment 27 (part of the disposable portion 21) is adjacent to and engages with the heating elements 23. EX1004, 4:42-47, 5:34-57. Reusable portion 20 houses power source 22, which provides power for heating elements 23, and a control circuit 24 configured to control the supply of electricity from power source 22 to heating elements 23. EX1004, 4:48-57. When power source

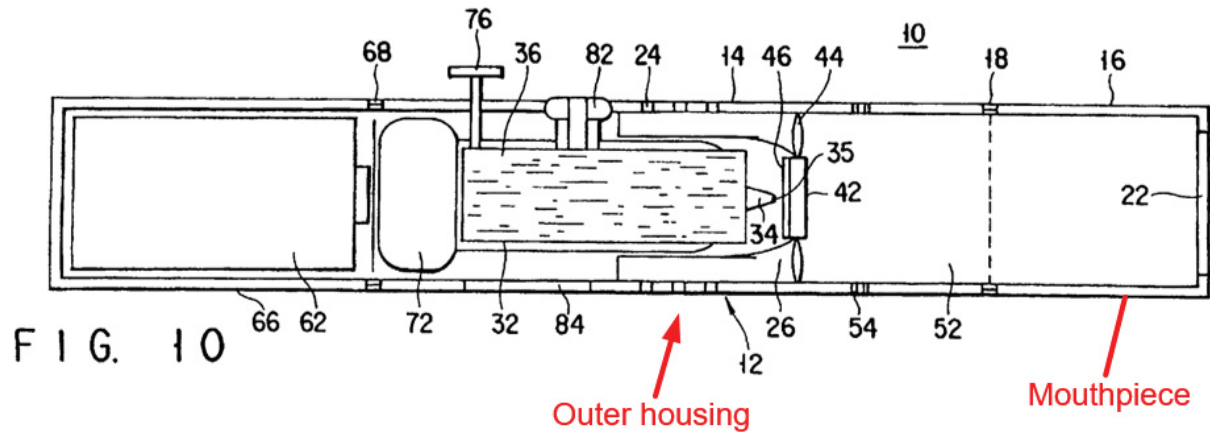
22 supplies power to heating elements 23, these heating elements 23 can heat aerosol precursor within flavor segment 27 to produce an aerosol that is inhaled by the user. EX1004, 5:58-65.

B. Susa (EX1006)

41. Susa is similar to Morgan (and to the '202 Patent) in that they describe cigarette-like electrical smoking articles that produce aerosol without burning tobacco. EX1004, 3:9-20, FIGS. 1-2; EX1006, [0001], FIG. 10. For example, the articles of Morgan and Susa both include an outer housing that is long and slender much like the profile of a conventional cigar or cigarette. EX1004, 4:42-5:5, FIGS. 1-2; EX1006, [0024]-[0025], FIG. 1, FIG. 10. The user inhales through one end of the outer housing in both references. EX1004, 4:42-5:5, 5:34-65, FIGS. 1-2; EX1006, [0026], [0042], FIG. 10. It is clear that Susa provided suggested improvements to provide known benefits to these types of articles.

42. For example, as I explain in Ground 1B below, even if one assumed that Morgan does not expressly disclose the claimed “mouthpiece defined at one of the two ends” of an outer housing (as recited in claim 1), such an option was conventionally implemented before 2006 in similar prior art devices (as suggested by Susa). EX1006, [0065]-[0068], FIG. 10. In particular, Susa suggests the traditional practice of using “a mouthpiece 16” that is “detachably mounted on the casing main body 14 through a connecting portion 18,” and that the mouthpiece can

further include a “suction port 22” through which the user can draw the aerosol into the mouth:



EX1006, FIG. 10 (annotated), [0066], *see also* FIGS. 9 and 11-14. Before October 2006, mouthpieces were conventional on smoking articles, and as I mentioned above, the '202 Patent admits that such a mouthpiece was implemented on commercially available ‘Ruyan’ smoking articles. Additionally, Susa further suggested that the removable mouthpiece 16 can be useful (when attached to a main body 14) to achieve an outer housing that protects and encloses disposable materials. EX1006, [0066], [0076], FIG. 10.

C. Gupta (EX1007)

43. Gupta is also similar to the '202 Patent because it discloses an “aerosol generating device” that uses an electrical power source to volatilize an aerosol-forming liquid. EX1007, [0008], [0038]-[0040], [0045], [0049], FIG. 1. Gupta’s electrical power source delivers electrical current to a heater so that the heater

volatilizes the liquid that is wicked toward the heater due to a capillary action. EX1007, [0039]-[0041], [0043], [0045], [0059], FIG. 1. In particular, Gupta describes a source of liquid aerosol formulation and a heated flow passage for transporting liquid to the heater. EX1007, [0039]-[0041], [0042]-[0047], [0049]-[0051], [0061] FIG. 1. Gupta's device is shown below in FIG. 1.

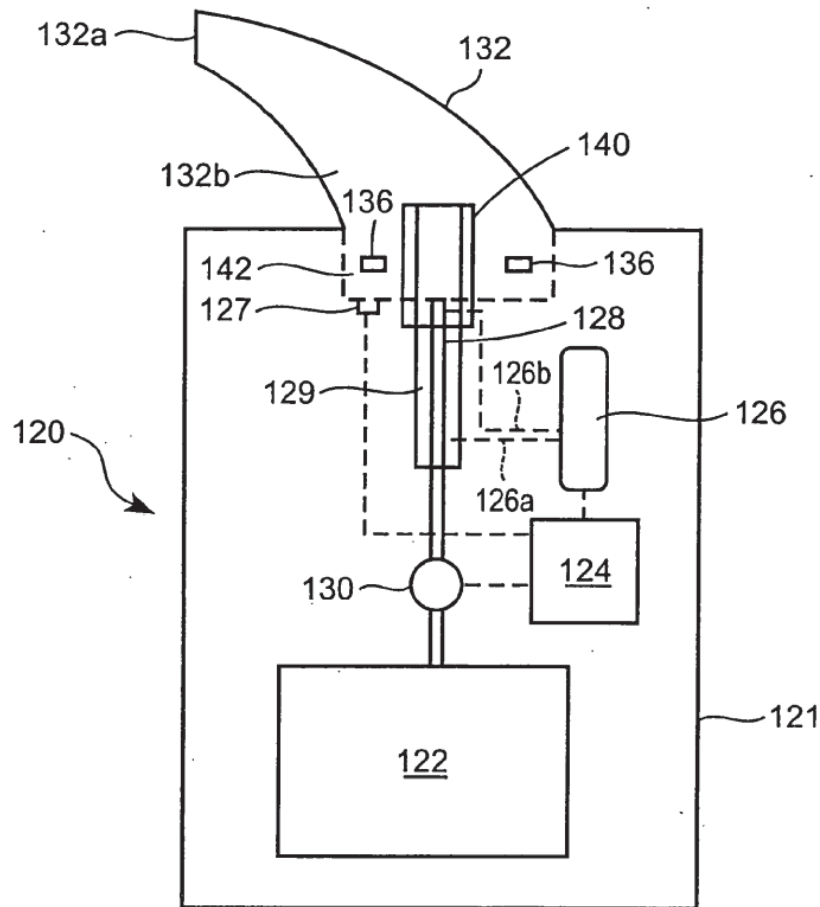


FIG. 1

EX1007, FIG. 1.

44. The flow passage of Gupta's aerosol generating device is "capillary sized" and is also referred to as a "capillary passage." EX1007, [0040]-[0041], FIG.

1. This type of traditional capillary action—which drives liquid through the flow passage to the heater—was conventionally implemented in such aerosol-generating devices. EX1007, [0039]-[0043], FIG. 1. Gupta describes different options for the heater, including a heater being part of the flow passage and a separate heater located along the flow passage. EX1007, [0040]-[0041], [0043], [0045], [0048], FIG. 1.

D. Takeuchi (EX1009)

45. Takeuchi also teaches a conventional handheld device that produces aerosol by heating an aerosol-forming liquid—much like Gupta. EX1007, [0008]-[0010], [0038]-[0039], [0049]-[0051], FIGS. 1-2; EX1009, 1:59-67, 2:1-16, FIG. 1. For example, both Gupta and Takeuchi describe the use of an outer housing where a mouthpiece is defined at an end of the outer housing. EX1007, [0039], FIG. 1; EX1009, 4:30-47, 7:45-56, FIG. 1. And, both devices include a compartment holding a liquid aerosol-forming material and a capillary tube for transporting this liquid to a heater for volatilization, the volatilized liquid mixing with air to create aerosol. EX1007, [0039]-[0061], FIGS. 1-2; EX1009, 4:26-7:56, FIG. 1. It is clear that Takeuchi taught suggested improvements that would have provided several benefits to Gupta’s device (articulated below).

46. For example, as articulated below in Ground 2B, even if one assumed that Gupta does not expressly disclose the claimed controller “configured to activate current through the heater in response to a draw on the device” (Element [1g]), such

an option was conventionally implemented before 2006 in similar prior art devices (as suggested by Takeuchi). EX1009, 4:23-62, FIG. 1. In particular, Takeuchi suggests using a “sensor 52” to detect “the inhalation action of a use[r].” EX1009, 6:23-29. Takeuchi also suggests that a “heater 42 and [a] power source 44 are driven[] under the control of [a] control circuit 46,” and that “[t]he control circuit 46 serves to start up the heater 42...in accordance with the inhaling action of the user based on the signal from the sensor 52.” EX1009, 6:23-25, 6:55-58, FIG. 1.

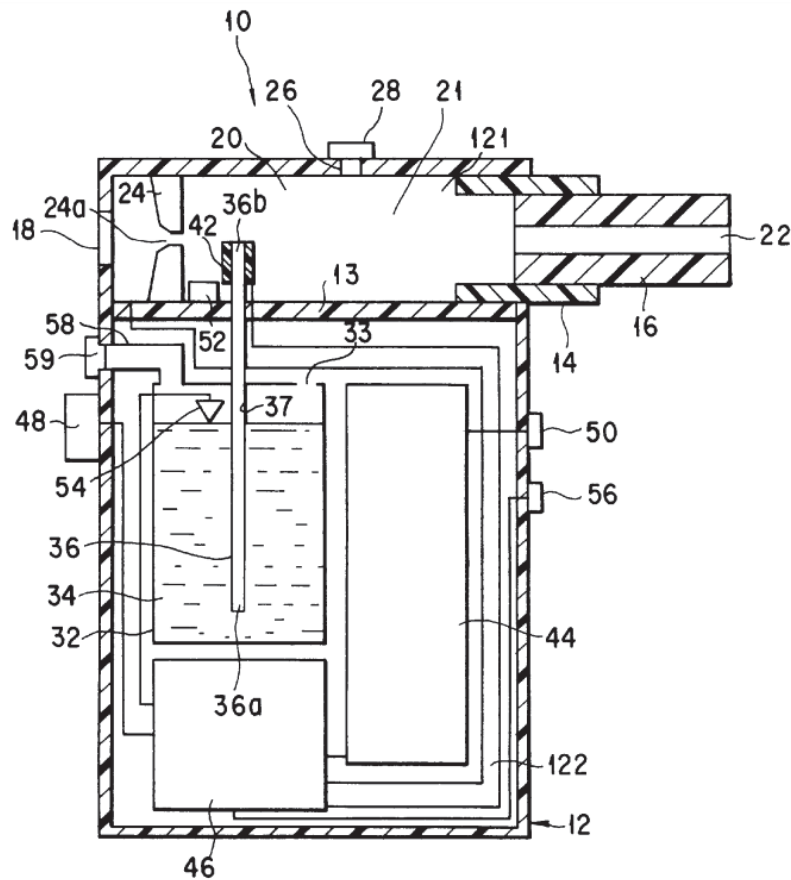


FIG. 1

EX1009, FIG. 1. Moreover, even if one assumed that the preamble of claim 1 is limiting such that Gupta does not expressly disclose a “smoking article,” Takeuchi suggests that such an aerosol-generating device can “contain tobacco components” therein for use “as a simulated smoking article.” EX1009, 5:40-46. I have addressed known benefits of such an implementation below in my analysis of Ground 2B (*see* §XI.A).

VIII. Ground 1A: MORGAN ANTICIPATES CLAIMS 1, 3, 4, AND 8-13

A. Independent Claim 1

47. Independent claim 1 of the '202 Patent recites:

What is claimed is: 1. An electrically-powered, aerosol-generating smoking article comprising: - an outer housing having two ends; - a mouthpiece defined at one of the two ends; - an electrical power source arranged within the outer housing; - an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;
an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and
a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

48. As I explain in more detail below through my element-by-element analysis, Morgan anticipates claim 1 because Morgan expressly teaches each and every element of claim 1.

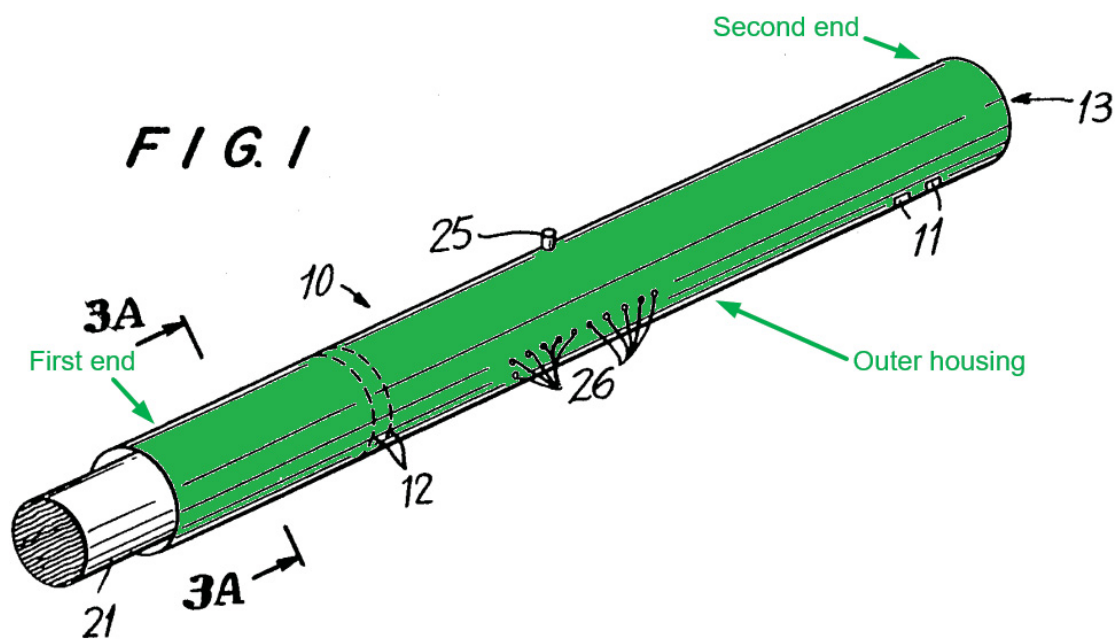
[1pre] An electrically-powered, aerosol-generating smoking article comprising:

49. Even if the preamble of claim 1 was treated as a limitation, my review of Morgan confirms that Morgan discloses an electrically-powered, aerosol-generating smoking article. As an initial matter and as I noted above, the '202 Patent admits that such a "smoking article" recited in the preamble was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 14:29-38, 19:43-48. Morgan confirms this fact and describes the details of an ***electrically-powered smoking article*** in the form of electrical smoking article 10.

EX1004, 4:42-67, FIGS. 1-4; *see also* EX1012, 16. This electrical smoking article 10 can “deliver [a] tobacco flavor substance as an aerosol,” which means that electrical smoking article 10 is *aerosol-generating*. EX1004, 5:42-43, *see also* 2:17-33, 3:9-68, 5:34-6:2, 6:23-45, FIGS. 5-6, 6:46-62, FIGS. 7-8, 6:63-7:10, FIGS. 9-10.

[1a] an outer housing having two ends;

50. As I noted above (§§29-31), the '202 Patent admits that the structure of an outer housing as recited Element [1a] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 20:1-4. Morgan confirms that such an outer housing was conventional and discloses the claimed outer housing because Morgan's cigarette-shaped article 10 includes an *outer housing* having *two ends*. EX1004, 3:9-37, 4:42-47, 4:67-5:5, FIGS.1-2. Morgan's FIG. 1 depicts this housing:



EX1004, FIG. 1 (annotated).

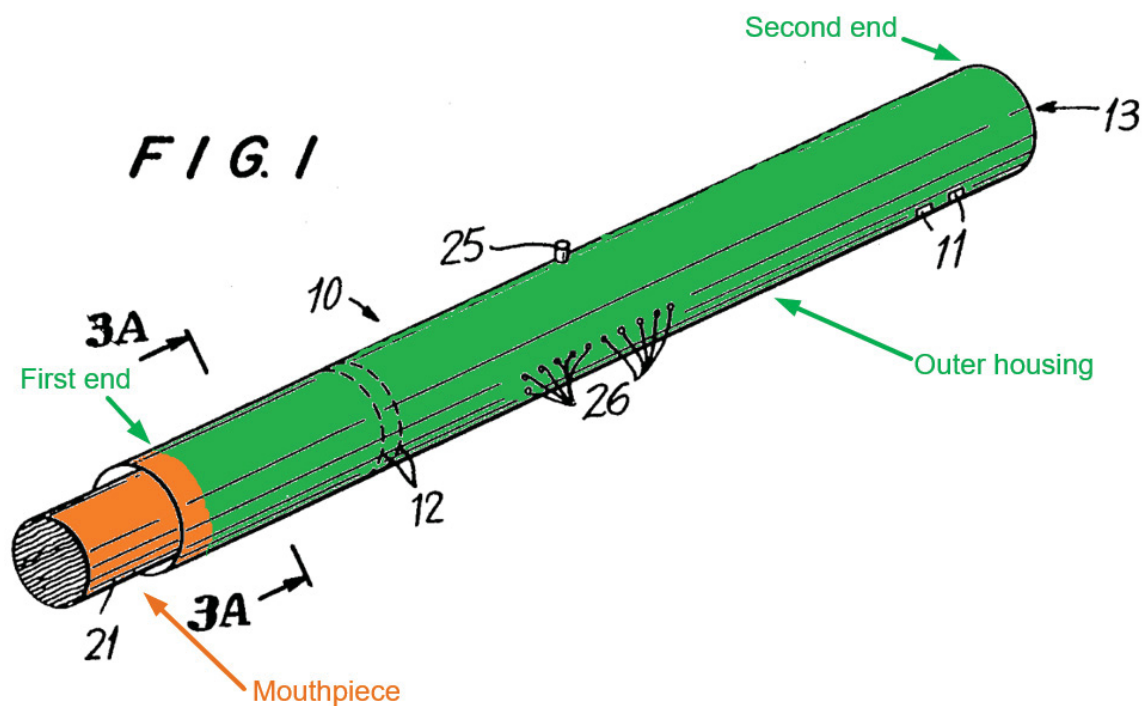
51. I note that my independent analysis here appears to be consistent with the Board's previous analysis of Morgan. *See* EX1012, 16-17.

52. Morgan also teaches that “[a]rticle 10 includes reusable or ‘permanent’ portion 20 and disposable filter/flavor portion or cartridge 21 which is received in a cavity 30 at the mouth end of portion 20.” EX1004, 4:44-47. As shown in the green shading above (FIG. 1), permanent portion 20 includes an outer surface that defines an *outer housing* having *two ends* including a first end (e.g., an end near an opening where the disposable portion is inserted into reusable portion) and a second end (e.g., far end 13). EX1004, FIG. 1.

[1b] a mouthpiece defined at one of the two ends;

53. As I noted above (¶¶29-31), the '202 Patent admits that the mouthpiece structure of Element [1b] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 24:20-29. Morgan confirms that such structures were known and teaches that the article 10 can “simulate a cigarette” where a “mouth end” of permanent portion 20 provides access to a cavity 30 from which the generated aerosol is drawn toward the user's mouth. EX1004, 3:10-11, 3:26, 4:44-47, 4:67-5:5 (“cigarette wrapping paper”), 5:28-33, 5:66-6:1 (“could be inserted flush”), FIGS. 1-2; *see also* EX1012, 16-17. Based on Morgan's teaching in which the user draws air into the outer housing and the aerosol

being generated and passing through the “mouth end” toward the user’s mouth, it is clear that the user’s mouth would apply to: [1] the rim of the “mouth end” defined by the housing portion 20, certainly for Morgan’s option in which the disposable portion 21 is fully “inserted flush” (col. 5:68-6:1), [2] to the filter segment 28 defined at the mouth end of the housing portion 20 (provides a “mouth feel,” col. 5:28-33), or [3] to a combination of both (depending upon the user’s lip size and mouth feel preference). EX1004, FIG. 1. The colored annotation of FIG. 1 below illustrates the combination of both (item [3] listed above), but any of Morgan’s uses [1]-[3] at the mouth end achieves Element [1b]:

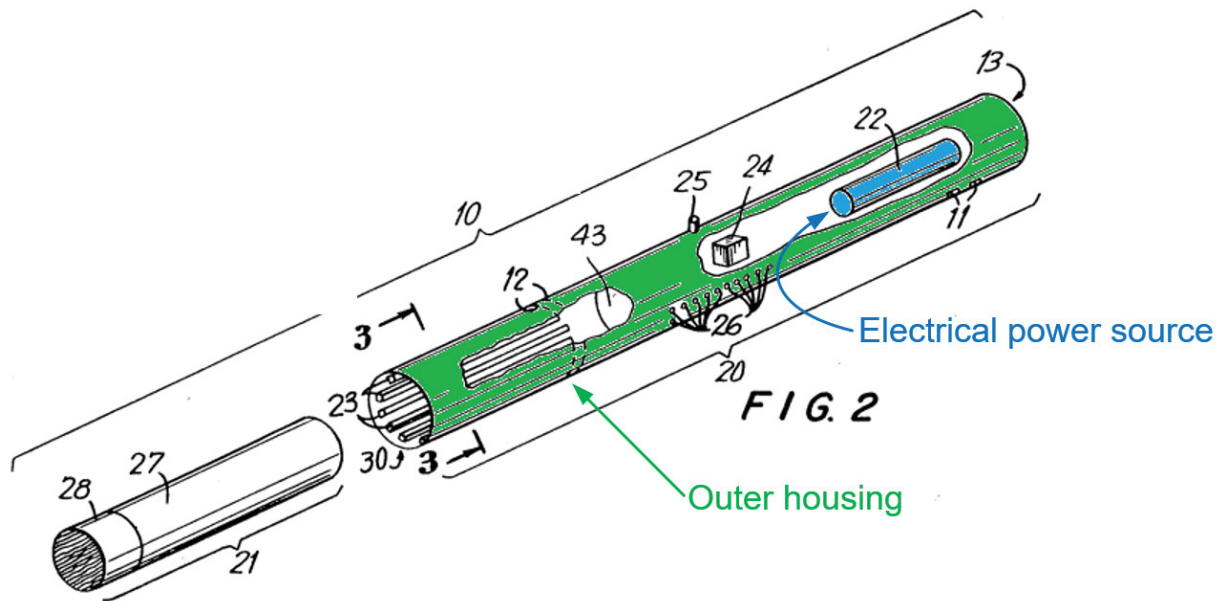


The EX1004, FIG. 1 (annotated).

54. Accordingly, Morgan depicts and describes a conventional option of a *mouthpiece* defined at *one of the two ends* of the *outer housing*. I note that my independent analysis here regarding the use of Morgan's article appears to be consistent with the Board's previous analysis of Morgan. *See* EX1012, 16-17.

[1c] an electrical power source arranged within the outer housing;

55. Here again and as I noted above (¶¶29-31), the '202 Patent admits that the power source structure of Element [1c] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 20:38-43. Morgan confirms that such power sources were known and plainly teaches that reusable portion 20 houses an *electrical power source* 22 in the form of "a battery, a capacitor or both." EX1004, 4:48-67, 2:17-33; *see also* EX1012, 18. Further, Morgan's FIG. 2 illustrates that the power source 22 is *arranged within the outer housing*:



EX1004, FIG. 2 (annotated).

56. I note that my independent analysis here regarding Morgan's power source appears to be consistent with the Board's previous analysis of Morgan. *See* EX1012, 18.

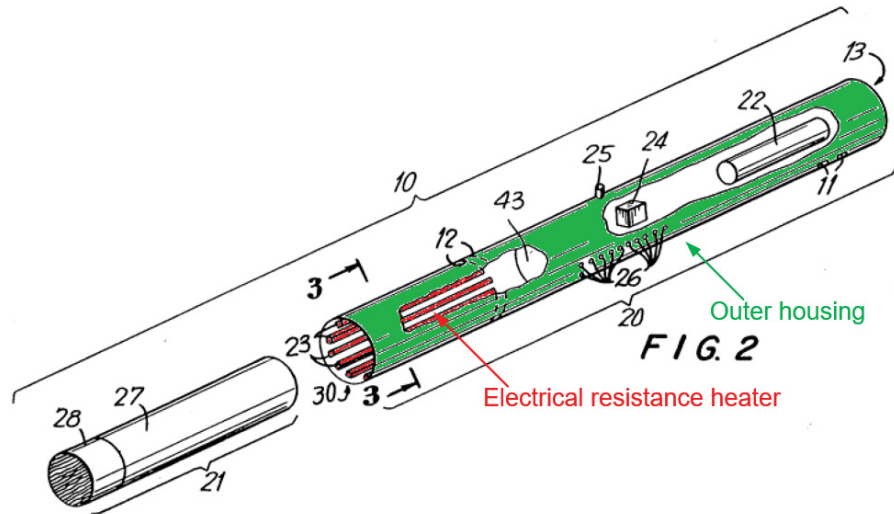
[1d] an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

57. As I noted above (¶¶29-31), the '202 Patent also admits that the structure of the heater in Element [1d] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 21:58-61. Morgan confirms such heaters were known and teaches the use of a *heater* that includes a set of controlled heating elements. EX1004, 2:17-33 (“electrical heating means”), 3:13-37 (heating elements “make thermal contact with” the compressible

tobacco segment), 3:58-4:51 (“heating elements “allow delivery” of “an aerosol containing tobacco flavors”), 4:56-59 (“[p]ower source 22 provides power for heating elements 23”), 5:6-25 (“preferably distributed substantially uniformly around the circumference of cavity 30”), 5:50-65, FIGS. 2-4. Morgan depicts three optional shapes for the set of heating elements—elongate heating elements 23 (FIGS. 1-4), elongate heating elements 51 (FIGS. 5-6), sharp-tipped heating elements 71 (FIGS. 7-8)—and each of these depicted options operates as a *resistance heater* positioned within the outer housing 20. EX1004, 4:8-9 (“a resistance of between about 0.5 ohm and 3.0 ohms”), 4:56-59, 6:23-35 (“connected to control circuitry”), 6:46-62 (“desired intimate thermal contact”).

58. I note that my independent analysis here regarding Morgan’s heater appears to be consistent with the Board’s previous analysis of Morgan. *See* EX1012, 23-34. Morgan’s teaching confirms that, long before 2006, such electrical resistance heaters were a common variety of electrical heaters used in battery-powered consumer products, including electrical smoking articles. In ordinary operation, when electrical current was delivered through a resistance element, it released energy in the form of heat. This heat was be traditionally regulated, for example, by controlling the magnitude of the electrical current flowing through the heater and controlling the amount of time that current is permitted to flow through the heater. *See* EX1004, 4:3-59.

59. Morgan's FIG. 2 illustrates one example of the set of heating elements representing an *electrical resistance heater* being positioned *within the outer housing* 20:



EX1004, FIG. 2 (annotated); *see also* FIGS. 3-8.

60. Morgan also explains that the heating elements are configured for electrical connection with an *electrical power source* (e.g., power source 22).

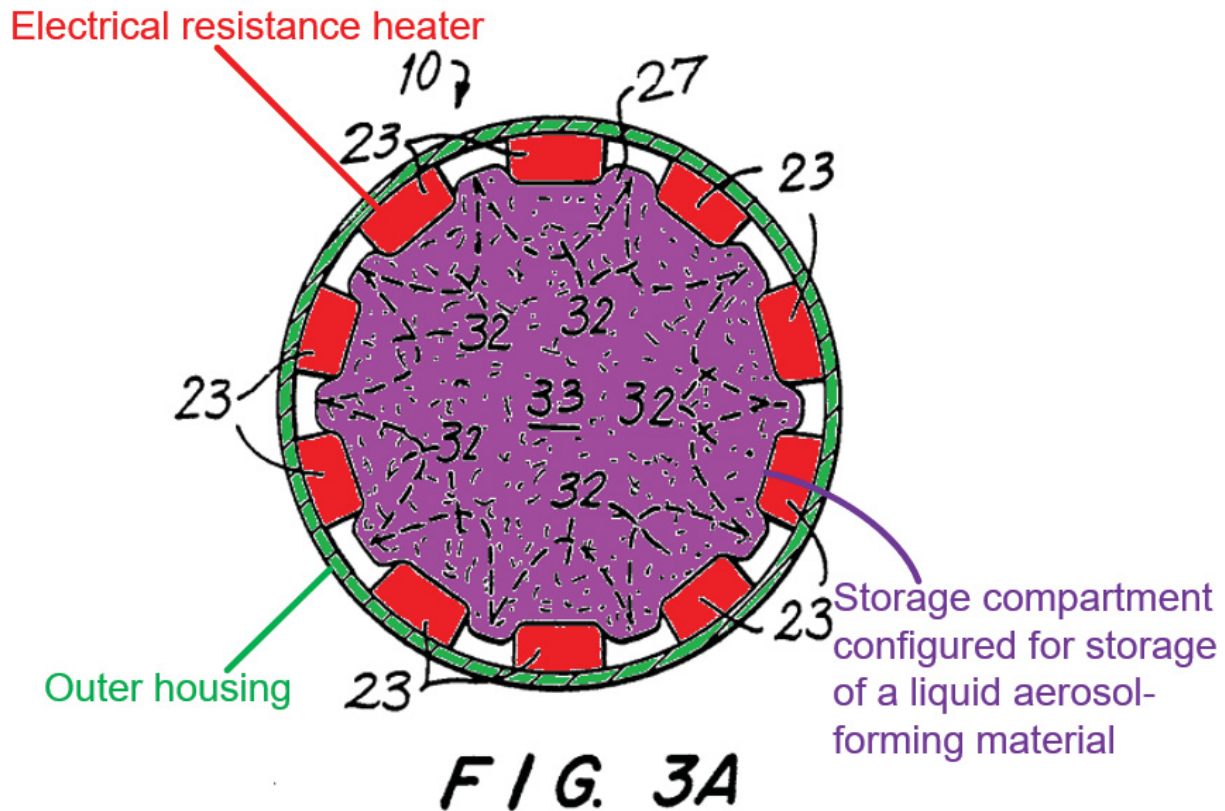
EX1004, 2:20-22, 4:56-67, 6:34-37, FIG. 2.

[1e] a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;

61. As previously noted above (§§29-31), the '202 Patent admits that traditional storage cartridges (like a storage compartment of Element [1e]) contained a liquid aerosol-forming material and fibrous substrate. EX1001, 22:19-26 and

22:46-23:34. Morgan provides another prior art example of known storage compartment, which included at least the flavor segment 27 (of Morgan's disposable portion 21) within cavity 30 at the mouth end of portion 20. EX1004, 5:26-65 ("open-cell foamed tobacco" segment wherein "an aerosol precursor such as glycerine is added"), 2:26-33 ("removable portion of tobacco flavor medium"), 3:26-64, 4:44-47, FIGS 1-2 and 3A; *see also* 6:23-45 ("lead-in for disposable portion 21"), 6:46-62 ("desired intimate thermal contact"). I note that my independent analysis here regarding Morgan's storage compartment appears to be consistent with the Board's previous analysis of Morgan. *See* EX1012, 19-23.

62. In more detail, Morgan discloses that "[f]lavor segment 27 can be any material that liberates flavors when hot air passes over or through it." EX1004, 5:34-35. In one embodiment, the flavor segment 27 can include "an extruded open-cell foamed tobacco product" where "an aerosol precursor such as glycerine is added to the composition." EX1004, 5:36-46 ("desirable to add an aerosol precursor"). A cross-sectional view of Morgan's article 10 in FIG. 3A depicts the flavor segment 27 is inserted into the cavity 30 and being compressed between the heating elements 23:



EX1004, FIG. 3A (annotated).

63. Morgan teaches that the flavor segment 27 includes added “glycerine” or other aerosol precursor, which are liquids that vaporize when heated so that “the visible condensed aerosol may mimic the appearance of cigarette smoke.” EX1004, 5:34-46, 8:45-55 (aerosol-forming material comprises liquid such as “glycerine” and “water”), 3:58-68, 2:26-33. Based on this teaching, Morgan’s teaching regarding the use of glycerine is consistent with my understanding that aerosol-producing devices can heat aerosol precursors that are *liquid* at room temperature to volatilize these liquids. When the liquid aerosol precursors are volatilized to create vapor gas, this

vapor can combine with air to produce aerosol. EX1004, 5:36-46 (“visible condensed aerosol”).

64. Additionally, because Morgan teaches that the flavor segment includes an “open-cell foamed” substrate, liquid aerosol precursors such as glycerine would—according to ordinary capillary action of liquid in such open-cell foam substrates—wick through the pores. This is certainly true during use of Morgan’s article when the glycerine is heated/volatilized and evacuated from those pores immediately adjacent the heating element, which would induce capillary action of the glycerine through the open-cell foam from other saturated pores toward those evacuated pores. EX1004, 5:34-46, 3:58-68. I have been informed that, in previous IPR proceedings, Patent Owner likewise explained that such traditional capillary action of fluid is an example of “wicking.” EX1015, 29. Based on Morgan’s teaching for such “intimate thermal contact” between the heating elements and the flavor segment 27 and the resulting “visible condensed aerosol” from the heated aerosol precursor therein, it is clear that Morgan teaches the glycerine or other liquid aerosol-forming precursor within flavor segment 27 “can be wicked into contact with” the heating elements Morgan’s heater. EX1004, 5:34-65, 3:28-68; 2:26-33.

65. This disclosure in Morgan is fully consistent with the above-described construction of “wicked into contact with” as noted in ¶35 above and with the related portions of the ’202 Patent. *See* EX1001, 21:44-61 (“in close proximity to”), 24:41-

59. Moreover, for purposes of corroborating my above-described explanation of the capillary action that naturally occurs within such open cell foam substrates having aerosol precursors within its pores, I note that others in the industry have similarly described such capillary action through a foam substrate for purposes of wicking the aerosol-forming liquid in similar devices, including corroborating examples in EX1017 (U.S. Publication No. US2013/0306064) and EX1018 (U.S. Publication No. US2014/0000638). *See* EX1017, [0030] (“the capillary wick may comprise sponge-like or foam-like material formed into a rod shape”), [0040], [0061] (“conveyed by capillary action”), [0084]-[0085]; EX1018, [0009] (“transport elements (e.g., wicks)” can be formed on “solid foams, or other porous materials” that exhibit “capillary action”), [0016] (“absorbed in a substrate” which can be “e.g., a foam”), [0018] (“a wick having a defined capillary action” which can have a material of “carbon foam”). Thus, as I explained in the preceding paragraphs, a POSITA would have readily recognized from Morgan’s teaching that the “open cell foam” substrate of Morgan’s flavor segment 27 would have provided this known capillary action to wick the glycerine liquid (or other aerosol precursor) from the saturated pores to the evacuated pores proximate to the heating element 23, and such wicking through pores of such open cell foam material was an ordinary physical trait corroborated by multiple corroborating publications.

[1f] an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn

66. As I noted above (¶¶29-31), the '202 Patent admits that Element [1f] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 20:1-4, 20:20-23, 20:30-44. Morgan confirms that such a structure for an air passageway was used in such devices and plainly teaches at least two options for “an air passageway through at least a portion of the outer housing.” EX1004, 5:1-5. In a first option, Morgan teaches “[p]erforations 12 may be provided in the wall of portion 20 to allow outside air to be drawn in during puffing.” EX1004, 5:1-3. The air passageway embodiment where air enters through perforations 12 is illustrated below in FIG. 1:



EX1004, FIG. 1 (annotated).

67. In a second option, Morgan teaches “outside air may be drawn through all of portion 20 via openings (not shown) at its far end 13.” EX1004, 5:3-5. Furthermore, as discussed above, disposable portion 21 includes a flavor segment 27 that is inserted into cavity 30. EX1004, 4:44-47, 5:26-29. As described above, this flavor segment 27 includes an aerosol precursor such as glycerine. EX1004, 5:34-42. Morgan also discloses that “[f]lavor segment 27 can be any material that liberates flavors when hot air passes over or through it” and “[i]t is desirable to add an aerosol precursor to deliver the tobacco flavor substance as an aerosol, so that when the consumer exhales the tobacco flavor substance, the visible condensed aerosol may mimic the appearance of cigarette smoke.” EX1004, 5:34-46.

68. As such, Morgan teaches the air drawn into the housing portion 20 (via the air passageway cited above) combines with the volatilized aerosol-forming material (e.g., the glycerine or other aerosol precursor that is heated by Morgan’s heater) to produce the “visible condensed aerosol” that can be drawn into the mouth of the user. EX1004, 5:34-65 (“liberates flavors” when the aerosol precursor is volatilized), 3:28-68. Based on Morgan’s express teaching that “flavor segment 27 can be any material that liberates flavors when hot air passes over or through it” such that the user inhales and subsequently exhales “visible condensed aerosol” that mimics “the appearance of cigarette smoke,” it is clear that this hot air passing

through flavor segment 27 can both volatilize the liquid aerosol precursor to “liberate” flavors therein and the hot air can also combine with the volatilized liquid aerosol precursor to produce aerosol. EX1004, 5:34-46. I note that my independent analysis here regarding Morgan’s air passageway appears to be consistent with the Board’s previous analysis of Morgan. *See* EX1012, 16-17.

[1g] a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

69. Yet again and as I noted above (¶¶29-31), the ’202 Patent admits that Element [1g] was commercially available or otherwise known before the earliest alleged filing date of the ’202 Patent. EX1001, 20:55-60. Morgan confirms that traditional electric smoking articles included such a controller structure and further explains that where “[p]ower source 22 provides power for heating elements 23, which are energized under the control of ***control circuit 24***, which is in turn actuated...by a puff-actuated sensor.” EX1004, 4:56-67, 2:22-33 (“control means”), 3:18-25 (describing the “control circuitry” and incorporating by reference U.S. Patent No. 5,060,671 (EX1013)), 6:34-37. I note that my independent analysis here regarding Morgan’s controller appears to be consistent with the Board’s previous analysis of Morgan and the Board’s similar acknowledgment of Morgan’s incorporation by reference of EX1013. *See* EX1012, 18-19.

70. In more detail, Morgan details the “control circuitry for energizing the heaters in an appropriate sequence, in response to...puff-induced actuation.” EX1004, 3:18-20. Based on Morgan’s teaching that control circuit 24 is actuated by a “puff-actuated sensor” and “puff-induced actuation” and that control circuit 24 energizes heating elements 23 based on detecting puffs by the user, it is clear that Morgan’s control circuit 24 is configured to activate current flow through the *electrical resistance heater* formed by heating elements 23 in response to a *draw* on electrical smoking article 10.

B. Claim 3

71. Claim 3 of the ’202 Patent recites:

3. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment comprises a fibrous substrate.
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72. As I explained in detail above in my analysis of Element [1e], the “storage compartment” includes Morgan’s flavor segment 27 within the cavity 30, which “comprises a fibrous substrate.” EX1004, 5:26-65. For example, Morgan discloses that “[p]referably, flavor segment 27 is a cylindrical portion of an extruded open-cell foamed tobacco product.” EX1004, 5:35-46 (incorporating by reference U.S. Patent No. 4,510,95 (EX1005)); *see also* EX1012, 22. Given that the open-cell foamed tobacco of the flavor segment 27 comprises fibrous material—including a significant amount of “tobacco” (plant-based fibrous material in an amount of “about

50 to about 98 wt. %) and additional “fibrous cellulose” (refer to the incorporated-by-reference EX1005 at col. 3:24-4:23), it is clear that Morgan’s flavor segment 27 “comprises” a fibrous substrate.

73. Additionally, even without the text of the incorporated-by-reference EX1005 (cited above), I note that Morgan expressly disclosed that the flavor segment 27 can be “any material” that liberates flavors and then claimed that the tobacco flavor medium “comprises tobacco” along with the aerosol-forming material. EX1004 5:34-35, 8:56-59 (claim 20), 8, 27-28 (“extruded tobacco material” in claim 10). As such, Morgan plainly contemplated that the flavor segment 27 would comprise a fibrous substrate including plant-based tobacco material.

C. Claim 4

74. Claim 4 of the ’202 Patent recites:

4. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the aerosol that is produced passes at least partially through the storage compartment before exiting through the mouthpiece.
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75. As previously noted, Morgan teaches that the aerosol produced by the smoking article 10 “passes at least partially through the storage compartment before exiting through the mouthpiece.” As I described in more detail above in Element [1e], Morgan discloses that air can pass “over *or through*” flavor segment 27 in a way that “liberates flavors” by volatilizing the aerosol precursor of flavor segment 27 (to generate the “visible condensed aerosol” that “mimic[s] the appearance of

cigarette smoke.” EX1004, 5:34-46 (“desirable to add an aerosol precursor”). Accordingly, when flavor segment 27 is placed within cavity 30, at least some of the liberated flavors (e.g., aerosol) are generated within flavor segment 27 and pass through the porous regions (and certainly the external pores) of the segment 27 before being drawn into the mouth of the user through the mouthpiece. EX1004, 5:44-46. Indeed, this is especially true for Morgan’s disclosed option for the heating elements 71 that “pierce and extend into” the flavor segment 27, thereby providing a configuration in which the flavor segment 27 would seat within the cavity 30 and the aerosol would be drawn through at least a portion of the porous material of the flavor segment. EX1004, 6:46-62, FIGS. 7-8.

76. Furthermore, as I described above in my analysis of Element [1b], there is an example where the user places her mouth on filter 28 of the disposable portion 21 that protrudes from reusable portion 20 and inhales aerosol through filter 28. EX1004, 5:26-33, 5:66-6:7. In this example, the aerosol produced by electrical smoking article 10 must pass at least partially through flavor segment 27 of disposable portion 21, because filter 28 is located downstream of flavor segment 27 relative to airflow when the user inhales. This means that in this example, the aerosol passes at least partially through the “storage compartment” of electrical emoking article 10.

D. Claim 8

77. Claim 8 of the '202 Patent recites:

8. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment is configured as a container for holding liquid.

78. As I detailed above in my analysis of Elements [1e] and [3], the “storage compartment” includes Morgan’s flavor segment 27 within the cavity 30, which includes a porous substrate that contains a liquid aerosol precursor (e.g., glycerine) within its pores. EX1004, 5:26-65 (“open-cell foamed tobacco” segment wherein “an aerosol precursor such as glycerine is added”), 2:26-33 (“removable portion of tobacco flavor medium”), 3:26-64, 4:44-47, FIGS 1-2 and 3A. Morgan teaches that the added “glycerine” or other aerosol precursor contained by the flavor segment 27 is a liquid that vaporizes when heated so to achieve “the visible condensed aerosol” that “mimic[s] the appearance of cigarette smoke.” EX1004, 5:34-46, 8:45-55 (aerosol-forming material comprises liquid such as “glycerine” and “water”).

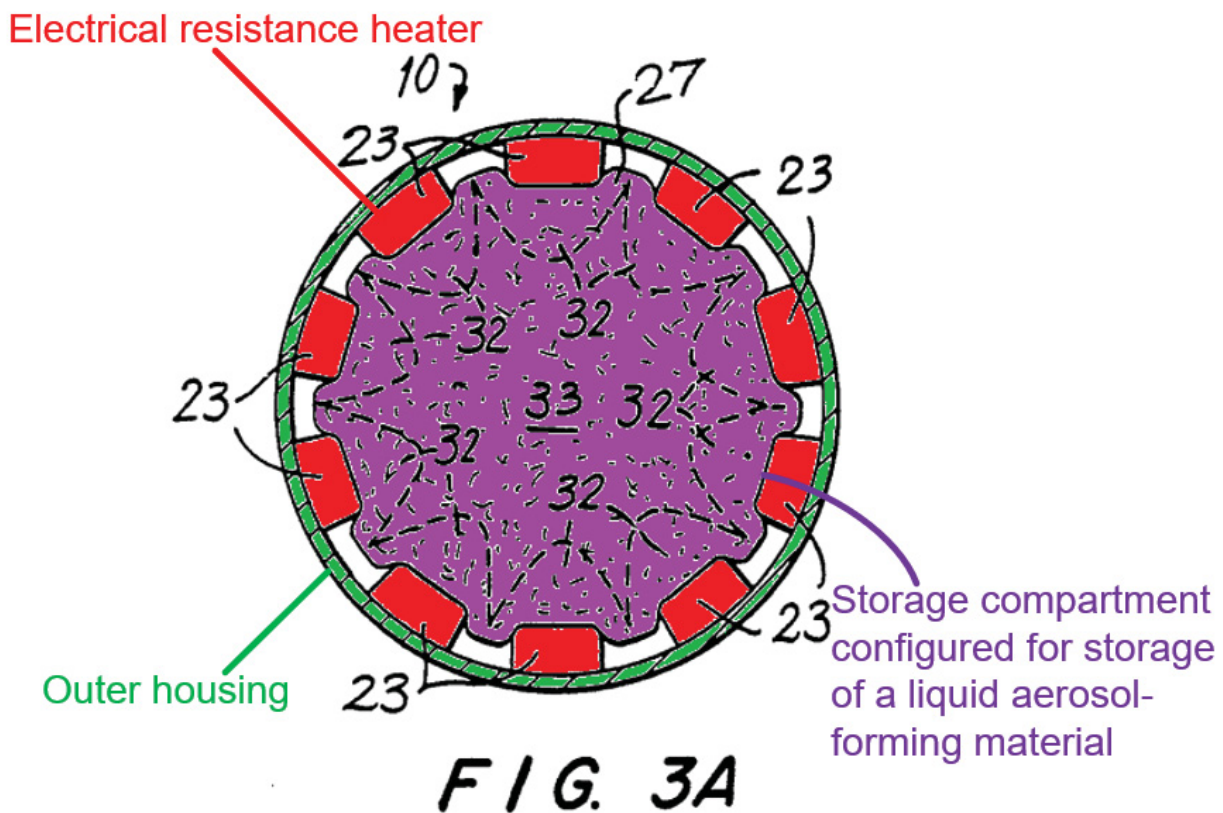
E. Claim 9

79. Claim 9 of the '202 Patent recites:

9. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged in contact with the storage compartment.

80. As I detailed above in my analysis of Element [1d], Morgan describes a heater that includes a set of controlled heating elements that “make thermal contact

with” the compressible flavor segment 27 within the cavity 30. EX1004, 3:13-37, 3:58-4:51 (“in contact with”), 5:6-65 (“press into flavor segment for intimate thermal contact”), FIG. 3A, 6:39-43, 6:50-52 (“pierce and extend into”), 6:63-7:1; *see also* EX1012, 23-34. For example, in FIG. 3A, because heating elements 23 have “intimate thermal contact” with flavor segment 23 and heating elements 23 are in compressed inwardly against the flavor segment 27, the heating elements 23 are “arranged in contact” with the storage compartment (including flavor segment 27):



EX1004, FIG. 3A (annotated).

F. Claim 10

81. Claim 10 of the '202 Patent recites:

10. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged proximate to an absorbent wicking material configured for transferring the liquid aerosol-forming material to the electrical resistance heater.

82. As I detailed above in my analysis of Elements [1d] and [9], Morgan describes a heater that includes a set of controlled heating elements that “make thermal contact with” the compressible flavor segment 27 within the cavity 30. EX1004, 3:13-37, 3:58-4:51, 5:6-65 (“press into flavor segment for intimate thermal contact”), FIG. 3A, 6:39-43, 6:50-52, 6:63-7:1; *see also* EX1012, 23-34. Morgan discloses that heating elements 23 are “arranged proximate to an absorbent wicking material configured for transferring the liquid aerosol-forming material to the electrical resistance heater,” as recited by claim 10. And as already demonstrated above in Element [1e], the flavor segment 27 can include a “open-cell foamed tobacco” substrate and an added “aerosol precursor” such as glycerine. EX1004, 5:37-42. Morgan teaches that such added “glycerine” or other aerosol precursor is a liquid that vaporizes when heated so that “the visible condensed aerosol may mimic the appearance of cigarette smoke.” EX1004, 5:34-65, 8:45-55 (liquid such as “glycerine” and “water”), 3:58-68.

83. Based on Morgan’s teaching, the liquid of the added glycerine or other aerosol precursor is absorbed throughout the open cells of the foamed tobacco substrate, and thus the open-cell foamed substrate of the flavor segment 27 is an

“absorbent wicking material.” (Refer above to my analysis of Element [1e] (“capillary action”)). Based on Morgan’s teaching of the open-cell foamed substrate, it is clear that this porous structure within flavor segment 27 is **absorbent**, because the aerosol precursor is liquid and Morgan discloses that flavor segment 27 includes a “composition” of the solid open-cell foamed tobacco product and the aerosol precursor. EX1004, 5:34-46.

84. Furthermore, it is clear that the evidence here confirms that the open-cell foamed tobacco substrate of Morgan’s flavor segment 27 is an **absorbent wicking material** because the liquid aerosol precursor can wick through the open cells from saturated regions to outer regions (with evacuated pores) in contact with the heating elements 23. *Supra*, Element [1e]. As was traditionally recognized, such capillary force can cause liquid to move through a lumen of a solid tube, through pores in a substrate, or through a small gap defined between opposing walls. In Morgan’s example, a POSITA would have readily understood that the open cells of the foamed tobacco substrate provided pores for such capillary action of a liquid (e.g., glycerine, water, or another aerosol precursor)—somewhat like a conventional household sponge—to wick toward Morgan’s heating elements and achieve “the visible condensed aerosol.” EX1004, 5:34-65, 8:45-55 (liquid such as “glycerine” and “water”), 3:58-68; *supra*, Element [1e].

G. Claim 11

85. Claim 11 of the '202 Patent recites:

11. The electrically-powered, aerosol-generating smoking article of claim 1, wherein at least a portion of the electrical resistance heater extends into the storage compartment.

86. Morgan teaches at least two examples of the heater extending into the storage compartment (which includes the flavor segment within the cavity 30). EX1004, 5:6-65 (“press into flavor segment for intimate thermal contact”), FIG. 3A, 6:50-52 (“pierce and extend into”), FIGS. 7-8. In a first example, Morgan teaches that the heating elements 23 of Morgan extend into the cavity 30 to thereby press into (and deform) portions of the compressible flavor segment 27. This result is plainly shown in Morgan’s FIG. 3A, which depicts the heating elements 23 extending into and deforming the (formerly) cylindrical flavor segment 27 to achieve “intimate thermal contact” with it:

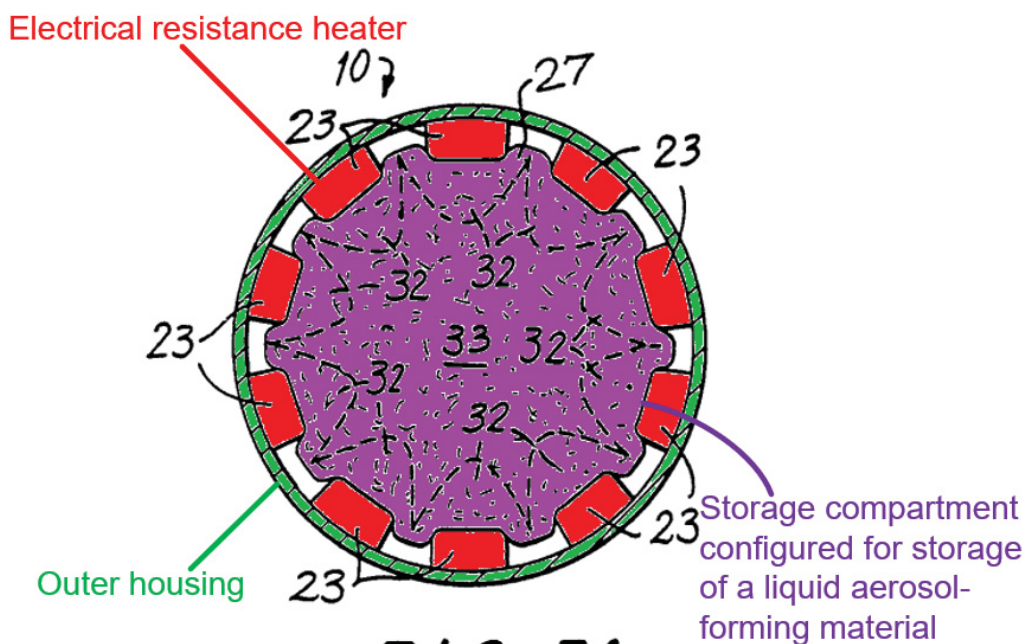


FIG. 3A

EX1004, FIG. 3A (annotated).

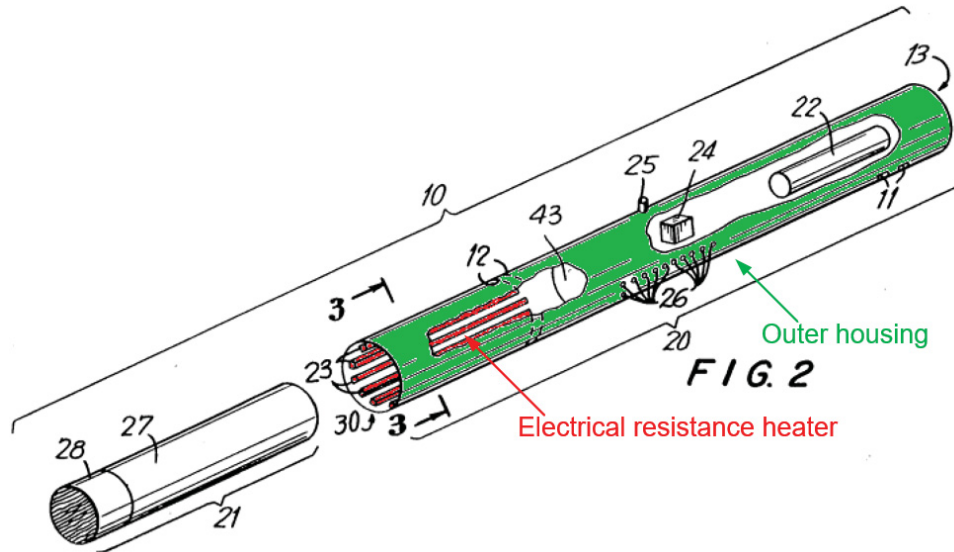
87. In a second example, Morgan teaches the option of using heating elements 71 with a different shape—“with a somewhat sharper ‘V’ tip”—to pierce into the flavor segment of the disposable portion 21. EX1004, 6:46-62, FIGS. 7-8. In particular, Morgan teaches that each of heating elements 71 of this optional heater configuration “actually pierce and extend into disposable portion 21 to provide the desired intimate thermal contact.” EX1004, 6:48-52.

H. Claim 12

88. Claim 12 of the '202 Patent recites:

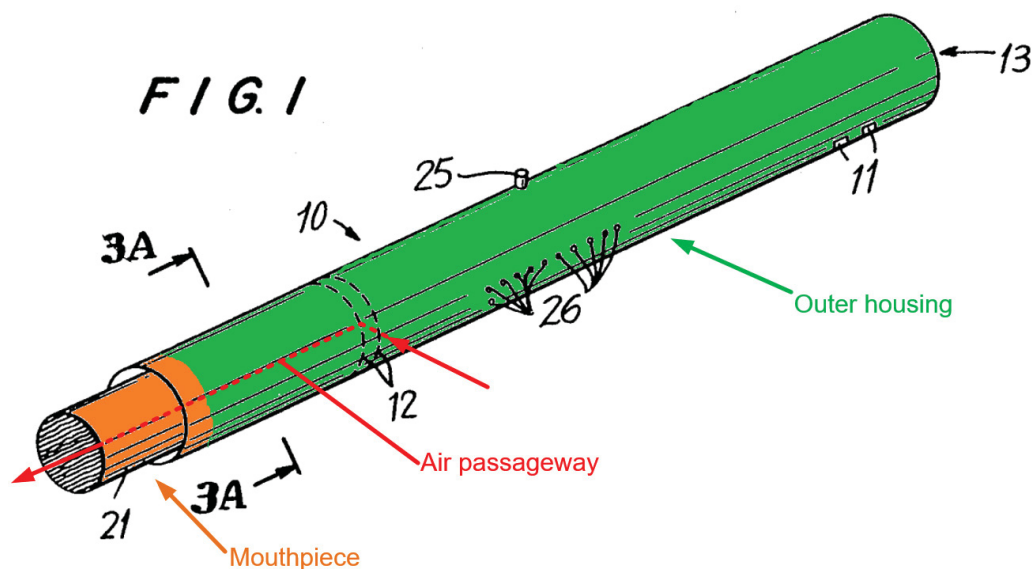
12. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is configured to allow airflow therethrough.
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89. As I detailed in my analysis of Elements [1d] and [1f] above, Morgan discloses a heater including a set of controlled heating elements (e.g., heating elements 23, heating elements 71) that are “preferably distributed substantially uniformly around the circumference of cavity 30.” EX1004, 5:6-25, 5:47-65, 6:46-62, FIGS. 3-3A, FIGS. 7-8, 2:17-33 (“electrical heating means”), 3:13-37. One example is depicted in FIG. 2:



EX1004, FIG. 2 (annotated).

90. Morgan also discloses that the flavor segment 27 of disposable portion 21 is positioned within the center of the cavity 30 compressed between the heating elements. EX1004, 3:13-37 (“make thermal contact with”), 5:6-65 (“intimate thermal contact”), 6:46-62 (“intimate thermal contact”). Morgan discloses that air passes “over or through” the flavor segment 27 (positioned centrally between the heating elements) to “liberates flavors” during use. EX1004, 5:34-35. In the option shown below, the air enters through “[p]erforations 12” of the outer housing portion 20 “to allow outside air to be drawn in during puffing.” EX1004, 5:1-3.



EX1004, FIG. 1 (annotated).

91. Based on Morgan's teaching, the air passes through flavor segment 27 and thus between the heating elements of Morgan's heater, so Morgan's electrical resistance heater *is configured to allow airflow therethrough*.

I. Claim 13

92. Claim 13 of the '202 Patent recites:

13. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising a sensor adapted for sensing the draw by a user on the electrically-powered, aerosol-generating smoking article.

93. As an initial matter, I note that the '202 Patent admits that the structure of a sensor as recited in Claim [13] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 21:14-21. Morgan confirms that such sensors were used in prior art devices, for example, in Morgan's

teaching that “[t]he disposable heater/flavor unit is mated to a more or less permanent unit containing a source of electrical energy such as a battery or capacitor, as well as control circuitry to actuate the heating elements in response to a puff by a smoker on the article.” EX1004, 5:34-35. Morgan also expressly discloses that that electrical smoking article 10 includes a control circuit 24 which provides power to heating elements 23 based on being “actuated by...a puff-actuated sensor.” EX1004, 4:56-67, 2:22-33 (“control means”), 3:18-25 (describing the “control circuitry” and incorporating by reference U.S. Patent No. 5,060,671 (EX1013)), 6:34-37; *see also* EX1012, 18-19 (likewise acknowledging the incorporated-by-reference teaching of U.S. Patent No. 5,060,671).

94. Based on Morgan’s teaching, it is apparent that the electrical smoking article 10 includes a *sensor* that is adapted for *sensing a draw by a user*, because Morgan uses the word “puff” to refer to user’s action of inhaling through the electrical smoking article 10. EX1004, 3:58-64 (describing a “puff” as an action that delivers aerosol to a smoker), 4:48-5:5 (disclosing that air is drawn into the electrical smoking article “during puffing”). This disclosure indicates that Morgan uses the word “puff” to refer to the same user action that is referred to as a “draw” in claim 13—user inhalation through the device.

IX. GROUND 1B: MORGAN IN COMBINATION WITH SUSA RENDERS CLAIMS 1, 3, 4, 8-13, 15 OBVIOUS

A. Overview of the Combination and Reasons to Combine

95. As I noted above (§§41-42), the Susa reference suggests some optional improvements to electric smoking articles (including those like Morgan's article)—improvements that would have provided several benefits recognizable to a POSITA. For example (and as detailed below), a POSITA would have been motivated to implement Morgan's article in accordance with Susa's suggested use of a detachable mouthpiece at an end of an outer housing of a smoking article. In this predictable combination, Morgan's electrical smoking article 10 would have predictably included a mouthpiece that removably attaches to Morgan's outer housing portion 20, thereby protecting Morgan's disposable portion 21 (including the filter segment 28) and securely retaining the disposable portion 21 in Morgan's desired position within the cavity. Indeed, multiple reasons would have prompted a POSITA to implement Morgan's article 10 in accordance with Susa's suggested improvement for a removable mouthpiece.

96. As a *first* reason, a POSITA would have been prompted to implement Morgan's article 10 to include Susa's suggestion (removable mouthpiece that can be attached to a mating end of the outer housing of a smoking article) so as to provide improved mechanical protection to Morgan's disposable portion 21 (including the filter 28) during use. Namely, this predictable result would have added mechanical support to the filter 28 of Morgan in a manner that reduces or eliminates the application of a bending moment/torsion upon Morgan's filter 28 during use. This is

certainly true compared to the original stresses imposed upon Morgan's filter 28 when directly engaged and cantilevered from the user's lips). For example, according to the predictable combination here, the user would place her mouth on the mouthpiece of the resulting article while the filter 28 is mechanically supported within an interior of the mouthpiece, thereby advantageously allowing the mouthpiece (and the outer housing portion 20) to carry some or all of the mechanical load in the event the article is cantilevered/suspended from the user's mouth during use.

97. As a *second* reason, a POSITA would have been prompted to implement Morgan's article 10 in accordance with Susa's suggestion for a removable mouthpiece to reduce the likelihood of inadvertent dislodgement of the filter 28/disposable portion 21 from Morgan's cavity 30 during use of the article. For example, Morgan's original filter 28 (FIGS. 1-2) could be grasped by the user's lips during use and possibly pulled away from the cavity 30 in some circumstances (when the user engages the filter 28 while outer housing 20 is freely suspended or inadvertently pulled away to overcome the retainment force from Morgan's heating elements 23). According to the predictable combination here, Susa's suggested improvement would provide a removable mouthpiece that secures to Morgan's outer housing portion 20 to further secure disposable portion 21 within the cavity and avoid partial or full dislodgement during use.

98. As a *third* reason, a POSITA would have been prompted to implement Morgan's article 10 in accordance with Susa's suggestion for a removable mouthpiece so that connecting the mouthpiece to the end of Morgan's outer housing portion 20 would advantageously insert/retain the disposable portion 21 (including the flavor segment 27) at a predictable and consistent insertion distance within the cavity 30. For example, to the extent Morgan's disposable portion 21 is not fully inserted by the user during installation of the disposable portion, the action of connecting the mouthpiece to the mating end of Morgan's outer housing portion 20 would have predictably urged further insertion of the disposable portion 21 into the cavity 30 and toward the predetermined/desired insertion depth.

99. As a *fourth* reason, implementing implement Morgan's article 10 in accordance with Susa's suggestion would have advantageously provided Morgan's article 10 with a uniform diameter, thereby more closely simulating the uniform cylindrical profile of a traditional cigarette or cigar. Indeed, Susa expressly suggested this benefit. EX1006, [0066], FIG. 10.

100. It is clear that a POSITA would have possessed the requisite level of skill to implement this combination given the overlapping technologies of Morgan and Susa. For example, both references are directed to electrical smoking devices that produce aerosol without burning tobacco, and both devices rely upon fairly basic mechanical structures for the outer housing and the elements housed therein. A

POSITA would have reasonably expected success in achieving this combination in the manner described above before the earliest effective filing date of the '202 Patent (October 18, 2006).

B. Claim 1

101. Claim 1 of the '202 Patent recites:

What is claimed is:

1. An electrically-powered, aerosol-generating smoking article comprising:

an outer housing having two ends;

a mouthpiece defined at one of the two ends;

an electrical power source arranged within the outer housing;

an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;

an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and

a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

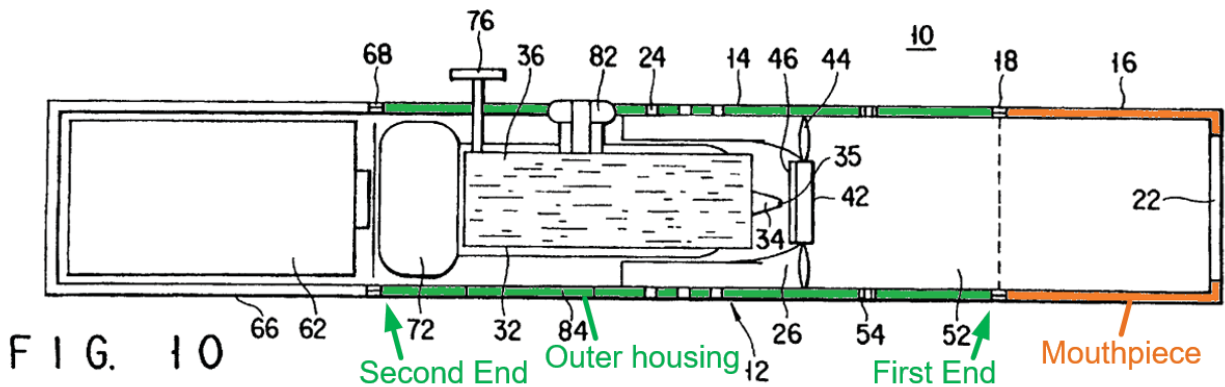
102. As I explain in more detail below through my element-by-element analysis, Morgan in view of Susa renders claim 1 obvious.

Elements [1pre]-[1a], [1c]-[1e], [1g]

103. The Morgan-Susa combination would have provided these claim elements for at least the same reasons that I described above in connection with my analysis of Morgan in Ground 1A above. *See supra*, Ground 1A (§VIII.B) at Elements [1pre]-[1a], [1c]-[1e], [1g].

[1b] a mouthpiece defined at one of the two ends;

104. Morgan discloses that its disposable portion 21 (including the flavor segment 27 and the filter 28) is configured for insertion into Morgan’s “cavity 30 at the mouth end” of the outer housing portion 20. EX1004, 4:44-47, 5:26-6:2. Even if one assumed that Morgan does not expressly disclose that article 10 includes “a mouthpiece defined at one of the two ends” of the outer housing portion 20, this conventional option would have been beneficially implemented in the predictable Morgan-Susa combination. *Supra*, §§V.B.1-V.B.2. As demonstrated above, Susa suggests that one end of a casing main body 14 of a smoking article can advantageously mate with a mouthpiece 16, which “detachably mount[s] on the casing main body 14 through a connecting portion 18.” EX1006, [0066]. The casing main body 14 of Susa represents an ***outer housing***, much like the outer surface of Morgans’ reusable portion 20 represents an outer housing.



EX1006, FIG. 10 (annotated).

105. As depicted in FIG. 10, Susa's removable mouthpiece 16 is defined at one of two ends of Susa's **outer housing** (casing main body 14). EX1006, FIG. 10. For at least the advantageous reasons expressly articulated above (*see* §IX.A), it is clear that a POSITA would have been motivated to combine Morgan and Susa such that Morgan's article 10 includes a detachable mouthpiece defined at the mouth end of Morgan's outer housing portion 20. Again, as I explained above, this resulting combination would have provided added protection for Morgan's disposable portion 21 (including the filter segment 28) and would have securely retained the disposable portion 21 in Morgan's desired position within the cavity 30. Therefore, the combination of Morgan and Susa provides Element [1b].

[1f] an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and

106. As discussed above (refer to my analysis of Element [1b] above), to the extent that Morgan does not disclose a “mouthpiece” as recited in claim 1, such a feature was suggested by Susa. Much like Morgan’s article 10 is arranged so that a user can “puff” on the article to draw aerosol into her mouth, Susa’s article 10 defines a suction port 22 “through which the user inhales the flavor.” EX1004, 5:1-3; EX1006, FIG. 10 (port 22), [0026]. Thus, in the predictable Morgan-Susa combination, Morgan’s heated *aerosol* would have been predictably drawn into the mouth of the user of article 10 *through the mouthpiece*. EX1006, [0065]-[0073], FIGS. 9-10.

C. Claim 3

107. Claim 3 of the ’202 Patent recites:

3. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment comprises a fibrous substrate.
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108. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan’s device in Ground 1A (claim 3).

D. Claim 4

109. Claim 4 of the ’202 Patent recites:

4. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the aerosol that is produced passes at least partially through the storage compartment before exiting through the mouthpiece.

110. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 4).

E. Claim 8

111. Claim 8 of the '202 Patent recites:

8. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment is configured as a container for holding liquid.
--

112. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 8).

F. Claim 9

113. Claim 9 of the '202 Patent recites:

9. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged in contact with the storage compartment.

114. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 9).

G. Claim 10

115. Claim 10 of the '202 Patent recites:

10. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged proximate to an absorbent wicking material configured for transferring the liquid aerosol-forming material to the electrical resistance heater.

116. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 10).

H. Claim 11

117. Claim 11 of the '202 Patent recites:

11. The electrically-powered, aerosol-generating smoking article of claim 1, wherein at least a portion of the electrical resistance heater extends into the storage compartment.

118. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 11).

I. Claim 12

119. Claim 12 of the '202 Patent recites:

12. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is configured to allow airflow therethrough.

120. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 12).

J. Claim 13

121. Claim 13 of the '202 Patent recites:

13. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising a sensor adapted for sensing the draw by a user on the electrically-powered, aerosol-generating smoking article.
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122. The teachings of Morgan and Susa provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Morgan's device in Ground 1A (claim 13).

K. Claim 15

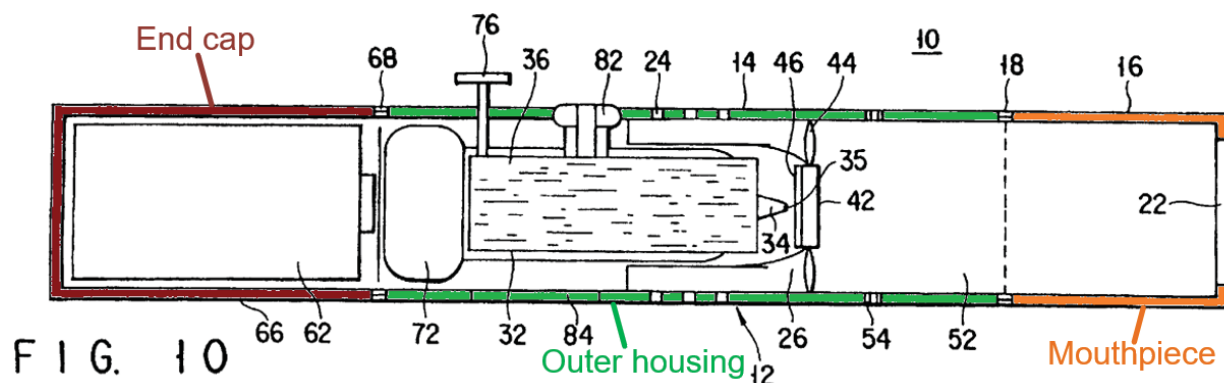
123. Claim 15 of the '202 Patent recites:

15. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising an end cap defined at a second of the two ends.

124. As an initial matter, I note here the '202 Patent admits that the end cap structure of Claim [15] was commercially available or otherwise known before the earliest alleged filing date of the '202 Patent. EX1001, 20:20-25. Here, the predictable Morgan-Susa combination would likewise provide a conventional end cap structure. For example, Morgan's outer housing portion 20 includes a "far end 13" that is near the power source 22 and opposite from the mouth end. EX1004, 4:48-5:5, FIGS. 1-2. However, even if Morgan's far end 13 did not expressly provide the claimed "end cap" (as recited in claim 15), such an option was conventionally

implemented before 2006 in similar prior art devices, as suggested by Susa's smoking article an. EX1006, [0073], FIG. 10.

125. For example, Susa discloses an *end cap* (e.g., power supply holder 66) defined at *a second of the two ends* of an *outer housing* (e.g., casing main body 14). EX1006, [0065]-[0073], FIGS. 9-10. This *second of the two ends* where power supply holder 66 is defined is opposite a *first of the two ends* of Susa's *outer housing* where mouthpiece 16 is defined. EX1006, [0065]-[0073], FIGS. 9-10. For example, Susa's power supply 62 "is stored in a power supply holder 66 which is detachably mounted on the casing main body 14 through a connecting portion 68." EX1006, [0073], FIGS. 9-10. As shown, power supply holder 66 and mouthpiece 16 are defined at opposite ends of casing main body 14.



EX1006, FIG. 10 (annotated).

126. It is clear that A POSITA would have been motivated to implement Morgan's article 10 to include an end cap (as suggested by Susa's holder 66) so that Morgan's power source 22 was readily accessible for simplified replacement. Again,

Morgan discloses that the power source 22 can be a “battery,” which may be exhausted or otherwise in need of replacement. In light of Susa’s suggestion, a POSITA would have been motivated to implement an end cap structure on the end of Morgan’s article 10 (near the battery 22) so as to provide a simple access path for battery replacement without disturbing or engaging Morgan’s other internal components (e.g., controller 24, heating elements 23, etc.). Further, based upon the predictable mechanical components involved in this combination and the state of the art at the time, it is clear that a POSITA would have has a reasonable expectation of success in achieving this predictable combination before the earliest effective filing date of the ’202 Patent (October 18, 2006). Therefore, the teachings of Morgan in view of Susa would have provided the structure recited in Claim [15].

X. GROUND 2A: GUPTA, WHICH INCORPORATES HOWELL BY REFERENCE, ANTICIPATES CLAIMS 1, 4, 8, 9, AND 13

A. Independent Claim 1

127. Independent claim 1 of the ’202 Patent recites:

What is claimed is: 1. An electrically-powered, aerosol-generating smoking article comprising: - an outer housing having two ends; - a mouthpiece defined at one of the two ends; - an electrical power source arranged within the outer housing; - an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;

an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and

a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

128. As I explain in more detail below through my element-by-element analysis, Gupta, which incorporates Howell by reference in its entirety, anticipates claim 1.

[1pre] An electrically-powered, aerosol-generating smoking article comprising:

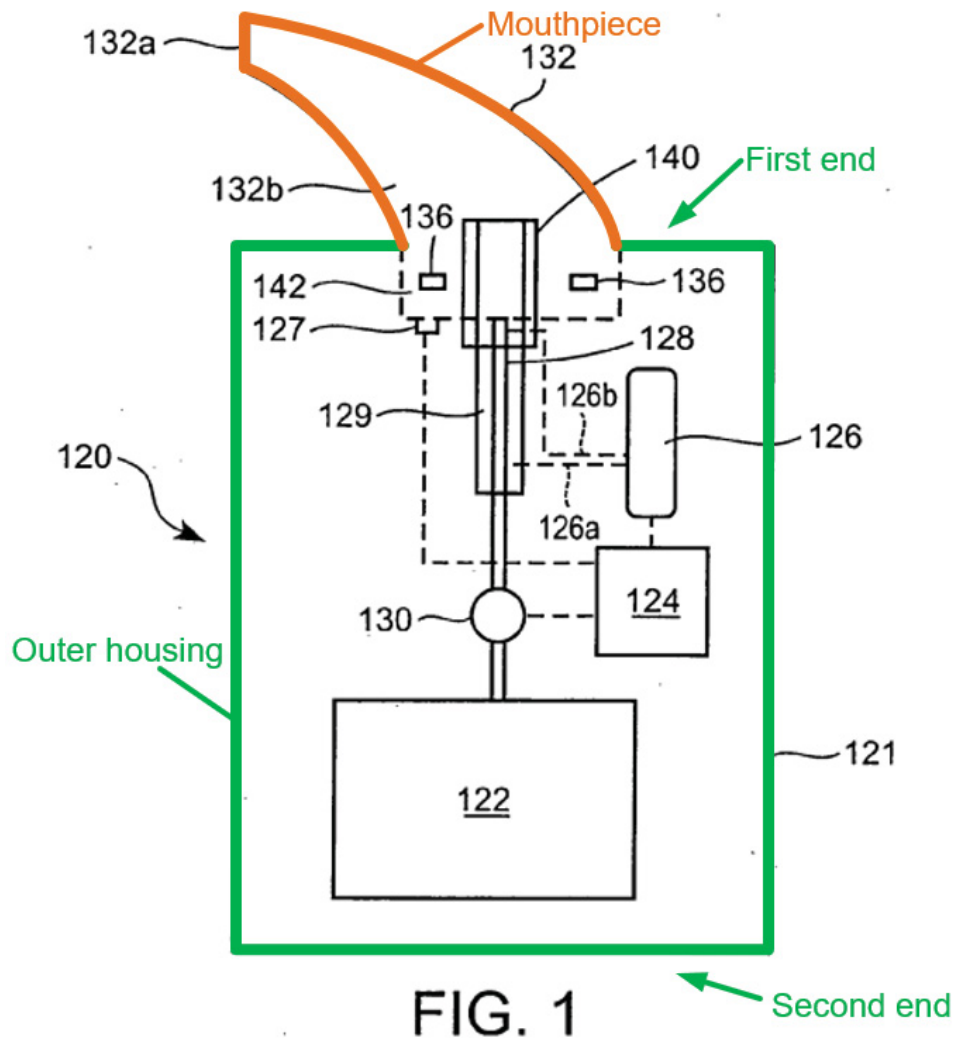
129. Even if the preamble of claim 1 was treated as a limitation and then one assumes the recited “smoking article” encompasses aerosol inhaler devices that provide a smoke-like appearance during use (EX1001, 14:15-38 (“considered to be ‘smoke-like’”)), Gupta discloses such an article. For instance, Gupta describes details of an aerosol-generating article (e.g., aerosol generating device 120). EX1007, [0038]-[0057]. This aerosol generating device 120 includes a power supply that provides electricity to other components of the device, meaning that aerosol

generating device 120 is electrically-powered. EX1007, [0039] (“a power source 126”), [0040] (“The controller 124 is operably connected to the power source 126, the sensor 127 and valve 130 to effect delivery of the liquid from the source 122 to the flow passage 128”), [0045], FIG. 1.

130. My review of Gupta also confirms that device 120 produces “a condensation aerosol” to be “inhaled by a user drawing on the mouthpiece” and employs the same type of aerosol-forming material (“propylene glycol”) described in the ’202 Patent as providing the “smoke-like” appearance. EX1007, [0059], [0013], [0061], [0065]; *see also* EX1001, 14:15-38.

[1a] an outer housing having two ends;

131. Gupta confirms that device 120 comprises an ***outer housing*** (e.g., housing 121) having ***two ends***—including a first end where a mouthpiece 132 is defined and a second end opposite the first end. EX1007, [0009], [0039], [0049]-[0050]. It is apparent that housing 121 is an ***outer*** housing, because housing 121 is the outer boundary of aerosol generating device 120. EX1007, FIG. 1 Gupta’s housing 121 and mouthpiece 132 are depicted below:



EX1007, FIG. 1 (annotated).

132. As shown above, Gupta plainly illustrates the outer housing having a first end that is oriented toward the user's mouth during use and a second end that is opposite from the first end (distal from the user's mouth during use). EX1007, FIG. 1. I note that my analysis of Gupta's housing and its first end and second end is consistent with Patent Owner's previous usage of the phrase "first end of the housing" in an earlier IPR proceeding. *See* EX1016, 19 (admitting that a structure "at a first

end of the housing” is satisfied when it is positioned at “the outer extent of some portion of the housing” oriented toward the user’s mouth) and 29-31 (“by virtue of [the structure] being on an outer surface of the housing”).

[1b] a mouthpiece defined at one of the two ends;

133. Gupta teaches that aerosol generating device 120 includes a ***mouthpiece*** (e.g., mouthpiece 132) that is ***defined at one of the two ends*** of housing 121. EX1007, [0009], [0039], [0049]-[0050]. For example, based on Gupta’s depiction of aerosol generating device 120 in FIG. 1, (refer to my analysis of Element [1a]), it is clear that mouthpiece 132 is defined at the first end of the ***outer housing*** (e.g., the end of housing 121 to be oriented toward the user’s mouth, as depicted in FIG. 1), which is opposite from the second end of housing 121 (annotated above in FIG. 1). EX1007, [0039], FIG. 1.

[1c] an electrical power source arranged within the outer housing;

134. Gupta describes aerosol generating device 120 as including an ***electrical power source*** (e.g., power source 126) in the form of a “battery” that is arranged within the ***outer housing*** (e.g., housing 121) of device 120. EX1007, [0039]-[0040], [0043], [0045], FIG. 1. Based on Gupta’s depiction of aerosol generating device 120 in FIG. 1, it is apparent that power source 126 is ***arranged within the outer housing*** (e.g., housing 121) of aerosol generating device 120, because power source 126 is shown in FIG. 1 as being within the boundary of

housing 121. The device 120 including housing 121 and power source 126 is depicted below in Gupta's FIG. 1:

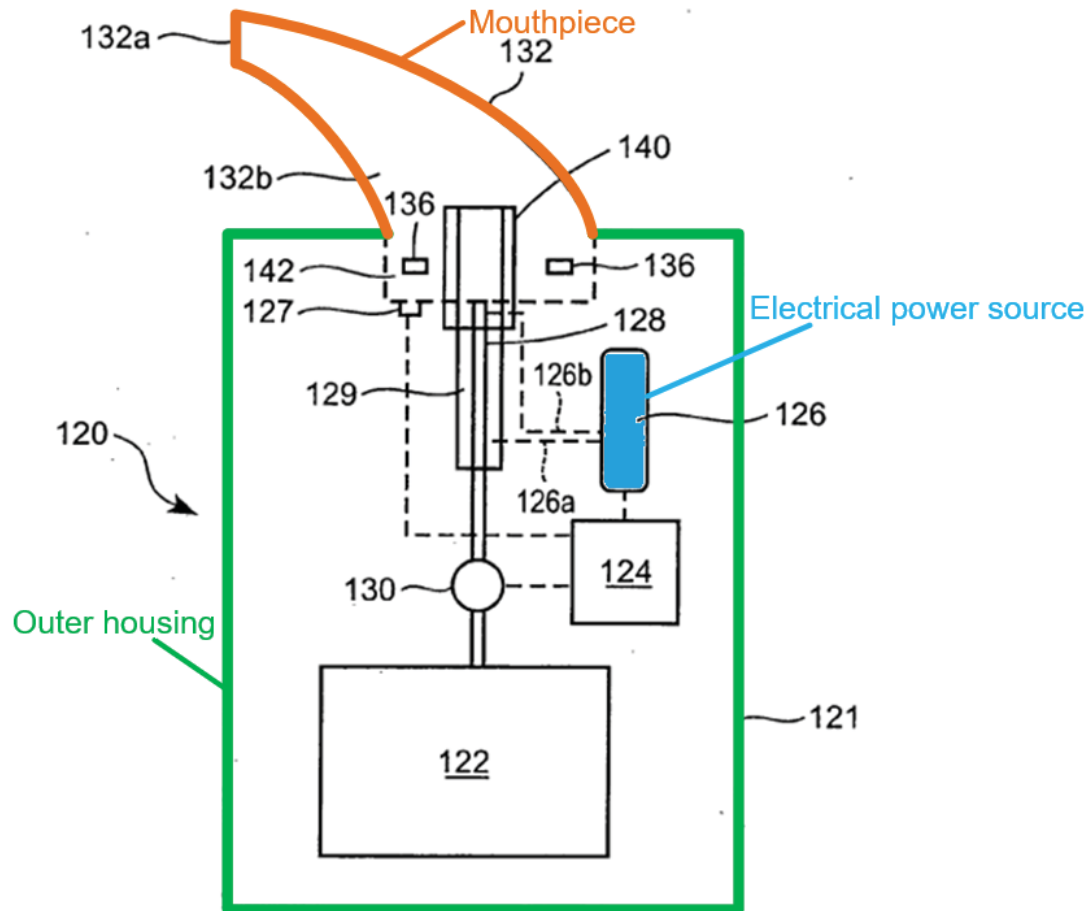


FIG. 1

EX1007, FIG. 1 (annotated).

135. Based on my review of Gupta, it is clear that power source 126 in the form of a battery is *electrical* because “electrical lines 126a, 126b” are “attached to positive and negative electrodes of battery 126.” EX1007, [0043], FIG. 1.

[1d] an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

136. Gupta teaches that device 120 includes a “controller 124” that is “operably connected to the power source 126...to operate a *heater* arranged to heat liquid” in a “heated flow passage 128.” EX1007, [0039]-[0047], [0049]-[0051], FIG. 1. Notably, Gupta describes several several examples of device 120’s *heater*, and all of these examples involve an *electrical resistance heater* positioned within housing 121. EX1007, [0039]-[0041], [0043] (describing the heater as including a “resistive heating material” and being located “as a section of metal tubing forming the flow passage” or as “a separate heater...located along the flow passage”), [0045], [0047]-[0049]. The example where Gupta’s heater is a section of metal tubing is depicted below:

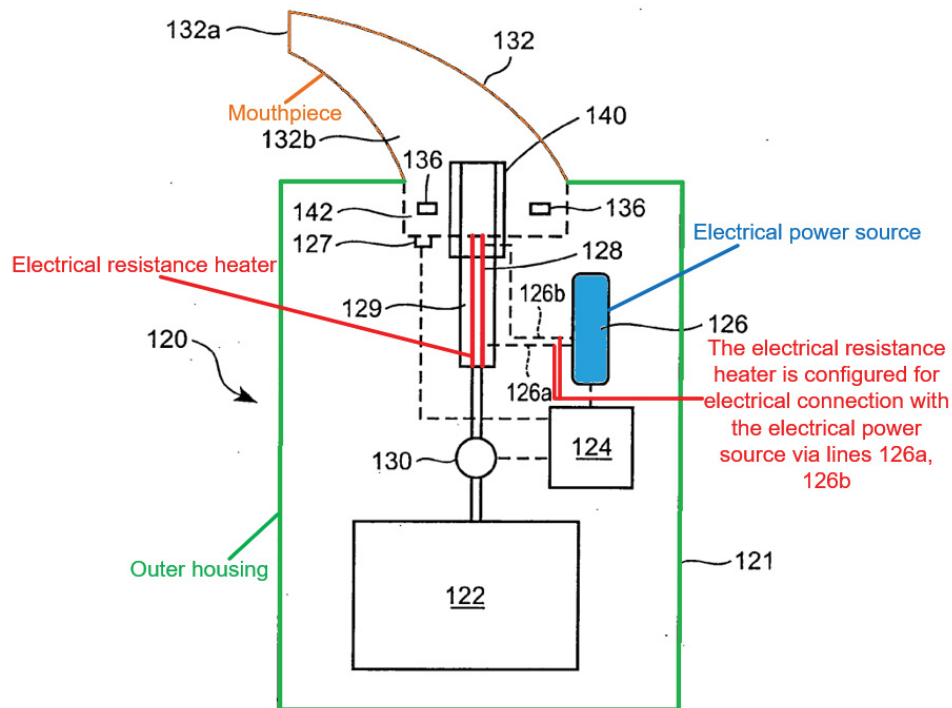


FIG. 1
EX1007, FIG. 1 (annotated).

137. Gupta discloses that “direct current can be passed through resistive heating material via electrical lines 126a, 126b attached to positive and negative electrodes of [a] battery,” which means that Gupta confirms that device 120 includes an *electrical resistance heater* that is *configured for electrical connection* with power source 126. EX1007, [0045], FIG. 1. Furthermore, it is apparent that Gupta’s electrical resistance heater is configured for electrical connection with power source 126 because FIG. 1 depicts electrical lines 126a, 126b as connecting the power source 126 to the portion of heated flow passage 128 that corresponds to the heater. EX1007, FIG. 1. Because one example of Gupta’s electrical resistance heater involves “a section of metal tubing forming the flow passage” and electrical lines 126a, 126b electrically connect the heater to power source 126, Gupta clearly teaches that the *electrical resistance heater* is *configured for electrical connection* with the *electrical power source*. EX1007, [0043], FIG. 1.

138. In my review of Gupta, I also noticed that Gupta provides an example of a “separate heater located along the flow passage” (from Gupta’s [0043]) by incorporating by reference U.S. Patent No. 5,743,251 (“Howell,” EX1008). EX1007, [0048]. This incorporated-by-reference disclosure in Howell teaches that a “power supply 29 is sized to provide sufficient power for [a] heating element 27 that heats the portion of [a] tube 23.” EX1007, 5:35-55; FIG. 1. Because Howell’s FIG. 1 depicts heating element 27 as a resistor, this means that heating element 27 is an

electrical resistance heater. EX1007, FIG. 1. Gupta expressly discloses that such a heater can be in the form of a “thin platinum layer, located along the flow passage” of Gupta’s device. EX1007, [0048], which means that Howell’s heating element 27 used in Gupta’s device 120 would be *positioned within the outer housing*.

[1e] a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;

139. Based on my review of Gupta, it is apparent that aerosol generating device 120 includes a *storage compartment* including at least source 122, heated flow passage 128, body 129, and an aerosol confinement sleeve 140. EX1007, [0039] (“[A] a source 122 of a liquid aerosol formulation...a valve 130...operable to deliver a volume of fluid...from the source 122 to the flow passage 128”), [0044] (“[A]n aerosol confinement sleeve 140 is provided about the body 129 and flow passage 128.”), FIG. 1. Gupta’s FIG. 1 demonstrates that source 122, flow passage 128, body 129, and aerosol confinement sleeve 140 define a connected volume and collectively represent a *storage compartment*. EX1007, FIG. 1.

[0045] (“liquid within the flow passage 128”), [0061] (“The source 122 may contain a suitable liquid aerosol formulation”), [0040] (“[V]alve... to effect delivery of the liquid from the source 122 to the flow passage 128”), FIG. 1. The liquid aerosol formulation within source 122 and heated flow passage 128 eventually *forms aerosol* when heated by the *electrical resistance heater*. EX1007, [0050]-[0062]. This aerosol formation happens within aerosol confinement sleeve 140, where liquid that is volatilized within flow passage 128 admixes with air to create the aerosol. EX1007, [0059].

141. Based on these teachings, it is apparent that Gupta’s source 122, flow passage 128, body 129, and aerosol confinement sleeve 140 collectively represent a *storage compartment* that is *configured for storage of a liquid aerosol-forming material* because these three components are connected to each other and define a connected volume that is capable of storing liquid. EX1007, FIG. 1. For example, because Gupta expressly discloses that source 122 and flow passage 128 can store liquid and expressly discloses that aerosol is formed in sleeve 140 when liquid in flow passage 128 is heated, this means that source 122, flow passage 128, body 129, and aerosol confinement sleeve 140 are all part of the same storage compartment. EX1007, [0050]-[0062].

142. Because Gupta teaches that heated flow passage 128 “comprises a capillary sized flow passage and alternatively refers to the flow passage as a

“capillary passage,” it is clear that the liquid aerosol formulation stored in source 122 and flow passage 128 would be capable of *wicking into contact* with Gupta’s electrical resistance heater through heated flow passage 128. EX1007, [0040]-[0041], [0043], [0045], [0047], FIG. 1. For example, capillary action can drive the liquid aerosol formulation to flow through Gupta’s heated flow passage 128—a capillary passage—and into contact with the *electrical resistance heater*. Accordingly, based on Gupta’s teaching that source 122 and heated flow passage 128 hold a liquid aerosol formulation and that heated flow passage 128 is a capillary passage, Gupta teaches that the liquid aerosol formation *can be wicked into contact with* the *electrical resistance heater*. EX1007, [0039]-[0041], [0043], [0045]-[0047], [0061], FIG. 1.

[1f] an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and

143. Gupta expressly discloses that an *air passageway* exists *through at least a portion* of the *outer housing* of aerosol generating device 120. EX1007, [0049] (“[T]he aerosol generating device 120 can include one or more air passages 136 to permit the passage of external air into the aerosol generating device 120. The external air passes into the interior space 132*b* defined by

the mouthpiece 132”), FIG. 1. Based on Gupta’s depiction of device 120 in FIG. 1, it is clear that air can pass into openings within the boundaries of housing 121 and subsequently flow through mouthpiece 132:

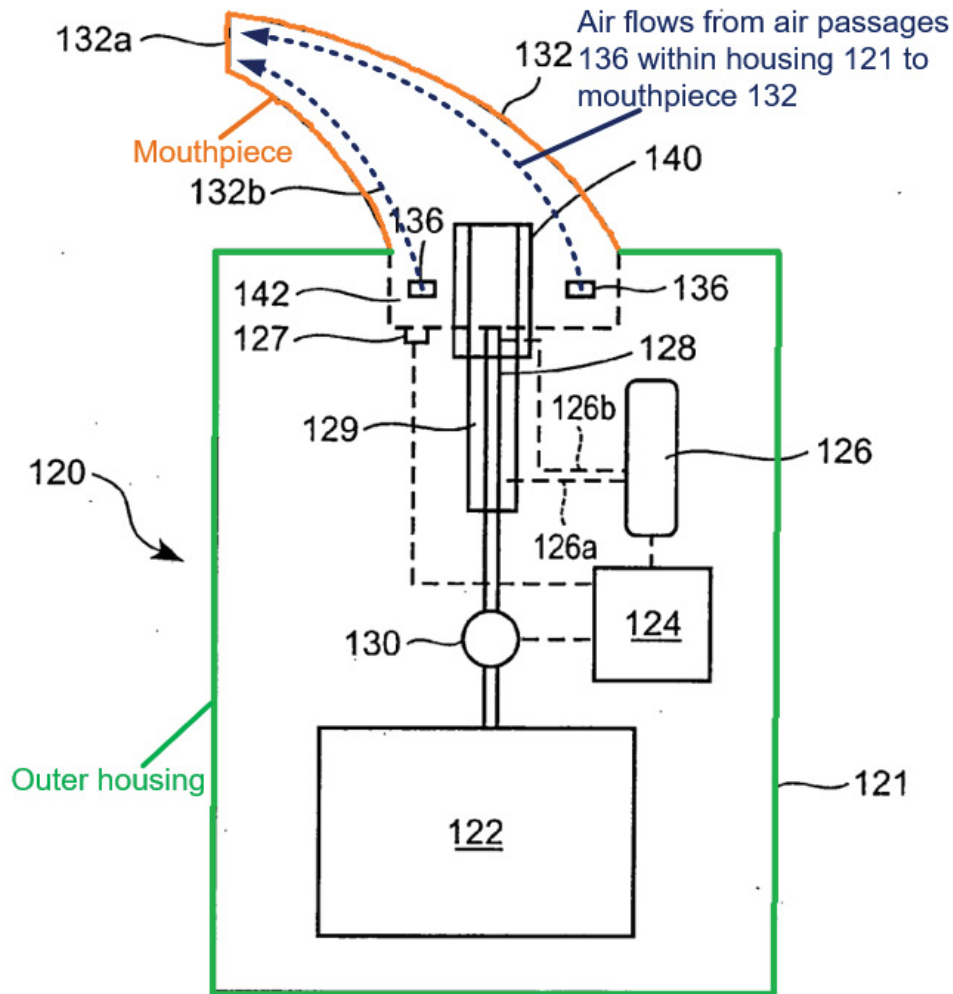


FIG. 1

EX1007, FIG. 1 (annotated).

144. It is apparent that Gupta’s *air passageway* is through at *least a portion of the outer housing*. For example, because the air passages 136 are within the boundaries of housing 121 and mouthpiece 132 is outside of the boundaries of

housing 121, air must flow through at least a portion of housing 121 to reach the user via mouthpiece 132. EX1007, FIG. 1.

145. Furthermore, Gupta expressly teaches that *air* that is *drawn into the outer housing* of device 120 through the one or more air passages 136 combines with *volatilized liquid aerosol-forming material* to produce an *aerosol*. EX1007, [0049] (“[T]o supply air for mixing with the volatilized liquid exiting from the flow passage 128, the aerosol generating device 120 can...permit the passage of external air into the aerosol generating device 120.”); [0059] (“Air...admixes with the volatilized material, which forms an aerosol”), FIG. 1. Gupta confirms that the *aerosol* that is formed when air mixes with the *volatilized liquid* can be drawn into the mouth of the user through the *mouthpiece*. EX1007, [0049] (“The mouthpiece 132 includes a mouthpiece opening 132a through which aerosol generated by the aerosol generating device 120 exits to a patient inhaling the aerosol.”), FIG. 1.

[1g] a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

146. Gupta discloses a *controller* (e.g., controller 124) that is “operably connected to the power source 126, the sensor 127 and valve 130 to...operate a heater arranged to heat liquid in the flow passage 128.” EX1007, [0040]. Because Gupta discloses that sensor 127 is a “pressure sensor” that can detect “vacuum pressure applied to the mouthpiece 132 by a user attempting to inhale aerosol from

the aerosol generating device 120,” it is apparent that sensor 127 can detect a *draw* on device 120. EX1007, [0039], [0050]. Based on this teaching, the “draw” of claim 1 refers to the same kind of action that is disclosed by Gupta—a user inhaling through the device.

147. Furthermore, Gupta’s controller 124 activates current flow through an electrical resistance heater based on detecting a *draw* on device 120. EX1007, [0040] (“The controller 124 is operably connected to the power source 126, the sensor 127 and valve 130 ... to operate a heater arranged to heat liquid in the flow passage 128.”); [0050] (“detection by the sensor 127 of the vacuum pressure applied to the mouthpiece 132 by a user attempting to inhale aerosol”). Moreover, as I noted above (refer to my analysis in Element [1d]), Gupta expressly incorporates by reference Howell’s disclosure. EX1007, [0048]. Howell plainly teaches that the device should be implemented “with a puff-actuated sensor” that is used to controllably activated the “heater” to “volatilize[]” the aerosol-forming material in the tube. EX1008, 6:10-16, FIG. 1, 3:3-59. For each of these reasons, it is apparent Gupta discloses that a *controller* can activate current flow through an *electrical resistance heater* in response to a *draw* on device 120.

B. Claim 4

148. Claim 4 of the ’202 Patent recites:

4. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the aerosol that is produced passes at least partially through the storage compartment before exiting through the mouthpiece.
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149. As noted above in my analysis of Element [1e], it is apparent based on Gupta's disclosure that device 120 includes a *storage compartment* configured for storage of a *liquid aerosol-forming material*. This *storage compartment* includes source 122, heated flow passage 128, body 129, and aerosol confinement sleeve 140. EX1007, [0039]-[0046], [0049]-[0051], [0061]. Gupta expressly teaches that an *electrical resistance heater* volatilizes liquid in the heated flow passage 128, and this volatilized liquid admixes with air in aerosol confinement sleeve 140 to create *aerosol*. EX1007, [0045] ("[L]iquid in the flow passage 128 is heated to a sufficient temperature to be vaporized"), [0059] ("Air in the interior space 142 admixes with [] volatilized material, which forms an aerosol,"), FIGS. 1-2.

150. Gupta also teaches that "[t]he aerosol exits from the outlet end of the aerosol confinement sleeve 140 and is inhaled by a user drawing on the mouthpiece 132." EX1007, [0059], FIGS. 1-2. Because aerosol confinement sleeve 140 is part of Gupta's *storage compartment* and *aerosol* travels from the aerosol confinement sleeve 140 out of mouthpiece 132, it is clear that *aerosol* produced by device 120 passes *at least partially through the storage compartment* before exiting *through the mouthpiece*. This is because the aerosol must travel through the opening at the top of aerosol confinement sleeve 140 to reach the user

through the mouthpiece 132 and therefore the *aerosol* must travel *at least partially* through Gupta's *storage compartment*.

C. Claim 8

151. Claim 8 of the '202 Patent recites:

8. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment is configured as a container for holding liquid.

152. As described above in my analysis of Elements [1e] and [4], it is apparent from Gupta's disclosure that device 120 includes a "storage compartment" including source 122, heated flow passage 128, body 129, and aerosol confinement sleeve 140. EX1007, [0039]-[0046], [0049]-[0051], [0061]. In several instances, Gupta expressly teaches that parts of the *storage compartment* hold *liquid*. EX1007, [0039] ("[S]ource 122 of a liquid aerosol formulation", "[H]eat liquid in the flow passage 128"), [0043] ("[V]aporize liquid in the flow passage"), [0046] ("[V]olatilize liquid within the flow passage 128"), [0061] ("[S]ource 122 may contain a suitable liquid aerosol formulation"), FIG. 1.

D. Claim 9

153. Claim 9 of the '202 Patent recites:

9. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged in contact with the storage compartment.

154. As detailed above in my analysis of Element [1d], Gupta’s disclosure provides at least two examples of an *electrical resistance heater*—including a first example where the heater is formed by part of the tubing of flow passage 128 and a second example where a separate heater is located along flow passage 128. EX1007, [0039]-[0041], [0043] [0045], [0047]-[0049]. In the first example, it is apparent from Gupta’s disclosure that the *electrical resistance heater* is *arranged in contact with the storage compartment* because the heater portion of flow passage 128 is in direct physical contact with the liquid inside of flow passage 128, body 129, and other portions of the storage compartment. In the second example, because the *electrical resistance heater* is “located along” the flow passage 128 and can heat liquid within flow passage 128, it is clear that the *electrical resistance heater* is *arranged in contact with the storage compartment*.

E. Claim 13

155. Claim 13 of the ’202 Patent recites:

13. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising a sensor adapted for sensing the draw by a user on the electrically-powered, aerosol-generating smoking article.
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156. As noted above in my analysis of Element [1g], Gupta’s disclosure makes it clear that device 120 includes a sensor 127 that can detect a *draw* by a user. EX1007, [0039] (“The aerosol generating device 120 comprises...an optional sensor 127”), [0050] (“detection by the sensor 127 of vacuum pressure applied to

the mouthpiece 132 by a user attempting to inhale aerosol from the aerosol generating device 120”), FIG. 1. Based on these teachings, it is apparent that aerosol generating device 120 of Gupta includes a *sensor* adapted for sensing the *draw* by a user.

XI. GROUND 2B: GUPTA IN COMBINATION WITH TAKEUCHI RENDERS CLAIMS 1, 3, 4, 8-13, AND 15 OBVIOUS

A. Overview of the Combination and Reasons to Combine

157. A POSITA would have been motivated to implement Gupta’s device in accordance with Takeuchi’s suggested use of a controller that activates a heater in response to a user draw on the device. It is clear that in the resulting combination, the controller 124 of Gupta’s aerosol generating device 120 would have predictably activated current flow through Gupta’s electrical resistance heater in response to the sensor 127 of Gupta detecting draw on the aerosol generating device 120 so that the heater is activated only in cases where the user is attempting to inhale from the device. Furthermore, in the combination, Gupta’s aerosol generating device 120 would have been predictably used as a “smoking article” in which tobacco components deliver tobacco flavor satisfaction via the aerosol, as suggested by Takeuchi.

158. Several reasons would have prompted a POSITA to implement Gupta’s device 10 in accordance with Takeuchi’s suggested improvements for controlling a heater based on a detected draw and for a simulated smoking experience. As a *first*

reason, a POSITA would have been prompted to implement Gupta's device 120 so that controller 124 causes power source 126 to deliver power to the electrical resistance heater in response to sensor 127 detecting a user draw (as suggested by Takeuchi) so as to limit the heater's power consumption to times when the user is drawing on the device. The device resulting from this predictable combination would have advantageously preserved/extended the life of power source 126 so that aerosol generating device 120 can last longer on a single charge. For example, in the device resulting from the predictable combination, the controller 124 of device 120 would activate the heater only when the user is attempting to inhale aerosol, thereby advantageously preventing the heater from needlessly drawing power when the user is not attempting to inhale aerosol.

159. As a *second* reason, a POSITA would have been prompted to implement Gupta's device 120 so that controller 124 activates the heater in response to a draw as suggested by Takeuchi because this would prevent the heater from producing heat when the device 120 is not in use. Namely, if the heater of Gupta's device 120 were activated for extended periods of time when the device is not in use, this could result in the heater damaging other components of the device 120, causing discomfort to the user, causing an injury to the user, exhausting a supply of aerosol-forming liquid in device 120, or any combination thereof. Because the device resulting from this predictable combination would be limited to drawing power only

when a user is drawing on the device 120, this would prevent the undesirable events I mentioned above from occurring.

160. As a *third* reason, it would be advantageous for a POSITA to implement the liquid aerosol formation of Gupta's device 120 in accordance with Takeuchi's suggested use of tobacco components with the aerosol-forming substances so as to advantageously provide a user with a simulated smoking experience and tobacco flavor. Some users desire to consume tobacco products or otherwise experience tobacco flavor satisfaction without inhaling combustion smoke that is produced from burning tobacco and other materials, and this predictable combination would have resulted in a device that can deliver such a simulated smoking experience. EX1009, 5:40-46.

161. Furthermore, It is clear that A POSITA would have reasonably expected success in achieving this combination in the manner described above before the earliest effective filing date of the '202 Patent (October 18, 2006). For example, both Gupta's device 120 and Takeuchi's device 10 are directed to electrical aerosol-producing devices and include predictable mechanical components, and in this context, a POSITA would have possessed ample skill to successfully implement the combination as described above.

B. Claim 1

162. Claim 1 of the '202 Patent recites:

What is claimed is:

1. An electrically-powered, aerosol-generating smoking article comprising:

- an outer housing having two ends;
- a mouthpiece defined at one of the two ends;
- an electrical power source arranged within the outer housing;
- an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

- a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;
- an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and
- a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

163. As I explain in more detail below through my element-by-element analysis, Gupta in view of Takeuchi renders claim 1 obvious.

[1pre] An electrically-powered, aerosol-generating smoking article comprising:

164. Gupta discloses that its device 120 is configured to produce aerosol and that a user is able to inhale the aerosol through mouthpiece 132 that is formed at an

end of the outer housing of the device 120. EX1007, [0038]-[0039], [0049]-[0050], FIG. 1. As I articulated above in my analysis of the Gupta-Takeuchi combination, this predictable combination would have provided a modification to Gupta’s device 120—namely, one in which tobacco components are used to deliver tobacco flavor satisfaction via the aerosol. *Supra*, §XI.A. Again, Takeuchi suggests that such an aerosol-generating device can be used as a “simulated smoking article” including a storage compartment that holds a combination of an aerosol-forming liquid and “tobacco components.” EX1009, 5:28-46, FIG. 1.

165. For at least the advantageous reasons expressly articulated above (*see* §XI.A), a POSITA would have been motivated to implement Gupta’s device 120 in a manner (as suggested by Takeuchi) to achieve the recited “smoking article.”

Elements [1a]-[1f]

166. The Gupta-Takeuchi combination would have provided these claim elements for at least the same reasons described above in connection with Gupta alone. *See supra*, Ground 2A (§X.A) at Elements [1a]-[1f].

[1g] a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

167. As noted above in my analysis of Ground 2A, Element [1g], Gupta expressly discloses a ***controller*** (e.g., controller 124) that is “operably connected to the power source 126, the sensor 127 and valve 130 to...operate a heater arranged

to heat liquid in the flow passage 128.” EX1007, [0040]. Gupta’s disclosure makes it clear that sensor 127 can detect a user’s *draw* on device 120 because sensor 127 is a “pressure sensor” that can detect “vacuum pressure applied to the mouthpiece 132 by a user attempting to inhale aerosol from the aerosol generating device 120.” EX1007, [0039], [0050]. Furthermore, it is apparent that Gupta discloses controller 124 activates current flow through heater in response to detecting a draw, because Gupta discloses that a “valve 130 may be opened either prior to or subsequent to detection...of vacuum pressure applied to the mouthpiece 132 by a user attempting to inhale aerosol” and “[l]iquid passing through the flow passage 128 is heated to a sufficient temperature to volatilize the liquid.” EX1007, [0050].

168. To the extent that Gupta does not expressly disclose that controller 124 activates current flow through the heater “in response to a draw on” device 120, it is apparent that this conventional option would have been beneficially implemented in the predictable Gupta-Takeuchi combination. *Supra*, §XI.A. Because Takeuchi expressly discloses that its control circuit 46 can “start up” its heater 42 based on sensor 52 detecting an inhaling action of a user, the device resulting from the Gupta-Takeuchi would involve controller 124 activating Gupta’s electrical resistance heater based on sensor 127 detecting a draw on device 120. EX1009, 6:23-42, FIG. 1. For at least the advantageous reasons that I expressly articulated above in my

analysis of the Gupta-Takeuchi combination (*see* §V.D.2), it is clear that a POSITA would have been motivated to combine Gupta and Takeuchi such that Gupta's controller 124 activates current flow through Gupta's heater in response to a draw on device 120.

C. Claim 3

169. Claim 3 of the '202 Patent recites:

3. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment comprises a fibrous substrate.

170. As detailed above in my analysis of Ground 2A, Elements [1e] and [4], it is apparent from Gupta's disclosure that device 120 has a "storage compartment" including source 122, heated flow passage 128, body 129, and aerosol confinement sleeve 140. EX1007, [0039]-[0046], [0049]-[0051], [0061]. Gupta discloses that liquid can flow through heated flow passage 128 to reach a heater that volatilizes the liquid. EX1007, [0050], FIG. 1. The storage compartments of Takeuchi's device 10 and Gupta's device 120 are very similar, because Takeuchi's storage compartment includes a container 32 for holding liquid and a capillary tube 36 for carrying the liquid to a heater much like Gupta's storage compartment includes a source 122 for holding liquid and a heated flow passage 128 for carrying the liquid to a heater. EX1007, [0039]-[0046], [0049]-[0051], [0061], FIG. 1; EX1009, 3:35-50, 5:47-6:22, FIG. 1.

171. To the extent that Patent Owner contends that Gupta's storage compartment does not comprise a "fibrous substrate," I understand that such an option was conventionally implemented before 2006 in similar prior art devices, as suggested by Takeuchi's smoking article. EX1009, 3:35-50, 10:50-63, FIG. 1, FIG. 14. Notably, Takeuchi expressly discloses that "the liquid passageway through which [a] liquid flavor source is transported by [] capillary force can be constituted by...an inter-communicating void or pore structure filled in an enclosure," and that "[r]epresentative examples of the structure include open-cell foamed structure, and bundled fibers." EX1009, 3:35-50. Because Takeuchi's capillary tube 36 can include "bundled fibers," it is clear that Takeuchi's storage compartment including capillary tube 36 comprises a "fibrous substrate." EX1009, 3:35-50.

172. One reason that a POSITA would have been motivated to implement Gupta's aerosol generating device 120 to include bundled fibers within heated flow passage 128, as suggested by Takeuchi, is to improve an ability of capillary action to cause liquid to flow through heated flow passage 128. For example, Takeuchi discloses that the extent to which capillary force can elevate a liquid within a capillary tube can depend upon the width of the capillary tube or a diameter of voids or pores in the fibrous substrate that fills the capillary tube. EX1009, 3:51-4:8. Specifically, Takeuchi's disclosure makes it clear that narrower passageways and

pores allow for greater elevation of liquids through capillary action.¹ EX1009, 3:51-4:8.

173. Consequently, a POSITA would have been motivated to implement Gupta's heated flow passage 128 with a fibrous substrate as suggested by Takeuchi because gaps and pores between the fibers are narrower than the width of flow passage 128, thus improving capillary flow of liquid from source 122 to the heater. Takeuchi's disclosure that the effect of capillary action depends on the width of the liquid passageway is consistent with the knowledge of a POSITA concerning capillary action in general, and it would have been apparent to a POSITA that implementing Gupta's device to include a fibrous substrate within heated flow passageway 128 would improve an ability of aerosol-generating device 120 to deliver liquid from the source 122 to the electrical resistance heater because the

¹ Takeuchi expressly discloses that the "height from the liquid level of the liquid flavor source to the outlet of the liquid passageway" is given by the equation $h = \frac{2\gamma \cos(\theta)}{d\rho g}$, where h is the height that capillary action can elevate liquid and d is the width of the liquid passageway. EX1009, 3:51-4:8. Because d is in the denominator of the equation, this means Takeuchi teaches that narrower pores result in greater liquid elevation.

narrower pores within the fibrous substrate would increase the distance that liquid can elevate from source 122.

D. Claim 4

174. Claim 4 of the '202 Patent recites:

4. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the aerosol that is produced passes at least partially through the storage compartment before exiting through the mouthpiece.
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175. The teachings of Gupta and Takeuchi provide the additional feature recited in this dependent claim for at least the reasons addressed above in my analysis of Ground 2A (claim 4).

E. Claim 8

176. Claim 8 of the '202 Patent recites:

8. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment is configured as a container for holding liquid.

177. The teachings of Gupta and Takeuchi provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Gupta alone in Ground 2A (claim 8).

F. Claim 9

178. Claim 9 of the '202 Patent recites:

9. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged in contact with the storage compartment.

179. The teachings of Gupta and Takeuchi provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Gupta alone in Ground 2A (claim 9).

G. Claim 10

180. Claim 10 of the '202 Patent recites:

10. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged proximate to an absorbent wicking material configured for transferring the liquid aerosol-forming material to the electrical resistance heater.

181. As detailed above in my analysis of Claim 3, a POSITA would have been motivated to modify the heated flow passage 128 of Gupta to include a pore structure including open cells and bundled fibers. EX1009, 3:31-50. A POSITA would have understood that this pore structure within heated flow passage 128 represents an *absorbent wicking material* configured for transferring liquid aerosol-forming material to an *electrical resistance heater*. I have been informed that in prior IPRs, Patent Owner admitted that capillary action through porous materials is an example of wicking. *See* EX1015, 29 (“‘capillary infiltration’ will occur wherever there is porous or fibrous material”).

182. Furthermore, as detailed above in my analysis of Ground 2A, Elements [1d] and [9], Gupta discloses an *electrical resistance heater* positioned within housing 121, and this electrical resistance heater is *arranged in contact* with a *storage compartment* including heated flow passage 128. EX1007, [0039]-[0041], [0043], [0045], [0047]-[0049]. Because the Gupta-Takeuchi combination involves heated flow passage 128 being filled with an *absorbent wicking material* as suggested by Takeuchi, it is clear that Gupta’s *electrical resistance heater* is arranged proximate to this *absorbent wicking material* within heated flow passage 128.

H. Claim 11

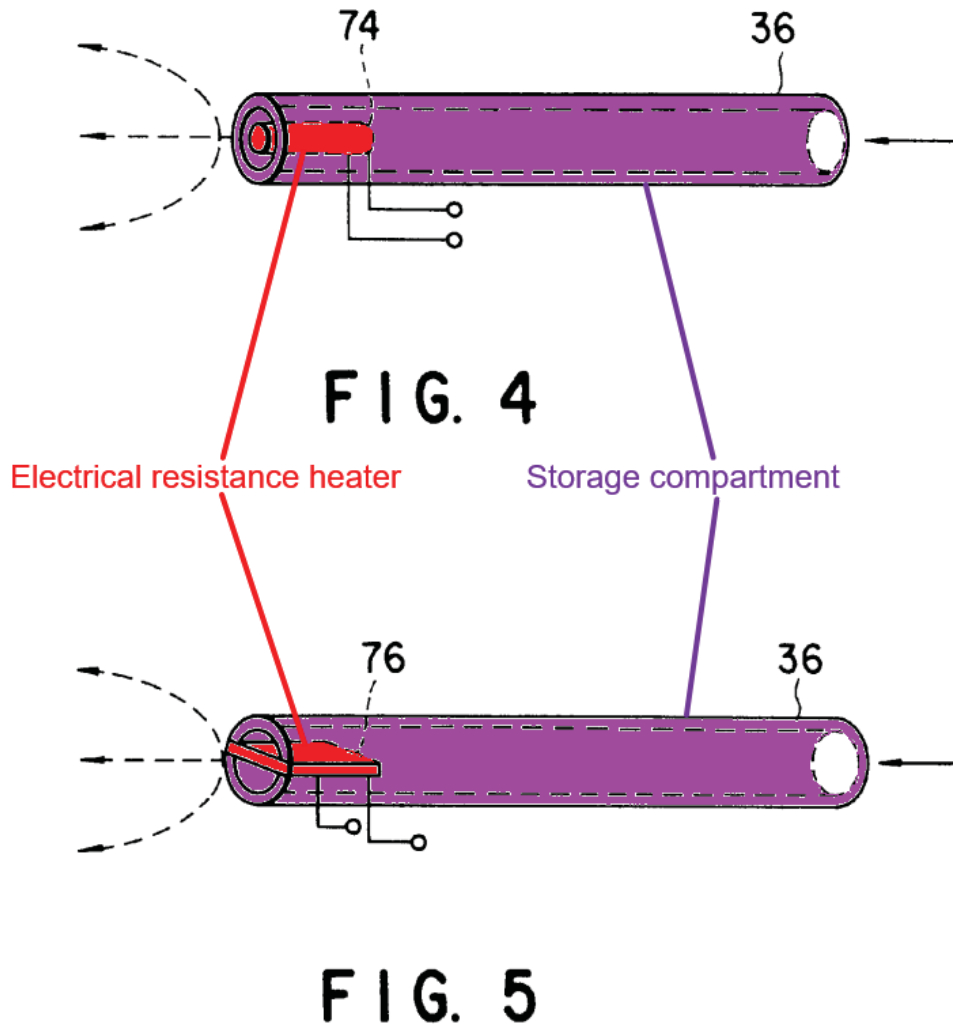
183. Claim 11 of the ’202 Patent recites:

11. The electrically-powered, aerosol-generating smoking article of claim 1, wherein at least a portion of the electrical resistance heater extends into the storage compartment.
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184. As detailed above in my analysis of Ground 2A, Elements [1d]-[1e], Gupta discloses at least two embodiments for an *electrical resistance heater* positioned within housing 121, and Gupta discloses that a storage compartment includes heated flow passage 128. EX1007, [0039]-[0041], [0043] (“[T]he flow passage can be heated by passing electrical current through a resistive heating material, such as a section of metal tubing forming the flow passage, or a separate heater can be located along the flow passage.”), [0047]-[0050] (“Liquid passing

through the flow passage 128 is heated to a sufficient temperature to volatilize the liquid”). To the extent that Patent Owner argues that Gupta does not disclose an electrical resistance heater that *extends into* Gupta’s *storage compartment*, Takeuchi’s clearly discloses this beneficial feature.

185. In particular, Takeuchi expressly discloses at least two embodiments where an *electrical resistance heater* extends into capillary tube 36. These include (1) a first embodiment where “a rod-like heater 74 is inserted into the outlet port 36a of the capillary tube 36” and (2) a second embodiment where “a plate-like heater 76 is inserted into the outlet port 36a of the capillary tube 36.” EX1009, 6:22-26, FIGS. 4-5. Takeuchi’s heater embodiments are depicted below in FIGS. 4 and 5.



EX1009, FIGS. 4-5 (annotated).

186. It is clear that a POSITA would have been motivated to implement Gupta's aerosol generating device 120 to include an electrical resistance heater that extends into heated flow passage 128, as suggested by Takeuchi, so that heat transfers efficiently from the electrical resistance heater outward into liquid within heated flow passage 128. For example, when the heater forms part of heated flow passage 128 or is outside of heated flow passage 128, at least some of the heat radiating from the heater does not reach the liquid within heated flow passage 128

because some of the heat would be lost outward from heated flow passage 128 and away from the liquid within the heated flow passage 128. However, when the heater extends into the heated flow passage 128 as suggested by Takeuchi, substantially more of the heat reaches the liquid. This means that implementing Gupta's heated flow passage 128 to include one of Takeuchi's heater embodiments that extends into the passage 128 could result in Gupta's device 120 using less energy to volatilize an amount of liquid as compared with the amount of energy used when the heater is part of passage 128 or outside of passage 128 as taught by Gupta. The power savings resulting from Takeuchi's heater embodiments would lead to Gupta's power source 126 lasting longer on a single charge.

I. Claim 13

187. Claim 13 of the '202 Patent recites:

13. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising a sensor adapted for sensing the draw by a user on the electrically-powered, aerosol-generating smoking article.
--

188. The teachings of Gupta and Takeuchi provide the additional feature recited in this dependent claim for at least the reasons addressed above in connection with my analysis of Gupta in Ground 2A (claim 13).

J. Claim 15

189. Claim 15 of the '202 Patent recites:

15. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising an end cap defined at a second of the two ends.

190. The predictable Gupta-Takeuchi combination provides this element. Gupta and Takeuchi both disclose, for example, a device including a storage compartment for holding a liquid aerosol-forming material. EX1007, [0039] (“[A] source 122 of a liquid aerosol formulation”), FIG. 1; EX1009, 5:28-30 (“the liquid container 32 housing a liquid flavor Source 34 is fixed within the lower chamber 122 of the casing 12.”), FIG. 1. To the extent that Gupta does not include an “end cap” defined at a second of two ends of housing 121, Takeuchi discloses such an end cap that can be removed to refill liquid container 121. EX1009, 7:18-30, FIG. 1. For example, Takeuchi discloses that “[a] pouring port 58 for replenishing the liquid flavor Source 34 is connected to the liquid container 32” and that “a removable cap 59 is provided in the exposed end portion of the pouring port 58.” EX1009, 7:18-30, FIG. 1. This removable cap 59 represents an *end cap*—one that Takeuchi suggests should be positioned at the end of the outer housing opposite from the mouth piece 16:

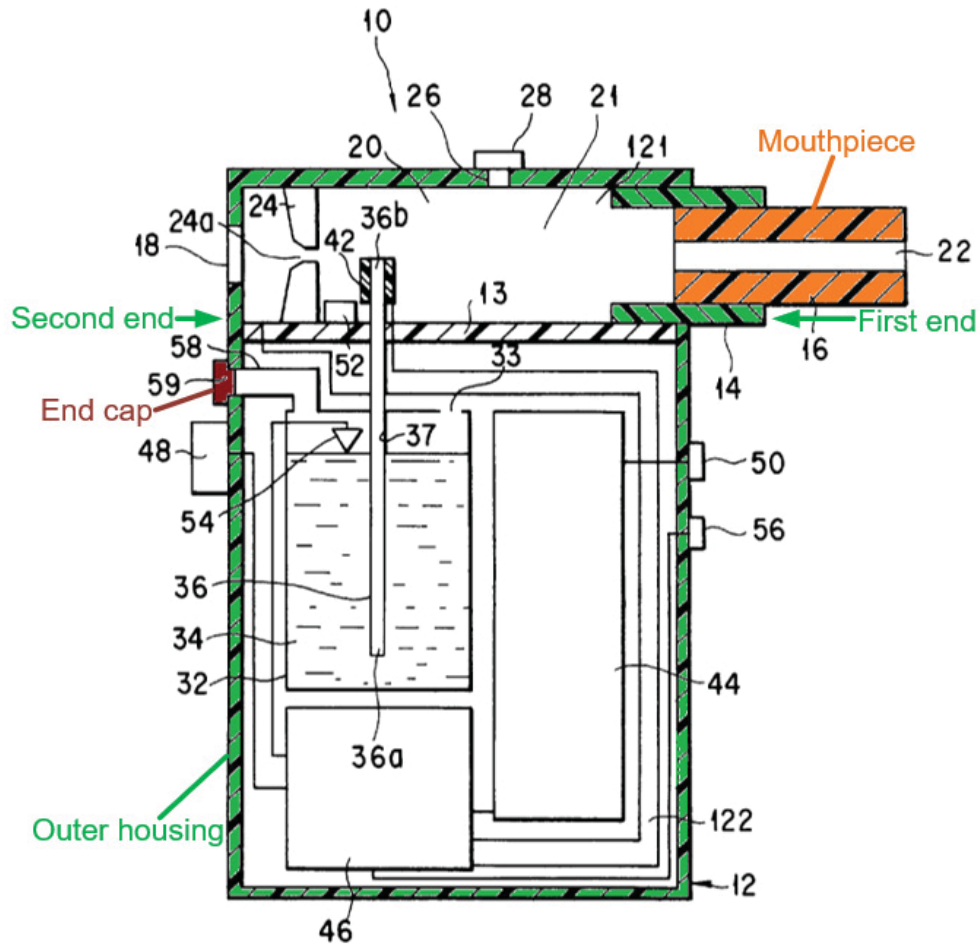


FIG. 1

EX1009, FIG. 1 (annotated).

191. A POSITA would have been motivated to implement Gupta's device 120 to include an *end cap* (as suggested by Takeuchi) so that liquid within source 122 can be refilled when the liquid is depleted. For example, because Gupta discloses that source 122 includes a "liquid aerosol formulation" which depletes as the liquid is vaporized to produce aerosol, it is clear that if device 120 were implemented with

a strategically-placed end cap for refilling source 122, this would improve an ability of the user to refill the liquid. EX1007, [0039]-[0040], [0045]-[0046], FIG. 1.

192. Based on Takeuchi's suggestion, a POSITA would have been motivated to implement an end cap structure on the end of Gupta's device 120 (near source 122) because this would provide a simple access path to replace fluid in source 122 without disturbing or engaging Gupta's other components such as controller 124, battery 126, and valve 130. On Gupta's device 120, it would be beneficial to place the end cap on the "bottom" end near source 122, which is opposite the "top" end where mouthpiece 132 is defined. EX1007, FIG. 1. This means that the *end cap* resulting from Takeuchi's suggestion would be defined at a *second of the two ends* of Gupta's outer housing opposite the first of the two ends where mouthpiece 132 is defined.

XII. GROUND 3: TAKEUCHI ANTICIPATES CLAIMS 1, 3, 8-11, 13, AND 15

A. Independent Claim 1

193. Independent claim 1 of the '202 Patent recites:

What is claimed is:

1. An electrically-powered, aerosol-generating smoking article comprising:

an outer housing having two ends;

a mouthpiece defined at one of the two ends;

an electrical power source arranged within the outer housing;

an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;

an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and

a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

194. As I explain in more detail below through my element-by-element analysis, Takeuchi anticipates claim 1.

[1pre] An electrically-powered, aerosol-generating smoking article comprising:

195. Even if the preamble is treated as a limitation (which Petitioner does not concede), Takeuchi discloses the recited “electrically-powered, aerosol-

generating smoking article.” Takeuchi discloses a “flavor-generating device 10” that is *electrically-powered* and provides a “simulated smoking” experience. EX1009, 4:26-38 (“a power source 44”), 6:12-22 (“electric power is supplied from a power source 44”), 1:4-9, FIG. 1. This is consistent with Patent Owner’s position in a prior IPR, in which Patent Owner submitted evidence admitting that “Electronic Cigarettes (‘e-cigarettes’) were well-known ... since at least the mid-1990s, as demonstrated by, for example, the ... Takeuchi reference[.]” EX1014, 16.

196. It is clear that Takeuchi’s device 10 is *aerosol-generating*, because the device 10 can store aerosol-forming substances that produce aerosol when heated. EX1009, 5:28-39 (“[I]t is possible for [a] liquid flavor source [] to contain a substance forming aerosol when heated.”), 10:5-13, FIG 1. Because flavor-generating device 10 is configured “for enjoying simulated smoking,” device 10 is a *smoking article*. EX1009, 1:4-9, *see also* 5:40-46 (“where the device is used as a simulated smoking article, it is possible for [a] liquid flavor source [] to contain tobacco components.”). Therefore, Takeuchi provides Element [1pre].

[1a] an outer housing having two ends;

197. Takeuchi’s device 10 includes an *outer housing* having *two ends*. EX1009, 4:25-38, FIG. 1; *see also* EX1016, 27 (Patent Owner admitting in a prior IPR that “Takeuchi discloses a housing” and citing in an annotated figure that Takeuchi’s housing includes casing 12 and inhalation port holder 14.). For example,

the *outer housing* of Takeuchi includes casing 12 and inhalation port holder 14, because these are the parts of device 10 that form an outer boundary. EX1009, 4:25-38, FIG. 1. The *outer housing* of device 10 is depicted below in FIG. 1:

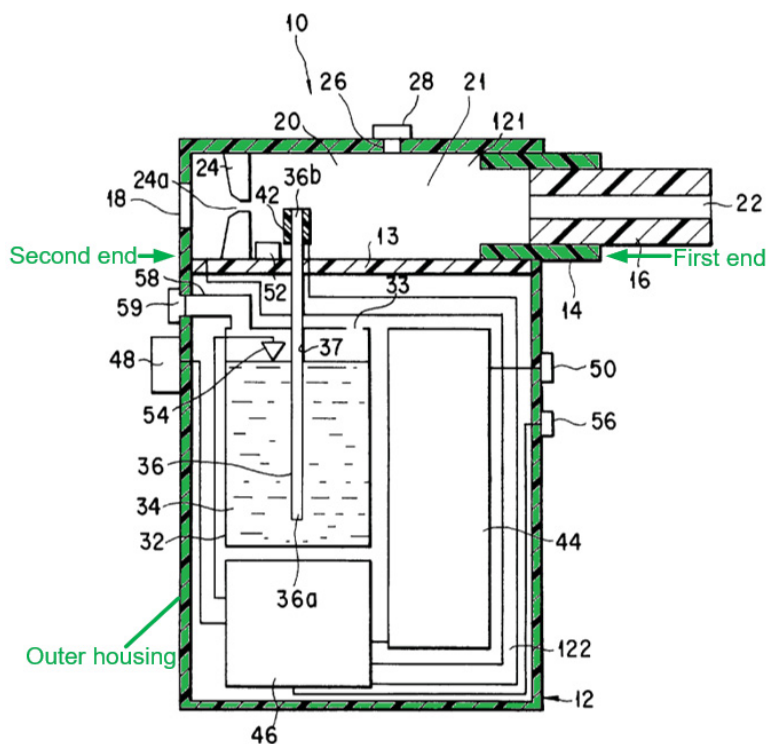


FIG. 1

EX1009, FIG. 1 (annotated).

198. As shown above, Takeuchi depicts the outer housing having *two ends*—a first end that is oriented toward the user’s mouth during use and a second end that is opposite from the first end (distal from the user’s mouth during use). EX1009, FIG. 1. I note that my analysis of the first end and second end of Takeuchi’s housing is consistent with Patent Owner’s previous usage of the phrase “first end of the housing” in an earlier IPR proceeding—one in which Patent Owner admitted that

the “first end” of Takeuchi’s outer housing is oriented toward the user’s mouth. *See* EX1016, 29-31 (pointing to the same end of Takeuchi as the “first end”) and 19 (“the outer extent of some portion of the housing”). Additionally, I note that claim 1 does not specify any particular shape or elongate requirement of the “outer housing,” nor does the specification provide any express definition or lexicography for any of the two “ends” recited in claim 1. For these reasons, it is clear that Takeuchi discloses the claimed outer housing recited in Element [1a].

[1b] a mouthpiece defined at one of the two ends;

199. Takeuchi’s mouth piece 16 providesI have been informed that Patent Owner admitted in a prior IPR that Takeuchi’s mouth piece 16 represents “a mouth piece on [a] housing.” EX1016, 28. Similarly, Takeuchi’s mouth piece 16 represents a ***mouthpiece*** defined at ***one of the two ends*** of the ***outer housing*** of device 10. EX1009, 4:39-47 (“A mouth piece 16...is detachably inserted into the holder 14”), 7:48-56 (“the mouth piece 16 is taken in the mouth of the user for the inhaling action through the inhalation port 22.”); *see also* EX1016, 28 (Patent Owner admitting in a prior IPR that Takeuchi’s mouth piece 16 represents “a mouth piece on [a] housing.”). As shown in FIG 1 (below), the ***mouthpiece*** of Takeuchi’s device 10 is defined at a first end of the ***outer housing***:

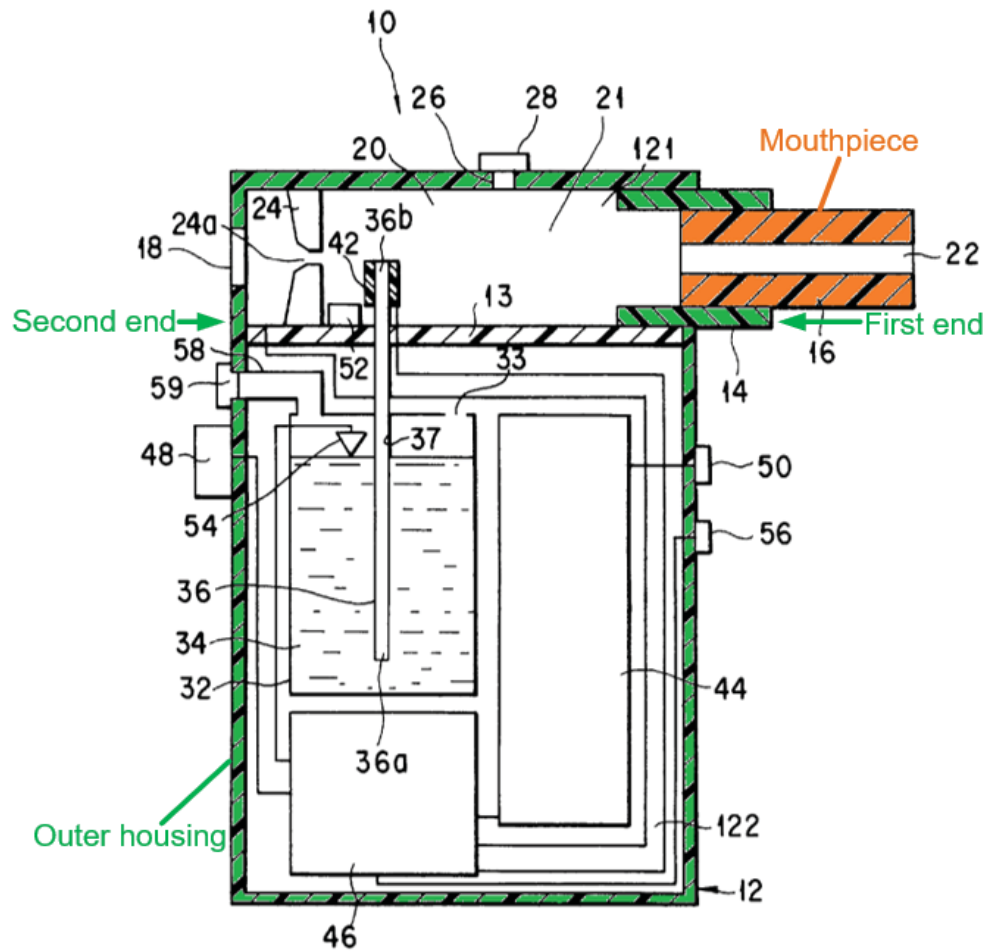


FIG. 1

EX1009, FIG. 1 (annotated).

[1c] an electrical power source arranged within the outer housing;

200. Takeuchi’s disclosure confirms this by teaching that power source 44 represents an *electrical power source* arranged within the *outer housing* of device 10. For example, Takeuchi expressly discloses that “casing 12 is partitioned into an upper chamber 121 and a lower chamber 122” and that “the lower chamber 122 is

used as a housing for...a power source 44.” EX1009, 4:30-38, FIG. 1; *see also* EX1016, 33 (Patent Owner admitting in a prior IPR that the power source 44 of Takeuchi represents “a battery within [a] housing.”). Regarding the power source 44, Takeuchi expressly discloses that “[i]t is desirable to use...a DC power source available on the market such as a primary battery (dry battery), or a secondary battery (rechargeable battery),.” so it is apparent that power source 44 is *electrical*. EX1009, 6:4-22, FIG. 1. As demonstrated below in Takeuchi’s FIG. 1 depiction of device 10, Takeuchi’s *electrical power source* is 1: 1 clearly arranged within the *outer housing* of device 10.

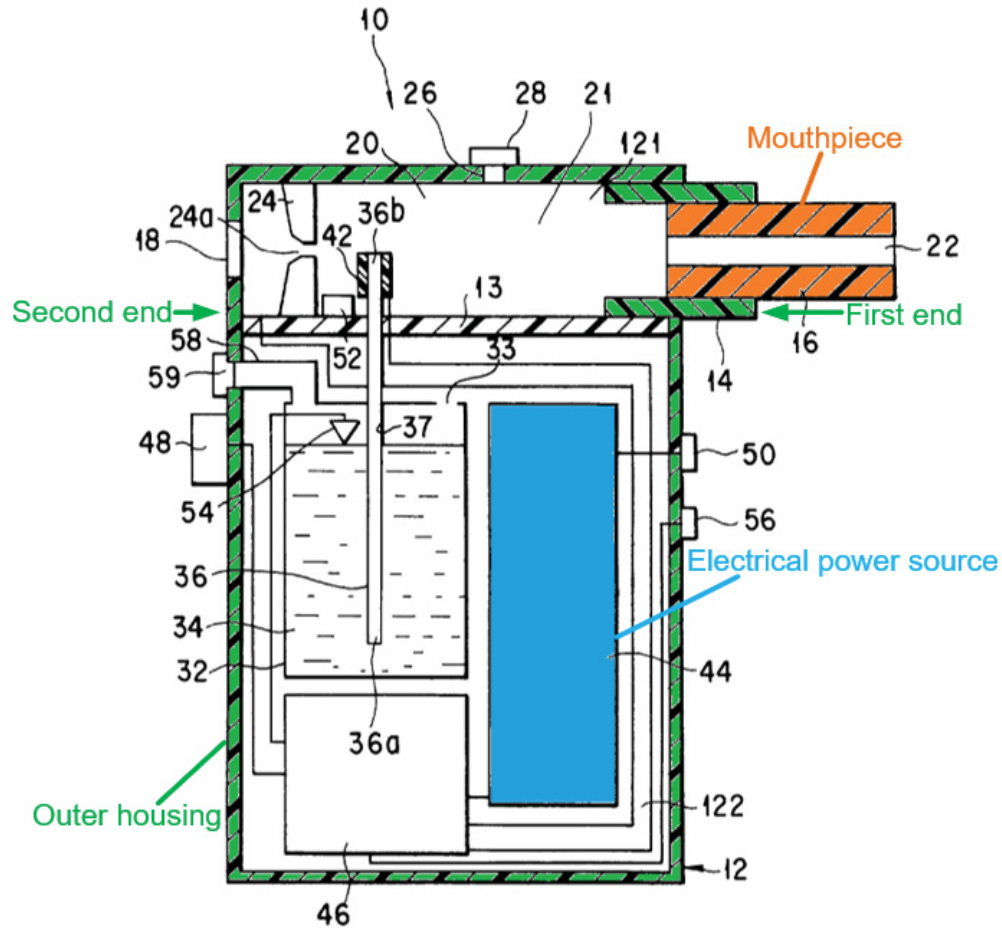


FIG. 1

EX1009, FIG. 1 (annotated).

[1d] an electrical resistance heater positioned within the outer housing, the electrical resistance heater being configured for electrical connection with the electrical power source

201. Takeuchi discloses Element [1d]. For example, Takeuchi discloses several embodiments of an *electrical resistance heater* positioned within the outer housing of device 10. EX1009, 6:4-22 (“capillary tube 36...is equipped with [] heater 42’), 8:19-21 (“ring-shaped heater 72”), 8:22-23 (“rod-like heater 74”),

8:24-25 (“plate-like heater 76”), FIG. 1, FIGS. 3-5. An embodiment where “the outlet port 36a of the liquid passageway 36 is formed by the heater 42” (col. 6:4-22) is depicted below in FIG. 1:

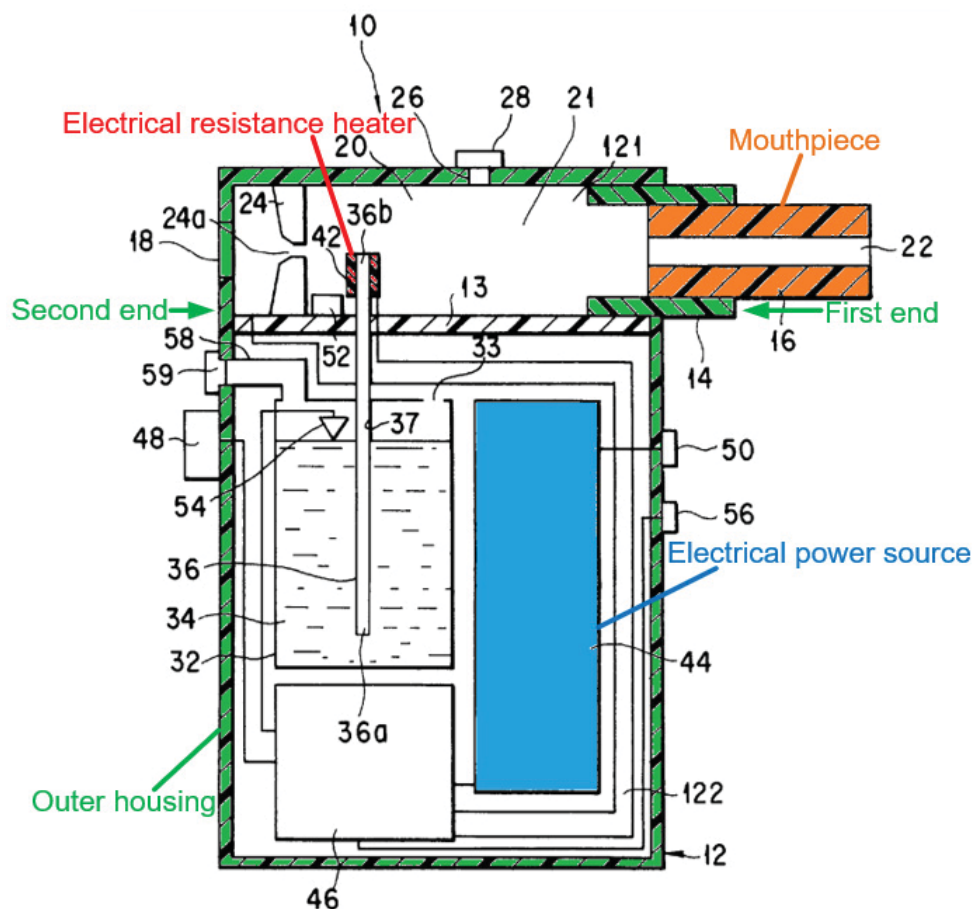


FIG. 1

EX1009, FIG. 1 (annotated).

202. Because Takeuchi discloses that “[a]n electric power is supplied from a power source 44...to the electric heater 42,” Takeuchi discloses that the *electrical resistance heater* is configured for electrical connection with the *electrical power*

source. EX1009, 6:5-22, see also 7:48-56 (“under the control of the control circuit 46, an electric power is supplied from the power source 44 to the heater 42.”). Also, based upon Takeuchi’s disclosure, it is clear that each of Takeuchi’s heater embodiments (e.g., heater 42, ring-shaped heater 72, rod-like heater 74, and plate-like heater 76) operate as **resistance heaters**—especially because Takeuchi states that it is “desirable” for power source 44 to be “a DC power source.” EX1009, 7:48-56, 6:4-22 (“electric power is supplied from the power source 44” to the heater). Here, a POSITA would have readily recognized that Takeuchi’s use of DC power and the wired connection to the disclosed metallic heater element indicates a traditional resistance heater that generates heat through resistance to unipolar current flow (unlike, for example, a traditional dielectric heater that requires a rapid alternating bipolar electric field created by high-frequency AC power).

[1e] a storage compartment defined within the outer housing, the storage compartment being configured for storage of a liquid aerosol-forming material and being arranged such that the liquid aerosol-forming material can be wicked into contact with the electrical resistance heater to volatilize the liquid aerosol-forming material;

203. Takeuchi discloses a **storage compartment** defined within the **outer housing** of device 10, and based on Takeuchi’s disclosure it is apparent that the storage compartment includes both liquid container 32 and liquid passageway 37. EX1009, 5:28-39 (“liquid container 32 housing a liquid flavor source 34 is fixed within the lower chamber 122 of the casing 12”), 5:47-52 (“capillary tube 36 defines

a liquid passageway 37 for the liquid flavor source”), 6:4-22 (“the outlet port 36a of the liquid passageway 36 is formed by the heater 42 itself.”); FIG. 1. Takeuchi’s *storage compartment* is depicted below in FIG. 1.

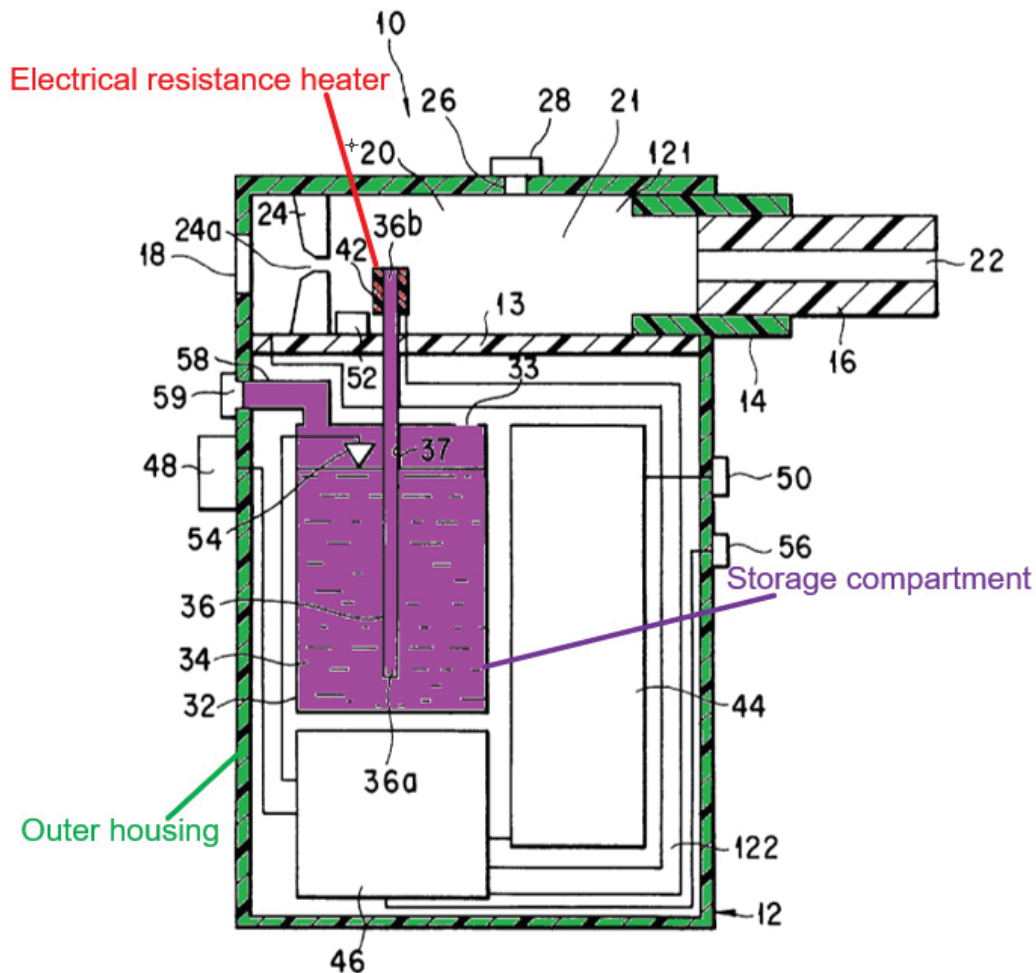


FIG. 1

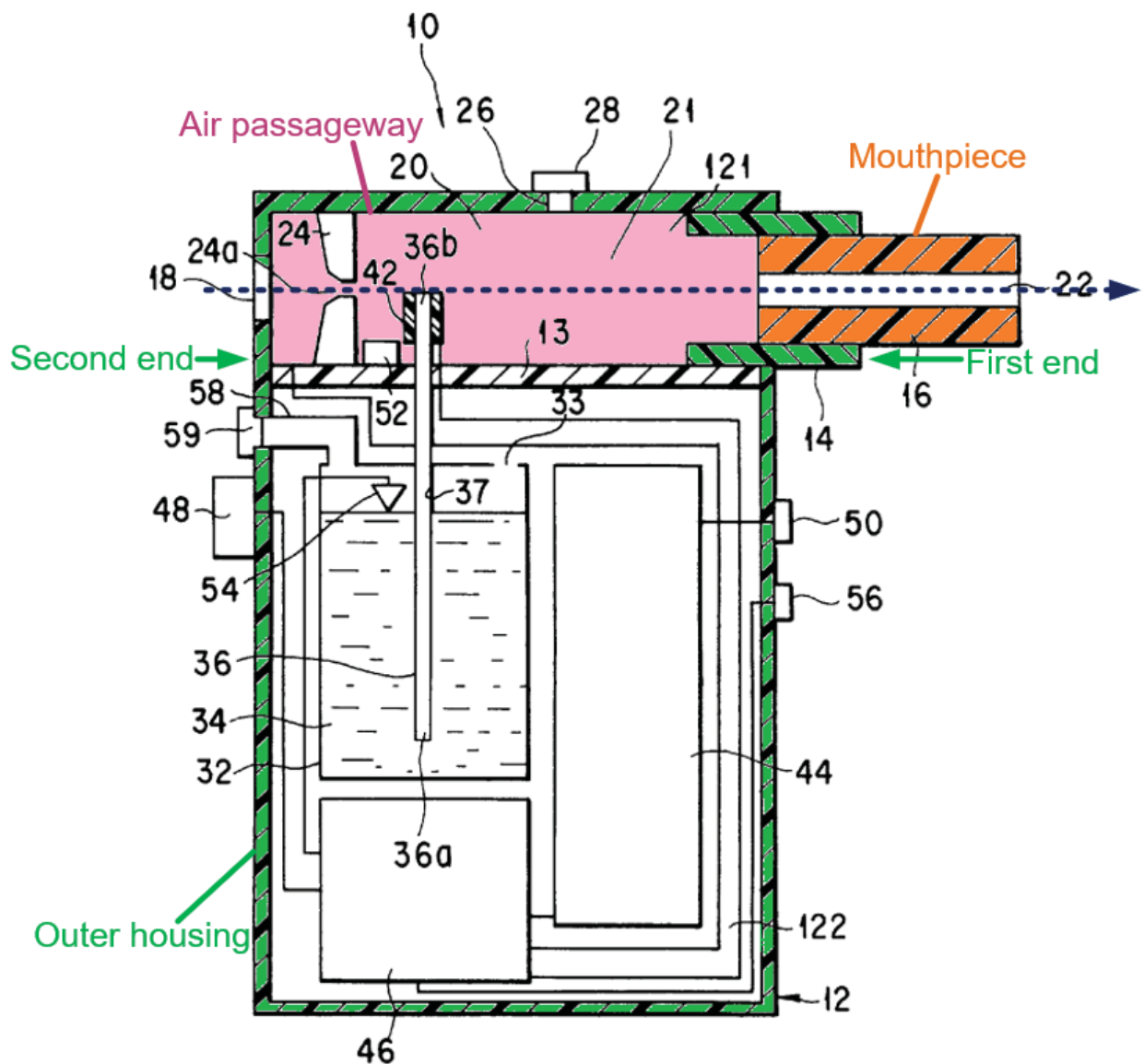
EX1009, FIG. 1 (annotated).

204. Because Takeuchi discloses that “it is possible for the liquid flavor source 34 to contain a substance forming aerosol when heated,” the *liquid* that is

stored within Takeuchi's storage compartment includes an *aerosol-forming material*. Because Takeuchi discloses that "it is possible for the liquid flavor source 34 to contain a substance forming aerosol when heated," it is clear that the *liquid* that is stored within Takeuchi's storage compartment includes an *aerosol-forming material*. EX1009, 5:28-39. Furthermore, Takeuchi discloses that the *storage compartment* is arranged such that the *liquid aerosol-forming material* can be *wicked into contact* with an *electrical resistance heater* to volatilize the *liquid aerosol-forming material*. For example, capillary tube 36 transports the liquid flavor source by traditional "capillary force," which I have been informed the Patent Owner admitted is an example of wicking. EX1015, 29. Capillary tube 36 transports the liquid to heater 42 so that the heater *volatilizes* the *liquid aerosol-forming material*. EX1009, 6:4-22 ("heater 42 serving to gasify the liquid flavor source"); 6:55-62 ("control circuit 46 serves to start up the heater 42...so as to gasify the liquid flavor source"), 8:1-4 ("supply and gasification of the liquid flavor source 34 are repeated within the outlet port 36a of the capillary tube 36.").

[1f] an air passageway through at least a portion of the outer housing, the air passageway being arranged so that air drawn into the outer housing combines with volatilized liquid aerosol-forming material to produce an aerosol that can be drawn into the mouth of a user of the electrically-powered, aerosol-generating smoking article through the mouthpiece; and

205. Takeuchi discloses Element [1f]. Takeuchi expressly discloses that an *air passageway* exists through at least a portion of the *outer housing*. EX1009, 4:30-38; 4:48-67; 7:57-8:15. For instance, Takeuchi discloses that a “gas passageway 20 is defined within the upper chamber 121 of the casing 12, between the air intake port 18 and the inhalation port 22.” EX1009, 4:50-52. The *air passageway* of Takeuchi is illustrated below.



EX1009, FIG. 1 (annotated).

206. The air passageway 20 of Takeuchi is a place where *air* drawn into the *outer housing* combines with the *volatilized liquid* produced by heater 42 to create *aerosol*. EX1009, 6:4-7; 6:55-62; 7:57-8:15. As detailed above in Element [1e], because Takeuchi discloses that heater 42 “serves to gasify the liquid flavor source,” heater 42 produces *volatilized liquid* that exits liquid passageway 37 into the air passageway 20. EX1009, 6:4-22; 6:55-62, 8:1-4, FIG. 1. This *volatilized liquid* “is mixed with the main air introduced through the air intake port 18 and the squeeze hole 24a...in accordance with the inhaling action of the user and, then, the mixture is transferred into the inhalation port 22.” EX1009, 8:5-15. The user inhales through inhalation port 22, which means that *aerosol* can be *drawn into the mouth* of the *user* through the mouthpiece. EX1009, 6:39-47; 7:48-56, FIG. .

[1g] a controller configured to activate current flow through the electrical resistance heater in response to a draw on the electrically-powered, aerosol-generating smoking article.

207. Takeuchi discloses Element [1g]. Takeuchi discloses a *controller*—control circuit 46—that is able to control components within the outer housing of device 10. EX1009, 6:23-42, 6:55-62, 7:48-56, FIG. 1. For instance, control circuit 46 is configured to “start up” heater 42 in response to detecting an inhaling action by the user. EX1009, 6:55-62 (“[C]ontrol circuit 46 serves to start up the heater 42...in accordance with the inhaling action of the user”), 7:48-56(“[A]n inhaling

action signal is transferred...to the control circuit 46... under the control of the control circuit 46, an electric power is supplied...to the heater 42”). Thus, based upon Takeuchi’s disclosure here, it is clear that Takeuchi’s **controller** is configured to **activate current flow** through heater 42 in response to a **draw**. I note that my analysis here is consistent with Patent Owner’s previous admission regarding Takeuchi’s control circuit. *See* EX1016, 25 (Patent Owner admitting in a prior IPR that, during use of Takeuchi’s device, “a user’s inhaling action is sensed by a sensor 52 and a control circuit 46 activates the heater 42, which vaporizes the liquid in the liquid passageway 37”).

B. Claim 3

208. Claim 3 of the ’202 Patent recites:

3. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment comprises a fibrous substrate.
--

209. Takeuchi discloses Claim 3 for the same reasons described above in connection with my analysis of Takeuchi’s cited disclosure in Ground 2B (claim 3). EX1009, 3:35-50, 5:47-6:22, FIG. 1.

C. Claim 8

210. Claim 8 of the ’202 Patent recites:

8. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the storage compartment is configured as a container for holding liquid.
--

211. As described above in Element [1e], Takeuchi discloses a *storage compartment* including liquid container 32 and liquid passageway 37 that is configured for storage of a *liquid aerosol-forming material*. EX1009, 5:28-39, 5:47-52, 6:4-22; FIG. 1. Namely, Takeuchi discloses that liquid container 32 is a *container* that can house a liquid flavor source 34. EX1009, 5:28-39, 5:58-6:3, FIG. 1. Takeuchi also discloses that liquid passageway 37 can hold the liquid flavor source. EX1009, 5:47-52, 6:4-22, FIG. 1. Takeuchi's *storage compartment* configured as a container for holding *liquid* is shown below in FIG. 1, which depicts liquid flavor source 34 as a liquid volume that is held within liquid container 32 and liquid passageway 37.

9. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged in contact with the storage compartment.
--

214. As described above in my analysis of Elements [1e] and [8], Takeuchi discloses a *storage compartment* including a liquid passageway. EX1009, 4:35-28, 5:47-52, 6:4-22; FIG. 1. Furthermore, as detailed above in my analysis of Element [1c], Takeuchi discloses several examples of an *electrical resistance heater* where the heater is *arranged in contact* with Takeuchi's liquid passageway. EX1009, 6:4-22 ("liquid passageway...formed by the heater 42"), 8:19-21 ("ring-shaped heater 72"), 8:22-23 ("rod-like heater 74... inserted into...capillary tube 36"), 8:24-25 ("plate-like heater 76... inserted into...capillary tube 36"), FIG. 1, FIGS. 3-5. Notably, because Takeuchi's heater embodiments each involve a heater that is in physical contact with the liquid passageway that carries liquid aerosol-forming material and is part of Takeuchi's storage compartment, Takeuchi teaches that an *electrical resistance heater* is arranged in contact with the *storage compartment*.

E. Claim 10

215. Claim 10 of the '202 Patent recites:

10. The electrically-powered, aerosol-generating smoking article of claim 1, wherein the electrical resistance heater is arranged proximate to an absorbent wicking material configured for transferring the liquid aerosol-forming material to the electrical resistance heater.
--

216. Takeuchi discloses Claim 10 for the same reasons described above in connection with my analysis of Takeuchi's cited disclosure in Ground 2B (claim 10). EX1009, 3:31-50.

F. Claim 11

217. Claim 11 of the '202 Patent recites:

11. The electrically-powered, aerosol-generating smoking article of claim 1, wherein at least a portion of the electrical resistance heater extends into the storage compartment.

218. Takeuchi discloses Claim 11 for the same reasons described above in connection with my analysis Takeuchi's cited disclosure in Ground 2B (claim 11). EX1009, 6:22-26, FIGS. 4-5.

G. Claim 13

219. Claim 13 of the '202 Patent recites:

13. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising a sensor adapted for sensing the draw by a user on the electrically-powered, aerosol-generating smoking article.
--

220. Takeuchi expressly discloses that sensor 52 can detect the "inhaling action" of a user. EX1009, 6:23-29, see also 6:32-42 ("[D]etection, by the sensor 52, of the inhalation action of a user."), 6:46-54 ("[U]se as the Sensor 52 a general pressure sensor for detecting a change in the pressure"). Consequently, Takeuchi discloses a *sensor* adapted for sensing a *draw* by a user on device 10.

H. Claim 15

221. Claim 15 of the '202 Patent recites:

15. The electrically-powered, aerosol-generating smoking article of claim 1, further comprising an end cap defined at a second of the two ends.
--

222. Takeuchi discloses Claim 15 for the same reasons described above in connection with my analysis of Takeuchi's cited teaching in Ground 2B. EX1009, 7:18-30, FIG. 1.

XIII. ADDITIONAL REMARKS

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

224. I hereby declare that all statements made are of my own knowledge are true and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this proceeding.

Dated: 9/6/2024

By: 
Dr. Samir Nayfeh, PhD
Dunn Loring, VA

Appendix CV

SAMIR A. NAYFEH

2235 Sandburg Street, Dunn Loring, VA 22027
samir.nayfeh@gmail.com

updated July 2024

Experience

- Consulting and Co-Development, July 2006–present.
 - designed the short-stroke reticle stage for the first production EUV lithography system; designed assembly tooling, alignment and qualification systems; assembled and qualified initial units for shipment; solved production problems leading to early failures in the field
 - developed new concepts for construction of precision machines including mag-lev stages, shutters, and steering mirrors for high accelerations and ultra-high vacuum, including measures for mitigation of magnetic stray fields, thermal distortions, and particle generation; assisted in design of rugged hand-held x-ray and optical instruments
 - developed design methods for large porous aerostatic bearings, designed leaky seals and scavenge systems for operation of aerostatic bearings in vacuum chambers, modeled and designed flow systems for measurement in near-vacuum environments
 - developed galvanometer, voice-coil, and reluctance electromagnetic actuators
 - designed water and gas flow systems to regulate the temperature of motor coils and precision substrates; guided and conducted analyses of magnetics, heat, strength, dynamics, and flow for nanometer-precision vacuum and air systems; analyzed and developed methods for liquid-filled gaps for damping and optics
 - developed methods to avoid adhesion and wear in vacuum; studied electrical and mechanical drivers of material transfer; developed models for distortion, pile-up, and surface fracture due to indentation and scratching of surfaces with hard coatings; designed structures, rotors, actuators, and tooling for use in a vacuum furnace
 - developed electromechanical tools for surgery; developed actuator and stiffness models for a medical robot; performed CFD-based optimization of mixing of reagents and samples for medical diagnostics; analyzed flow instabilities in microfluidic systems
 - analyzed patents and products and testified as expert witness in various patent litigations
- Chief Scientist (part time), Top Flight Technologies, April 2016–December 2019.
 - developed mobile energy strategies and solutions for industrial multi-rotor UAVs
 - provided leadership in mechanical design, engineering analysis, IP development

- Assistant Professor, Department of Mechanical Engineering, MIT, July 1998–July 2005.
Associate Professor, Department of Mechanical Engineering, MIT, July 2005–July 2006.
 - designed, built, and delivered to our industrial partner the first machine capable of weaving 3D multilayer structures with fibers interwoven at various angles
 - developed concepts for short-run weaving with individual tension and yarn control
 - performed original research and wrote highly cited papers on vibration control, damping, gas-turbine dynamics, and machine elements
 - raised more than \$2M in research funding from a variety of sources, supervised 16 M.S. and 4 Ph.D. theses
 - taught courses in product development, mechanical design, dynamics, and control
 - collaborated with industry on a diverse set of problems, from power car seats to rotary transfers to vehicle drive shafts

Education

- PhD, Mechanical Engineering, MIT, 1998.
- MS, Engineering Mechanics, Virginia Tech, 1993.
- BS, Engineering Science and Mechanics, Virginia Tech, 1991.

Awards Received

- Best Paper, Structural Dynamics Committee of the International Gas Turbine Institute, 2002.
- Gas Turbine Award for the Most Outstanding Technical Paper in *ASME Journal of Turbomachinery*, 2002.

Major Research Projects (1998–2008)

1. Ford Motor Company, “Advanced Tool Holding,” development of low-runout collets with improved damping for gun drills and slender milling tools, 1999–2000, \$160,000.
2. Pro Cut International, “Automatic Cutting Head for an On-Car Brake Lathe,” design of a compact numerically controlled cutting head for machines which perform in-situ refacing automotive brakes, 2000–2001, \$67,000.
3. Silicon Valley Group, “Dynamic Modeling of a Photolithography System,” development of modeling techniques suitable for complicated precision machines, damping techniques suitable for ultra-precision structures, 2000–2001, \$215,000.
4. Caterpillar, “Development of Pin Joints with Improved Galling Resistance,” analytical and experimental study of factors affecting galling failures in heavily-loaded pin-bushing pairs, development of improved bushings using tailored compliance, 2001–2002, \$245,000.

5. Bally Ribbon Mills, “Development of a Bias Weaving System,” design and development of a process and machine for making 3D woven structures with multi-axis strength and stiffness by interweaving yarns that run at angles with those that run at 0 and 90 degrees, 2001–2004, \$1,130,000.
6. Laser Interferometer Gravitational-Wave Observatory, “Active and Passive Vibration Isolation,” study and development of feedforward, feedback, and measurement-based decoupling techniques for ultra-precision seismic vibration isolation, 2002–2004, \$125,000.
7. Teradyne Connection Systems, “In-Situ Back-Plane Fiber-Optic Ferrule Inspection,” development of an imaging, vision, and machine system for automatic inspection of the ends of fibers in optical back planes, 2002–2006, \$127,000.
8. Ford Motor Company, “Integral Damping of Vehicle Propeller Shaft,” study of the dynamics of vehicle drive shafts and development of damping approaches for vehicle noise reduction, 2005–2006, \$267,000.
9. Deshpande Center for Technological Innovation, “Short-Warp Weaving,” development of a modular weaving process and machine for reduction of setup costs and lead time to enable responsive, short-run production, 2005–2006, \$50,000.
10. Air Force Research Lab, “Limit-Cycle Oscillation Identification and Management,” development of strategies for identification and management of aeroelastically induced limit-cycle oscillations in aircraft (STTR Phase I), 2007–2008, \$100,000.

Teaching Experience (1998–2008)

- “Introduction to Design and Manufacture,” lab instructor. This is an introductory course on mechanical design, with an emphasis on individual design projects culminating in a contest.
- “Elements of Mechanical Design,” lecturer, lab instructor, and project mentor. This is an undergraduate course that combines lectures, homeworks, and exams on the fundamentals of machine design with group design projects done for an external client. The projects span the entire development process starting with an understanding of customer needs.
- “Systems Modeling and Dynamics I,” lecturer, recitation and lab instructor. This undergraduate course teaches the fundamentals of system modeling, linear-system dynamics, and feedback control.
- “Systems Modeling and Dynamics II,” recitation and lab instructor. This undergraduate course focuses on the dynamics and control of mechanical systems.
- “Design of Motion Systems,” lecturer. I developed this graduate course to teach the fundamentals of machine design for dynamic performance.
- “The Product Engineering Process,” lab instructor. I mentored several groups through the process of team organization, idea generation, market research, design, construction, and presentation. Projects include a water-pump for irrigation of crops in developing regions to a bicycle that helps children with developmental problems learn to ride.

Patents and Patent Applications Pending

1. Maue, H. W., Krupp, E. J., Maass, M. N., Sims, J. R., Nayfeh, S. A., Raade, J. W., Cai, A. W., Faiz, J. S., Montoya, M., Rios, E., Tribin, P., Blanco, E., "Single motor module for a vehicle seat," US 6,626,064.
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14. Subramanyam, P. K., Williams M. E., and Nayfeh, S. A., "Arrangement of a Reticle Positioning Device for Actinic Inspection of EUV Reticles," US 8,779,635 B2.
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Patent Analysis and Expert Testimony

I performed patent analysis on behalf of the parties in italics in the list below.

1. *ASM Lithography* v. Nikon Lithography, NDCA C01-5031-MHP, C02-5081-MHP, C02-5601-MHP.
2. *Mykrolis Corporation* v. Pall Corporation, DCMA 03-10392-GAO.
3. *Braun GMBH* v. Rayovac Corporation, 03-1248-WGY.
4. *Cricket Productions* v. RGSA, DCMA 06-CA-10506-WGY.
5. *Cricket Productions* v. Lentek, DCMA 1:06-cv-11944.
6. *Cricket Productions* v. Aroa Marketing, Inc. and Walgreen Co., DCMA 1:07-cv-10143.
7. *Entegris* v. Pall Corporation, 06-10601-GAO (DCMA).
8. *Millipore Corportation* v. W.L. Gore Associates, Inc, DCNJ CA 11-1453(ES).
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10. *Allen Medical Systems, Inc.* v. Schuerch Corporation, DCMA 1:15-cv-13024-GAO.
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12. *DEKA and Segway* v. Hangzhou Chic Intelligent Technology, Co., Ltd., Swagway, LLC, Changzhou Airwheel Technology Co. Ltd., and Powerboard LLC; ITC Investigation No. 337-TA-1007/1021.
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14. *Bestway USA, Inc.* v. Intex Marketing Ltd., PGR2017-00029.
15. Palomar Technologies, Inc. v. *MRSI Systems, LLC*, DCMA 1:18-cv-10236-FDS.
16. *Philip Morris Products S.A.* v. RAI Strategic Holdings, Inc., IPR2020-00920.
17. *Philip Morris Products S.A.* v. RAI Strategic Holdings, Inc., IPR2020-01097.
18. *Crown Packaging Technology, Inc. & Carnaud Metal Box Engineering, Ltd.* v. Belvac Production Machinery, Inc., WDVA 18-cv-70.
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7. Nayfeh, S. A., Nayfeh, A. H., and Mook, D. T., “Nonlinear Response of a Taut String to Parametric and External Excitation,” *Journal of Vibration and Control* 1, pp. 307–334, 1995.
8. Nayfeh, A. H., Chin, C., and Nayfeh, S. A., “On Nonlinear Normal Modes of Systems with Internal Resonance,” *Journal of Vibration and Acoustics* 118, pp. 340–345, 1996.
9. Al-Nahwi, A. A., Pauduano, J. D., and Nayfeh, S. A., “Aerodynamic-Rotordynamic Interaction in Axial Compression Systems—Part I: Modeling and Analysis of Fluid-Induced Forces,” *ASME Journal of Turbomachinery* 125, pp. 405–415, 2003.
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14. Varanasi, K. K. and Nayfeh, S. A., “Dynamics of Leadscrew Drives: Low-Order Modeling and Experiments,” *Journal of Dynamic Systems, Measurement, and Control* 126, pp. 388–396, 2004.

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20. Zuo, L. and Nayfeh, S. A., "The Two-Degree-of-Freedom Tuned-Mass Damper for Suppression of Single-Mode Vibration Under Random and Harmonic Excitation," *Journal of Vibration and Acoustics* 128, pp. 56–65, 2006.
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1. Nayfeh, S. A., and Nayfeh, A. H., "The Response of Nonlinear Systems to Modulated High-Frequency Input," *Dynamics and Vibration of Time-Varying Systems and Structures, ASME 14th Biennial Conference on Mechanical Vibration and Noise*, Albuquerque, New Mexico, 1993.
2. Nayfeh, S. A., and Asada, H., "Orthogonal Sets of Design Changes for Torsional Vibration Problems," *Symposium on the Vibration of Continuous Systems, ASME 15th Biennial Conference on Vibration and Noise*, Boston, Massachusetts, 1995.
3. Scagnetti, P., Marsh, E., Slocum, A., and Nayfeh, S., "A New Method for Improving Dynamic Stiffness of Advanced Ceramic Structures," *American Society for Precision Engineering 11th Annual Meeting*, Austin, Texas, 1996.

4. Nayfeh, S. A., and Slocum, A. H., "Flexural Vibration of a Viscoelastic Sandwich Beam in its Plane of Lamination," *Symposium on the Vibration of Continuous Systems, ASME 16th Biennial Conference on Vibration and Noise*, Sacramento, California, 1997.
5. Nayfeh, S. A., and Slocum, A. H., "Enhancing Ballscrew Axial Dynamics," *American Society for Precision Engineering 13th Annual Meeting*, St. Louis, Missouri, 1998.
6. Devitt, D., Nayfeh, S. A., and Varanasi, K. K., "Dynamic Stiffness of Porous Air bearings and Force-Balanced Bearing," *American Society for Precision Engineering 14th Annual Meeting*, Monterey, California, 1999.
7. Nayfeh, S. A., Varanasi, K., "Design of Leadscrew Drives for Dynamic Performance," *American Society for Precision Engineering 16th Annual Conference*, Crystal City, Virginia, 2001.
8. Nayfeh, S. A., "Constrained-Layer Damping of Torsional Vibration of Thin-Walled Tubes," *ASME 18th Biennial Conference on Vibration and Noise*, Pittsburgh, Pennsylvania, 2001.
9. Zuo, L. and Nayfeh, S. A., "Design of Multi-Degree-of-Freedom Tuned-Mass Dampers: a Minimax Approach," *43rd AIAA Structures, Structural Dynamics, and Materials Conference*, Denver, Colorado, 2002.
10. Zuo, L. and Nayfeh, S. A., "Design of Passive Mechanical Systems via Decentralized Control Techniques," *43rd AIAA Structures, Structural Dynamics, and Materials Conference*, Denver, Colorado, 2002.
11. Al-Nahwi, A. A., Pauduano, J. D., and Nayfeh, S. A., "Aerodynamic-Rotordynamic Interaction in Axial Compression Systems—Part I: Modeling and Analysis of Fluid-Induced Forces," *ASME/IGTI Turbo Expo 2002*, Amsterdam, The Netherlands, 2002.
12. Al-Nahwi, A. A., Pauduano, J. D., and Nayfeh, S. A., "Aerodynamic-Rotordynamic Interaction in Axial Compression Systems—Part II: Impact on Overall System Stability," *ASME/IGTI Turbo Expo 2002*, Amsterdam, The Netherlands, 2002.
13. Zuo, L. and Nayfeh, S. A., "Decentralized H2 Optimal Control with Regional Pole Constraints," *American Control Conference 2003*, Denver, Colorado, 2003.
14. Varanasi, K. K., and Nayfeh, S. A., "Damping of Flexural Vibration by Low-Density Foam and Granular Materials," *ASME Design Engineering Technical Conference 2003*, Chicago, Illinois, 2003.
15. Zuo, L., and Nayfeh, S. A., "The Multi-Degree-of-Freedom Tuned-Mass Damper for Suppression of Single-Mode Vibration under Random and Harmonic Excitation," *ASME Design Engineering Technical Conference 2003*, Chicago, Illinois, 2003.
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17. Zuo, L. and Nayfeh, S. A., "Active Vibration Isolation Using a Post-Buckled Spring," *ASPE Spring Topical Meeting: Control of Precision Systems*, Boston, Massachusetts, 2004.
18. Zuo, L. and Nayfeh, S. A., "Damping of Vibration in Belt-Driven Motion Systems Using a Layer of Low-Density Foam," *ASPE Spring Topical Meeting: Control of Precision Systems*, Boston, Massachusetts, 2004.
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Other Major Publications

1. Nayfeh, A. H., Nayfeh, S. A., Anderson, T. J., and Balachandran, B., "Transfer of Energy from High-Frequency to Low-Frequency Modes," *Nonlinearity and Chaos in Engineering Systems*, edited by Thomson, J. M. T. and Bishop, S. R., Wiley Interscience, 1994.
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3. Vallance, R., Kiani, S., and Nayfeh, S., "Open Design of Manufacturing Equipment," *Proceedings of CIRP First International Conference on Agile, Reconfigurable Manufacturing*, Ann Arbor, Michigan, 2001.
4. Verdirame, J. M., Nayfeh, S. A., and Zuo, L., "Design of Multi-Degree-of-Freedom Tuned-Mass-Dampers," *SPIE's 9th Annual International Symposium on Smart Structures and Materials*, San Diego, California, 2002.
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6. Trumper, D. L., Nayfeh, S. A., Lilienkamp, K. A., "Projects for Teaching Mechatronics at MIT," *Proceedings of the Eighth International Conference on Mechatronics*, Enschede, The Netherlands, 2002.
7. Slocum, A. H., Basaran, M., Cortesi, R., and Nayfeh, S. A., "Get a Preload of This: Actuator and Bearing Technology is Changing How Grinding Machines Move," *American Machinist*, December, 2002.
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10. Varanasi, K. K. and Nayfeh, S. A., "Damping in Belt-Driven Servomechanisms Using Low-Density, Low-Wave-Speed Materials," *SPIE's 11th Annual International Symposium on Smart Structures and Materials*, San Diego, California, 2004.
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14. Zuo, L. and Nayfeh, S. A., "Modified LMS Feed-Forward Control for Vibration Isolation with Actuator Limits," *SPIE's 12th Annual International Symposium on Smart Structures and Materials*, San Diego, California, 2005.
15. Verdirame, J. M. and Nayfeh, S. A., "Vibration Damping in Cylindrical Shells Filled With Low-Density, Low-Wave-Speed Media," *SPIE's 12th Annual International Symposium on Smart Structures and Materials*, San Diego, California, 2005.

Selected Invited Lectures

1. "Some New Twists on the Dynamic Vibration Absorber," October 2003, Department of Mechanical Engineering, Tufts University, Medford, Massachusetts
2. "Vibration Suppression by Dynamic Interaction with Low-Density, Low-Wave-Speed Media," October 2003, Center for Acoustics and Vibration, The Pennsylvania State University, College Station, Pennsylvania.
3. "Some New Approaches to Vibration Suppression in Precision Machines," October 2003, Department of Mechanical Engineering, University of Maryland, College Park, Maryland.
4. "Some New Approaches to Vibration Suppression in Precision Machines," October 2003, National Institute of Standards and Technology, Gaithersburg, Maryland.
5. "Some New Twists on the Dynamic Vibration Absorber," October 2003, Cambridge University Mechanics Colloquium, Cambridge, England.
6. "Bias-Woven Structures," March 2004, Mechanics Seminar, MIT Department of Mechanical Engineering, Cambridge, Massachusetts.
7. "Vibration Damping for Sound and Vibration Reduction," July 2004, Ford Motor Company Advanced Technology Center, Dearborn, Michigan.
8. "Vibration Damping in Precision Machines," September 2004, Philips Research Center, Eindhoven, The Netherlands.
9. "Three-Dimensional Bias Weaving," December 2004, Milliken Research Corporation, Spartanburg, South Carolina.
10. "Three-Dimensional Bias Weaving," February 2005, Technical University of Eindhoven, The Netherlands.
11. "Increasing Endurance: How Increasing Power Sources Can Improve Your Bottom Line," March 2017, AUVSI Webinar.

Doctoral Theses Supervised

1. Varanasi, Kripa, "Vibration Damping Using Low-Wave-Speed Media with Application to Precision Machines," February 2004.
2. Dever, Christopher, "Parameterized Maneuvers for Autonomous Vehicles," August 2004 (reader).
3. Zuo, Lei, "Element and System Design for Active and Passive Vibration Isolation," October 2004.
4. Wilson, Andrew, "In-Situ Inspection of Optical Fiber Connections," January 2006.
5. Verdirame, Justin, "Structural Vibration Damping Using Light-Weight Low-Wave-Speed Media," January 2007.

Master's Theses Supervised

1. Schiller, David, "Investigation of Methods of Compensating for Setting Problems of Tapered Roller Bearings in Dimensionally Unstable Bearing Housings," May 1999.
2. Athanasopoulus, Andreas, "Design of Damped Toolholders for Increased Cutting Performance," May 2000.
3. Morfino, Paolo, "Damping of Torsional Vibration by Segmented Constrained-Layer Dampers," Dec 2000, visiting student from Turino.
4. Valdivia, Pablo, "Design, Analysis and Control of an Autonomous Conveyance Module for Well Exploration," May 2001.
5. Wilson, Andrew "Design of an Automated Cutting Head for an On-Car Brake Lathe," May 2001.
6. Varanasi, Kripa, "On the Design of a Precision Machine for Closed-Loop Performance," Jan 2002.
7. Zuo, Lei, "Decentralized Control Techniques and Their Application to the Design of Passive Mechanical Systems," Jan 2002.
8. Farzaneh, Nader, "Factors Affecting Galling Failures in Heavily Loaded Bushings," May 2002.
9. Radighieri, Greg, "Design of a Tester to Study Galling Failures in Heavily Loaded Bushings," May 2002.
10. Verdirame, Justin, "Design of Multi-Degree-of-Freedom Tuned-Mass Dampers Based on Perturbation Techniques," May 2002.
11. Mariappan, Dhanushkodi, "Dynamics of Belt-Driven Servomechanisms: Theory and Experiment," May 2003.

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3. Dyer, Kyrilian, G., "Design of a Mechanically Isolated Electronic Hardware Mounting System for a Small Autonomous Rotorcraft," May 2000.
4. Raade, Justin, "Design of a Multiplexing Gearbox and Zero-Backlash Flexure Clutch for Application in Automobile Seats," May 2001.
5. Redman, Debra, "Constrained-Layer Damping for Vibration Control in Torsion and Bending," May 2001.
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