No. 26-1554 (consolidated with No. 26-1851)

IN THE UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

STIIIZY INC., dba Shryne Group Inc., STIIIZY IP LLC, fka STIIIZY, LLC, ALD GROUP LTD., ALD (HONG KONG) HOLDINGS LTD.,
Appellants.

INTERNATIONAL TRADE COMMISSION,
Appellee,

PAX LABS, INC.
Intervenors.

On Appeal from the United States International Trade Commission in Investigation No. 337-TA-1392.

CORRECTED NONCONFIDENTIAL PRINCIPAL BRIEF OF APPELLANTS ALD GROUP LTD., & ALD (HONG KONG) HOLDINGS LTD.

September 10, 2026

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UNITED STATES COURT OF APPEALS
FOR THE FEDERAL CIRCUIT

CERTIFICATE OF INTEREST

Case Number 26-1554 (consolidated with 26-1851)

Short Case Caption STIIIZY Inc. v. ITC

Filing Party/Entity ALD Group Ltd. and ALD (Hong Kong) Holdings Ltd.

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1. Represented Entities. Fed. Cir. R. 47.4(a)(1).	**2. Real Party in Interest.** Fed. Cir. R. 47.4(a)(2).	**3. Parent Corporations and Stockholders.** Fed. Cir. R. 47.4(a)(3).
Provide the full names of all entities represented by undersigned counsel in this case.	Provide the full names of all real parties in interest for the entities. Do not list the real parties if they are the same as the entities. ☑ None/Not Applicable	Provide the full names of all parent corporations for the entities and all publicly held companies that own 10% or more stock in the entities. ☐ None/Not Applicable
ALD Group Limited		ALD Investment Limited
ALD (Hong Kong)		ALD INTERNATIONAL HOLDINGS LIMITED

☐ Additional pages attached

4. Legal Representatives. List all law firms, partners, and associates that (a) appeared for the entities in the originating court or agency or (b) are expected to appear in this court for the entities. Do not include those who have already entered an appearance in this court. Fed. Cir. R. 47.4(a)(4).

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5. Related Cases. Other than the originating case(s) for this case, are there related or prior cases that meet the criteria under Fed. Cir. R. 47.5(a)?

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6. Organizational Victims and Bankruptcy Cases. Provide any information required under Fed. R. App. P. 26.1(b) (organizational victims in criminal cases) and 26.1(c) (bankruptcy case debtors and trustees). Fed. Cir. R. 47.4(a)(6).

☑ None/Not Applicable ☐ Additional pages attached

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ALD Group Ltd. and ALD (Hong Kong) Holdings Ltd. provide the following description of the general nature of the material redacted in the public version of the addendum to their brief and addendum thereto. In the public version of this brief, material reciting information that PAX Labs, Inc. ("PAX") designated CONFIDENTIAL BUSINESS INFORMATION pursuant to the March 6, 2024 Protective Order has been redacted. Specifically, on pages on pages 6-8, information describing confidential aspects of PAX's business operations and business model has been deleted. In the public version of the addendum, the materials redacted in the Order Denying Respondents' Motion for Summary Determination, the Final Initial Determination, the Remand Initial Determinations, the Commission Opinion, and the Order Granting-in-Part PAX's Motion *in Limine* #3 include information that Appellants and PAX designated CONFIDENTIAL BUSINESS INFORMATION pursuant to the March 6, 2024 Protective Order. The omitted material contains confidential business information regarding the accused products (including inventory, value, and pricing) and the operation of PAX's business.

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STATEMENT OF RELATED CASES

Pursuant to Federal Circuit Rule 47.5(a), no other appeal in or from the same proceeding at the Commission was previously before this or any other appellate court.

Appellants ALD Group Ltd. and ALD (Hong Kong) Holdings Ltd., join the brief of STIIIZY Inc. and STIIIZY IP LLC, addressing: (1) Whether investments made before a patent issues can satisfy the economic prong of the domestic-industry requirement under 19 U.S.C. § 1337(a)(3), when the statute requires that qualifying investments be made with respect to the articles "protected" by the patent and, before issuance, no patent exists and no articles are protected by it; and (2) Whether PAX's asserted pre-issuance investments can satisfy the economic prong of the domestic-industry requirement under 19 U.S.C. § 1337, when PAX was not a licensee of the patents until after they issued.

The following cases may affect or may be affected by this Court's decision in the pending case: (1) *Pax Labs Inc. v. ALD Grp. Ltd, et al*., 2:24-cv-00782-MCS-AJR. C.D. Cal. (stayed); (2) *Pax Labs Inc. v. Stiiizy IP LLC*, 2:24-cv-00788 (C.D. Cal. 2024) (stayed); (3) *Ex parte* Reexamination Ser. No. 90/016,113 (USPTO); and (4) *Certain Oil Vaporizing Devices, Components Thereof, and Products Containing Same*, ITC Investigation No. 337-TA-1392 (Enforcement Proceeding).

STATEMENT OF JURISDICTION

The U.S. International Trade Commission ("Commission") exercised jurisdiction over the complaint brought by PAX against Appellants ALD Group Ltd. and ALD (Hong Kong) Holdings Ltd. (collectively, "ALD"), and STIIIZY Inc. & STIIIZY IP LLC (collectively, "STIIIZY"), under 19 U.S.C. § 1337.

On January 20, 2026, the Commission issued its Final Determination finding a violation of Section 337, affirming the presiding Administrative Law Judge's ("ALJ") finding that the domestic industry economic prong was satisfied, and issuing a limited exclusion order ("LEO") against ALD.

ALD timely appealed on May 15, 2026. This Court has jurisdiction under 28 U.S.C. § 1295(a)(6).

I. STATEMENT OF THE ISSUES

1. Whether the Commission legally erred in finding that PAX satisfied the domestic industry economic prong requirement under 19 U.S.C. § 1337 (a)(3) by relying on investments in federally illegal marijuana oil commerce in violation of the Controlled Substances Act ("CSA"), 21 U.S.C. § 801 *et seq.*

2. In the alternative, whether the Commission incorrectly concluded that the federal illegality of PAX's purported domestic industry was not relevant to the public interest factors.

II. INTRODUCTION

This appeal presents a question that neither this Court nor the Commission has ever squarely addressed: whether domestic expenditures made in furtherance of federally illegal commerce may be counted toward the economic prong of the domestic industry requirement of Section 337 of the Tariff Act. The answer, under longstanding principles of federal law, is no.

Complainant-Intervenor PAX manufactures vaporizer devices and cartridges ("pods") specifically designed for use with cannabis oils. It is these vaporizer devices and pods that satisfy the technical prong of the domestic industry requirement—something that ALD does not challenge on appeal and did not challenge below.

However, PAX has stipulated that *at least* 95% of its domestic industry pods were, by design and as the quintessential core of its business model, filled with federally illegal marijuana oil—a Schedule I controlled substance whose manufacture, distribution, sale, and possession are federally illegal pursuant to the CSA—and ultimately sold for consumption to U.S. consumers. PAX's website even directs potential consumers to their local federally illegal marijuana dispensaries where they can purchase PAX pods filled with federally illegal marijuana oil. This renders *at least* 95% of PAX's domestic industry economic prong expenditures part and parcel of an illegal drug distribution conspiracy in violation of 21 U.S.C. § 846.

The Commission can find a Section 337 violation only if there is a *legitimate* domestic industry relating to "articles protected by the patent." 19 U.S.C. § 1337(a)(2). Accordingly, Section 337 protects *lawful* domestic industries from unfair acts of importation. But the Commission erroneously found a domestic industry in this case based on PAX's investments in activities directed toward federally illegal marijuana oil commerce that violates the CSA.

Federal courts have consistently refused to lend aid to claims founded on federally illegal marijuana commerce. For example, the Third Circuit recently vacated a trial court's judgment, *sua sponte,* for its failure to determine whether the underlying transaction involved illegal conduct under the CSA. *Apical Biotek LLC v. Maitri Holdings LLC*, No. 25-1396, 2026 WL 177927 (3d Cir. Jan. 22, 2026)

(nonprecedential). Similarly, the Ninth Circuit recently dismissed claims arising from marijuana commerce because "it is clear that Congress did not intend" to protect such activity. *Shulman v. Kaplan*, 58 F.4th 404, 411–12 (9th Cir. 2023).

And, as to the core question of whether investments in illegal commerce can satisfy §1337's domestic industry requirements, this Court, in *Philip Morris Products S.A. v. ITC*, 63 F.4th 1328, 1342 (Fed. Cir. 2023), rejected an illegality challenge to domestic industry only because the products at issue were not, in fact, illegal—unlike here. Accordingly, this Court has already heralded the narrow, common-sense holding ALD seeks in this appeal: Expenditures made to establish and maintain an *actually* federally illegal domestic industry cannot, as a matter of law, be credited in the economic prong analysis.

Yet below, both the presiding ALJ and the Commission refused to assess whether PAX's asserted domestic industry expenditures—admittedly incurred to enable profitable, but federally illegal, downstream sales of marijuana oils within PAX's domestic industry pods—were legally cognizable. The ALJ found ALD's arguments relating to the illegal nature of PAX's domestic industry expenditures "beyond the scope of this investigation" and declined to meaningfully address them. Appx2. The Commission then affirmed the ALJ's domestic industry finding while declining to review the ALJ's refusal to consider the illegality of PAX's domestic industry investments.

This was fundamental legal error. Neither the ALJ nor the Commission could logically determine whether PAX's expenditures are "significant"—the statutory test—without first determining whether at least 95% of such expenditures are legally cognizable and could be included in such determination. To resolve the error, this Court should hold that expenditures made in furtherance of federally illegal activity cannot be credited in the domestic industry economic prong analysis and vacate the LEO, and then reverse the Commission's Final Determination—or at least remand for the Commission to determine, in the first instance and on the existing record, whether the *at most* 5% of PAX's asserted expenditures directed toward federally *legal* commerce are sufficient to establish a domestic industry.

Additionally, for the reasons argued in STIIIZY's principal brief—which ALD joins pursuant to Fed. R. App. P. 28(i)—the Court should vacate the LEO and reverse due to PAX's failure to satisfy the economic prong requirement without improper reliance on pre-patent issuance investments.

III. STATEMENT OF THE CASE

A. PAX Admits that Commerce in Vaporizer Pods Filled with Federally Illegal Marijuana Oil Is the *Raison D'être* for at Least 95% of its Asserted Domestic Industry Expenditures

PAX presents itself as "a leading global cannabis brand." Appx19916. It manufactures vaporizer devices and pods that are filled with cannabis oils—both federally illegal marijuana oil (at least 95%) and federally legal hemp oils (at most

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5%)—before being distributed to U.S. consumers for consumption. Appx19517 (¶1). All of PAX's asserted domestic industry expenditures were incurred to establish and grow a domestic industry in these cannabis oil-filled vaporizer products. Appx156-Appx157. And it is these products—and only these products—that the Commission found to meet the technical prong of the domestic industry requirement. Appx44-Appx45; Appx77-Appx78; Appx89-Appx90; Appx121; Appx211.

It is undisputed that the market for PAX's empty domestic industry pods directly corresponds to the market for pods filled with cannabis oils. Appx19809 at 124:3-125:10; Appx20056-Appx20058. That is, but for the lucrative downstream sales of PAX's cannabis oil-filled pods, there would *literally* be no commerce in PAX's empty, asserted domestic industry pods—or the vaporizer devices needed for end consumers to use them. *Id.* Indeed, PAX's asserted domestic industry pods are *never* intended to be sold to end consumers empty, *not* offered for sale to end consumers empty, and *never* intended to be filled or refilled by end consumers. Appx19787 at 34:13-21.

PAX has stipulated that *at least* 95% of its asserted domestic industry pods are filled with, and ultimately sold to consumers containing, federally illegal marijuana oil—all pursuant to PAX's[1] [*items*] with [*entity*] and

[1] PAX engages in much of the activity addressed in this subsection via its wholly owned subsidiary. *E.g.*, Appx19517-Appx19518 at ¶¶4, 6, 8.

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[*entity*] of federally illegal marijuana oils. Appx19516-Appx19518 (¶¶1, 4, 6). Thus, PAX's involvement in marijuana oil commerce is not incidental to its domestic industry in cannabis vaporizer products—it is the beating heart of its business and encompasses *at least* 95% of its asserted economic prong expenditures.

Ultimately, PAX's own marketing slogan—"Our devices, our oils, our standards"—accurately summarizes its seamless integration with federally illegal marijuana oil commerce. Appx19931. It is undisputed that PAX requires its marijuana oil [*entities*] who [*action*] its empty domestic industry pods to (i) [*action*] with marijuana oils manufactured in accordance with PAX's proprietary marijuana oil formulations (ii) using PAX's proprietary oil [*items*]. Appx19517 at ¶4; Appx20038; Appx20056-20058; Appx19782-Appx19783 at 15:9-25, 17:3-18:1; Appx19803 at 98:6-99:12; Appx19807-Appx19809 at 114:3-116:24, 121:17-122:23; Appx19857 at §§4-5.1; Appx19896; Appx19899. It is undisputed that PAX requires that its marijuana oil [*entities*] (iii) provide [*action*] results for each manufactured batch of marijuana oil—which enables PAX to guarantee, to downstream marijuana consumers, the quality of the marijuana oil sold within its domestic industry pods—and (iv) distribute the marijuana oil filled pods in PAX-provided, PAX-branded consumer packaging that tout the pods' marijuana content. Appx19517-Appx19518 at ¶¶ 6,8; Appx19785-Appx19786 at 29:8-31:3; Appx19789-Appx19791 at 45:9-46:12, 50:4-51:3; Appx19804 at 105:3-

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18; Appx19917; Appx19919. And it is undisputed that PAX (v) requires its marijuana oil [*entities*] to report back the [*property*] of each flavor or type of marijuana oil-filled pod sold. Appx19805 at 108:25-109:23. PAX even (vi) directs consumers, via its website, to their local federally illegal (but state legal) marijuana dispensaries that sell marijuana oil-filled PAX pods. Appx19518 at ¶¶ 11, 9; Appx19967-Appx19969; Appx19934. Beyond this, (vii) PAX employees themselves used federally illegal marijuana oil for [*action*] of its domestic industry pods. Appx19800 at 87:8-21.

Thus, the record demonstrates that at least 95% of PAX's asserted expenditures are part and parcel of an illegal CSA conspiracy to manufacture, distribute, possess and sell marijuana oil-filled PAX pods.

B. The Commission Declined to Address ALD's Argument that PAX's Expenditures Toward Federally Illegal Commerce in Marijuana Oil-filled Vaporizer Pods Should Not Count Toward Its Purported Satisfaction of the Domestic Industry Economic Prong Requirement

Based on PAX's complaint, the Commission instituted Investigation No. 337-TA-1392 on March 6, 2024, concerning certain oil vaporizing devices, components thereof, and products containing the same. Appx188. PAX asserted, *inter alia,* that ALD and STIIIZY infringed four of its patents, that PAX's vaporizers and pods practiced each of those patents, and that it had established a domestic industry in the same. *Id.;* Appx193-Appx197.

On August 21, 2024, having obtained PAX's stipulated admission that at least 95% of its asserted domestic industry pods were filled with federally illegal marijuana oils to effectuate PAX's business model, ALD moved for summary determination that PAX could not satisfy the economic prong because those expenditures were made in furtherance of federally illegal activity and are therefore not cognizable under Section 337. Appx1; Appx220; Appx19516-Appx19519. The ALJ denied the motion for summary determination ("MSD") on October 8, 2024. Appx1-Appx3. The ALJ avoided the merits of ALD's illegality argument, including the legal question of whether illegal expenditures may be credited towards the domestic industry economic prong, and the factual question of whether at least 95% of PAX's expenditures were illegal under the CSA. *Id.* Instead, the ALJ declined to consider the issue, finding that ALD's argument was "beyond the scope of this investigation" and characterized it as, "at best," a public interest issue that the Commission had not authorized evidence on. Appx2.

The ALJ then compounded this error. On October 18, 2024, the ALJ granted PAX's motion *in limine* #3, striking the portion of ALD's prehearing brief that made the illegality argument—and ALD's expert witness testimony regarding the same. Appx28094-Appx28095. The ALJ agreed with PAX "that these arguments relate to a public interest issue that is outside the scope of this investigation." *Id.* ALD was

thus prevented from presenting evidence or argument on its domestic industry illegality defense at the October 21–23, 2024, evidentiary hearing. *See* Appx189.

On March 6, 2025, the ALJ issued his Final Initial Determination ("FID"), which found no violation because PAX had not satisfied the economic prong of the domestic industry requirement—but on grounds unrelated to the illegality issue. Appx126-Appx128; Appx129 at ¶31; Appx189. That day, the Commission also requested submissions on the public interest. Appx29532-Appx29534.

On March 18, 2025, PAX sought review of the ALJ's determination that it had not satisfied the domestic industry requirement. Appx139-Appx140; Appx190. ALD contingently sought review of, *inter alia*, the ALJ's summary rejection and preclusion of its illegality argument. *Id*.

On April 7, 2025, ALD filed its first submission in the public interest, which addressed the illegality of PAX's business. Appx190; Appx220-Appx221. Law Professor William J. McNichol, Jr. also filed a public interest submission regarding the illegality doctrine in support of ALD's position. *Id.*

On May 16, 2025, the Commission determined to review the ALJ's economic prong finding, concluding that the FID had legally erred with respect to the treatment of pre-patent-issuance investments and remanding to the ALJ for reconsideration. Appx191. Without comment, the Commission declined to review whether the ALJ erred by refusing to consider whether domestic industry investments in federally

illegal products are legally cognizable, and therefore adopted the ALJ's conclusion that the issue was outside the scope of the investigation. Appx139-Appx140; *cf.* Appx220 (addressing the illegality argument in the public interest context).

On July 18, 2025, the ALJ issued his Remand Initial Determination ("RID"), finding that PAX satisfied the economic prong under 19 U.S.C. § 1337(a)(3)(A) and (B). Appx191.

On September 22, 2025, the Commission affirmed the RID with limited modifications and requested, *inter alia*, additional written submissions on the public interest. Appx178; Appx192. ALD filed additional public interest comments, as did Professor McNichol. Appx192.

On January 20, 2026, the Commission issued its Final Determination, finding a violation of Section 337, affirming the RID with additional reasoning, and issuing an LEO against ALD. Appx187-Appx188. In issuing the LEO, the Commission determined that the illegality of PAX's business was not relevant to the public interest determination. Appx220 ("Neither Respondents' submission nor the two public submissions explain why the ability of the domestic industry products to be used with cannabis oils is relevant to the public interest analysis, which assesses the effect of excluding the infringing products on the statutory public interest factors."). The Commission further concluded that the illegality of PAX's domestic industry commerce was "not supported by record evidence" solely because PAX "has not

been accused of violating the Controlled Substances Act by the U.S. government." Appx221 (citing Appx2 n.2).

Thus, the ALJ and the Commission refused to determine or consider whether PAX's expenditures, made overwhelmingly and admittedly in furtherance of federally illegal marijuana oil commerce, are cognizable domestic industry expenditures. The result is that the Commission counted all of PAX's asserted expenditures toward domestic industry without even considering whether the massive portion of those expenditures admittedly directed toward federally illegal marijuana oil commerce may properly be counted.

IV. SUMMARY OF ARGUMENT

Federal tribunals have long and consistently held that they will not lend aid to causes of action founded on federally illegal activity. This principle applies with full force to marijuana commerce that violates the CSA, as recently held by several sister circuits and numerous district and bankruptcy courts. In Section 337 investigations, the principle is readily and easily applicable to disqualify federally illegal expenditures from being used to satisfy the domestic industry requirement. Indeed, this Court, in *Philip Morris*, rejected an illegality challenge to domestic industry expenses only because the asserted domestic industry was *legal*—signaling that actually illegal expenditures cannot be counted toward the domestic industry economic prong requirement. 63 F.4th at 1342.

The ALJ, and then the Commission, erred by finding that PAX satisfied the economic prong without determining (i) whether asserted expenditures must be legal to qualify as cognizable domestic industry expenses, (ii) whether at least 95% of PAX's asserted domestic industry expenditures were federally illegal under the CSA's prohibition of Marijuana commerce conspiracies,[2] and (iii) whether the remaining at most 5% of legal expenditures satisfied the economic prong. The ALJ found the illegality question "beyond the scope of this investigation" and struck ALD's evidence and argument. Appx2. The Commission affirmed the domestic industry finding while declining to review whether investments supporting federally illegal commerce may be used to satisfy the economic prong. This was error. The Commission cannot properly determine whether expenditures are "significant" under 19 U.S.C. § 1337(a)(3) without first determining whether those expenditures are legally cognizable.

This Court should hold that expenditures in furtherance of federally illegal activity cannot be counted toward the domestic industry economic prong requirement and vacate the LEO. Because no factfinding was conducted below on

[2] *But see* Appx221. Although the ALJ observed in a footnote that U.S. government has not accused PAX of violating the CSA (Appx2 n.2), he declined to consider any record evidence on the issue—including PAX's stipulated admissions, PAX's testimonial admissions, and PAX's own documents—because he found he found the issue of PAX's CSA infringing activity "beyond the scope of this investigation," (Appx2, Appx28094).

(ii) whether the at least 95% of PAX's expenditures in furtherance of marijuana oil commerce were legal or (iii) whether the remaining *at most* 5% of expenditures directed at federally legal commerce could, alone, satisfy the domestic industry requirement, this Court should, at a minimum, remand to the Commission for such factual findings—and the ultimate determination of whether PAX met its burden to satisfy the domestic industry requirement.

In the alternative, the Court should hold that the Commission abused its discretion by failing to meaningfully consider the federal illegality of PAX's domestic industry in the context of the public interest before issuing an LEO in support of PAX's federally-illegal marijuana oil commerce—and remand accordingly. Although the ALJ found that the illegality issue was "at best" a public interest argument to be addressed by the Commission (Appx2), the Commission later concluded that the illegality of PAX's industry was also not at all relevant to the public interest determination, (Appx220). The Commission thus erroneously concluded that whether a complainant's commerce for which it seeks protection under the trade statutes is legal has no place anywhere in a Section 337 investigation. Such an approach defies common sense and the consistent approach taken by federal courts in analogous cases and circumstances.

V. ARGUMENT

In addition to the arguments made below, the Court should vacate the LEO and reverse due to PAX's failure to satisfy the economic prong requirement without improper reliance on pre-patent issuance investments as argued in STIIIZY's principal brief—which ALD joins pursuant to Fed. R. App. P. 28(i).

A. Applicable Law and Legal Standards

1. Standard of Review

This Court reviews the Commission's legal conclusions *de novo*. *Apple Inc. v. ITC*, 169 F.4th 1363, 1371 (Fed. Cir. 2026). Statutory interpretation is a question of law and is therefore reviewed *de novo*. *Mayborn Grp., Ltd. v. ITC*, 965 F.3d 1350, 1353 (Fed. Cir. 2020). Courts have the final word on the meaning of statutes, and agency interpretations of statutes "are not entitled to deference." *Loper Bright Enterprises v. Raimondo*, 603 U.S. 369, 391-92 (2024). Whether expenditures made in support of federally illegal commerce are cognizable for domestic industry economic prong purposes is a question of law reviewed without deference.

The Commission's factual findings are reviewed for substantial evidence. *Apple*, 169 F.4th at 1371. Here, the Commission declined to substantively consider the factual questions of whether *at least* 95% of PAX's asserted expenditures were federally illegal, or whether the *at most* 5% of expenditures directed at federally *legal* commerce could, alone, satisfy the domestic industry requirement.

Accordingly, to the extent this Court does not reverse outright, the instant appeal seeks remand to the Commission for determination of these factual questions in the first instance.

The Commission's findings on the public interest are reviewed for abuse of discretion. *Hyundai Elecs. Indus. Co. v. ITC*, 899 F.2d 1204, 1208 (Fed. Cir. 1990).

2. Domestic Industry – Economic Prong

Section 337 requires that "an industry in the United States, relating to the articles protected by the patent . . . exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). Section 337(a)(3) specifies, in relevant part, that,

> an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent … concerned—
>
> (A) significant investment in plant and equipment; [or]
>
> (B) significant employment of labor or capital….

The complainant, here PAX, bears the burden to show that the economic prong of the domestic industry requirement was met as of the filing date of its complaint. *Philip Morris*, 63 F.4th at 1341 n.4; *Zircon Corp. v. ITC,* 101 F.4th 817, 826 (Fed. Cir. 2024).

3. The Controlled Substances Act, 21 U.S.C. 801 *et seq*.

Under the CSA, manufacturing, distributing, dispensing, selling, and even merely possessing marijuana or its derivatives—including marijuana oil—are *per se*

illegal under federal law. 21 U.S.C. §§ 841(a), 844(a)[3] Willing participation in conspiracies to manufacture, distribute, dispense, sell, or possess, *inter alia*, marijuana oil is also *per se* illegal. 21 U.S.C. § 846.[4] Such federal illegality exists notwithstanding (i) various states' legalization and regulation of marijuana commerce and (ii) formal and informal federal policies tolerating marijuana commerce. *E.g., Gonzales v. Raich*, 545 U.S. 1 (2005) (upholding federal CSA enforcement notwithstanding state legalization); *U.S. v. Nixon*, 839 F.3d 885, 888 (9th Cir. 2016) ("the CSA continues to apply in all 50 states"); *Safe Streets All. v. Hickenlooper*, 859 F.3d 865, 876-877 (10th Cir. 2017) (reversing dismissal of CSA-based RICO claims against state-legal Colorado marijuana growers). *Contra* Appx221 (finding the federal government's apparent tolerance of PAX's marijuana oil-based commerce dispositive as to its legality under the CSA).

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[3] "[A]ny … preparation, which contains any quantity of …" of Marijuana and "Tetrahydrocannabinols, except for tetrahydrocannabinols in hemp" are Schedule I controlled substances under the CSA. 21 U.S.C. § 812 (c) Sch. I (c)(10) & (17). Marijuana is defined as "all parts of the plant Cannabis sativa L., … and every … preparation of such plant"—except, in relevant part, "hemp." 21 USC § 802(16). Hemp, in turn, is defined as "the plant Cannabis sativa L. and any part of that plant, including … all derivatives … with a delta-9 tetrahydrocannabinol ["THC"] concentration of not more than 0.3 percent …." 7 USC § 1639o (1). Thus, hemp and its derivatives are legal under the CSA.

[4] The elements of a CSA conspiracy are (1) an agreement to violate the CSA (2) knowledge of the agreement; and (3) voluntarily joining it. *E.g., U.S. v. Ruan,* 56 F.4th 1291, 1299 (11th Cir. 2023). "The knowing agreement to distribute drugs in violation of § 841(a)(1) is itself the completed crime of a distribution conspiracy." *U.S. v. Wheat*, 988 F.3d 299, 306 (6th Cir. 2021).

B. Expenditures Made in Support of a Federally Illegal Domestic Industry Cannot Be Counted Toward Satisfaction of the Economic Prong

1. Congress Intended Relief Under Section 337 to Protect Only *Legitimate* Businesses from Unfair Trade Practices

The Commission legally erred by finding a domestic industry based on PAX's federally illegal CSA-infringing commerce. Section 337's statutory text and legislative history foreclose the Commission's finding of a domestic industry based on illegal commerce. Congress authorized the Commission to wield its Section 337 authority only to protect domestic industries—i.e., "only if an industry in the United States . . . exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). Review of the legislative history confirms that Congress limited the protected industries to *legitimate* industries for which significant investments in plant and equipment, labor or capital, or exploitation of intellectual property have been made. *See id.* § 1337(a)(3)(A)-(C). The ALJ's conclusion (and the Commission inherent adoption of it) that the issue of the illegality of PAX's purported domestic industry was "beyond the scope of this investigation" (Appx2), is contrary to the statutory text and its purpose. Section 337's context confirms a protected "industry" cannot be premised on sale of unlawful products. Indeed, the very purpose of Section 337 is to exclude products unlawfully in competition in the United States.

Section 337's legislative history confirms that "an industry" exists only as to legal products—*i.e.*, products whose sale in the U.S. is not illegal. As the

Commission itself explained, Congress intended the Act to advance "legitimate" business: "During the Senate debates on the 1930 act, Senator Simmons stated that Section 337 applies 'to all industries alike. Wage earner, farmer, stockman, producer, and *legitimate business in general* have everything to gain.'" *Certain Airtight Cast-Iron Stoves*, Inv. No. 337-TA-69, 1980 WL 41970, at *5 (I.T.C. Dec. 31, 1980) (emphasis added); *see also ClearCorrect Operating, LLC v. ITC*, 810 F.3d 1283, 1298 (Fed. Cir. 2015) (finding that the legislative history impacts Section 337 interpretation).

The Commission's interpretation of "an industry" required by Section 337 leads to the absurd result that Congress, through silence, meant to protect domestic commerce that is "unlawful"—i.e., fail to comply with Congress's own statutes—from unfair competition and acts. This interpretation cannot be correct. *See Public Citizen v. U.S. Dep't of Justice*, 491 U.S. 440, 454 (1989) (avoiding interpretation producing "an odd result"); *Timex V.I., Inc. v. U.S.*, 157 F.3d 879, 887 (Fed. Cir. 1998) (avoiding interpretation that "frustrates Congress's intent, encourages undesirable behavior, and produces absurd results"). In this Investigation, the Commission found a domestic industry based on expenditures admittedly made to distribute and derive profit from pods filled with federally illegal marijuana oil—contrary to the statutory scheme. Because there is no viable record evidence to support a lawful domestic industry, the Commission's decision should be reversed.

2. Federal Courts Consistently Refuse to Lend Aid to Claims Founded on Federally Illegal Activity—Including Marijuana Commerce

It is a bedrock principle of federal law that courts will not lend their aid to parties whose claims are founded on illegal activity. *E.g., Higgins v. McCrea*, 116 U.S. 671, 686 (1886) ("No court will lend its aid to a man who founds his cause of action upon an … illegal act."). As a growing body of recent authority holds, this principle applies with particular force to marijuana commerce, which violates the CSA. Thus, a Section 337 complainant that founds its case on a domestic industry that embodies federally-illegal CSA-infringing activity should not be aided by the Commission or by this Court.

In the most recent, directly applicable circuit authority, the Third Circuit vacated a district court judgment, *sua sponte,* and remanded for factfinding on whether the allegedly breached contract at issue involved illegal conduct under federal marijuana laws. *Apical,* 2026 WL 177927, at *2. The court observed that "federal courts may not assist parties in carrying out the terms of an illegal contract, . . . and will decline to enforce such a contract where the judgment would order a violation of federal law." *Id.* at *1 (internal quotation marks omitted). Although Pennsylvania had "legalized the possession and use of marijuana in limited circumstances," the court noted that "possessing, distributing, and manufacturing marijuana remain illegal under federal law," namely the CSA. *Id.* at *2 (internal

quotation marks omitted). The court concluded that the "breach of contract alleged here involves Defendants' purported failure to pay Plaintiffs for services provided to Defendants' medical marijuana business" and if a "business cultivates, manufactures, or distributes a federally controlled substance, then claims based on a contract to provide such a business services should be dismissed because enforcement would require this Court to stamp its approval on the parties' unlawful activities, namely, violations of the federal drug laws." *Id.* (internal quotation marks omitted).

The Tenth Circuit reached a similar conclusion in *Bartch v. Barch*. 111 F.4th 1043, 1049 (10th Cir. 2024). There, the court vacated an enforcement order requiring a judgment debtor to satisfy a monetary judgment by selling equity in a marijuana business. *Id*. It remanded for the district court to determine whether the order violated public policy by requiring the debtor to rely on the marijuana business's "continued CSA-infringing business operations to enable them to sell the equity" and thereby "abetting continued operations in violation of federal law." *Id.*

Perhaps most poignantly, the Ninth Circuit also recently upheld an illegality defense in *Shulman v. Kaplan*, where it affirmed dismissal of RICO claims asserted by a cannabis business because federal courts cannot protect commerce that violates federal law. 58 F.4th 404. That appeal turned on a statutory interpretation question striking similar to the one at bar. The Ninth Circuit explained that, "for Appellants

to establish RICO standing, the statute's use of the term 'business or property' must encompass businesses and property engaged in the cultivation, sale, and marketing of cannabis—an enterprise that is legal under [state] law, but illegal under federal law." *Id.* at 410. Although the "text of RICO does not define either 'business' or 'property,'" the court determined that "it is clear that Congress did not intend 'business or property' to cover cannabis-related commerce," expressly "not[ing] that Congress passed the [CSA] and RICO in the same year." *Id.* at 411; *see also id.* ("Were we to substitute a drug like heroin for cannabis for the purposes of our analysis, the conclusion seems obvious: Congress could not have intended to allow a heroin dealer to recover RICO damages from someone who, by mail and wire fraud, stole a shipment of heroin.").

Analogously, this Court should hold that expenditures in furtherance of a marijuana oil "enterprise that is legal under [state] law, but illegal under federal law," should not count towards the domestic industry economic prong. *Id.* at 410. Indeed, in the span of a few months, the same 100th Congress that redrafted the domestic industry provisions of §1337(a)(3) into their current form also substantially increased federal punishments for marijuana violations—including by authorizing a $10,000 federal civil penalty for mere possession of a "personal use amount" of marijuana and by establishing lengthy mandatory minimum prison terms for possessing quantities of marijuana plants required to enable marijuana commerce—

quantities without which PAX's business could not possibly be sustained.[5] The Congress that passed "[a]n Act to prevent the manufacturing, distribution, and use of illegal drugs," could not possibly have intended for expenditures made in furtherance of a marijuana oil commerce conspiracy to meet its freshly revamped statutory definition of a domestic industry. 102 Stat. at 4181; *Timex,* 157 F.3d at 887 (avoiding interpretation that "frustrates Congress's intent, encourages undesirable behavior, and produces absurd results").

Beyond circuit courts, federal district courts have applied the illegality principle broadly across causes of action involving marijuana industry participants.[6]

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[5] *Compare* Omnibus Trade and Competitiveness Act of 1988, Pub. L. 100-418, §1342(a)(1), 102 Stat. 1107, 1212-1213 (August 23, 1988) (amending 19 U.S.C. §1337 (a)(3)) *with* Anti-Drug Abuse Act of 1988, Pub. L. 100-690, §6486, 102 Stat. 4181, 4384-4385 (Nov. 18, 1988) (establishing monetary penalty under 21 U.S.C. § 844a(a)) *and* Pub. L. 100-690, §6469, 102 Stat. 4181, 4381-4382 (amending 21 U.S.C. § 841(b)(1)).

[6] *Sensoria, LLC v. Kaweske*, 581 F. Supp. 3d 1243, 1260, 1272 (D. Colo. 2022) (Dismissing all claims, except fraud claims where Plaintiffs might seek return of their principal investment: "Even if the CSA does not automatically bar Plaintiffs' ability to sue Defendants, the illegality issue still limits the Court's ability to provide relief. … [T]he injury itself must be cognizable and legitimate. As such, the Court may not vindicate equity in or award profits from a business that grows, processes, and sells marijuana."); *Sensoria, LLC v. Kaweske*, 548 F. Supp. 3d 1011, 1026–27 (D. Colo. 2021) ("Marijuana is not an indirect or tangential aspect of the dispute. It lies at the heart of the business and thus the lawsuit."); *J. Lilly, LLC v. Clearspan Fabric Structures Int'l, Inc.*, No. 3:18-CV-01104-HZ, 2020 WL 1855190, *11 (D. Or. Apr. 13, 2020) ("The Court raised *sua sponte* the question of whether a federal court sitting in diversity can award a party lost profits generated from the sale of marijuana and ordered the parties to brief the issue. [T]he Court concludes that it

Such judicial abstention has even been applied against companies that do not produce, process, or distribute marijuana, but rather merely support marijuana industry commerce.[7] Additionally, marijuana companies have faced extraordinary difficulty in availing themselves of federal bankruptcy protections. Because "bankruptcy laws and bankruptcy courts are purely creatures of federal law," federal bankruptcy courts have "consistently dismissed cases where debtors engaged in ongoing CSA violations, or where a debtor's reorganization efforts depend on funds which can be considered proceeds of CSA violations." *In re Way To Grow, Inc*., 597

cannot …."); *Shulman v. Kaplan*, No. 219CV05413ABFFMX, 2020 WL 7094063, at *3 (C.D. Cal. Oct. 29, 2020) ("Because Plaintiffs claim for false advertising rests wholly on Defendants' use of its trademark to advertise marijuana products, it encompasses an unlawful use such that Plaintiffs are not within the 'zone of interest' protected by the Lanham Act. Plaintiffs' claim for false advertising … fails."); *Polk v. Gontmakher*, No. 2:18-cv-01434, 2019 WL 4058970, at *2 (W.D. Wash. Aug. 28, 2019) (Plaintiff "alleges that he is entitled to an ownership interest in [Marijuana company]. … Under the …[CSA], however, the production, distribution, and sale of marijuana remains illegal. … So any agreement giving [plaintiff] an equity interest … is illegal under federal law.").

[7] *E.g., Viridis Lab'ys, LLC v. Kluytman*, No. 1:22-CV-283, 2023 WL 5058087, at *1, 3 (W.D. Mich. June 20, 2023), *report and recommendation adopted,* No. 1:22-CV-283, 2023 WL 4861698 (W.D. Mich. July 31, 2023) ("Plaintiffs ... are 'marijuana safety compliance facilities' licensed by the Michigan Marijuana Regulatory Agency (MRA) to 'sample and test adult-use and medical cannabis products.' … It is simply not possible, in this context, to divorce the general liberty and property interests asserted by Plaintiff from the product around which Plaintiff's alleged property and liberty interests revolve.").

B.R. 111, 117 (Bankr. D. Colo. 2018), *aff'd*, 610 B.R. 338 (D. Colo. 2019).[8]

Section 337 and the ITC are likewise "purely creatures of federal law." 597 B.R. at 117. The same principle applies and the same result must follow.

3. This Court Has Already Implicitly Recognized that Illegal Expenditures Should Not Be Counted in the Domestic Industry Economic Prong Analysis

This Court's opinion and reasoning in *Philip Morris* suggested that expenditures directed toward a truly illegal domestic industry are not cognizable under the economic prong. 63 F.4th at 1340-1342. There, the Federal Circuit "was presented with the singular question of whether the economic prong of the domestic industry analysis excludes products that have not received regulatory authorization as of the filing of the complaint." *Id.* at 1341.

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[8] *E.g., In re Arenas*, 535 B.R. 845, 853 (B.A.P. 10th Cir. 2015) (dismissing bankruptcy case because it would be "impossible" for the trustee to lawfully administer the estate "because selling and distributing the proceeds of the marijuana assets would constitute federal offenses"); *In re Mayer*, No. 2:21-BK-06572-DPC, 2022 WL 18715955, at *4, *6 (Bankr. D. Ariz. Jan. 31, 2022) (collecting cases: "Courts have consistently dismissed cases where (1) debtors were directly engaged in violations of the CSA, or (2) debtor's reorganization efforts depended on proceeds derived from CSA violations."); *In re Basrah Custom Design, Inc.,* 600 B.R. 368, 370 (Bankr. E.D. Mich. 2019) ("…this Chapter 11 case raises the question whether the Debtor's entanglement with a medical marijuana dispensary business, which business is illegal under federal criminal law but not necessarily illegal under Michigan law, requires the dismissal of this federal bankruptcy case. The Court concludes that dismissal is required."); *In re Rent-Rite Super Kegs W. Ltd.,* 484 B.R. 799, 805 (Bankr. D. Colo. 2012) ("Unless and until Congress changes that law, the Debtor's operations constitute a continuing criminal violation of the CSA and a federal court cannot be asked to enforce the protections of the Bankruptcy Code in aid of a Debtor whose activities constitute a continuing federal crime.").

Appellant-respondent Philip Morris argued that intervenor-complainant Reynolds's domestic industry nicotine-vaporization products had not received FDA approval and were thereby rendered "illegal and unusable in a domestic industry analysis." *Id.* The court rejected this argument for the express—and only—reason that the alleged non-compliance with FDA regulations was *not* "illegal":

> That the regulatory process, for which there was an explicit grace period, was not complete at the time that Reynolds filed the complaint does not mean the domestic industry products were "illegal," as Philip Morris insists.

Id. at 1342. By affirming on this ground (*i.e.,* lack of regulatory approval does not equate to illegality) after expressly interpreting 19 U.S.C. §1337(a)(3)—as opposed to holding that a domestic industry's illegality does not impact economic prong assertions, this Court signaled that expenditures in furtherance of an actually illegal domestic industry are not cognizable.

The limited relevant Commission precedent supports this conclusion. In *Certain Pouch-Type Battery Cells, Battery Modules, and Battery Packs, and Products Containing the Same,* the Chief Administrative Law Judge noted that there was no disagreement that "costs due to illegal labor should be excluded from [domestic industry] calculations." Inv. No. 337-TA-1179, Order No. 34, 2020 WL 5836572, at *2 (Aug. 20, 2020). If illegal labor costs must be excluded, expenditures in furtherance of federally illegal CSA-infringing marijuana commerce must be excluded *a fortiori*.

Here, unlike in *Philip Morris*, there is no legitimate question that the manufacture, sale, possession, and distribution of marijuana oil-filled PAX pods—each step of which PAX is intimately involved in—are federally illegal under the CSA. Expenditures toward this illegal activity—which PAX has stipulated comprises at least 95% of its domestic industry business—should not count in the economic prong analysis.

4. Trademark Law's "Lawful Use in Commerce" Doctrine Confirms the Principle that Federal Legality Is a Prerequisite for Federal Intervention

Federal trademark jurisprudence provides another close analogy for application of the illegality doctrine that should guide the Court. Both trademark registration and Commission-granted Section 337 injunctive relief are federal benefits premised on a demonstration of domestic commercial activity.

The USPTO, this Court, and other courts of appeals have all held that the Lanham Act's "use in commerce" requirement requires *lawful* use in commerce. *E.g., Gray v. Daffy Dan's Bargaintown,* 823 F.2d 522, 526 (Fed. Cir. 1987) ("A valid application cannot be filed at all for registration of a mark without 'lawful use in commerce.'"). Recently, the Federal Circuit addressed this requirement in the context of trademark enforcement in *VPR Brands, LP v. Shenzhen Weiboli Tech. Co,* where it vacated a preliminary injunction due to the trial court's unreasonable rejection of the appellant's "unlawful-use defense." No. 2023-1544, 2024 WL

3811774 (Fed. Cir. Aug. 14, 2024) (nonprecedential). The *VPR* panel discussed the origins and application of the trademark doctrine, including that the Ninth and Tenth Circuits have expressly recognized illegality as a defense against trademark enforcement. *Id.* at *3-*6; *CreAgri, Inc. v. USANA Health Scis, Inc.*, 474 F.3d 626, 630 (9th Cir. 2007) ("use in commerce only creates trademark rights when the use is lawful"); *United Phosphorus, Ltd. v. Midland Fumigant, Inc*., 205 F.3d 1219, 1225 (10th Cir. 2000) ("the well-reasoned proposition that shipping goods in violation of federal law cannot qualify as the 'use in commerce' necessary to establish trademark rights."); *see also Coahoma Chem. Co., Inc. v. Smith*, 113 U.S.P.Q. 413, 1957 WL 7113, at *6 (Com'r Pats. & Trademarks 1957) ("Reduced to its simplest terms, the question is: May property rights be acquired as a result of unlawful acts? The obvious answer to the question in its simplified form is in the negative. No decision in a trademark case has been found which is directly in point; but in other fields of the law which might reasonably be analogous, i.e. real property and personal property, where claimed ownership was based on acquisition by unlawful means, the principle is so well-established that citation of authorities is unnecessary.").[9]

[9] Other circuits have declined to apply the doctrine where no illegality was found or the argument was waived. *FN Herstal SA v. Clyde Armory Inc.*, 838 F.3d 1071, 1086–87 (11th Cir. 2016) (holding the unlawful use doctrine to be futile in view of evidentiary deficiencies); *Perry v. H. J. Heinz Co. Brands, L.L.C.*, 994 F.3d 466, 475 (5th Cir. 2021) (declining to adopt the "unlawful use doctrine" where illegality allegation was merely that trademark holder "failed to comply with state and federal

As the Ninth Circuit explained in *AK Futures LLC v. Boyd St. Distro, LLC*, the lawful-use requirement prevents "the *absurd* result of the government 'extending the benefits of trademark protection to a seller based upon actions the seller took in violation of that government's own laws.'" 35 F.4th 682, 689 (9th Cir. 2022) (quoting *CreAgri*, 474 F.3d at 630; emphasis added). While the illegality defense failed in *AK Futures*, it was only because the commerce at issue was *legal,* just like that domestic industry product at issue in *Philip Morris. Compare AK Futures,* 35 F.4th at 695 ("AK Futures' [hemp-derived] delta-8 THC products are lawful [under the CSA]… and may receive trademark protection.") *with Philip Morris,* 63 F.4th at 1342 ("That the regulatory process … was not complete at the time that Reynolds filed the complaint does not mean the domestic industry products were 'illegal.'"). In stark contrast, PAX's commerce in marijuana oil-filled domestic industry pods here violates the CSA and is *per se* federally illegal.

Still, interpretation of the "use in commerce" requirement extends even further than being a trademark registration pre-requisite. For example, one court held that federally illegal (but state legal) use of a mark in marijuana commerce could not even support a prior use defense against a junior (but fully legal) user of the mark.

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food labelling regulations when he omitted required information from … labels"); *Lane Cap. Mgmt., Inc. v. Lane Cap. Mgmt., Inc*., 192 F.3d 337, 349 (2d Cir. 1999) (discussing unlawful use defense where investment advisor trademark owner failed to register with the SEC, but affirming lower court's rejection of the defense as waived).

Kiva Health Brands LLC v. Kiva Brands Inc., 402 F. Supp. 3d 877, 890 (N.D. Cal. 2019). The court explained that:

> [Defendant]'s prior use was illegal under federal law … [because] all [of its] products contain cannabis. …To hold that [Defendant]'s prior use of the KIVA mark on a product that is illegal under federal law is a legitimate defense to [Plaintiff]'s federal trademark would "put the government in the anomalous position of extending the benefits of trademark protection to a seller based upon actions the seller took in violation of that government's own laws."

Id. (quoting *CreAgri*, 474 F.3d at 630).

Unlike in district court, where non-practicing entities are free to enforce their patents without regard to commercial market participation, Section 337 relief at the Commission is only open to patentees who can prove that they have established a "legitimate" domestic industry worthy of protection. That is, proving "significant" domestic industry expenses tied to the asserted patents is a prerequisite for any relief: *It is the price of admission*. 19 U.S.C. § 1337(a)(3)(A) & (B). In this manner, the domestic industry requirement corresponds to trademark law's "use in commerce" requirement.

Thus, just as the Lanham Act has been interpreted to preclude extending the benefits of trademark protection to a seller engaged in illegal commerce, the same principles compel that such a complainant engaged in illegal commerce cannot demonstrate an industry entitled to protection under Section 337. If the government cannot extend the benefits of trademark protection based on illegal commerce, it

likewise cannot extend the far more powerful benefit of Commission exclusion orders based on a federally illegal domestic industry.

C. The Commission Legally Erred by Finding the Domestic Industry Requirement Met While Refusing to Consider the Illegality Issue

Whether domestic industry expenditures are cognizable is not solely a public interest issue—it is a threshold economic prong question. But aside from rejecting this axiom and noting that PAX hadn't been prosecuted for CSA violations, the ALJ declined to address the merits of ALD's illegality argument in any aspect. *Id*.

The Commission reviewed the ALJ's domestic industry economic prong findings but declined to meaningfully consider the illegality argument. *Cf.* Appx221. The result is that the Commission—without even considering the PAX's admissions that *at least* 95% of PAX's asserted economic prong expenditures were unambiguously directed toward a CSA conspiracy to manufacture, distribute, dispense, sell, and possess Schedule I controlled substances and other extensive record evidence—counted all of PAX's asserted expenditures toward the economic prong, and issued an LEO against ALD on that basis. This is reversible error.

A domestic industry analysis that credits alleged expenditures without first determining whether they are legally cognizable is necessarily incomplete as a matter of law. Accordingly, by inherently deeming PAX's economic prong expenditures "significant" without considering whether (and to what extent) they were legally cognizable, the Commission committed legal error. To correct it, this

Court should hold that domestic industry expenditures made in furtherance of federally illegal commerce may not be counted in the economic prong analysis.

D. This Court Should Remand for Factfinding on Whether PAX's Marijuana Oil Commerce Expenditures Are Illegal, and Whether the at Most 5% of Remaining Expenditures Can Satisfy the Economic Prong

Because the ALJ found the illegality question "beyond the scope" of the Investigation and the Commission never addressed it, no factual findings exist on whether (and to what extent) PAX's cannabis commerce expenditures may be considered in the economic prong analysis. This Court should therefore remand to the Commission for determination of these critical questions—to the extent it does not reverse the Commission's Final Determination outright.

The Third and Tenth Circuit's approaches—vacating trial court judgments and remanding for factfinding to determine, in the first instance, whether the conduct at issue was illegal under the CSA—are directly instructive on this point. *Apical*, 2026 WL 177927; *Bartch*, 111 F.4th 1043. Such a threshold factual determination as to CSA illegality must be made before a federal tribunal may lend its aid to enforce the underlying claim. *Id.; Higgins*, 116 U.S. at 686. The same principle applies here: the Commission must determine whether PAX's expenditures embody illegal conduct under the CSA before it may count them toward domestic industry. *See also CCH Acquisitions, LLC v. J&J&D Holdings, LLC*, No. 2:23-CV-2983, 2025 WL 601249, at *6 (S.D. Ohio Feb. 25, 2025) ("Ultimately, every asset … is entangled with

marijuana ….. The Court cannot calculate the value of these assets without becoming complicit in the parties' illegal agreement.").

Thus, this Court should vacate the Final Determination, and, at a minimum, remand to the Commission to make a factual determination, in the first instance, as to whether—after excluding all CSA-violative expenditures—PAX can satisfy the domestic industry economic prong. On remand, the Commission should consider the evidence and argument that the ALD presented in its MSD and that the ALJ excluded from the evidentiary hearing below.

E. In the Alternative, the Commission Abused its Discretion by Concluding that the Illegality of PAX's Purported Domestic Industry Was Not Relevant to the Public Interest

If a Section 337 violation is found, "the Commission must consider the effect of [its] remedy on four statutory public interest factors: (1) public health and welfare, (2) competitive conditions in the U.S. economy, (3) the production of like articles in the United States, and (4) U.S. consumers." *Philip Morris*, 63 F.4th at 1339 (citing 19 U.S.C. § 1337(d)(1), (f)(1).) Although the ALJ refused to consider the illegality issue, finding that "at best, that argument raises issues of public interest" for determination by the Commission, the Commission then also found that it was precluded from considering the illegality issue as part of its public interest determination. *Compare* Appx2 *with* Appx220 ("Neither Respondents' submission nor the two public submissions explain why the ability of the domestic industry

products to be used with cannabis oils is relevant to the public interest analysis, which assesses the effect of excluding the infringing products on the statutory public interest factors."). Thus, the Commission effectively concluded that the determination of whether a complainant's industry for which it seeks protection is lawful has no place in a Section 337 investigation. That approach defies common sense and runs contrary to how federal courts have consistently treated this issue.

It cannot be in the public interest to use the machinery of federal government to protect a domestic industry that embodies a federally illegal drug distribution enterprise. *See Shulman,* 58 F.4th at 411 ("Were we to substitute a drug like heroin for cannabis for the purposes of our analysis, the conclusion seems obvious…."). Further, as to at least the first public interest factor, "the public health and welfare," the federal illegality of PAX's industry is relevant. 19 U.S.C. §1337 (d)(1). Indeed, as the Supreme Court recently reiterated, "[t]he CSA … was adopted to protect 'the health and general welfare of the American people.'" *U.S. v. Hemani*, 146 S. Ct. 1677, 1692 (2026) (quoting 21 U.S.C. § 801 (2).) Surely, it is against the public welfare (and corrosive to the rule of law) to permit federal government agencies to use federal resources and federal power to protect a federally-unlawful business from competition. Yet, that is exactly what the Commission's LEO does.

Thus, in the alternative, the LEO against ALD should be vacated and the case remanded for the Commission to properly consider PAX's CSA-violative domestic industry with respect to the public interest factors—and articulate its reasoning.

VI. CONCLUSION AND STATEMENT OF RELIEF SOUGHT

For the foregoing reasons, Appellants ALD Group Ltd. and ALD (Hong Kong) Holdings Ltd. respectfully request that this Court:

1. Hold that expenditures made in furtherance of federally illegal activity cannot be counted toward the domestic industry economic prong of 19 U.S.C. § 1337(a)(3), vacate the limited exclusion order against ALD, and (unless it reverses outright) remand to the Commission for determination of whether PAX has satisfied the domestic industry economic prong in light of that holding; or

2. In the alternative, vacate the limited exclusion order against ALD and remand for the Commission to properly consider PAX's CSA violations in a public interest analysis under 19 U.S.C. §1337 (d)(1), and articulate its reasoning.

Additionally, for the reasons argued in STIIIZY's principal brief, ALD respectfully requests that this Court vacate the limited exclusion order and reverse due to PAX's failure to satisfy the economic prong requirement without improper reliance on pre-patent issuance investments.

Dated: September 10, 2026

Respectfully submitted,

/s/ *Laurence M. Sandell*

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CERTIFICATE UNDER FED. CIR. R. 25.1(e)(2)

I hereby certify that this principal brief contains 15 unique words (including numbers) marked confidential. This number does not exceed the maximum of 15 words permitted by Fed. Cir. R. 25.1(d)(1)(A). The unique words reflect information PAX has designated CONFIDENTIAL BUSINESS INFORMATION pursuant to the March 6, 2024, Protective Order.

Dated: September 10, 2026

/s/ *Laurence M. Sandell*
Laurence M. Sandell

ADDENDUM

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

In the Matter of	
CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	**Inv. No. 337-TA-1392**

ORDER NO. 22: DENYING RESPONDENTS' MOTION FOR SUMMARY DETERMINATION THAT PAX FAILS TO SATISFY THE DOMESTIC INDUSTRY ECONOMIC PRONG

(October 8, 2024)

On August 21, 2024, Respondents ALD Group Limited and ALD (Hong Kong) Holdings Limited (collectively, "ALD") moved (Mot. No. 1392-011) for summary determination that Complainant PAX Labs Inc. ("PAX") has failed to satisfy the economic prong of the domestic industry requirement under 19 U.S.C. § 1337(a)(3). PAX opposed the motion on September 3, 2024.

The ALD Respondents claim that "at least 95% of [PAX's] asserted domestic industry product pods are filled with, and ultimately sold to consumers containing, federally illegal Marijuana oil pursuant to its voluntary agreements with producers and distributors of federally illegal Marijuana oils." Mot. at 1; *see also* Mem. at 4-5. They argue that PAX cannot rely on investments made in furtherance of an alleged "illegal federal drug conspiracy" to satisfy the economic prong of the domestic industry requirement. *Id*. (citing 21 U.S.C. § 846 (the "Controlled Substances Act").) ALD therefore asserts PAX cannot satisfy the economic prong of the domestic industry requirement as a matter of law. *Id*. at 2.

PAX asserts that its domestic industry is not based on activities that are illegal under the Controlled Substances Act. Opp. at 1. PAX explains that the expenses and expenditures it relies

on are "all directed toward research and development, product design, testing procurement, quality control and manufacturing-related expenses for batteries and empty pods, which are federally legal activities." *Id*. at 5 (citing Ex. A at ¶¶ 42-48, 56-99). PAX also asserts that ALD's motion is a "thinly veiled attempt to convince the Commission to deny PAX relief based on an unauthorized public interest argument." *Id*. at 2.

Summary determination is appropriate when there is no genuine issue as to any material fact and the moving party is entitled to a determination as a matter of law. *See* 19 C.F.R. § 210.18. In determining whether there is a genuine issue of material fact, "the evidence must be viewed in the light most favorable to the party opposing the motion with doubts resolved in favor of the nonmovant." *Crown Operations Int'l, Ltd. v. Solutia, Inc.*, 289 F.3d 1367, 1374 (Fed. Cir. 2002) (citations omitted).

Having reviewed the parties' briefs and the attached evidence, I find that summary determination is not appropriate because genuine issues of material fact remain at least as to the qualitative and quantitative significance of PAX's domestic industry investments.[1] I also find that ALD's argument that PAX is engaged in a criminal conspiracy to violate the Controlled Substances Act to be beyond the scope of this investigation.[2] At best, that argument raises issues of public interest, which the Commission did not authorize me to take evidence on. *See* 19 C.F.R. § 210.50(b)(1) ("Unless the Commission orders otherwise, and except as provided for in paragraph (b)(2) of this section, an administrative law judge shall not take evidence on the issue of the public interest for purposes of the recommended determination under § 210.42(a)(1)(ii).").

Accordingly, Motion Docket No. 1392-011 for summary determination is DENIED.

[1] The Asserted Patents are generally directed to "vaporizer cartridges and vaporizer apparatuses" for vaporizing oil-based vaporizable materials.
[2] PAX has not been accused of violating the Controlled Substances Act by the U.S. government.

PUBLIC VERSION

Within seven days of the date of this document, the parties shall submit to the Office of the Administrative Law Judges a joint statement as to whether they seek to have any portion of this document deleted from the public version. If the parties do seek to have portions of this document deleted from the public version, they must submit to this office a copy of this document with red brackets indicating the portion or portions asserted to contain confidential business information. The submission should be emailed by the aforementioned date and need not be filed with the Commission Secretary.

SO ORDERED.

Bryan F. Moore
Administrative Law Judge

Certain Oil Vaporizing Devices, Components Thereof, and Products Containing the Same; Inv. No. 337-TA-1392 (Violation)

337-1392 Violation

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
862839	Public	Order	09/24/2025 10:46 AM	Denying Respondents' Motion for Summary Determination That PAX Fails to Satisfy the Domestic Indu...

Service Date: September 24, 2025

/s

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CERTIFICATE OF SERVICE

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PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

IN THE MATTER OF CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	**Inv. No. 337-TA-1392**

INITIAL DETERMINATION ON VIOLATION OF SECTION 337 AND RECOMMENDED DETERMINATION ON REMEDY AND BOND

Administrative Law Judge Bryan F. Moore

(March 6, 2025)

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LIST OF ABBREVIATIONS

The following abbreviations may be used in this Initial Determination:

CDX	Complainant's demonstrative exhibit
CPX	Complainant's physical exhibit
CX	Complainant's exhibit
CIB	Complainant's initial post-hearing brief
CRB	Complainant's reply post-hearing brief
CPHB	Complainant's pre-hearing brief
Dep.	Deposition
JX	Joint Exhibit
RDX	Respondents' demonstrative exhibit
RPX	Respondents' physical exhibit
RX	Respondents' exhibit
RIB	Respondents' initial post-hearing brief
RRB	Respondents' reply post-hearing brief
RPHB	Respondents' pre-hearing brief
Tr.	Transcript
RUCL	Respondents' Undisputed Claim Limitations
CUCL	Complainant's Amended List of Undisputed Claim Limitations

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

In the Matter of	
CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	**Inv. No. 337-TA-1392**

INITIAL DETERMINATION ON VIOLATION OF SECTION 337 AND RECOMMENDED DETERMINATION ON REMEDY AND BOND

Administrative Law Judge Bryan F. Moore

(March 6, 2025)

Pursuant to the Notice of Investigation, this is the final initial determination in the matter of *Certain Oil Vaporizing Devices, Components Thereof, and Products Containing the Same*, Investigation No. 337-TA-1392.

For the reasons stated herein, I have determined that no violation of section 337 of the Tariff Act of 1930, as amended, has occurred in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same with respect to U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580.

PUBLIC VERSION

I. INTRODUCTION

A. Procedural History

The Commission instituted the present investigation on March 6, 2024, based on a complaint filed by Complainant PAX Labs Inc. ("PAX"). 89 *Fed. Reg.* 16,025-26 (Mar. 6, 2024). The complaint, as supplemented, alleges violations of section 337 by the importation into the United States, sale for importation, or the sale in the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same that infringe one or more of the asserted claims of U.S. Patent Nos. 11,369,756 (the "'756 patent"); 11,369,757 (the "'757 patent"); 11,766,527 (the "'527 patent"); and 11,759,580 (the "'580 patent") (collectively, the "Asserted Patents"). *Id*. The complaint further alleges that a domestic industry exists. *Id*. The notice of institution named two groups of respondents: (1) STIIIZY IP LLC f/k/a STIIIZY, LLC and STIIIZY, Inc. d/b/a Shryne Group Inc. (collectively, "STIIIZY"); and (2) ALD Group Limited and ALD (Hong Kong) Holdings Limited (collectively, "ALD") (together, "Respondents"). *Id*. The Office of Unfair Import Investigations is not a party to this investigation.

A *Markman* hearing was held on June 25, 2024. *See* EDIS Doc. ID 824458. A *Markman* order issued on August 30, 2024, construing certain claim terms. Order No. 19.

Over the course of the proceeding, PAX withdrew several of its patent infringement allegations. Specifically, on July 11, 2024, I granted a motion by PAX to terminate claims 4 and 21 of the '527 patent. Order No. 11, *unreviewed*, Comm'n Notice (July 30, 2024). I also granted a motion for partial termination of the investigation with respect to claims 2-3, 6-9, and 11-17 of the '756 patent; claims 3-8, 10-12, 14, and 17-19 of the '757 patent; claims 2-3, 6-9, 12-16, 19-20, 24-25, and 27-29 of the '527 patent; and claims 2-5, 9, 12-15, and 19 of the '580 patent. Order No. 20, *unreviewed*, Comm'n Notice (Oct. 7, 2024).

An evidentiary hearing was held from October 21, 2024, to October 23, 2024.

After the hearing, claims 2, 9, and 16 of the '757 patent; claims 23, 26, and 30 of the '527 patent; and claims 11, 16-18, and 20 of the '580 patent were terminated from the investigation. Order No. 32, *unreviewed*, Comm'n Notice (Dec. 10, 2024).

B. The Parties

1. Complainant Pax Labs, Inc.

PAX is a corporation organized under the laws of the State of Delaware, having its principal place of business at 660 Alabama St., Second Floor, San Francisco, CA 94110. EDIS Doc. ID 812857 ("Compl.") at ¶ 9. PAX designs and develops vaporizing technology, including vaporizing hardware and software products. *Id*.

2. Respondents

a) The ALD Respondents

i) ALD Group Limited

ALD Group Limited is a Chinese corporation located in Shenzhen, China. RIB at 2.

ii) ALD (Hong Kong) Holdings Limited

ALD (Hong Kong) Holdings Limited is a Hong Kong corporation located in Hong Kong. *Id*. ALD HK wholly owns ALD Group Limited. Compl., ¶ 5.

b) The STIIIZY Respondents

i) STIIIZY Inc. d/b/a Shryne Group Inc.

On March 14, 2023, Shryne Group Inc. was merged into STIIIZY Inc., with the surviving corporation being STIIIZY Inc. *Id*. at ¶ 16. STIIIZY Inc. is a Delaware corporation with its principal place of business in Los Angeles, CA. RIB at 2. It is the parent of STIIIZY IP LLC. *Id*. at ¶ 17.

ii) STIIIZY IP LLC f/k/a STIIIZY LLC

In March 2023, STIIIZY LLC changed its name to STIIIZY IP LLC. JX-0144C at 23. STIIIZY IP LLC f/k/a STIIIZY LLC is a California corporation located in Los Angeles, CA. RIB at 2.

C. The Technology at Issue

The technology at issue relates to vaporizer cartridges, vaporizer bodies, and vaporizers. CIB at 3; RIB at 2.

D. The Products at Issue

The plain language description of the accused products or category of accused products is "vaporizing devices capable of vaporizing oils, components thereof and products containing the same' where the components of a vaporizing device are 'a mouthpiece, a cartridge body, an atomizer, a distal member, a bottom cover, a vaporizer body including a cartridge receiver,' as well as a 'battery,' and where products containing the same are cartridge and battery components 'sold in combination with a power charging device in which the [cartridge] or battery would each be one component of the downstream product.'" 89 *Fed. Reg.* 16,025.

1. The Accused Products

PAX accuses numerous vaporizer and vaporizer cartridge products of infringing the Asserted Patents. CIB at 4-8. According to PAX, "[t]he accused cartridges all have substantially the same components (e.g., mouthpiece, cartridge body, atomizer/heater, bottom cover), and they all function in substantially the same way." *Id*. at 4. Likewise, the accused vaporizers all include substantially the same components (*e.g.*, vaporizer cartridge, vaporizer body, battery), and they all function in substantially the same way. *Id.* at 5.

PUBLIC VERSION

The Accused Products set forth below are product categories, most of which have numerous variants that "differ only in ways that are immaterial to infringement, such as differences in oil flavor or cosmetic appearance." *Id*.

Accused Products	Asserted Patents			
	'756 Patent	'757 Patent	'527 Patent	'580 Patent
STIIIZY-1G(C) [JPX-0010]	✓	✓	✓	✓
STIIZY-05G(C) [JPX-0011]	✓	✓	✓	✓
STIIIZY-ORIG-1G [JPX-0012 + JPX-0010]	✓	✓	✓	✓
STIIIZY-ORIG-05G [JPX-0012 + JPX-0011]	✓	✓	✓	✓
STIIIZY-BIIIG-1G [JPX-0013 + JPX-0010]	✓	✓	✓	✓
STIIIZY-BIIIG-05G [JPX-0013 + JPX-0011]	✓	✓	✓	✓
STIIIZY-LIIIL [JPX-0014]	✓	✓	✓	✓
STIIIZY-AIO [JPX-0015]			✓	✓
FLARE(C) [JPX-0002]			✓	✓
FLARE(V) [JPX-0001 + JPX-0002]			✓	✓
ROVE(C) [JPX-0005]			✓	✓
ROVE(V) [JPX-0004 + JPX-0005]			✓	✓
STIIIZY-1G-REDESIGN(C) [JPX-0008]				✓
STIIZY-05G-REDESIGN(C) [JPX-0009]				✓
STIIIZY-ORIG-1G-REDESIGN [JPX-0012 + JPX-0008]				✓
STIIIZY-ORIG-05G-REDESIGN [JPX-0012 + JPX-0009]				✓
STIIIZY-BIIIG-1G-REDESIGN [JPX-0013 + JPX-0008]				✓
STIIIZY-BIIIG-05G-REDESIGN [JPX-0013 + JPX-0009]				✓
STIIIZY-AIO-REDESIGN [JPX-0007]				✓
FLARE-REDESIGN(C) [JPX-0003]				✓
FLARE-REDESIGN(V) [JPX-0001 + JPX-0003]				✓
ROVE-REDESIGN(C) [JPX-0006]				✓
ROVE-REDESIGN(V) [JPX-0004 + JPX-0006]				✓

2. The Domestic Industry Products

PAX relies on the following products to establish the existence of a domestic industry:

DI Products	Asserted Patents			
	'756 Patent	'757 Patent	'527 Patent	'580 Patent
ERA-05G(C) [CPX-0009]	✓	✓	✓	✓
ERA-1G(C) [CPX-0008]	✓		✓	
ERA-ORIG-05G [CPX-0001 + CPX-0009]	✓	✓	✓	✓
ERA-ORIG-1G [CPX-0001 + CPX-0008]	✓		✓	
ERA-PRO-05G [CPX-0002 + CPX-0009]	✓	✓	✓	✓
ERA-PRO-1G [CPX-0002 + CPX-0008]	✓		✓	
ERA-LIFE-05G [CPX-0003 + CPX-0009]	✓	✓	✓	✓
ERA-LIFE-1G [CPX-0003 + CPX-0008]	✓		✓	
ERA-GO-05G [CPX-0004 + CPX-0009]	✓	✓	✓	✓
ERA-GO-1G [CPX-0004 + CPX-0008]	✓		✓	

Id. at 8. PAX explains: "In the DI Products, an Era vaporizer is formed by inserting an Era cartridge into an Era battery. The Era cartridges include the ERA-05G(C) and ERA-1G(C). The Era batteries include the ERA-ORIG(B), ERA-PRO(B), ERA-LIFE(B), and ERA-GO(B). Any Era battery can be combined with any Era cartridge to form an Era vaporizer." *Id*.

As with the Accused Products, the DI Products listed above are product categories, with some having numerous variants that "differ only in ways that are immaterial to practicing the Asserted Patents." *Id*. at 9; *see also* EDIS Doc. ID 825968 (Joint Statement Identifying Accused Prods.).

E. The Asserted Patents

The Asserted Patents are all entitled "Leak-Resistant Vaporizer Device" and name the same six inventors: Nicholas Jay Hatton, Steven Christensen, Esteban Leon Duque, Ariel Atkins, James Monsees, and Adam Bowen. JX-0001–JX-0004. The Asserted Patents are generally directed to "leak-resistant vaporizer cartridges and apparatuses adapted for use with oil-based vaporizable materials including Cannabis oils." *See, e.g.*, JX-0001 at Abstract. They share a common specification and were issued from continuation applications of App. No. 15/396,584, filed

December 31, 2016, which issued as U.S. Patent No. 11,660,403 ("the '403 patent"). JX-0001–JX-0004. The Asserted Patents and the '403 patent all claim priority to Provisional App. No. 62/398,494, filed on Sept. 22, 2016. *Id.*

The asserted claims are apparatus claims focusing on the mechanical aspects of vaporizing devices. An exemplary vaporizer cartridge is shown in Figure 3B of the '756 patent and is reproduced below.

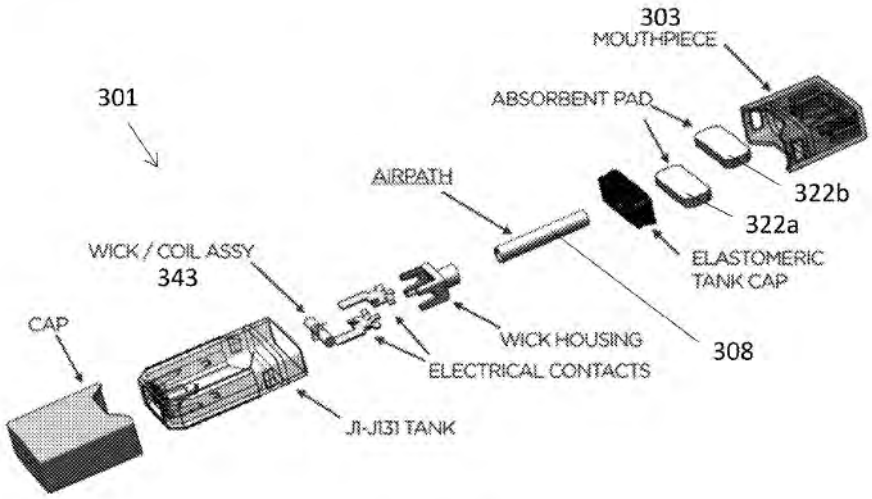


FIG. 3B

JX-0001 at Fig. 3B.

1. Claim Construction

During the *Markman* phase, the parties agreed to the construction of the following claim terms:

Claim Term	Parties' Agreed Construction
"air opening"/ "air openings"	Plain and ordinary meaning: An opening allowing air to pass
"pad"	A piece of absorbent material

Claim Term	Parties' Agreed Construction
"A housing opening configured to receive at least [a/the] portion of the heater"	Plain and ordinary meaning: A housing opening configured to receive at least [a/the] portion of the heater

Order No. 19 at 26. In the *Markman* order, I construed the following terms:

Claim Term	Parties' Agreed Construction
"bottom cover"	Plain and ordinary meaning: A structure covering a bottom of a component
"bottom portion"	Plain and ordinary meaning
"heater"	Plain and ordinary meaning
"housing opening into which at least a portion of the atomizer passes into the housing piece"	Plain and ordinary meaning

Id. at 28, 32, 34. 39.

2. Person of Ordinary Skill in the Art

I previously determined that a person of ordinary skill in the art with respect to the Asserted Patents would have a bachelor's degree in electrical and/or mechanical engineering or a related scientific discipline and at least a year of practical experience in mechanical engineering or a similar industry. *Id*. at 25. I further found that a higher level of education may substitute for a lesser amount of experience, and vice versa. *Id*.

II. PRELIMINARY ISSUES

A. Statutory Authority

The Commission has statutory authority[1] to investigate an alleged violation of section 337(a)(1)(A) by named respondents when such respondents have allegedly used unfair methods of

[1] Prior Commissions decisions have referred to terms such as "subject matter jurisdiction," "personal jurisdiction," and/or "in rem jurisdiction." *Certain Liquid Transfer Devices with an Integral Vial Adapter*, Inv. No. 337-TA-1362, Comm'n Op. at 9 (July 26, 2024). Although the Commission has used such terms in the past as a shorthand for statutory authority, the Commission

competition and unfair acts in the importation of articles into the United States, the threat or effect of which is to destroy or substantially injure a domestic industry in the United States or prevent the establishment of an industry in the United States. 19 U.S.C. § 1337(a)(1)(A). Here, PAX's complaint states that Respondents violated section 337 by importing the Accused Products by reason of infringement of certain claims of the Asserted Patents. Compl., ¶¶ 48-49. The Commission thus has statutory authority to conduct this investigation.

Both PAX and Respondents have actively participated in this investigation. Neither has contested the Commission's statutory authority. CIB at 9; RIB at 3. I find that the Commission has statutory authority over PAX and Respondents in accordance with the Commission's governing statutes. *See, e.g.*, 19 U.S.C. §§ 1333, 1337(e)-(f).

B. Importation

The statute defines a violation of section 337 as "[t]he importation into the United States, the sale for importation, or the sale within the United States after importation by the owner, importer, or consignee, of articles that . . . infringe a valid and enforceable United States patent." 19 U.S.C. § 1337(a)(1)(B). Accordingly, "[t]o prevail under section 337, a complainant must prove that a respondent actually imported or sold for [or after] importation the articles at issue." *Certain Carbon & Alloy Steel Prods.*, Inv. No. 337-TA-1002, Order No. 103 at 33, *unreviewed*, Comm'n Notice (Nov. 1, 2017).

Respondents have stipulated that the Accused Products have been imported into the United States. EDIS Doc. ID 832808 (Joint Stipulation re: Importation and Inventory); *see also* RPHB at

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has "endeavor[ed] to realign its terminology with the language of section 337" and has clarified that "it has 'statutory authority' to investigate the alleged violation, rather than 'subject matter jurisdiction,' 'personal jurisdiction,' and/or '*in rem* jurisdiction' under Article III" of the U.S. Constitution. *Id.*

5 ("Respondents do not contest . . . that importation of Respondents' Accused Products has occurred.").

C. Ownership

Commission Rule 210.12 states in relevant part "[f]or every intellectual property based complaint (regardless of the type of intellectual property involved), [the complaint must] include a showing that at least one complainant is the owner or exclusive licensee of the subject intellectual property." 19 C.F.R. § 210.12(a)(7); *see also Certain Active Matrix Organic Light-Emitting Diode Display Panels & Modules for Mobile Devices, & Components Thereof*, Inv. No. 337-TA-1351, Comm'n Op. at 14 (May 15, 2024).

The record demonstrates that PAX has ownership of the Asserted Patents. CX-0079–CX-0082 (assignment records for the Asserted Patents); *see also* RPHB at 5 ("Respondents do not contest that PAX owned the Asserted Patents at the time the Complaint was filed.").

III. LEGAL PRINCIPLES

A. Infringement

In a section 337 investigation, the complainant bears the burden of proving infringement of the asserted patent claims by a preponderance of the evidence. *See Spansion, Inc. v. Int'l Trade Comm'n*, 629 F.3d 1331, 1349 (Fed. Cir. 2010). This standard "requires proving that infringement was more likely than not to have occurred." *Warner-Lambert Co. v. Teva Pharm. USA, Inc*., 418 F.3d 1326, 1341 n.15 (Fed. Cir. 2005).

1. Direct Infringement

a) Literal Infringement

"Literal infringement requires the patentee to prove that the accused device contains each limitation of the asserted claim(s). If any claim limitation is absent, there is no literal infringement as a matter of law." *Bayer AG v. Elan Pharm. Res. Corp*., 212 F.3d 1241, 1247 (Fed. Cir. 2000). Literal infringement is a question of fact. *Finisar Corp. v. DirecTV Grp., Inc.*, 523 F.3d 1323, 1332 (Fed. Cir. 2008).

b) Doctrine of Equivalents

"[A] product or process that does not literally infringe upon the express terms of a patent claim may nonetheless be found to infringe if there is 'equivalence' between the elements of the accused product or process and the claimed elements of the patented invention." *Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, 520 U.S. 17, 21 (1997). "[T]he proper time for evaluating equivalency . . . is at the time of infringement, not at the time the patent issued." *Id*. at 37.

"The 'essential inquiry' in determining whether there has been infringement under this doctrine is whether 'the accused product or process contains elements identical or equivalent to each claimed element of the patented invention.'" *Am. Calcar, Inc. v. Am. Honda Motor Co.,* 651 F.3d 1318, 1338 (Fed. Cir. 2011) (quoting *Warner–Jenkinson,* 520 U.S. at 40). An element in the accused device is equivalent to a claim limitation if the only differences between the two are insubstantial to one of ordinary skill in the art. *Wavetronix LLC v. EIS Elec. Integrated Sys.*, 573 F.3d 1343, 1360 (Fed. Cir. 2009); *AquaTex Indus. v. Techniche Sols.*, 419 F.3d 1374, 1382 (Fed. Cir. 2005). In order to assess insubstantiality, a court considers whether an element of the accused product "performs substantially the same function in substantially the same way to obtain the same result" as the patented invention. *Am. Calcar,* 651 F.3d at 1338; *see also Voda v. Cordis Corp.*, 536

F.3d 1311, 1326 (Fed. Cir. 2008). A patentee alleging infringement under the doctrine of equivalents must submit particularized evidence as to equivalence and must explain specifically why the difference between the claimed invention and what the accused product actually does is "insubstantial." *Am. Calcar,* 651 F.3d at 1338.

Prosecution history estoppel can prevent a patentee from relying on the doctrine of equivalents when the patentee relinquished subject matter during prosecution of the patent, either by amendment or argument. *AquaTex*, 419 F.3d at 1382. In particular, "[t]he doctrine of prosecution history estoppel limits the doctrine of equivalents when an applicant makes a narrowing amendment for purposes of patentability, or clearly and unmistakably surrenders subject matter by arguments made to an examiner." *Id*.

2. Indirect Infringement

Indirect infringement may be either induced or contributory. Direct infringement must first be established for a claim of indirect infringement to prevail. *BMC Res. v. Paymentech,* 498 F.3d 1373, 1379 (Fed. Cir. 2007).

a) Induced Infringement

Section 271(b) of the Patent Act provides: "Whoever actively induces infringement of a patent shall be liable as an infringer." 35 U.S.C. §271(b). To establish liability, the patent holder must prove that "once the defendants knew of the patent, they 'actively and knowingly aid[ed] and abett[ed] another's direct infringement.'" *DSU Med. Corp. v. JMS Co., Ltd.*, 471 F.3d 1293, 1305 (Fed. Cir. 2006) (*en banc*) (citations omitted). A finding of induced infringement requires "evidence of culpable conduct, directed to encouraging another's infringement, not merely that the inducer had knowledge of the direct infringer's activities." *Id*. at 1306. Although § 271(b) requires knowledge that the induced acts constitute patent infringement, the Supreme Court has held that

liability will also attach when the defendant is willfully blind. *Global-Tech Appliances, Inc. v. SEB S.A.*, 131 S. Ct. 2060, 2068-2069 (2011). The burden is on the complainant to prove that the respondent had the specific intent and took action to induce infringement. *DSU*, 471 F.3d at 1305-06. Intent may be proven by circumstantial evidence. *Lucent Techs., Inc. v. Gateway, Inc.*, 580 F.3d 1301, 1322 (Fed. Cir. 2009).

b) Contributory Infringement

"[T]o prevail on contributory infringement in a Section 337 case, the complainant must show *inter alia*: (1) there is an act of direct infringement in violation of Section 337; (2) the accused device has no substantial non-infringing uses; and (3) the accused infringer imported, sold for importation, or sold after importation within the United States, the accused components that contributed to another's direct infringement." *Spansion*, 629 F.3d at 1353 (Fed. Cir. 2010).

B. Validity

A patent is presumed valid. *See* 35 U.S.C. § 282; *Microsoft Corp. v. i4i Ltd. P'ship*, 564 U.S. 91, 95 (2011). A respondent who has raised patent invalidity as an affirmative defense has the burden of overcoming this presumption by clear and convincing evidence. *See Microsoft*, 564 U.S. at 95.

1. 35 U.S.C. § 102 (Anticipation)

Under 35 U.S.C. § 102, a claim is anticipated and therefore invalid when "the four corners of a single, prior art document describe every element of the claimed invention, either expressly or inherently, such that a person of ordinary skill in the art could practice the invention without undue experimentation." *Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1282 (Fed. Cir. 2000), cert. denied, 532 U.S. 904 (2001). To be considered anticipatory, the prior art reference must be enabling and describe the applicant's claimed invention sufficiently to have

placed it in possession of a person of ordinary skill in the field of the invention. *Helifix Ltd. v. Blok-Lok, Ltd.*, 208 F.3d 1339, 1346 (Fed. Cir. 2000).

2. 35 U.S.C. § 103 (Obviousness)

Under 35 U.S.C. § 103, a patent may be found invalid as obvious if "the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." 35 U.S.C. § 103. Because obviousness is determined at the time of invention, rather than the date of application or litigation, "[t]he great challenge of the obviousness judgment is proceeding without any hint of hindsight." *Star Scientific, Inc. v. R.J. Reynolds Tobacco Co*., 655 F.3d 1364, 1375 (Fed. Cir. 2011) ("*Star II*").

When a patent is challenged as obvious, the critical inquiry in determining the differences between the claimed invention and the prior art is whether there is a reason to combine the prior art references. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 418-21 (2007). The Federal Circuit has since held that "the burden falls on the patent challenger to show by clear and convincing evidence that a person of ordinary skill in the art would have had reason to attempt to make the composition or device, or carry out the claimed process, and would have had a reasonable expectation of success in doing so." *PharmaStem Therapeutics, Inc. v. ViaCell, Inc.*, 491 F.3d 1342, 1360 (Fed. Cir. 2007) (citations omitted).

Obviousness is a determination of law based on underlying determinations of fact. *Star II*, 655 F.3d at 1374. The factual determinations behind a finding of obviousness include: (1) the scope and content of the prior art, (2) the level of ordinary skill in the art, (3) the differences between the claimed invention and the prior art, and (4) secondary considerations of non-obviousness. *KSR,*

550 U.S. at 399 (citing *Graham v. John Deere Co*., 383 U.S. 1, 17 (1966)). These factual determinations are referred to collectively as the "*Graham* factors." Secondary considerations of non-obviousness include commercial success, long felt but unresolved need, and the failure of others. *Id.* When present, secondary considerations "give light to the circumstances surrounding the origin of the subject matter sought to be patented," but they are not dispositive on the issue of obviousness. *Geo. M. Martin Co. v. Alliance Mach. Sys. Int'l.*, 618 F.3d 1294, 1304-06 (Fed. Cir. 2010). A court must consider all the evidence from the *Graham* factors before reaching a decision on obviousness. For evidence of secondary considerations to be given substantial weight in the obviousness determination, its proponent must establish a nexus between the evidence and the merits of the claimed invention. *W. Union Co. v. MoneyGram Payment Sys. Inc.*, 626 F.3d 1361, 1372-73 (Fed. Cir. 2010) (citing *In re GPAC Inc.,* 57 F.3d 1573, 1580 (Fed. Cir. 1995)).

3. 35 U.S.C. § 112, ¶ 1 (Written Description)

The specification must provide a written description of the claimed invention that "reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (*en banc*). Determining whether the written description requirement has been satisfied "requires an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art[]" to determine whether the specification "show[s] that the inventor actually invented the invention claimed." *Id.* Compliance with the written description requirement is a question of fact and "the level of detail required to satisfy the written description requirement varies depending on the nature and scope of the claims and on the complexity and predictability of the relevant technology." *Id.*

C. Domestic Industry

For a patent-based complaint, a violation of section 337 can be found "only if an industry in the United States, relating to the articles protected by the patent . . . concerned, exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). The complainant bears the burden of establishing that the domestic industry requirement is satisfied. *John Mezzalingua Assocs., Inc. v. Int'l Trade Comm'n*, 660 F.3d 1322, 1331 (Fed. Cir. 2011). This domestic industry requirement of section 337

is often described as having a "technical prong" and an "economic prong." *InterDigital Commc'ns, LLC v. Int'l Trade Comm'n*, 707 F.3d 1295, 1298 (Fed. Cir. 2013).

The "technical prong" is satisfied when the complainant in a patent-based section 337 investigation establishes that it is practicing or exploiting the patents at issue. *See* 19 U.S.C. § 1337(a)(2), (3); *Certain Microsphere Adhesives, Processes for Making Same, & Prods. Containing Same, Including Self-stick Repositionable Notes*, Inv. No. 337-TA-366 ("*Microsphere Adhesives*"), USITC Pub. No. 2949, Comm'n Op. at 24 (Jan. 16, 1996). "The test for satisfying the 'technical prong' of the industry requirement is essentially [the] same as that for infringement, *i.e.*, a comparison of domestic products to the asserted claims." *Alloc, Inc. v. Int'l Trade Comm'n*, 342 F.3d 1361, 1375 (Fed. Cir. 2003). To prevail, the patentee must establish by a preponderance of the evidence that the domestic product practices one or more valid claims of the patent. *See id.*; *Spansion*, 629 F.3d at 1349; *Certain Vision-Based Driver Assistance Sys. Cameras & Components Thereof*, Inv. No. 337-TA-907, Comm'n Op. at 36, USITC Pub. No. 4866 (Feb. 2019). It is sufficient to show that the products practice any claim of that patent, not necessarily a claim of that patent asserted for infringement. *See Certain Male Prophylactic Devices*, Inv. No. 337-TA-546, Comm'n Op. at 38 (Aug. 1, 2007).

The "economic prong" requires, with respect to the products protected by a patent, either: (A) "significant investment in plant and equipment"; (B) "significant employment of labor or capital"; or (C) "substantial investment in [the patent's] exploitation, including engineering, research and development, or licensing." 19 U.S.C. § 1337(a)(3)(A)-(C). These activities must be related to the particular patent(s) at issue. *Certain Stringed Musical Instruments & Components Thereof*, Inv. No. 337-TA-586, Comm'n Op. at 13 (May 16, 2008). There is no minimum monetary expenditure required to show that an investment is "substantial" or "significant"; rather, this is a fact-dependent inquiry will depend on the industry in question, the complainant's relative size, and other factors. *Id.* at 25-26.

IV. U.S. PATENT NO. 11,369,756

A. Overview

The '756 patent issued on June 28, 2022, and has 17 claims. JX-0001 at cover page. Claims 1, 5, and 10 are asserted in this investigation. CIB at 14. These claims are reproduced below:

Claim	Claim Language
756.1.pre	A vaporizer cartridge comprising:
756.1.a	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
756.1.b	a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;
756.1.c.	a reservoir comprising an internal volume at least partially defined by the cartridge body, the internal volume configured to hold a vaporizable material;
756.1.d	a first reservoir seal;
756.1.e	a second reservoir seal, wherein the first reservoir seal and the second reservoir seal are each configured to cover a corresponding reservoir opening exposing the internal volume of the reservoir;
756.1.f	a first pad positioned within an interior of the mouthpiece;
756.1.g	a second pad positioned within the interior of the mouthpiece;
756.1.h	a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening;
756.1.i	a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;

Claim	Claim Language
756.1.j	a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and
756.1.k	a heater chamber comprising:
756.1.k.i	an atomizer configured to heat the vaporizable material from the reservoir to generate an aerosol;
756.1.k.ii	a housing piece configured to house at least a portion of the atomizer, the housing piece comprising a housing opening into which at least a portion of the atomizer passes into the housing piece; and
756.1.k.iii	an air tube extending from the housing piece, the air tube configured to deliver the aerosol from the atomizer to the mouthpiece;
756.1.l	wherein the first pad and the second pad do not intersect with a central axis of the air tube.
756.5.pre	A vaporizer device, comprising:
756.5.a	the vaporizer cartridge of claim 1; and
756.5.b	the vaporizer body, comprising:
756.b.i	a cartridge receiver configured to insertably receive the vaporizer cartridge, the cartridge receiver comprising:
756.b.ii	the first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;
756.b.iii	the second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;
756.b.iv	an insertion end into which the vaporizer cartridge is inserted; and
756.b.v	a base opposite the insertion end.
756.10.pre	The vaporizer cartridge of claim 1, wherein the bottom portion of the bottom cover comprises:
756.10.a	a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; and
756.10.b	a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.

B. Direct Infringement

PAX asserts that the '756 Accused Products identified below infringe the asserted claims of the '756 patent:

'756 Accused Products	Representative Products	Asserted Claims
STIIIZY-1G(C)	STIIIZY-1G(C)	1 and 10
STIIZY-05G(C)		
STIIIZY-ORIG-1G	STIIIZY-ORIG-1G	1, 5, and 10
STIIIZY-ORIG-05G		
STIIIZY-BIIIG-1G		
STIIIZY-BIIIG-05G		
STIIIZY-LIIIL	STIIIZY-LIIIL	1

Id.

1. STIIIZY-LIIIL

a) Claim 1

i) Limitations 756.1.pre – 756.1.g

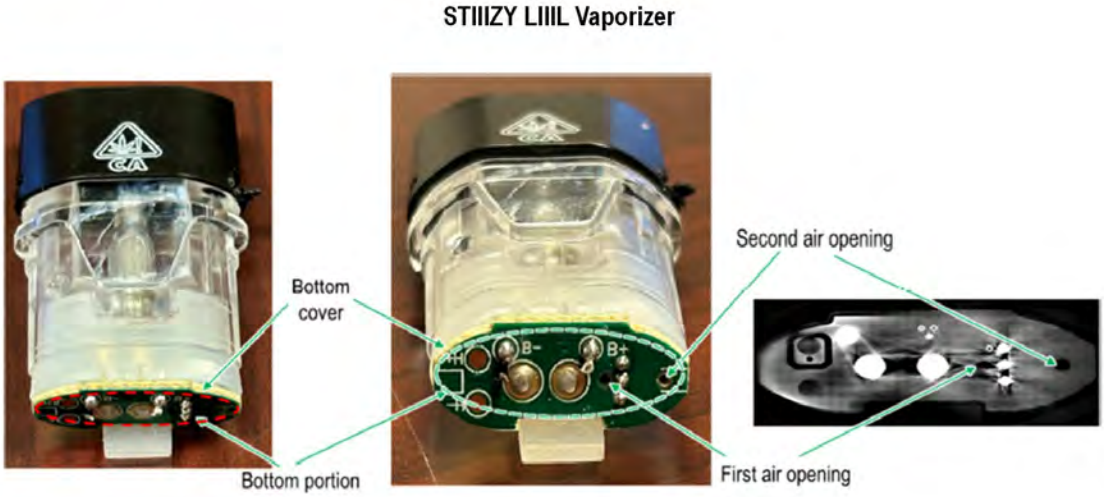
Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 2. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 100-101, 104, 107, 111.

ii) Limitation 756.1.h

Limitation 756.1.h recites "a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening." JX-0001, cl. 1. The parties' dispute centers on the claimed "bottom cover." PAX alleges that this limitation is satisfied by a printed board circuit that is press-fit into the bottom of the cartridge and covers the bottom of the cartridge when that component is fully assembled. CIB at 15-16; CRB at 2-3. Respondents insist the circuit board is not part of the cartridge. RIB at 6-7;

RIB at 2-3. According to Respondents, "[t]the circuit board electrically connects the battery via attached wires, all from within the vaporizer base."[2] RIB at 6.

"Bottom cover" has been construed to mean "a structure covering a bottom of a component." Order No. 19 at 28. Limitations are not read in isolation, however. *See Phillips,* 415 F.3d at 1314 ("[T]he context in which a term is used in the asserted claim can be highly instructive.") Thus, when read in the context of the claim, the bottom cover does not cover just any component, as Respondents claim. It covers the vaporizer cartridge. *See* JX-0001, cl. 1. As seen in the photos below, the circuit board is a structure covering the bottom of the cartridge component.



CDX-0252; *see also* -0 (Kodama) at Q/As 115, 118.

[2] Respondents point to the specification's disclosure of control circuits being housed within the vaporizer body for some embodiments. RIB at 6. This reliance is misplaced, however. The Federal Circuit has made clear that "the accused device must be compared to the claims rather than to a preferred or commercial embodiment." *See Amgen Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1347 (Fed. Cir. 2003).

Respondents argue that the circuit board is really part of the vaporizer body.[3] This is contradicted by the product's assembly instructions. JX-0414C; *see also* CX-4747C (Kodama) at Q/As 138-140. [redacted]

[redacted]

[3] Respondents claim there is also a foam component on part of the bottom of the circuit board which is positioned more distally than the circuit board relative to the cartridge body. RIB at 6. They cite to a photo of a disassembled STIIIZY-LIIIL but that photo does not identify the foam component. *Id.* [redacted]

Id. at 11.



Id. at 12; *see also* Pecht, Tr. at 201:13-19

For these reasons, I find that the claimed "bottom cover" is present in the STIIIZY LIIIL. The evidence further shows that the STIIIZY LIIIL has a "bottom portion positioned distally relative to the cartridge body" (*see* CX-4747C (Kodama) at Q/As 118-119; CDX-0001.0021) and

"a first air opening and a second air opening" (*see* CX-4747C (Kodama) at Q/A 122; CDX-0001.0023).

iii) Limitations 756.1.i – 756.1.l

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 2-3. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 122, 129, 132.

iv) Conclusion

Accordingly, I find that the STIIIZY-LIIIL product infringes claim 1 of the '756 patent.

2. STIIIZY-1G(C)

a) Claim 1

PAX asserts that the STIIIZY-1G(C) infringes claim 1. CIB at 15.

Respondents did not set forth any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 5-7; *see also* G.R. 14.2 ("Any contentions that are not set forth in detail in the post-hearing initial brief shall be deemed abandoned or withdrawn.").

The evidence shows that the STIIIZY-1G(C) satisfies the limitations of claim 1. CX-. 4747C (Kodama) at Q/As 100-102, 105, 108-109, 112-116, 120, 123-127, 130. Accordingly, I find that the STIIIZY-1G(C) infringes claim 1 of the '756 patent.

b) Claim 10

Claim 10 depends from claim 1, adding "cartridge electrical contact opening" limitations. JX-0001, cl. 10.

PAX asserts the STIIIZY-1G(C) infringes claim 10. CIB at 17.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 5-7.

The evidence shows that the STIIIZY-1G(C) satisfies the additional limitations of claim 10. CX-4747C (Kodama) at Q/A 141. Accordingly, I find that the STIIIZY-1G(C) infringes claim 10 of the '756 patent.

3. STIIIZY-ORIG-1

a) Claim 1

PAX asserts the STIIIZY-ORIG-1 infringes claim 1. CIB at 15.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 5-7.

The evidence shows that the STIIIZY-ORIG-1 satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/As 100-101, 103. 106, 108, 110, 112-114, 117, 121, 123-124, 128, 131. Accordingly, I find that the STIIIZY-ORIG-1 infringes claim 1 of the '756 patent.

b) Claim 5

Claim 5 is directed to a vaporizer device consisting of the vaporizer cartridge of claim 1 and certain "vaporizer body" limitations. JX-0001, cl. 5.

PAX asserts the STIIIZY-ORIG-1 infringes claim 5. CIB at 16-17.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 5-7.

The evidence shows that the STIIIZY-ORIG-1 satisfies the limitations of claim 5. CX-4747C (Kodama) at Q/As 144-147. Accordingly, I find that the STIIIZY-ORIG-1 infringes claim 5 of the '756 patent.

c) Claim 10

Claim 10 depends from claim 1, adding "cartridge electrical contact opening" limitations. JX-0001, cl. 10.

PAX asserts the STIIIZY-ORIG-1 infringes claim 10. CIB at 17.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 5-7.

The evidence shows that the STIIIZY-ORIG-1 satisfies the additional limitations of claim 10. CX-4747C (Kodama) at Q/A 142. Accordingly, I find that the STIIIZY-ORIG-1 infringes claim 10 of the '756 patent.

4. The STIIIZY Redesigned Products

Prior to the hearing, Respondents sought adjudication of infringement with respect to its STIIIZY-1G-REDESIGN(C), STIIIZY-ORIG-1G-REDESIGN, and STIIIZY-AIO-REDESIGN (collectively, the "STIIIZY Redesigned Products").[4] EDIS Doc. ID 830275 ("MSD").

Pursuant to the Ground Rules and Order No. 6, Respondents introduced certain redesigned vaporizer products, including the STIIIZY Redesigned Products, into the investigation. MSD at 1. Mr. Kodama did not render an opinion on the alleged infringement of these products for the '756, '757, and '527 patents, despite having expressly considered them in his analysis for the '580 patent. MSD Exs. A, B-D. Nor did PAX accuse these products of infringing the '756, '757, and '527 patents. EDIS Doc. ID 831359 ("Opp."). Respondents assert that they are entitled to a finding of

[4] The STIIIZY-1G-REDESIGN(C) and STIIIZY-05G-REDESIGN(C) are considered the same for the purposes of infringement. EDIS Doc. ID 831438 (Joint Stipulation regarding Representative Prods., Asserted Claims, and Asserted Prior Art References). Likewise, the STIIIZY-ORIG-1G-REDESIGN and STIIIZY-ORIG-05G-REDESIGN are considered the same. *Id*.

noninfringement (MSD at 2), while PAX argues that Respondents seek "an impermissible advisory ruling" (Opp. at 1).

The Commission's test for determining whether a respondent has met its burden for adjudication of a redesigned product includes four factors: (1) whether the product is within the scope of the investigation; (2) whether it has been imported; (3) whether it is sufficiently fixed in design; and (4) whether it has been sufficiently disclosed by respondent during discovery. *Certain Human Milk Oligosaccharides & Methods of Producing the Same*, Inv. No. 337-TA-1120, Comm'n Op. at 18 (June 8, 2020). Additionally, the Commission has a "policy in favor of adjudicating redesigns to prevent subsequent and potentially burdensome proceedings that could have been resolved in the first instance in the original Commission investigation." *Id.*

Respondents submit that the Redesigned Products meet all four factors for justiciability. MSD at 4-6. I agree. PAX does not contest the Redesigned Products fall within the scope of the investigation. *See* Opp at 1-3. In fact, PAX has accused these very same products of infringing the '580 patent. *Id*; *see also* CIB at 54. PAX also does not dispute the STIIIZY Redesigned Products are sufficiently fixed, have been subject to extensive discovery, and have been imported to warrant adjudication of infringement. *Id*. at 2 (admitting that it has sufficient information to make an infringement determination). And, as the Commission has stated, a complainant cannot ignore evidence of noninfringement but rather must "present evidence of infringement or withdraw its allegations concerning these products." *Certain Elec. Digital Media Devices & Components Thereof*, Inv. No. 337-TA-796, Comm'n Op. at 104 (Sept. 6, 2013).

PAX has willfully chosen not to introduce any evidence of infringement. As such, it has failed to meet its burden to show that the STIIIZY Redesigned Products infringe the '756 patent. *See Spansion*, 629 F.3d at 1349 (holding that complainant bears the burden of proving infringement

of the asserted patent claims by a preponderance of the evidence); *see also Certain Two-Way Radio Equip. & Sys., Related Software & Components Thereof*, Inv. No. 337-TA-1053, Comm'n Op. at 27 (Dec. 18, 2018) ("[B]ecause Motorola failed to put forward evidence on infringement it did not carry its burden to prove infringement by a preponderance of the evidence it did not carry its burden to prove infringement by a preponderance of the evidence.").

C. Indirect Infringement

The asserted claims of the '756 patent include some claims directed to a "vaporizer cartridge" (*e.g.*, claim 1), and other claims directed to a "vaporizer device" that includes a vaporizer cartridge as one of its components (*e.g.*, claim 5). Likewise, some of the Accused Products are vaporizer cartridges and others are vaporizers designed to either work with one of the accused vaporizer cartridges or include a cartridge as an integral component.

With respect to the fully assembled cartridges (whether filled with oil or not), PAX alleges that to the extent Respondents are importing such products into the United States, selling them for importation, and/or selling them within the United States after importation, such activity indirectly infringes—contributorily and by inducement— the asserted "vaporizer device" claims. CIB at 73-74. Similarly, to the extent Respondents are engaging in such activities with regard to unassembled cartridges, such as cartridges without mouthpieces attached prior to being filled with oil, PAX contends that this constitutes indirect infringement—both contributory and induced—of the "vaporizer cartridge" claims. *Id*.

Respondents only contest indirect infringement on the basis that there can be no indirect infringement absent direct infringement. RIB at 136. They present no other arguments. *Id*. Because PAX has proven direct infringement of the asserted claims of the '756 patent, Respondents' argument against liability fails.

PAX has introduced substantial evidence to show that Respondents are liable for contributory infringement and that they have induced others to infringe the '756 patent. *See, e.g.*, CX-4747X (Kodama) at Q/As 584-594; JX-0068 at 30:12-20; JX-0009C at 37:3-38:21; JX-0092C at 19:7-10; CX-0054; JX-0116C at 11; CX-1466C; JX-0357C; JX-0079C; JX-0358C; RX-0471C at Q/A 22; CX-1644C–CX-1652; CX-4301C; CX-1422C; CX-1423C; JX-0312C at 84:20-90:16; JX-0016C; JX-0009C at 38:13-39:13, 75:21-80:4; JX-0013C; JX-0014C; JX-0307. This evidence stands unrebutted.

Accordingly, I find that Respondents indirectly infringe claims 1, 5, and 10 of the '756 patent, both contributorily and by inducement.

D. Technical Prong of the Domestic Industry Requirement

PAX asserts that the '756 DI Products identified below practice the certain claim of the '756 patent:

'756 DI Products	Representative Products	Practiced Claims
ERA-05G(C)	ERA-05G(C)	1
ERA-ORIG-05G	ERA-ORIG-05G	1 and 5
ERA-PRO-05G		
ERA-LIFE-05G		
ERA-GO-05G		
ERA-1G(C)	ERA-1G(C)	1
ERA-ORIG-1G	ERA-ORIG-1G	1 and 5
ERA-PRO-1G		
ERA-LIFE-1G		
ERA-GO-1G		

CIB at 80.

Respondents take no position on the technical prong of the domestic industry. RIB at 139. Respondents have therefore waived their right to dispute that PAX satisfies the technical prong of the domestic industry requirement.

The evidence shows that the '756 DI Products practice claims 1 and 5 of the '756 patent. Mr. Kodama explained how the ERA-05G(C), ERA-ORIG-05G, ERA-1G(C), and ERA-ORIG-1G practice the limitations of claim 1. CX-4747C (Kodama) at Q/As 617-656. Mr Kodama likewise explained how the ERA-ORIG-05G and ERA-ORIG-1G practice the limitations of claim 5. *Id*. at Q/As 657-663.

For these reasons, I find that the technical prong of the domestic industry requirement is satisfied for the '756 patent.

E. Validity

Respondents assert that the '756 patent is invalid because: (1) U.S. 2016/007362 ("Alarcon") anticipates claims 1 and 5 (RIB at 7-18); (2) Alarcon in view of U.S. 2017/0086498 ("Daryani") renders claims 1 and 5 obvious (*id.* at 18-23); (3) Alarcon in view of CN 204 888 741 ("Xiang") renders claim 10 obvious (*id*. at 24-34); (4) Alarcon in view of Daryani and Xiang renders claim 10 obvious (*id*. at 34-35); and (5) there is insufficient written description for the claimed "bottom cover" (*id.* at 35-42).

1. Anticipation

a) Alarcon

i) Claim 1

Respondents assert that Alarcon discloses every limitation of claim 1. RIB at 7-16. PAX disputes that Alarcon discloses a vaporizer cartridge with two pads within the interior of the mouthpiece or a vaporizer cartridge with a "bottom cover." CIB at 18-22.

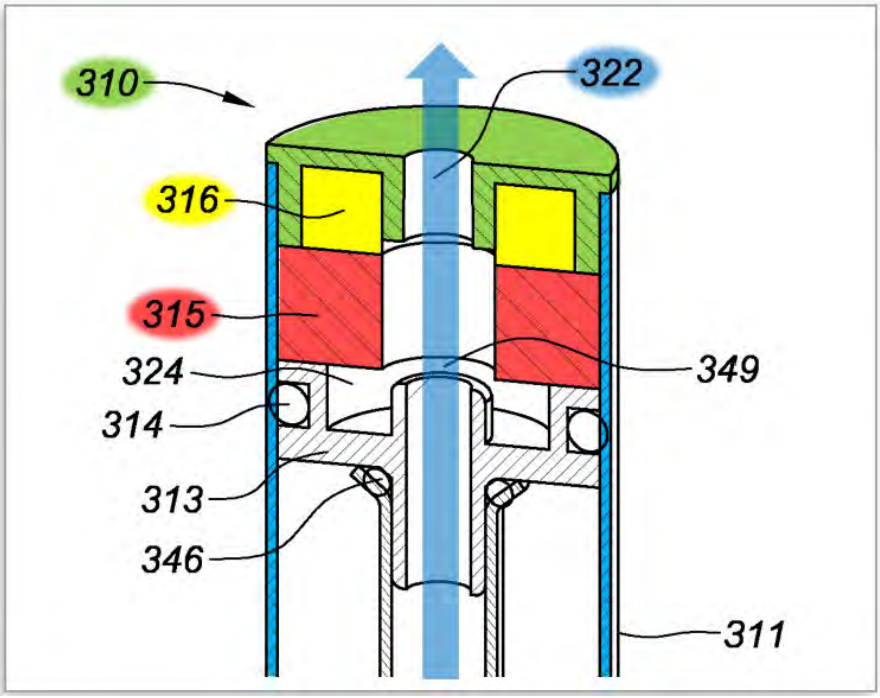
In an anticipation analysis, the dispositive question is whether a skilled artisan would "reasonably understand or infer" from a prior art reference that every claim limitation is disclosed in that single reference. *Akamai Techs., Inc. v. Cable & Wireless Internet Servs., Inc*., 344 F.3d 1186, 1192 (Fed. Cir. 2003). For the reasons discussed below, I find that Respondents have not shown by clear and convincing evidence that Alarcon discloses either limitation 756.1.g or limitation 756.1.h.

(1) Limitation 756.1.g

Respondents argue that Alarcon discloses "at least a portion of the second pad between portions of the mouthpiece, thereby positioning the second pad within the interior of mouthpiece—or at least suggests the same." RIB at 9. Respondents' argument presumes that limitation 756.1.g only requires a portion of the second pad be inside the mouthpiece. This is incorrect, however. The claim language expressly requires the second pad to be "positioned ***within the interior*** of the mouthpiece."[5] JX-0001, cl. 1 (emphasis added). Thus, when considered together with limitation 756.1.f, the claimed invention requires that the vaporizer cartridge have two absorbent pads within the interior of the mouthpiece. *Id*.

The evidence shows that Alarcon discloses one absorbent pad, not two. JX-00021. Figure 10 is illustrative.

[5] While Respondents contend that "[a] POSITA would not interpret 756.1.g to require the entirety of the second pad to be within the mouthpiece," they provide no support for this assertion beyond a conclusory statement by Dr. Jackson. RIB at 9; *see also* RX-0473C (Jackson) at Q/A 228).)



Id. at Fig. 10 (annotated). It depicts an embodiment with a mouthpiece 310 (highlighted in green), a first porous material 315 (highlighted in red) and a second porous material (highlighted in yellow). JX-0021 at ¶ [0150]; CX-4750C (Sturges) at Q/A 57. Only second porous material 316 is within the interior of the mouthpiece 310. *Id*. at ¶ [0125] ("[A] second porous material 316 can be placed in an annular groove formed in the mouth piece."); *see also* CX-4750C (Sturges) at Q/A 58. Dr. Jackson cites to first porous material 315 as satisfying the "second pad" limitation (RX-0473C at Q/A 226), but as the figure above shows, no portion of the first porous material 315 is within the interior of the mouth piece. CX-4750C (Sturges) at Q/A 62. Alarcon itself confirms that "a first porous material 315 can be placed ***between*** the proximal seal 313 and the mouth piece 310" to absorb condensate before it reaches the mouthpiece. JX-0021 at ¶ [0125] (emphasis added). And, on cross-examination, Dr. Jackson admitted that Alarcon does not disclose any embodiment as having two pads within the mouthpiece.

Q. Alarcon itself does not describe any of the embodiments that you discuss in your witness statement as having two pads within the interior of the mouthpiece; correct?

A. He does not describe that, but looking at that, you can see that it goes down, so I would say a POSITA would say that it's within the mouthpiece.

Q. Alarcon was a POSITA, wasn't he?

A. Yes.

Q. He described it as being between the mouthpiece and the proximal seal; right?

A. Yes. That's how he described it.

Jackson, Tr. at 439:11-24.

Nonetheless, Respondents claim that even if "756.1.g requires the entirety of the second pad to be within the mouthpiece, a POSITA would still understand Alarcon to teach this limitation." RIB at 10. To support their theory, Respondents rely on an annotated version of FIG. 6.[6]

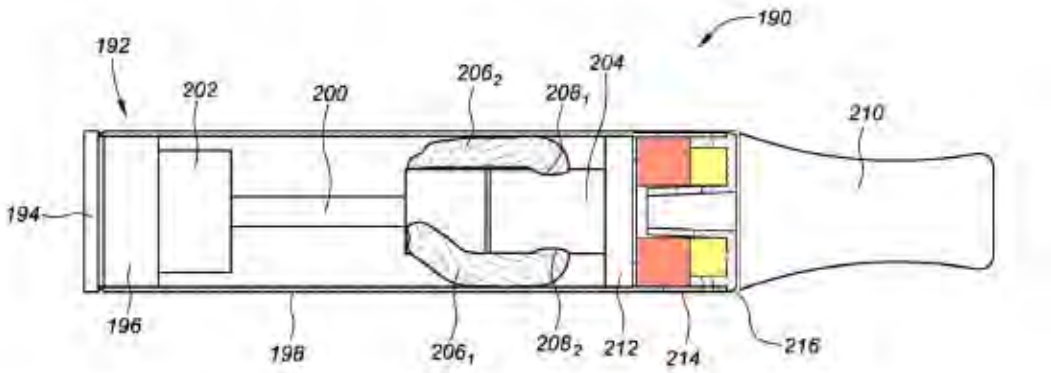


FIG. 6

[6] "Prior art that must be modified to meet the disputed claim limitation does not anticipate the claim." *Enplas Display Device Corp. v. Seoul Semiconductor Co., Ltd.*, 909 F.3d 398, 405 (Fed. Cir. 2018); *see also In re Chudik*, 851 F.3d 1365, 1374 (Fed. Cir. 2017).

Id. at 11. In this version, the absorbent material from FIG. 13[7] has been inserted into the embodiment of FIG. 6. *Id*. ("wherein an annotated excerpt from Fig. 13 is disposed within 'outer surface 214' of 'mouth piece 210.'"). There is no such disclosure in Alarcon. *See generally* JX-

[7] Figure 13 discloses a mouth piece 310, mouth piece absorbent chamber 384, and secondary annular absorbent chamber 383. JX-0021 at FIG. 13.

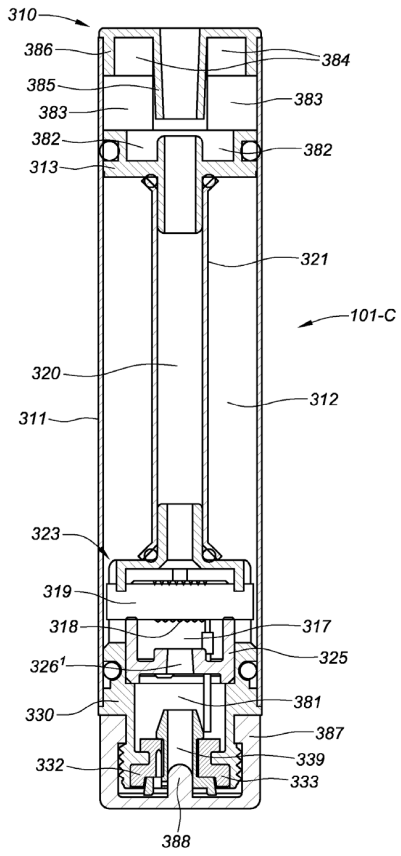


FIG. 13

Dr. Jackson points to the secondary annular absorbent chamber 383 as the second pad limitation. RX-0473C (Jackson) at Q/A 227. However, as Dr. Sturges explained, "the top of the secondary annular chamber 383 abuts the bottom of the mouth piece structure and the first porous material, and it is bounded by the outer tube on one side and by the exterior wall of the mouth piece tube 385 on the other side." CX-4750 (Sturges) at Q/A 64. "None of that absorbent material is within the interior of the mouth piece." *Id*. This is consistent with Alarcon's disclosure that "a secondary annular chamber 383 can be formed *between* the mouth piece 310 and the proximal seal 313." JX-0021 at ¶ [0150] (emphasis added).

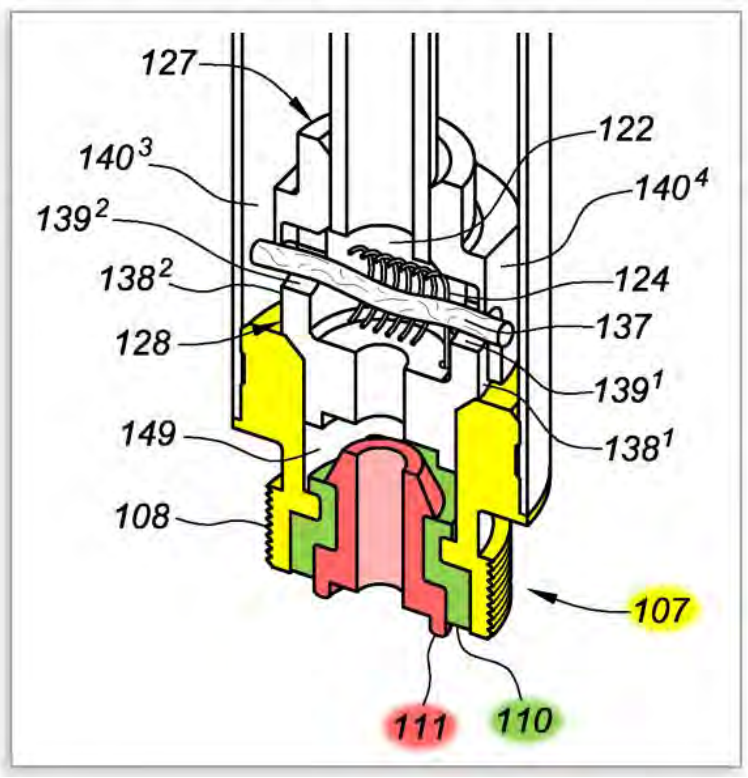
0021. Nor does Dr. Jackson explain how the mouth piece 310, mouth piece absorbent chamber 384, and secondary annular absorbent chamber from FIG. 13 could be combined with the embodiment shown in Figure 6. He merely states: "A POSITA would readily understand how to combine Alarcon's disclosures in this manner. And, a POSITA would understand Alarcon to teach this." RX-0473 (Jackson) at Q/A 229. The Federal Circuit has cautioned against accepting such generalized testimony as evidence of invalidity. *Schumer v. Lab'y Computer Sys., Inc.,* 308 F.3d 1304, 1316 (Fed. Cir. 2002) ("[T]o accept . . . generalized testimony as evidence of invalidity is improper"); *see also Aspex Eyewear, Inc. v. Concepts In Optics, Inc.* 111 F. App'x 582, 588 (Fed. Cir. 2004) ("Typically, testimony concerning anticipation must be testimony from one skilled in the art and must identify each claim element, state the witnesses' interpretation of the claim element, and explain in detail how each claim element is disclosed in the prior art reference. The testimony is insufficient if it is merely conclusory.").

As such, Respondents have failed to establish by clear and convincing evidence that Alarcon discloses this limitation.

(2) Limitation 756.1.h

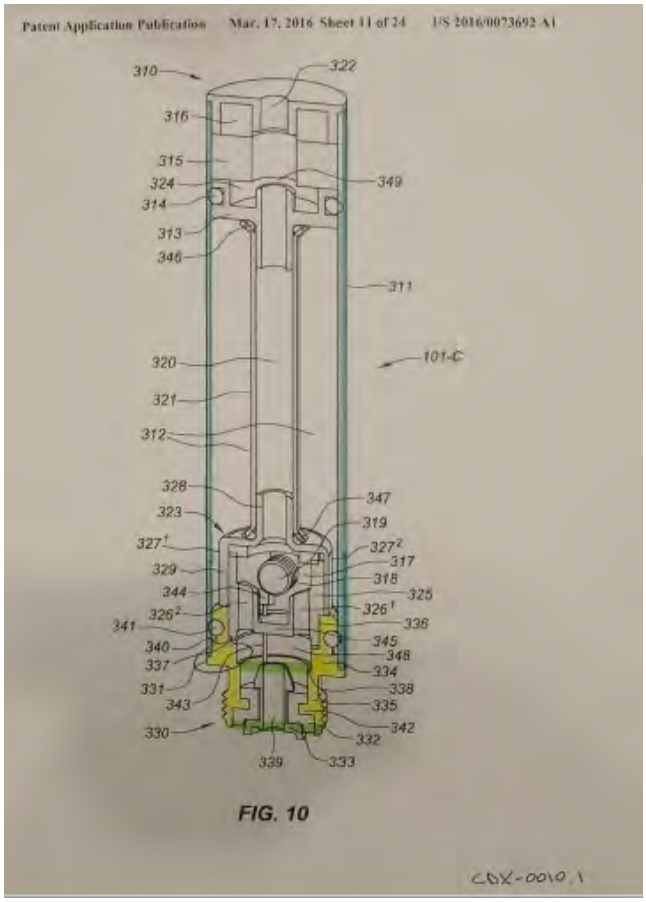
Limitation 756.1.h recites "a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening." JX-0001, cl. 1. As with infringement, the parties' dispute focuses on the claimed "bottom cover." Respondents point to "battery connector 107" / "battery connector 330" as satisfying this element. RIB at 12. PAX contends that the battery connector 107/330 "doesn't cover the bottom of the cartridge, and is instead completely open at the bottom." CIB at 20-21.

As shown in Figure 3 from Alarcon below, the battery connector 107 *is* completely open at the bottom.



JX-0021, Fig. 3 (annotated). "That open space is then filled by the insular grommet 110 and center battery connect 111, the latter of which includes a central air hole." CX-4750C (Sturges) at Q/A 90. On cross-examination, Dr. Jackson admitted that the battery connector is open at the bottom, thereby exposing the cartridge's internal elements to the environment. Jackson, Tr. at 431:22-432:10 ("Q. Looking just at the battery connector 107 that you identified as the bottom cover, before the centered connector 111 is put in there, before that grommet 110 is put in there, that component is completely open at the bottom; correct? A. At the bottom in the center, that is correct."), 433:6-8 ("Q. It's not covering anything in the center of the device, though; right? A. It's not covering anything in the center, no."); 434:3-6 ("Q. But it's not covering the bottom of the atomizer, is it? A. The bottom of the atomizer? No. Not in this case, no."). He nonetheless maintains that the battery connector satisfies the "bottom cover" limitation because it covers the

bottom edge of the outer tube 311 (highlighted in blue).[8] *Id*. at 514:22-519:17; *see also* RIB at 12 (arguing that battery connector 107/330 is installed internal to outer tube 105/311 and forms the distalmost outer enclosure of device 101/101-C).



CDX-0010.1. But as discussed above, the claimed "bottom cover" is "a structure covering a bottom of a [vaporizer cartridge]." Because battery connector 107/330 is open at the bottom and does not cover the vaporizer cartridge, I find that Respondents have not established by clear and convincing evidence that Alarcon discloses this limitation.[9]

[8] This theory was disclosed for the first time on cross-examination.

[9] Nor does the evidence suggest that a skilled artisan would view the "protruding step 109/311" of battery connector 107/330 to be the claimed "bottom cover." *See* Sturges, Tr. at 711:23-713:7

(3) Conclusion

Accordingly, I find that Respondents have failed to show that Alarcon anticipates claim 1 of the '756 patent.

ii) Claim 5

Because I found independent claim 1 is not anticipated by Alarcon, dependent claim 5 is also not anticipated by Alarcon. *See, e.g.*, *Home Semiconductor Corp. v. Samsung Elecs. Co.*, 701 F. App'x 1006, 1013 (Fed. Cir. 2017) (finding dependent claim not anticipated because independent claim not anticipated); *Trintec Indus., Inc. v. Top-U.S.A. Corp.*, 295 F.3d 1292, 1296 (Fed. Cir. 2002) ("Because claim 3 is not inherently anticipated, dependent claims 4 and 5 also are not anticipated.").

2. Obviousness

a) Alarcon in view of Daryani

i) Claim 1

Respondents contend that Alarcon in view of Daryani renders claim 1 obvious. In the foregoing section, I found that Alarcon does not disclose the "bottom cover" limitation (756.1.h). Thus, for Respondents to prevail, Daryani must disclose that limitation. Respondents do not allege that Daryani discloses this limitation. RIB at 18 (relying on Daryani for "two pads"). As such, Respondents have failed to meet their burden to establish that Alarcon and Daryani renders claim 1 obvious.

Respondents have also failed to demonstrate by clear and convincing evidence that a person of ordinary skill in the art would have been motivated to combine the teachings of Alarcon and

(confirming that merely covering the bottom of the outer tube 105/311 would not satisfy the "bottom cover" limitation).

Daryani in the manner claimed. *See P&G v. Teva Pharms. USA, Inc*., 566 F.3d 989, 994 (Fed. Cir. 2009) (party seeking to invalidate patent must provide clear and convincing evidence of motivation to combine). Daryani is directed to an electronic cigarette that uses replaceable liquid capsules. JX-0228. More specifically, Daryani discloses that the mouthpiece of the electronic cigarette is designed as a cartridge extraction/insertion tool that enables a user to extract a spent capsule and insert a new one without having to touch the capsule, avoiding the user coming into contact with condensation on the surface of the used capsule. *Id*. This is depicted in Figure 1 below:

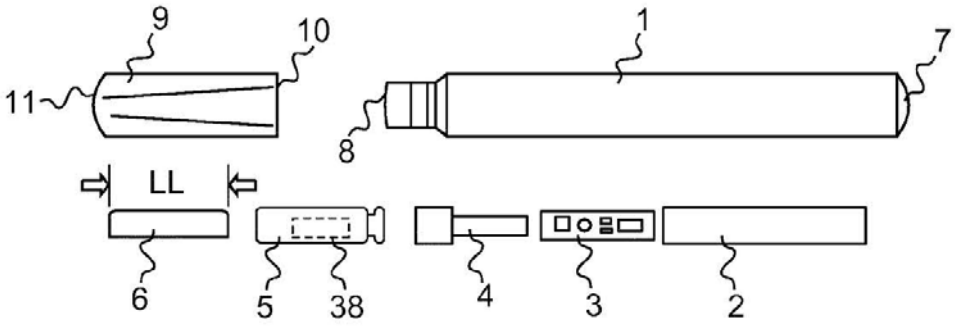


Fig. 1

Id. at FIG. 1. Alarcon, on the other hand, is directed to leakage mitigation technology. JX-0021. As Dr. Sturges explained: "Alarcon discloses what may be described as a more conventional vaporizer arrangement in which the vaporizable liquid is contained in a liquid media storage tank 117 within a cartridge component 101 that also includes a heater coil 124 for vaporizing the liquid. Alarcon appears to contemplate that the liquid media storage tank 117 can be refilled by removing the mouth piece 102 and the proximal seal 121." CX-4750C (Sturges) at Q/A 76. And, unlike Daryani, Alarcon does not use liquid capsules, replaceable or otherwise. *Id*.; *see also* JX-0021.

Despite these differences, Respondents nevertheless claim that a person of skill would have been motivated to modify the vaporizer device disclosed in Alarcon to incorporate Daryani's

segmented absorbers.[10] RIB at 18-22. They rely on the testimony of Dr. Jackson to establish this motivation. RX-0473C (Jackson) at Q/A 269. He opined: "[A] POSITA would be motivated to segment the absorbent material of the first pad within the mouthpiece to maintain effective absorption within a flattened mouthpiece, maximize space usage within the mouthpiece, reduce manufacturing costs, and/or the like." *Id*. These are only conclusory generalizations and do not constitute substantial evidence of a motivation to combine.[11] *See, e.g., In re Nuvasive, Inc.*, 842 F.3d 1376, 1382 (Fed. Cir. 2016) ("'[C]onclusory statements' alone are insufficient and, instead the finding must be supported by a 'reasoned explanation'."). Moreover, Dr. Jackson failed to explain how dividing Alarcon's "donut-shaped pad that fills a circular groove embedded in the material forming the mouthpiece" into multiple segments would improve its absorption or increase usage of space within the mouthpiece. *See* RX-0473C (Jackson) at Q/A 226; CX-4750C (Sturges) at Q/A 78. And Daryani itself teaches that manufacturing would be easier and less expensive if the absorbent material is not segmented. JX-0228 at ¶ [0017] ("The absorber 14 may also be provided as a circumferential element, for ease of manufacturing, especially if the absorber is in the form of a unitary element.").

[10] Dr. Sturges also testified that a person of skill would not have been motivated to combine these references because Alarcon relies on an open central air tube that is unobstructed, while Daryani teaches a vapor path that is obstructed, by both the liquid capsule 6 and the absorber 14. CX-4750C (Sturges) at Q/A 82. Thus, in Dr. Sturges' opinion, a person of skill looking to improve Alarcon "would have bypassed Daryani." *Id*.

[11] "[A]n obviousness determination requires finding that a person of ordinary skill in the art would have had a reasonable expectation of success." *See Elekta Ltd. v. Zap Surgical Sys., Inc.,* 81 F.4th 1368, 1375-1368 (Fed. Cir. 2023). Respondents claim that "incorporating Daryani's pads into Alarcon's mouthpiece is nothing more than simple substitution of known prior art features to yield predictable results." RIB at 22. This is not sufficient for Respondents to meet their burden nor is it sufficient under my Ground Rules.

For these reasons, I find that Respondents have not established that Alarcon and Daryani render obvious claim 1 of the '756 patent.

ii) Claim 5

Because claim 5 depends from claim 1, it also is not rendered obvious by the combination of Alarcon and Daryani. *Ortho-McNeil Pharm., Inc. v. Mylan Labs., Inc.*, 520 F.3d 1358, 1365 (Fed. Cir. 2008) (claims cannot be obvious if they depend from a nonobvious claim).

b) Alarcon in view of Daryani and Xiang

Respondents assert that to the extent Alarcon does not expressly teach two pads in the mouthpiece, Alarcon in view of Daryani and Xiang renders claim 10 obvious. RIB at 34.

Claim 10 depends from claim 1. In the preceding section, I found that Respondents failed to show by clear and convincing evidence that Alarcon and Daryani renders claim 1 obvious. As such, Alarcon and Daryani do not render claim 10 obvious. Nor does the addition of Xiang remedy the deficiencies discussed above. Xiang does not disclose absorbent pads within the interior of the mouthpiece nor have Respondents set forth any arguments to that effect. JX-0185. Respondents only cite Xiang for its alleged teaching of a "bottom cover" that includes "a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed." RIB at 33-35.

Even if the references disclosed all the limitations of the asserted claims, which they do not, Respondents still need to show that a person of skill in the art would combine the references to arrive at the claimed invention. They write: "A POSITA would be motivated to combine the teachings of Alarcon with Daryani and Xiang for the reasons discussed above with respect to the

combination of Alarcon with Daryani and Alarcon and Xiang." RIB at 35. Respondents' single sentence is not sufficient under my Ground Rules and is therefore waived.[12]

Additionally, Respondents failed to address why a person of ordinary skill would combine these *specific* references. RIB at 35. Respondents merely cross-reference arguments for other combinations (*i.e.*, Alarcon + Daryani and Alarcon + Xiang). *Id*. My Ground Rules require that each unique combination of prior references relied upon be addressed in detail, including a motivation to combine said references. *See* G.R. 14.2. This is because "[r]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *KSR*, 550 U.S. at 418 (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

Accordingly, I find that Respondents have not met their burden to show that Alarcon in view of Daryani and Xiang renders obvious claim 10 of the '756 patent

c) Alarcon in view of Xiang

Respondents assert that Alarcon in view of Xiang renders claim 10 of the '756 patent obvious. RIB at 24-34. Respondents explain that one of skill "would look to Xiang when seeking

[12] I find Dr. Jackson's testimony to be similarly deficient. RX-0473C (Jackson) at Q/A 277. Beyond conclusory statements, he did not meaningfully address why one of skill would combine these references. For example, he opined that "a POSITA would look to Xiang when seeking to improve in Alarcon's device" because "it was well-known and commonplace in the art to incorporate two cartridge electrical contact openings into the bottom portion of the bottom cover a cartridge." *Id*. He further stated that: "Using a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed was a known solution that a POSITA would have used on Alarcon with predictable results." *Id*. His reasoning seems to imply that a person of skill would have would have understood that these references *could be* combined. But as the Federal Circuit has stated: "It does not suffice to simply be known. A reason for combining must be exist." *Virtek Vision Int'l ULC v. Assembly Guidance Sys., Inc.*, 97 F.4th 882, 888 (Fed. Cir. 2024); *see also Belden Inc. v. Berk-Tek LLC,* 805 F.3d 1064, 1073 (Fed. Cir. 2015) ("[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated* to make the combinations or modifications of prior art to arrive at the claimed invention.").

to improve Alarcon's device for numerous reasons, including that both are cartridge-based vaporizer references in the same field of endeavor that a POSITA would consider and glean teachings from when improving on any prior art vaporizer." *Id*. at 28.

As explained above, I found that Alarcon does not disclose a vaporizer with two pads in the mouthpiece. *See* Section IV.E.1.a.i.1. I also found that Alarcon does not disclose the claimed "bottom cover." *Id*. Respondents do not allege that Xiang discloses these limitations. RIB at 29-34 (relying only on Xiang for the disclosure of first and second cartridge electrical contact openings). Nor have they set forth any arguments as to how a person of ordinary skill would modify Alarcon with Xiang to fulfill these missing limitations. *Id*. As such, Respondents have failed to meet their burden to establish that Alarcon in view of Xiang renders claim 10 of the '756 patent obvious.

d) Secondary Considerations

Secondary considerations of nonobviousness may rebut a prima facie case of obviousness. *Merck Sharp & Dohme Corp. v. Hospira, Inc.*, 874 F.3d 724, 733 (Fed. Cir. 2017) ("[once it is established] a prima facie case [of obviousness is shown] we turn to [a party's] attempt to rebut this prima facie case with secondary considerations of nonobviousness.") (quoting *Muniauction, Inc. v. Thomson Corp.,* 532 F.3d 1318, 1327 (Fed. Cir. 2008)). Here, where Respondents have not made out a *prima facie* case of obviousness, there is no showing to rebut. Accordingly, I need not consider any secondary considerations of nonobviousness.

3. Written Description

The term "a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom cover comprising: a first air opening" or its equivalent is present in every asserted independent claim of the '756 patent. JX-0001, cls. 1, 5, 10. Respondents argue:

"[T]the common disclosure—including the specification text, the figures, and other patent documents purported to be incorporated by reference—never discloses a bottom cover positioned distally to the cartridge body, as claimed." RIB at 36. Thus, according to Respondents, all claims of the '756 patent are invalid for lack of written description with respect to this claim term. *Id*. PAX contends that the '756 specification confirms that the inventors were in possession of the claimed invention at the time the original patent application was filed. CIB at 29.

A patent is presumed to have adequate written description. *Novartis*, 38 F.4th at 1019. Respondents must overcome this presumption with clear and convincing evidence. *Ariad*, 598 F.3d at 1354-1355.

Respondents argue that the patent shows "the entirety of 'bottom cover piece 691' is embedded within 'tank 441' such that no aspect of 'bottom cover piece 691 (e.g., a "bottom portion") is 'positioned distally relative to' 'tank 441.'" RIB at 36. Thus, according to Respondents, the bottom cover must be external to or "part of the outer enclosure" of the cartridge body.[13] *Id*. at 40, 42. During the *Markman* proceedings, Respondents also advocated for a construction that limited the bottom cover to being an external cover. Order No. 19 at 26-28. I was not persuaded by Respondents' arguments there nor am I persuaded by their arguments here.[14]

Contrary to Respondents' contention, the specification sufficiently describes a "bottom cover comprising a bottom portion positioned distally relative to the cartridge body," such that it

[13] At trial, Dr. Jackson confirmed that he interpreted "positioned distally relative to the cartridge body" to require that the bottom cover be "external to the cartridge body." Jackson, Tr. at 555:24-556:9, 558:1-7.

[14] Conclusory expert witness testimony (like Dr. Jackson's) and attorney argument alone are not sufficient to show that claims lack a written description by clear and convincing evidence.

meets the requirements of § 112.[15] The Federal Circuit has analogized such a disclosure as "'mark[ing] trails by making blaze marks on . . . trees' to 'find[ ] one's way through the woods' of a specification such that a skilled artisan would be able to follow that trail and understand what the inventors had invented." *Quake v. Lo,* 928 F.3d 1365, 1374 (Fed. Cir. 2019 (quoting *In re Ruschig*, 379 F.2d 990, 994–95 (C.C.P.A. 1967)). The applicants did just that. For example, the embodiment in Figure 6D shows a vaporizer cartridge that includes a "bottom cover" positioned distally to the cartridge body.[16]

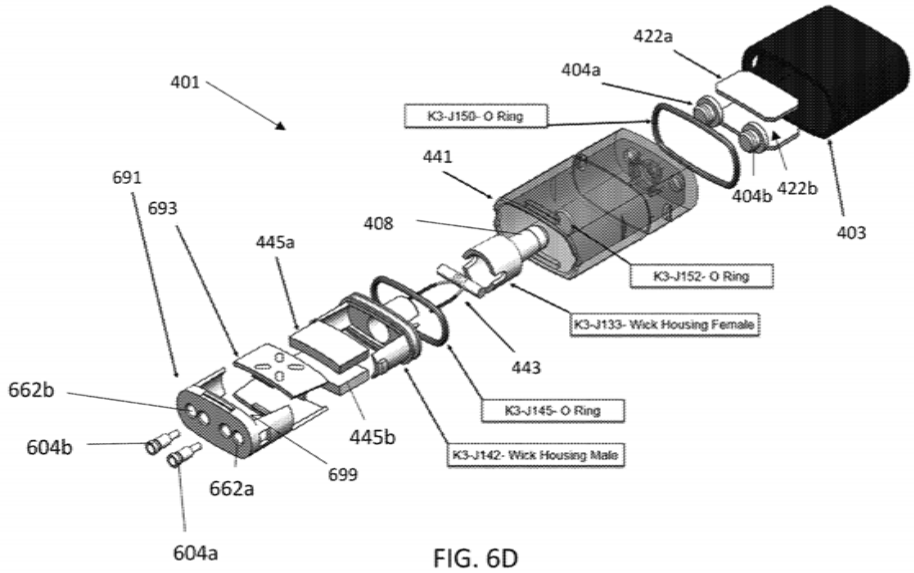


FIG. 6D

[15] When read in the context of the claim, the term "positioned distally relative to the cartridge body" simply means that the bottom cover is positioned towards the end of the cartridge furthest from the mouthpiece. JX-0001, cl. 1; *see also* CX-4750C (Sturges) at Q/A 305.

[16] As the Federal Circuit has stated, an applicant "may employ 'such descriptive means as words, structures, figures, diagrams, formulas, etc., that fully set forth the claimed invention." *In re Skvorecz,* 580F.3d 1262, 1269 (Fed. Cir. 2002).

JX-0001, FIG. 6D The specification explains that the "bottom cover piece 691" is located "[a]t the distal end of the cartridge." *Id*. at 20:58-63. Figure 6A depicts an assembled cartridge with "bottom cover piece 691" at the distal end of the cartridge, just as claimed.

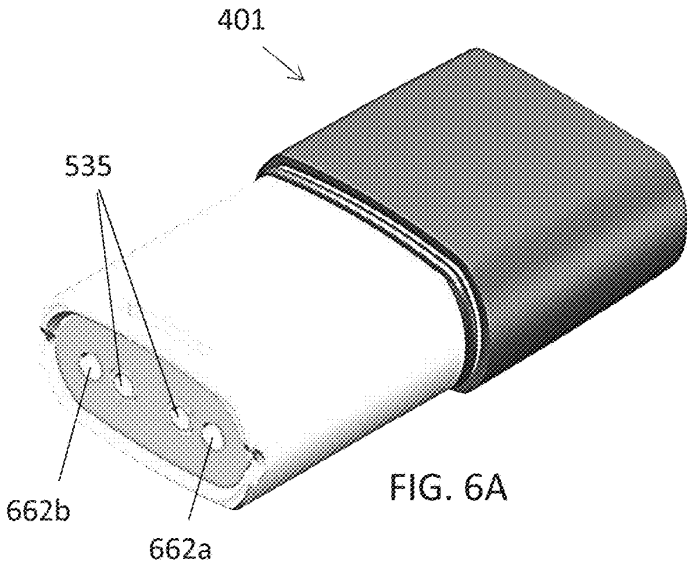


FIG. 6A

Id. at FIG. 6A. Yet another example is seen in FIG. 10A, with the "bottom portion" being the bottom surface of the "bottom 1019."

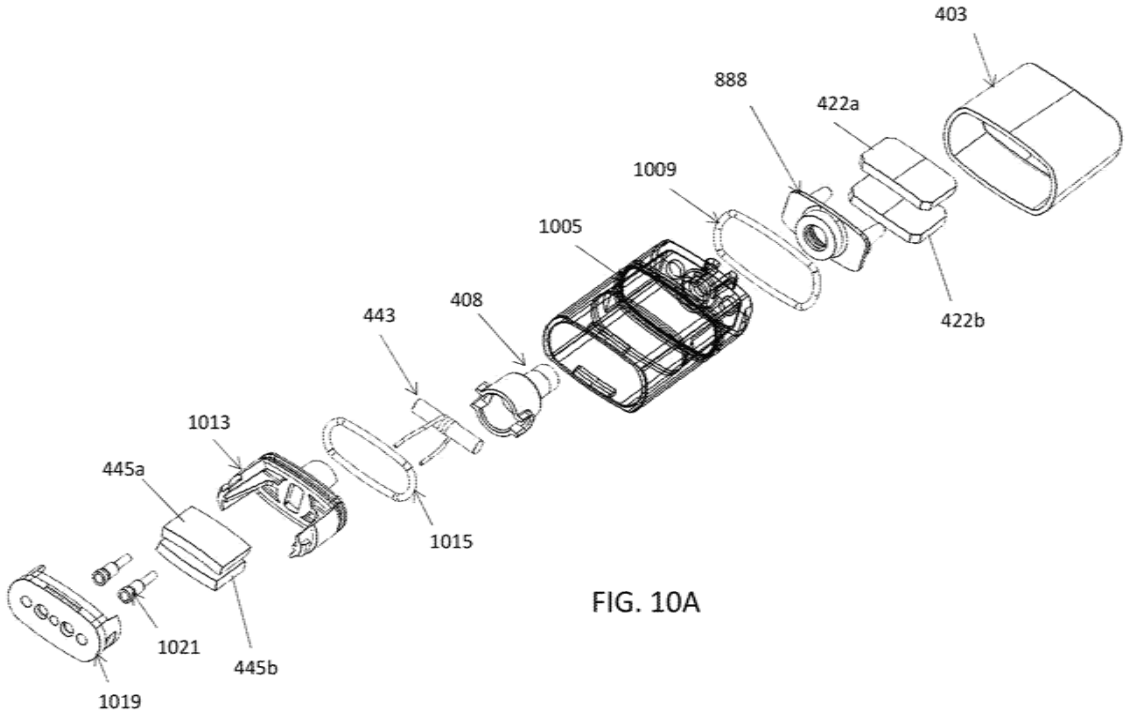


FIG. 10A

Id. at FIG. 10A; *see also id*. at 10:30 ("FIG. 7E is a bottom view" of a cartridge), 13:50-51 ("The piece forming the bottom of the cartridge 1019 ….''). Dr. Sturges confirmed that based on these disclosures, "a POSITA would have no trouble understanding what the 'bottom cover' limitations of the claims is referring to." CX-4750 (Sturges) at Q/A 307; *see also id*. at Q/As 306-310.

For the above reasons, I find that Respondents have not shown by clear and convincing evidence that the asserted claims of the '756 patent are invalid under 35 U.S.C. § 112.

V. U.S. PATENT NO. 11,766,527

A. Overview

The '527 patent issued on September 26, 2023, and has 30 claims. JX-0004 at cover page. Claims 1, 5, 10-11, 17-18, and 22 are asserted in this investigation. CIB at 32. These claims are reproduced below:

PUBLIC VERSION

Claim	Claim Language
527.1.pre	A vaporizer cartridge comprising:
527.1.a	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
527.1.b	a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;
527.1.c	a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to hold a vaporizable material;
527.1.d	a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;
527.1.e	a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;
527.1.f	a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;
527.1.g	a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;
527.1.h	a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and
527.1.i	a vaporization chamber comprising:
527.1.i.i	a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol
527.1.i.ii	a wicking material comprising ceramic;
527.1.i.iii	a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and
527.1.i.iv	an air tube configured to deliver the aerosol to the mouthpiece.
527.5.pre	A vaporizer device, comprising:
527.5.a	the vaporizer cartridge of claim 1; and
527.5.b	the vaporizer body, comprising:
527.5.b.i	a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:
527.5.b.i.a	the first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;
527.5.b.i.b	the second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;
527.5.b.i.c	an insertion end into which the vaporizer cartridge is inserted; and
527.5.b.i.d	a base opposite the insertion end.
527.10.pre	The vaporizer cartridge of claim 1, wherein the bottom cover comprises a bottom portion, and wherein the bottom portion comprises:

PUBLIC VERSION

Claim	Claim Language
527.10.a	the first air opening;
527.10.b	a second air opening;
527.10.c	a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; and
527.10.d	a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.
527.11.pre	A vaporizer device, comprising:
527.11.a	a vaporizer cartridge comprising:
527.11.a.i	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
527.11.a.ii	a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;
527.11.a.iii	a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to hold a vaporizable material;
527.11.a.iv	a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;
527.11.a.v	a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;
527.11.a.vi	a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;
527.11.a.vii	a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;
527.11.a.viii	a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and
527.11.a.ix	a vaporization chamber comprising:
527.11.a.ix.a	a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol;
527.11.a.ix.b	a wicking material comprising a ceramic;
527.11.a.ix.c	a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and
527.11.a.ix.d	an air tube configured to deliver the aerosol to the mouthpiece; and
527.11.b	a vaporizer body, comprising:
527.11.b.i	a cartridge receiver configured to insertably receive the vaporizer cartridge,
527.11.b.ii	wherein the cartridge receiver comprises:
527.11.b.ii.a	a first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;
527.11.b.ii.b	a second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;

PUBLIC VERSION

Claim	Claim Language
527.11.b.ii.c	an insertion end into which the vaporizer cartridge is inserted; and
527.11.b.ii.d	a base opposite the insertion end;
527.11.b.iii	a pressure sensor configured to detect a change in pressure, causing activation of the vaporizer device; and
527.11.b.iv	a channel extending between the base of the cartridge receiver and the pressure sensor.
527.17.pre	The vaporizer device of claim 11, wherein the bottom cover comprises a bottom portion, and wherein the bottom portion comprises
527.17.a	the first air opening;
527.17.b	a second air opening;
527.17.c	a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; an
527.17.d	a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.
527.18.pre	A vaporizer cartridge comprising:
527.18.a	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
527.18.b	a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;
527.18.c	a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to cover a first reservoir;
527.18.d	a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;
527.18.e	a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;
527.18.f	at least one pad positioned within an interior of the mouthpiece;
527.18.g	a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;
527.18.h	a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;
527.18.i	a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and
527.18.j	a vaporization chamber comprising:
527.18.j.i	a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol;
517.18.j.ii	a wicking material comprising ceramic;

Claim	Claim Language
527.18.j.iii	a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and
527.18.j.iv	an air tube configured to deliver the aerosol to the mouthpiece.
527.22	The vaporizer cartridge of claim 18, wherein the at least one pad includes two pads.

B. Infringement

PAX asserts that the '527 Accused Products identified below infringe the asserted claims of the '527 patent:

'527 Accused Products	Representative Products	Asserted Claims
STIIIZY-1G(C)	STIIIZY-1G(C)	1, 10, 18, and 22
STIIZY-05G(C)		
STIIIZY-ORIG-1G	STIIIZY-ORIG-1G	1, 5, 10-11, 17-18, and 22
STIIIZY-ORIG-05G		
STIIIZY-BIIIG-1G		
STIIIZY-BIIIG-05G		
STIIIZY-LIIIL	STIIIZY-LIIIL	1, 18, and 22
STIIIZY-AIO	STIIIZY-AIO	1
ROVE(C)	ROVE(C)	1 and 10
ROVE(V)	ROVE(V)	1, 5, 10-11, and 17
FLARE(C)	FLARE(C)	1
FLARE(V)	FLARE(V)	1 and 5

Id.

1. STIIIZY-LIIIL

a) Claim 1

i) Limitations 527.1.pre – 527.1.e

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 5-6. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 151, 154, 162.

ii) Limitation 527.1.f

The parties rely on the arguments presented for the "bottom cover" limitation in the '756 patent for this limitation. CIB at 33; RIB at 43-44. Thus, for the reasons discussed in Section IV.B.1.a.ii, the evidence shows that this limitation is met. *See also* CX-4747C (Kodama) at Q/As 172-173.

iii) Limitations 527.1.g – 527.1.i.iv

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 6. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 182, 196-198.

iv) Conclusion

Accordingly, I find that the STIIIZY-LIIIL infringes claim 1 of the '527 patent.

b) Claim 18

Claim 18 is identical to claim 1 but adds a "pad" limitation (527.18.f). JX-0004, cl. 18. Respondents do not dispute limitation 527.18.f (RUCL at 8) and the evidence shows this limitation is met. CX-4747 (Kodama) at Q/As 216-219, 223. I therefore find that the STIIIZY-LIIIL infringes claim 18 of the '527 patent.

c) Claim 22

Claim 22 depends from claim 18, adding that "the at least one pad includes two pads." JX-0004, cl. 22. Respondents do not dispute the STIIIZY-LIIIL meets the additional limitation of claim 22 and the evidence confirms this limitation is met. RUCL at 8; CX-4747C (Kodama) at Q/A 227. I therefore find that the STIIIZY-LIIIL infringes claim 22 of the '527 patent.

2. STIIIZY- AIO

a) Claim 1

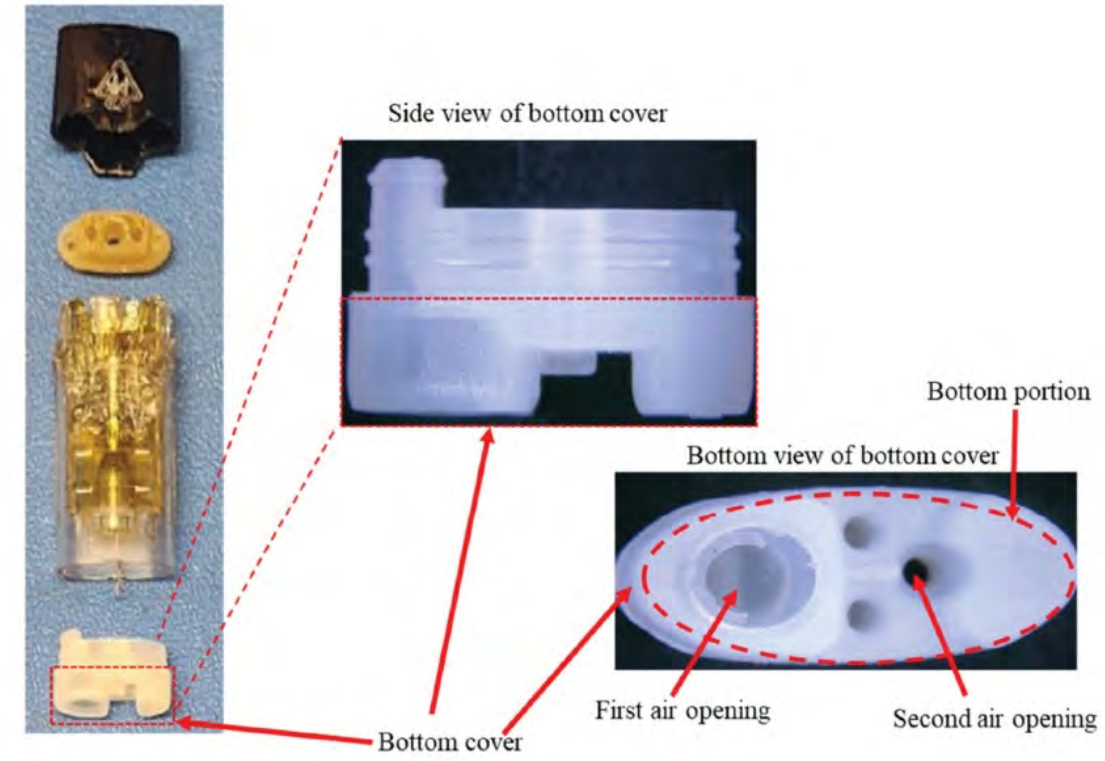
i) Limitations 527.1.pre – 527.1.e

Respondents do not dispute that the STIIIZY-AIO meets these limitations. RUCL at 5-6. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 151, 155, 163.

ii) Limitation 527.1.f

Limitation 527.1.f recites "a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening." JX-0004, cl. 1. The parties' dispute centers on the "bottom cover" language, just as it did for the nearly identical limitation in the '756 patent. Respondents present two arguments for why this limitation is not met, neither of which I find persuasive. RIB at 44-47; RRB at 18-19.

First, Respondents argue that PAX "improperly accuses the same physical component in different devices of meeting different and distinct claim limitations." RIB at 44. According to Respondents, PAX points to the "silicone base" for the STIIIZY-AIO. *Id*. at 44-45 However, despite that same component being in the STIIIZY-1G(C), Respondents claim PAX pointed to an entirely different component as the bottom cover. *Id*. This argument ignores the fact that these are two different products with different assembly instructions. In the STIIIZY-AIO, the silicone base is the lowermost component of the vaporizer cartridge, whereas in the STIIIZY-1G(C), the circuit board covers the silicone base and thus is the lowermost component of the cartridge. CX-4747C (Kodama) at Q/As 174-175. As shown below, nothing covers the silicone base in the STIIIZY AIO product.



CDX-0001.0048. The STIIIZY-AIO assembly instructions provide further confirmation. They explain that the cartridge component includes a translucent "silicone base" that is inserted into the bottom of the cartridge. JX-0415C at 12-13. The base covers the bottom of the cartridge body except for two air openings and two electrical contact openings. *Id.*

[redacted]

Id.; *see also* CX-4747C (Kodama) at Q/As 174-175.

Respondents next argue that "Complainant's alleged 'bottom cover' is entirely internal, like an internal partition rather than a cover." RIB at 46-47. This argument has already been rejected – both during the *Markman* and above (*see* Section IV.E.3). Respondents also suggest that "[a] POSITA would know that there is no need for a cover since the cartridge is built into the vaporizer and is not a removable or replaceable component; that is, the cartridge is fully enclosed in the vaporizer device and does not require a cover." RIB at 47. But their own expert acknowledged that if the silicone base did not close off the bottom of the cartridge, leaked oil could drip into the electronics in the vaporizer base. Pecht, Tr. at 218:20-219:4.

For these reasons, I find the evidence to establish that this limitation is met.

iii) Limitations 527.1.g – 527.1.i.iv

Respondents do not dispute that the STIIIZY-AIO meets these limitations. RUCL at 6. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 183, 199-201.

iv) Conclusion

Accordingly, I find that the STIIIZY-AIO infringes claim 1 of the '527 patent.

3. STIIIZY-1G(C)

a) Claim 1

PAX asserts the STIIIZY-1G(C) infringes claim 1. CIB at 33.

Respondents did not set forth any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-1G(C) satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/As 151-152, 160, 169-170, 180, 189-194. Accordingly, I find that the STIIIZY-1G(C) infringes claim 1 of the '527 patent.

b) Claim 10

Claim 10 depends from claim 1, adding "bottom cover" limitations. JX-0004, cl. 5.

PAX asserts that the STIIIZY-1G(C) infringes claim 10. CIB at 35.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-1G(C) satisfies the additional limitations of claim 10. CX-4747C (Kodama) at Q/A 211. I therefore find that the STIIIZY-1G(C) infringes claim 10 of the '527 patent.

c) Claim 18

Claim 18 is identical to claim 1 but adds a "pad" limitation. JX-0004, cl. 18.

PAX asserts that the STIIIZY-1G(C) infringes claim 18. CIB at 36.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-1G(C) satisfies the limitations of claim 18. CX-4747C (Kodama) at Q/As 216-219, 221. Accordingly, I find that the STIIIZY-1G(C) infringes claim 18 of the '527 patent.

d) Claim 22

Claim 22 depends from claim 18, adding that "the at least one pad includes two pads." JX-0004, cl. 22.

PAX asserts that the STIIIZY-1G(C) infringes claim 22. CIB at 37.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-1G(C) satisfies the additional limitations of claim 22. CX-4747C (Kodama) at Q/A 225. I therefore find that the STIIIZY-1G(C) infringes claim 22 of the ’527 patent.

4. STIIIZY-ORIG-1G

a) Claim 1

PAX asserts the STIIIZY-ORIG-1G infringes claim 1. CIB at 33.

Respondents did not set forth any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/As 151, 153, 161, 171, 181, 195. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 1 of the ’527 patent.

b) Claim 5

Claim 5 is directed to a vaporizer device consisting of the vaporizer cartridge of claim 1 and certain “vaporizer body” limitations. JX-0004, cl. 5.

PAX asserts the STIIIZY-ORIG-1G infringes claim 5. CIB at 35.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 5. CX-4747C (Kodama) at Q/As 229-230, 233, 236. I therefore find that the STIIIZY-ORIG-1G infringes claim 5 of the ’527 patent.

c) Claim 10

Claim 10 depends from claim 1, adding “bottom cover” limitations. JX-0004, cl. 10.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 10. CIB at 35.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 10. CX-4747C (Kodama) at Q/A 212. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 10 of the '527 patent.

d) Claim 11

Claim 11 includes the limitations of claim 5, plus additional "pressure sensor" and "channel" limitations. JX-0004, cl. 11.

PAX asserts the STIIIZY-ORIG-1G infringes claim 11. CIB at 35-36.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 11. CX-4747C (Kodama) at Q/As 241-244. I therefore find that the STIIIZY-ORIG-1G infringes claim 11 of the '527 patent.

e) Claim 17

Claim 17 depends from claim 11, adding the same "bottom cover" limitations recited in claim 10. JX-0004, cl. 17.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 10. CIB at 36.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 17. CX-4747C (Kodama) at Q/As 247. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 17 of the '527 patent.

f) Claim 18

Claim 18 is identical to claim 1 but adds a "pad" limitation. JX-0004, cl. 18.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 18. CIB at 36.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 18. CX-4747C (Kodama) at Q/As 216-219, 222. I therefore find that the STIIIZY-ORIG-1G infringes claim 18 of the '527 patent.

g) Claim 22

Claim 22 depends from claim 18, adding that "the at least one pad includes two pads." JX-0004, cl. 22.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 22. CIB at 37.

Respondents did not present any noninfringement arguments in its briefs and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 22. CX-4747C (Kodama) at Q/A 226. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 22 of the '527 patent.

5. ROVE Products

a) Claim 1

PAX asserts that the ROVE(C) and ROVE(V) infringe claim 1. CIB at 33.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the ROVE(C) and ROVE(V) satisfy the limitations of claim 1. CX-4747C (Kodama) at Q/As 151, 156-157, 164-165, 176-177, 184-185, 202-205. Accordingly, I find that the ROVE(C) and ROVE(V) infringe claim 1 of the '527 patent.

b) Claim 5

Claim 5 is directed to a vaporizer device consisting of the vaporizer cartridge of claim 1 and certain "vaporizer body" limitations. JX-0004, cl. 5.

PAX asserts the ROVE(V) infringes claim 5. CIB at 35.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the ROVE(V) satisfies the limitations of claim 5. CX-4747C (Kodama) at Q/As 229, 231, 234, 237. I therefore find that the ROVE(V) infringes claim 5 of the '527 patent.

c) Claim 10

Claim 10 depends from claim 1, adding "bottom cover" limitations. JX-0004, cl. 10.

PAX asserts that the ROVE(C) and ROVE(V) infringe claim 10. CIB at 35.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the ROVE(C) and ROVE(V) satisfy the additional limitations of claim 10. CX-4747C (Kodama) at Q/As 213-214. Accordingly, I find that the ROVE(C) and ROVE(V) infringe claim 10 of the '527 patent.

d) Claim 11

Claim 11 includes the limitations of claim 5, plus additional "pressure sensor" and "channel" limitations. JX-0004, cl. 11.

PAX asserts the ROVE(V) infringes claim 11. CIB at 35-36.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the ROVE(V) satisfies the limitations of claim 11. CX-4747C (Kodama) at Q/As 241-243, 245. Accordingly, I find that the ROVE(V) infringes claim 11 of the '527 patent.

e) Claim 17

Claim 17 depends from claim 11, adding the same "bottom cover" limitations recited in claim 10. JX-0004, cl. 17.

PAX asserts that the ROVE(V) infringe claim 10. CIB at 36.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the ROVE(V) satisfies the additional limitations of claim 17. CX-4747C (Kodama) at Q/A 248. I therefore find that the ROVE(V) infringes claim 17 of the '527 patent.

6. FLARE Products

a) Claim 1

PAX asserts that the FLARE(C) and FLARE(V) infringe claim 1. CIB at 33.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the FLARE(C) and FLARE(V) satisfy the limitations of claim 1. CX-4747C (Kodama) at Q/As 151, 158-159, 166-167, 178-179, 186-187, 206-209. Accordingly, I find that the FLARE(C) and FLARE(V) infringe claim 1 of the '527 patent.

b) Claim 5

Claim 5 is directed to a vaporizer device consisting of the vaporizer cartridge of claim 1 and certain "vaporizer body" limitations. JX-0004, cl. 5.

PAX asserts the FLARE(V) infringes claim 5. CIB at 35.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 43-47.

The evidence shows that the FLARE(V) satisfies the limitations of claim 5. CX-4747C (Kodama) at Q/As 229, 232, 235, 238. I therefore find that the FLARE(V) infringes claim 5 of the '527 patent.

7. The STIIIZY Redesigned Products

PAX has not introduced any evidence of infringement. As such, it has failed to meet its burden to show that the STIIIZY Redesigned Products infringe the '527 patent. *See Spansion*, 629 F.3d at 1349 (holding that complainant bears the burden of proving infringement of the asserted patent claims by a preponderance of the evidence).

C. Indirect Infringement

The asserted claims of the '527 patent raise substantially the same issues as the asserted claims of the '756 patent. PAX relies on the same unrebutted evidence as presented for the '756 patent. Thus, for the reasons set forth in Section IV.C, PAX has established that Respondents indirectly infringe claims 1, 5, 10-11, 17-18, and 22 of the '527 patent, both contributorily and by inducement.

D. Technical Prong of the Domestic Industry Requirement

PAX asserts that the '527 DI Products identified below practice certain claims of the '527 patent:

'527 DI Products	Representative Products	Practiced Claims
ERA-05G(C)	ERA-05G(C)	1 and 18
ERA-ORIG-05G	ERA-ORIG-05G	1, 5, 11, and 18
ERA-PRO-05G		
ERA-LIFE-05G		
ERA-GO-05G		
ERA-1G(C)	ERA-1G(C)	1 and 18
ERA-ORIG-1G	ERA-ORIG-1G	1, 5, 11, and 18
ERA-PRO-1G		
ERA-LIFE-1G		
ERA-GO-1G		

CIB at 81.

Respondents take no position on the technical prong of the domestic industry. RIB at 139. As such, Respondents have waived their right to dispute that PAX satisfies the technical prong of the domestic industry requirement.

The evidence shows that the '527 DI Products practice claims 1, 5, 11, and 18 of the '527 patent. Mr. Kodama explained how the ERA-05G(C), ERA-ORIG-05G, ERA-1G(C), and ERA-ORIG-1G practice the limitations of claims 1 and 18. CX-4747C (Kodama) at Q/As 666-699. Mr. Kodama also provided unrebutted testimony on how the ERA-ORIG-05G and ERA-ORIG-1G practice the limitations of claims 5 and 11. *Id*. at Q/As 700-709.

For these reasons, I find that the technical prong of the domestic industry requirement is satisfied for the '527 patent.

E. Validity

Respondents assert that the '527 patent is invalid because: (1) Alarcon in view of U.S. 2015/0034104 ("Zhou") and U.S. 2013/0192615 ("Tucker") renders claims 1, 5, 11, 18, and 22

obvious claims 1 and 5 (RIB at 47-61); (2) Alarcon in view of Zhou, Tucker, and Xiang renders claims 10 and 17 obvious (*id*. at 61-62); (3) Alarcon in view of Zhou, Tucker, and Daryani renders claim 22 obvious (*id.* at 62-63); and (4) there is insufficient written description for the claimed "bottom cover" (*id.* at 63).

1. Obviousness

a) Alarcon in view of Zhou and Tucker

i) Claims 1, 11, and 18

Respondents assert that claims 1, 11, and 18 are rendered obvious by the combination of Alarcon, Zhou and Tucker. RIB at 47. Respondents rely on Alarcon for most of the limitations, including the same "bottom cover" limitation found in claim 1 of the '756 patent. *Id*. at 52-56. Respondents cite Zhou only for its disclosure of two reservoir seals in the mouthpiece and Tucker for its disclosure of ceramic heating elements. *Id* at 53-55.

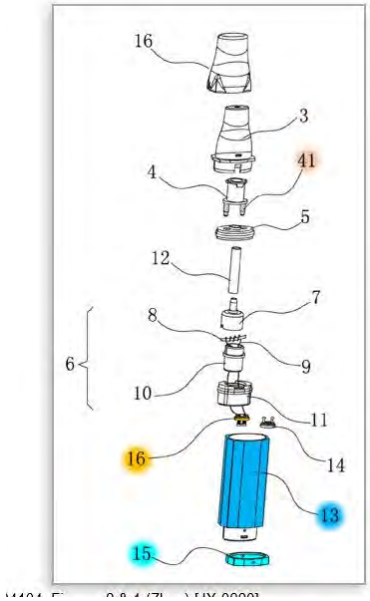
As explained above, I found that Alarcon does not disclose the claimed "bottom cover." *See* Section IV.E.1.a.i.2. Respondents do not allege that either Zhou or Tucker teaches this limitation. RIB at 52-56. Nor have they set forth any arguments as to how a person of skill would modify Alarcon with Zhou and Tucker to supply the missing claim limitation. *Id*. at 50-52. Without such a showing, Respondents cannot meet their burden to establish that Alarcon in view of Zhou and Tucker renders claim 1, 11, or 18 of the '527 patent obvious.

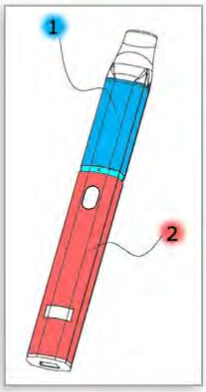
Nor can Respondents establish that one of skill would be motivated to combine Alarcon, Zhou and Tucker.[17] Respondents once more rely on the testimony of Dr. Jackson for this showing.

[17] Dr. Jackson's addition of Tucker relies on the combination of Alarcon with Zhou. RX-0473C (Jackson) at Q/As 645-646.

Dr. Jackson argues that "[a] POSITA would have been motivated to convert a threaded-connection vaporizer like Alarcon into a slot-in vaporizer like that described in Zhou due to "user convenience" and the risks of "fatigue failures and alignment issues."[18] RX-0473C (Jackson) at Q/A 645. Dr. Jackson provides no support for his opinion beyond his own assertions. *Acoustic Tech, Inc. v. Itron Networked Sols., Inc.*, 949 F.3d 1366, 1375 (Fed. Cir. 2020) (explaining that conclusory expert testimony and attorney argument cannot constitute substantial evidence of a motivation to combine"). For example, he failed to identify anything in Alarcon's arrangement such that a skilled artisan would look to Zhou to make the suggested change. CX-4750C (Sturges)

[18] Notably, Dr. Jackson does not rely on Zhou for its connection method in his obviousness opinion. He only cites to Zhou for the "reservoir seal" limitations, which are separate and distinct from the slot-in connection Dr. Jackson relies on for motivation to combine. RX-0473C (Jackson) at Q/As 657-659. As shown below, the "first reservoir seal" and "second reservoir seal" (*i.e.*, "sealing cylinders 41") are internal components of Zhou's atomizer shell 13 (Figure 2 at left), whereas Zhou's "slot-in" connection connects the atomizer 1 with the battery assembly 2 (Figure 1 at right). JX-0220 at FIGS. 1, 2.





CDX-0004.33. As Dr. Sturges explained: "Because these aspects are wholly unrelated functionally and positionally, any motivation to adopt the connection mechanism of Zhou has no reasonable bearing on whether a POSITA would also adopt the reservoir seals of Zhou." CX-4750C (Sturges) at Q/A 175.

at Q/A 174. *Innogenetics, N.V. v. Abbott Labs.*, 512 F.3d 1363, 1373 (Fed. Cir. 2008) ("[K]nowledge of a problem and motivation to solve it are entirely different from motivation to combine particular references to reach the particular claimed [device]."). His analysis also ignores the fact that "combining Alarcon and Zhou's connection does not involve simply changing the way in which the cartridge and battery components engage one another, but instead also requires completely changing the power scheme of the device." *Id*.

For these reasons, I find that Respondents have not established that Alarcon, Zhou, and Tucker renders obvious claims 1, 11, and 18 of the '527 patent.

ii) Claims 5 and 22

Because claim 5 and claim 22 depend from independent claims 1 and 18 respectively, they too are not rendered obvious by the combination of Alarcon, Zhou, and Tucker.

b) Alarcon in view of Zhou, Tucker, and Xiang

Respondents allege that Alarcon in view of Zhou, Tucker, and Xiang render claims 10 and 17 obvious. RIB at 61. The record evidence is insufficient to make such a determination. Respondents' arguments on motivation to combine and a reasonable expectation of success consist of two sentences. For example, Respondents write: "A POSITA would be motivated to combine the teachings of Alarcon with those of Zhou and Tucker and would be motivated to further combine with Xiang." *Id*. To explain how these references could be combined, Respondents merely state: "The teachings of Alarcon and the teachings of Zhou, Tucker, and Xiang could be combined by a POSITA at the time of the purported invention in a predictably way to, predictably, arrive at the purported invention." *Id*. These types of conclusory arguments constitute waiver under my Ground Rules.

Accordingly, Respondents have not met their burden to show that Alarcon in view of Zhou, Tucker, and Xiang renders claims 10 and 17 of the '527 patent obvious.

c) Alarcon in view of Zhou, Tucker, and Daryani

Respondents assert that Alarcon in view of Zhou, Tucker, and Daryani renders claim 22 obvious. RIB at 62. Again, Respondents offer only two sentences on the issues of motivation to combine and a reasonable expectation of success. *Id*. at 62-63. Respondents also failed to address why a person of skill would be motivated to combine these particular references to achieve the claimed invention. *Id*. (cross-referencing arguments for different combinations – Alarcon+Zhou+Tucker and Alarcon+Daryani). This is not sufficient under my Ground Rules. Accordingly, these arguments are waived.

As such, Respondents have failed to meet their burden to establish that Alarcon, Zhou, Tucker, and Darynai render claim 10 of the '527 patent obvious.

d) Secondary Considerations

Secondary considerations of nonobviousness may rebut a prima facie case of obviousness. Here, where Respondents have not made out a prima facie case of obviousness, there is no showing to rebut. Accordingly, I need not consider any secondary considerations of nonobviousness.

2. Written Description

Respondents assert that every asserted claim of the '527 patent is invalid for non-compliance with the written description requirement. RIB at 63. They rely on their § 112 analysis for the '756 patent in support. *Id*. Thus, for the same reasons discussed in Section IV.E.3 above, Respondents have not shown by clear and convincing evidence that the asserted claims of the '527 patent are invalid under 35 U.S.C. § 112.

VI. U.S. PATENT NO. 11,369,757

A. Overview

The '757 patent issued on June 28, 2022, and has 20 claims. JX-0002 at cover page. Claims 1, 13, 15, and 20 are asserted in this investigation. CIB at 43. These claims are reproduced below:

Claim	Claim Language
757.1.pre	A vaporizer cartridge comprising:
757.1.a	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
757.1.b.	a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;
757.1.c	a reservoir configured to hold a vaporizable material;
757.1.d	a first pad positioned within an interior of the mouthpiece;
757.1.e	a second pad positioned within the interior of the mouthpiece;
757.1.f	a heater chamber comprising:
757.1.f.i	a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;
757.1.f.ii	a housing piece configured to house at least a portion of the heater, the housing piece comprising a housing opening configured to receive at least a portion of the heater;
757.1.f.iii	an air tube extending from the housing piece;
757.1.g	a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening; and
757.1.h	a distal member positioned at least partially within the cartridge body between the housing piece and the bottom cover, the distal member comprising:
757.1.h.i	a proximal side;
757.1.h.ii	a distal side opposite the proximal side;
757.1.h.iii	a lateral side extending between the proximal side and the distal side; and
757.1.h.iv	at least one recessed surface positioned on the lateral side;
757.1.i	wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and
757.1.j	wherein the first air opening and the second air opening of the bottom portion allow air to pass into the air chamber.
757.13.pre	The vaporizer cartridge of claim 1, wherein the bottom portion of the bottom cover comprises:
757.13.a	a first cartridge electrical contact of the vaporizer cartridge is exposed; and
757.13.b	a second cartridge electrical contact opening through which a second cartridge electrical contact of the vaporizer cartridge is exposed.
757.15.pre	A vaporizer device comprising:

PUBLIC VERSION

Claim	Claim Language
757.15.a	a vaporizer cartridge, comprising:
757.15.a.i	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
757.15.a.ii	a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;
757.15.a.iii	a reservoir configured to hold a vaporizable material;
757.15.a.iv	a first pad positioned within an interior of the mouthpiece;
757.15.a.v	a second pad positioned within the interior of the mouthpiece;
757.15.a.vi	a heater chamber comprising:
757.15.a.vi.a	a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;
757.15.a.vi.b	a housing piece configured to house at least a portion of the heater, the housing piece configured to receive at least a portion of the heater;
757.15.a.vi.c	an air tube extending from the housing piece.
757.15.a.vii	a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening;
757.15.a.viii	a distal member positioned at least partially within the cartridge body between the housing piece and the bottom cover, the distal member comprising:
757.15.a.viii.a	a proximal side;
757.15.a.viii.b	a distal side opposite the proximal side;
757.15.a.viii.c	a lateral side extending between the proximal side and the distal side; and
757.15.a.viii.d	at least one recessed surface positioned on the lateral side;
757.15.a.ix	wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and
757.15.a.x	wherein the first air opening and the second air opening of the bottom portion allow air to pass into the air chamber;
757.15.a.xi	a first cartridge electrical contact; and
757.15.a.xii	a second cartridge electrical contact; and
757.15.b	a vaporizer body, comprising:
757.15.b.i	a cartridge receiver configured to insertably receive the vaporizer cartridge, the cartridge receiver comprising:
757.15.b.i.a	a first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;
757.15.b.i.b	a second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;
757.15.b.i.c	an insertion end into which the vaporizer cartridge is inserted; and
757.15.b.i.d	a base opposite the insertion end; and
757.15.b.ii	one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heater of the vaporizer cartridge.

Claim	Claim Language
757.20.pre	The vaporizer device of claim 15, wherein the bottom portion of the bottom cover comprises: electrical contact opening and the second cartridge electrical contact opening;
757.20.a	a first cartridge electrical contact opening through which the first cartridge electrical contact of the vaporizer cartridge is exposed;
757.20.b	a second cartridge electrical contact opening through which the second cartridge electrical contact of the vaporizer cartridge is exposed; and
757.20.c	a region positioned between the first cartridge
757.20.d	wherein the bottom cover comprises exactly two air openings, the air openings comprising the first air opening and the second air opening; and
757.20.e	wherein the first air opening and the second air opening are not positioned within the region.

B. Infringement

PAX asserts that the '757 Accused Products identified below infringe the asserted claims of the '757 patent:

'757 Accused Products	Representative Products	Asserted Claims
STIIIZY-1G(C)	STIIIZY-1G(C)	1 and 13
STIIZY-05G(C)		
STIIIZY-ORIG-1G	STIIIZY-ORIG-1G	1,13, 15, and 20
STIIIZY-ORIG-05G		
STIIIZY-BIIIG-1G		
STIIIZY-BIIIG-05G		
STIIIZY-LIIIL	STIIIZY-LIIIL	1

Id.

1. STIIIZY-LIIIL

a) Claim 1

i) Limitations 757.1.pre – 757.1.f.iii

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 3-4. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 264, 267, 271, 278.

ii) Limitation 757.1.g

The parties rely on the arguments they presented for the "bottom cover" limitation in the '756 patent for this limitation. CIB at 44; RIB at 64.

Thus, for the reasons discussed in Section IV.B.1.a.ii, the evidence shows that this limitation is met. *See* CX-4747C (Kodama) at Q/As 282-283.

iii) Limitations 757.1.h – 757.1.j

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations RUCL at 4. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 286, 289, 292.

iv) Conclusion

Accordingly, I find that the STIIIZY-LIIIL infringes claim 1 of the '757 patent.

2. STIIIZY-1G(C)

a) Claim 1

PAX asserts the STIIIZY-1G(C) infringes claim 1. CIB at 44.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 63-64.

The evidence shows that the STIIIZY-1G(C) satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/A 264-265, 269, 272-276, 279, 284, 287, 290, 293. Accordingly, I find that the STIIIZY-1G(C) infringes claim 1 of the '757 patent.

b) Claim 13

Claim 13 depends from claim 1, adding "cartridge electrical contact opening" limitations. JX-0002, cl. 13.

PAX asserts that the STIIIZY-1G(C) infringes claim 13. CIB at 44-45.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 63-64.

The evidence shows that the STIIIZY-1G(C) satisfies the additional limitations of claim 13. CX-4747C (Kodama) at Q/A 303. I therefore find that the STIIIZY-1G(C) infringes claim 13 of the '757 patent.

3. STIIIZY-ORIG-1G

a) Claim 1

PAX asserts that the STIIIZY-ORIG-1G infringes claim 1. CIB at 44.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 63-64.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/As 264, 266, 270, 277, 281, 285, 288, 291, 294. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 1 of the '757 patent.

b) Claim 13

Claim 13 depends from claim 1, adding "cartridge electrical contact opening" limitations. JX-0002, cl. 13.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 13. CIB at 44-45.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 63-64.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 13. CX-4747C (Kodama) at Q/A 304. I therefore find that the STIIIZY-ORIG-1G infringes claim 13 of the '757 patent.

c) Claim 15

PAX asserts that the STIIIZY-ORIG-1G infringes claim 15. CIB at 45.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 63-64.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 15. CX-4747C (Kodama) at Q/As 311-315. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 15 of the '757 patent.

d) Claim 20

Claim 20 depends from claim 15, adding that the vaporizer device includes a bottom cover having the same cartridge electrical contact openings as claim 13. JX-0002, cl. 20. Claim 20 further adds "region" limitations. *Id*.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 20. CIB at 45.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 63-64.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 20. CX-4747C (Kodama) at Q/As 319-320. I therefore find that the STIIIZY-ORIG-1G infringes claim 20 of the '757 patent.

4. The STIIIZY Redesigned Products

PAX does not introduce any evidence of infringement. As such, it has failed to meet its burden to show that the STIIIZY Redesigned Products infringe the '757 patent. *See Spansion*, 629 F.3d at 1349 (holding that complainant bears the burden of proving infringement of the asserted patent claims by a preponderance of the evidence).

C. Indirect Infringement

The asserted claims of the '757 patent raise substantially the same issues as the asserted claims of the '756 patent. PAX relies on the same unrebutted evidence as presented for the '756 patent. Thus, for the reasons set forth in Section IV.C, I find that PAX has established that Respondents indirectly infringe claims 1, 13, 15, and 20 of the '757 patent, both contributorily and by inducement.

D. Technical Prong of the Domestic Industry Requirement

PAX asserts that the '757 DI Products identified below practice certain claims of the '757 patent:

'757 DI Products	Representative Products	Practiced Claims
ERA-05G(C)	ERA-05G(C)	1
ERA-ORIG-05G	ERA-ORIG-05G	1 and 15
ERA-PRO-05G		
ERA-LIFE-05G		
ERA-GO-05G		

CIB at 82.

Respondents take no position on the technical prong of the domestic industry. RIB at 139. As such, Respondents have waived their right to dispute that PAX satisfies the technical prong of the domestic industry requirement.

The evidence shows that '757 DI Products practice claims 1 and 15 of the '757 patent. Mr. Kodama explained how the ERA-05G(C) and ERA-ORIG-05G products practice every limitation of claim 1. CX-4747C (Kodama) at Q/As 716-737. Mr. Kodama also provided unrebutted testimony on how the ERA-ORIG-05G meets every limitation of claim 15. *Id*. at Q/As 738-746.

For these reasons, I find that the technical prong of the domestic industry requirement is satisfied for the '757 patent.

E. Validity

Respondents assert that the '757 patent is invalid because: (1) Alarcon anticipates claims 1 and 15 (RIB at 64-70); (2) Alarcon in view of Daryani renders claims 1 and 15 obvious (*id.* at 70); (3) Alarcon in view of Xiang renders claims 13 and 20 obvious (*id*. at 70-72); (4) Alarcon in view of Daryani and Xiang renders claims 13 and 20 obvious (*id*. at 72-73); (4) Tucker in view of Alarcon renders claims 1 and 15 obvious (*id*. at 73-86); (5) Tucker in view of Alarcon and Daryani renders claims 1 and 15 obvious (*id*. at 87); (6) Tucker in view of Alarcon and Xiang renders claims 13 and 20 obvious (*id*. at 87-90); (7) Tucker in view of Alarcon, Daryani, and Xiang renders claims 13 and 20 obvious (*id*. at 91); and (8) there is insufficient written description for "a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom cover comprising: a first air opening" (*id.* at 91).

1. Anticipation

a) Alarcon

i) Claim 1

Respondents assert that Alarcon anticipates claim 1 for the same reasons as claim 1 of the '756 patent. RIB at 64-67. Thus, for the same reasons set forth in Section IV.E.1.a, I find that Alarcon does not disclose limitations 757.1.e ("second pad") and 757.1.g ("bottom cover").

Accordingly, Alarcon does not anticipate claim 1 of the ’757 patent.

ii) Claim 15

Claim 15 includes the same “second pad” and “bottom cover” limitations as claim 1. JX-0002, cl. 15. Because Alarcon does not disclose these limitations (*see* Section IV.E.1.a), Alarcon does not anticipate claim 15 of the ’757 patent.

2. Obviousness

a) Alarcon in view of Daryani

Respondents assert that Alarcon and Daryani render claims 1 and 15 obvious for the same reasons as claim 1 of the ’756 patent. RIB at 7. Thus, for the same reasons set forth in Section IV.E.2.a, Respondents have failed to meet their burden to establish that Alarcon in view of Daryani renders claims 1 and 15 of the ’757 patent obvious.

b) Alarcon in view of Xiang

Respondents contend that a “POSITA would be motivated to combine Alarcon with Xiang for the same reasons discussed above with respect to 756.10.” RIB at 71. Thus, for the same reasons set forth in Section IV.E.2.c, Respondents have failed to meet their burden to establish that Alarcon in view of Xiang renders claims 13 and 20 of the ’757 patent obvious.

c) Alarcon in view of Daryani and Xiang

Respondents assert that “a POSITA would be motivated to combine Alarcon with Daryani and Xiang for the same reasons discussed above with respect to 756.10.” RIB at 73. Thus, for the same reasons set forth in Section IV.E.2.b, Respondents have failed to meet their burden to establish that Alarcon in view of Daryani and Xiang renders claims 13 and 20 of the ’757 patent obvious.

d) Tucker in view of Alarcon

Respondents assert that Tucker and Alarcon render claims 1 and 15 obvious. RIB at 73-87. According to Respondents, "a person of skill in the art would look to Alarcon to improve Tucker's device for numerous reasons, including that both are cartridge-based vaporizer references in the same field of endeavor and that a POSITA would consider and glean teachings from when improving on any prior art vaporizer." *Id*. at 73. While PAX did not address this combination in its initial brief (*see generally* CIB at 50-52) and have therefore waived any such arguments, Respondents still bear the burden of proof. *See Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1360 (Fed. Cir. 2012) ("At all times, the burden is on the defendant to establish by clear and convincing evidence that the patent is obvious.").

Respondents only rely on Alarcon for the second pad in the mouthpiece. RIB at 77. But, as discussed *infra*, Respondents have not established that Tucker discloses the "bottom cover" and "distal member" limitations. *See* Section VII.E.1.b. Without any such disclosure, Respondents cannot show by clear and convincing evidence that Tucker in view of Alarcon renders claims 1 and 15 of the '757 patent obvious.

e) Tucker in view of Alarcon and Daryani

Respondents assert that Tucker in view of Alarcon and Daryani renders claims 1 and 15 obvious. RIB at 87. Once again, Respondents only offer conclusory arguments.[19] *Id*. at 87. And the conclusory arguments they do offer relate to different combinations—*i.e.*, Tucker+Alarcon and Alarcon+Daryani. *Id*. As I previously explained, this constitutes waiver under my Ground Rules.

Respondents have therefore not met their burden to establish that the combination of Tucker, Alarcon, and Daryani renders claims 1 and 15 of the '757 patent obvious.

[19] The entirety of their argument is less than one page. *See* RIB at 87.

f) Tucker in view of Alarcon and Xiang

Respondents assert that the combination of Tucker, Alarcon, and Xiang renders claims 13 and 20 obvious. RIB at 87. Respondents again failed to provide any explanation as to how or why these references would be combined to produce the claimed invention. For example, on the issue of motivation to combine, they merely state: "A POSITA would be motivated to combine the teachings of Tucker with those of Alarcon and Xiang for the reasons discussed above with respect to the combinations of Tucker with Alarcon and Alarcon with Xiang." *Id*. at 87-88. Their argument on a reasonable expectation of success is similarly lacking. They write: "The teachings of Tucker and the teachings of Alarcon and Xiang could be combined by a POSITA at the time of the purported invention in a predictable way to, predictably, arrive at the purported invention." *Id*. at 88. Respondents have therefore waived these arguments.

As such, Respondents have failed to meet their burden to establish that Tucker in view of Alarcon and Xiang renders claims 13 and 20 of the '757 patent obvious.

g) Tucker in view of Alarcon, Daryani, and Xiang

Respondents assert that Tucker in view of Alarcon, Daryani, and Xiang renders claims 13 and 20 obvious. RIB at 91. Respondents' analysis for this combination suffers from the same flaws as Tucker in view of Xiang and Tucker in view of Alarcon and Xiang. Once more, they only offer conclusory arguments. And instead of explaining why a person of skill would combine these four references, Respondents cross-reference arguments for different combinations. *Id*. at 91. Not only is this deficient under my Ground Rules but it also falls far short of the clear and convincing standard.

Accordingly, Respondents have not met their burden to establish that the combination of Tucker, Alarcon, Daryani, and Xiang renders claims 13 and 20 of the '757 patent obvious.

h) Secondary Considerations

Secondary considerations of nonobviousness may rebut a prima facie case of obviousness. Here, where BOE has not made out a prima facie case of obviousness, there is no showing to rebut. Accordingly, I need not consider any secondary considerations of nonobviousness.

3. Written Description

Respondents assert that every asserted claim of the '757 patent is invalid for non-compliance with the written description requirement. RIB at 91. They rely on their § 112 analysis for the '756 patent in support. *Id.* For the same reasons discussed in Section IV.E.3 above, Respondents have not shown by clear and convincing evidence that the asserted claims of the '757 patent are invalid under 35 U.S.C. § 112.

VII. U.S. PATENT NO. 11,759,580

A. Overview

The '580 patent issued on September 19, 2023, and has 20 claims. JX-0003 at cover page. Claims 1, 6-8, and 10 are asserted in this investigation. CIB at 54. These claims are reproduced below:

Claim	Claim Language
580.1.pre	A vaporizer cartridge comprising:
580.1.a	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
580.1.b	a mouthpiece coupled to the proximal body end, where the mouthpiece comprises an outlet;
580.1.c	a reservoir configured to hold a vaporizable material;
580.1.d	a vaporization chamber comprising:
580.1.d.i	a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;
580.1.d.ii	a housing piece configured to house at least a portion of the heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and
580.1.d.iii	an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;
580.1.e	an extension wire extending from the heater;

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Claim	Claim Language
580.1.f	a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening; and
580.1.g	a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:
580.1.g.i	a proximal side;
580.1.g.ii	a distal side opposite the proximal side;
580.1.g.iii	a lateral side extending between the proximal side and the distal side; and
580.1.g.iv	an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member, and
580.1.g.v	wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member;
580.1.g.vi	wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and
5801.g.vii	wherein at least a portion of the extension wire extends at least partially through the distal member;
580.1.h	wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover.
580.6.pre	A vaporizer device, comprising:
580.6.a	the vaporizer cartridge of claim 1;
580.6.b	a vaporizer body, comprising:
580.6.b.i	a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:
580.6.b.i.a	a body electrical contact;
580.6.b.i.b	an insertion end into which the vaporizer cartridge is inserted; and
580.6.b.i.c	a base opposite the insertion end;
580.6.c	a sensor configured to detect a draw on the mouthpiece, causing activation of the heater;
580.6.d	a channel extending from the base of the cartridge receiver to the sensor; and
580.6.e	one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heater of the vaporizer cartridge.
580.7.pre	The vaporizer cartridge of claim 1, wherein the bottom portion of the bottom cover comprises:
580.7.a	a first cartridge electrical contact opening through which a first cartridge electrical contact of the vaporizer cartridge is exposed; and
580.7.b	a second cartridge electrical contact opening through which a second cartridge electrical contact of the vaporizer cartridge is exposed.
580.8.pre	A vaporizer device comprising:
580.8.a	a vaporizer cartridge, comprising:

PUBLIC VERSION

Claim	Claim Language
580.8.a.i	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
580.8.a.ii	a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;
580.8.a.iii	a reservoir configured to hold a vaporizable material;
580.8.a.iv	a vaporization chamber comprising:
580.8.a.iv.a	a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;
580.8.a.iv.b	a housing piece configured to house at least a portion of the heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and
580.8.a.iv.c	an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;
580.8.a.v	an extension wire extending from the heater;
580.8.a.vi	a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening;
580.8.a.vii	at least one cartridge electrical contact; and
580.8.a.viii	a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:
580.8.a.viii.a	a proximal side;
580.8.a.viii.b	a distal side opposite the proximal side;
580.8.a.viii.c	a lateral side extending between the proximal side and the distal side; and
580.8.a.viii.d	an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member, and
580.8.a.viii.e	wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member;
580.8.a.viii.f	wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and
580.8.a.viii.g	wherein at least a portion of the extension wire extends at least partially through the distal member;
580.8.a.ix	wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and
580.8.b	a vaporizer body, comprising:
580.8.b.i	a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:
580.8.b.i.a	at least one body electrical contact configured to electrically couple to the at least one cartridge electrical contact of the vaporizer cartridge;
580.8.b.i.b	an insertion end into which the vaporizer cartridge is inserted; and
580.8.b.i.c	a base opposite the insertion end;
580.8.b.ii	a sensor configured to detect a draw on the mouthpiece, causing activation of the heater; and
580.8.b.iii	a channel extending from the base of the cartridge receiver to the sensor.

Claim	Claim Language
580.10.pre	The vaporizer device of claim 8, wherein the bottom portion of the bottom cover comprises:
580.10.a	a first cartridge electrical contact opening through which the first cartridge electrical contact of the vaporizer cartridge is exposed;
580.10.b	a second cartridge electrical contact opening through which the second cartridge electrical contact of the vaporizer cartridge is exposed; and
580.10.c	a region positioned between the first cartridge electrical contact opening and the second cartridge electrical contact opening,
580.10.d	wherein the bottom cover comprises exactly two air openings, and
580.10.e	wherein the air openings are not positioned within the region.

B. Infringement

PAX asserts that the '580 Accused Products identified below infringe the asserted claims of the '580 patent:

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'580 Accused Products	Representative Products	Asserted Claims
STIIIZY-1G(C)	STIIIZY-1G(C)	1 and 7
STIIZY-05G(C)		
STIIIZY-ORIG-1G	STIIIZY-ORIG-1G	1, 6-8, and 10
STIIIZY-ORIG-05G		
STIIIZY-BIIIG-1G		
STIIIZY-BIIIG-05G		
STIIIZY-LIIIL	STIIIZY-LIIIL	1
STIIIZY-AIO	STIIIZY-AIO	1
ROVE(C)	ROVE(C)	1 and 7
ROVE(V)	ROVE(V)	1, 6-8, and 10
FLARE(C)	FLARE(C)	1
FLARE(V)	FLARE(V)	1
STIIIZY-1G-REDESIGN(C)	STIIIZY-1G-REDESIGN(C)	1 and 7
STIIZY-05G-REDESIGN(C)		
STIIIZY-ORIG-1G-REDESIGN	STIIIZY-ORIG-1G-REDESIGN	1, 6-8, and 10
STIIIZY-ORIG-05G-REDESIGN		
STIIIZY-BIIIG-1G-REDESIGN		
STIIIZY-BIIIG-05G-REDESIGN		
STIIIZY-AIO-REDESIGN	STIIIZY-AIO-REDESIGN	1
ROVE-REDESIGN(C)	ROVE-REDESIGN(C)	1 and 7
ROVE-REDESIGN(V)	ROVE-REDESIGN(V)	1, 6-8, and 10
FLARE-REDESIGN(C)	FLARE-REDESIGN(C)	1
FLARE-REDESIGN(V)	FLARE-REDESIGN(V)	1

Id.

1. STIIIZY-LIIIL

a) Claim 1

i) Limitations 580.1.pre – 5801.e

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 8-9. The evidence confirms that these limitation are met. CX-4747C (Kodama) at Q/As 326-327, 330, 343-345, 349.

ii) Limitation 580.1.f

The parties rely on the arguments they presented for the "bottom cover" limitation in the '756 patent for this limitation. CIB at 55; RIB at 92-93.

Thus, for the reasons discussed in Section IV.B.1.a.ii, the evidence shows that this limitation is met. *See* CX-4747C (Kodama) at Q/A 365-366.

iii) Limitations 580.1.g – 580.1.h

Respondents do not dispute that the STIIIZY-LIIIL meets these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 381, 396, 411, 430, 445, 460, 475.

iv) Conclusion

Accordingly, I find that the STIIIZY-LIIIL infringes claim 1 of the '580 patent.

2. STIIIZY-AIO

a) Claim 1

i) Limitations 580.1.pre – 580.1.e

Respondents do not dispute that the STIIIZY-AIO meets these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 333, 352.

ii) Limitation 580.1.f

The parties rely on their arguments for the "bottom cover" limitation in the '527 patent for this limitation. CIB at 55; RIB at 93.

Thus, for the reasons discussed in Section V.B.1.a.ii, the evidence shows that this limitation is met. *See* CX-4747C (Kodama) at Q/A 369.

iii) Limitations 580.1.g – 580.1.h

Respondents do not dispute that this the STIIIZY-AIO meets these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 384, 399, 415, 433, 448, 463, 478.

iv) Conclusion

Accordingly, I find that the STIIIZY-AIO infringes claim 1 of the '580 patent.

3. STIIIZY-1G(C)

a) Claim 1

PAX asserts that the STIIIZY-1G(C) infringes claim 1. CIB at 55.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-1G(C) satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/As 326-328, 346-347, 362-363, 379, 394, 409, 428, 443, 458, 473. Accordingly, I find that the STIIIZY-1G(C) infringes claim 1 of the '580 patent.

b) Claim 7

Claim 7 depends from claim 1, adding the "exposed through" limitations. JX-0003, cl. 7.

PAX asserts that the STIIIZY-1G(C) infringes claim 7. CIB at 67.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-1G(C) satisfies the additional limitations of claim 7. CX-4747C (Kodama) at Q/A 498. Accordingly, I find that the STIIIZY-1G(C) infringes claim 7 of the '580 patent.

4. STIIIZY-ORIG-1G

a) Claim 1

PAX asserts the STIIIZY-ORIG-1G infringes claim 1. CIB at 55.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 1. CX-4747C (Kodama) at Q/As 326-327, 329, 348, 364, 380, 395, 410, 429, 444, 459, 474. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 1 of the '580 patent.

b) Claim 6

Claim 6 is directed to a vaporizer device consisting of the vaporizer cartridge of claim 1 and "vaporizer body" limitations. JX-0003, cl. 6.

PAX asserts the STIIIZY-ORIG-1G infringes claim 6. CIB at 67.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 6. CX-4747C (Kodama) at Q/As 523-524, 528, 532, 536, 540. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 6 of the '580 patent.

c) Claim 7

Claim 7 depends from claim 1, adding the "exposed through" limitations. JX-0003, cl. 7.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 7. CIB at 67.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 7. CX-4747C (Kodama) at Q/A 499. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 7 of the '580 patent.

d) Claim 8

PAX asserts that the STIIIZY-ORIG-1G infringes claim 8. CIB at 67-68.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-ORIG-1G satisfies the limitations of claim 8. CX-4747C (Kodama) at Q/As 549-550, 554-555. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 8 of the '580 patent.

e) Claim 10

Claim 10 depends from claim 8, adding the "exposed through" limitations. JX-0003, cl. 8.

PAX asserts that the STIIIZY-ORIG-1G infringes claim 10. CIB at 68.

Respondents did not present any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the STIIIZY-ORIG-1G satisfies the additional limitations of claim 10. CX-4747C (Kodama) at Q/A 561, 565. Accordingly, I find that the STIIIZY-ORIG-1G infringes claim 10 of the '580 patent.

5. FLARE Products

a) Claim 1

PAX asserts that the FLARE(C) and FLARE(V) infringe claim 1. CIB at 55.

Respondents did not set forth any noninfringement arguments and have therefore waived any such argument as to this claim. *See generally* RIB at 92-119.

The evidence shows that the FLARE(C) and FLARE(V) satisfy the limitations of claim 1. CX-4747C (Kodama) at Q/As 326-327, 334-335, 353-354, 370-371, 385-386, 400-402, 416-417, 434-435, 449-450, 464-465, 479-480. Accordingly, I find that the FLARE(C) and FLARE(V) infringe claim 1 of the '580 patent.

6. ROVE Products

a) Claim 1

i) Limitations 580.1.pre – 580.1.g.iii

Respondents do not dispute that the ROVE(C) and ROVE(V) meet these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 331-332, 350-351.

ii) Limitation 580.1.g.iv

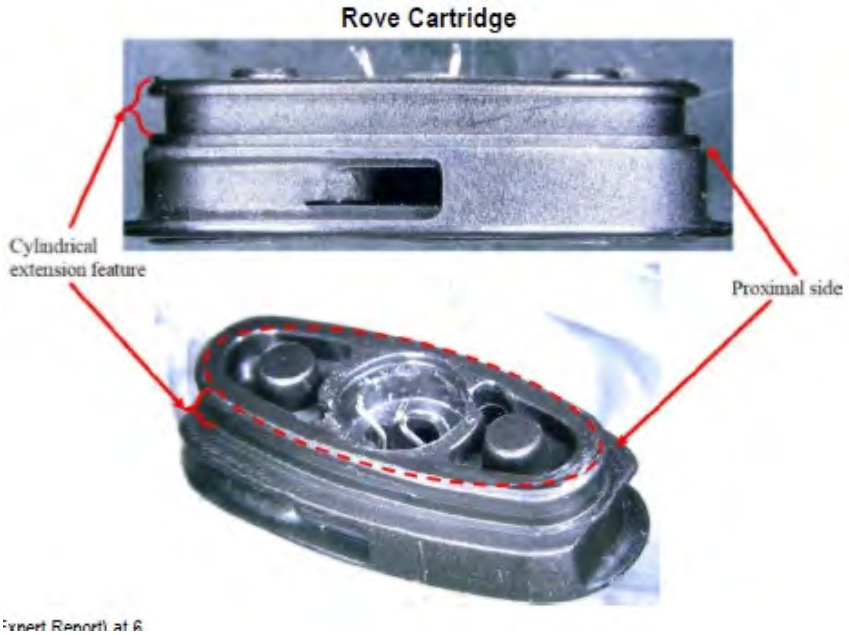
Limitation 580.1.g.iv recites "an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member." JX-0003, cl. 1. PAX contends that the ROVE (C) and ROVE (V) practice this limitation. CIB at 64-67. Respondents argue that "the alleged extension feature is an integral part of the distal member and is only externally shaped differently because it is press-fitted to the cartridge chamber." RIB at 94. Thus, according to Respondents, it cannot satisfy this limitation "because there is nothing significantly

different from the proximal to the distil [*sic*] side of the distil [*sic*] member, with respect to airflow." *Id*.

I find Respondents' argument unavailing. First, nothing in the claim language requires that the "extension feature" be distinct from the "distal member" from which it extends. JX-0003, cl. 1. Similarly, the claim language does not preclude an extension feature that is relatively uniform from the proximal to distal side or stated differently, that extends from the proximal side to the distal side. *Id*.; *see also* CX-4747C (Kodama) at Q/A 489 ("[T]he claim neither defines the dimensions of the extension feature nor requires any difference between the extension feature and the portion from the proximal side to the distal side."). Respondents further claim that "it does not at all resemble the 'extension feature' in the patent, the alleged "extension feature" in other Accused Products, and the purported 'extension feature' in the ERA products." RIB at 95; *see also* RX-04747C (Pecht) at Q/A 124 (arguing same). While this may be true, it is not relevant to the infringement analysis. It is axiomatic that the accused device be compared to the claims, not a domestic industry product, a preferred embodiment, or another accused product. *Wavetronix LLC v. EIS Elec. Integrated Sys.*, 573 F.3d 1343, 1354 (Fed. Cir. 2009) ("Infringement analysis involves a two-step process: the court first determines the meaning of disputed claim terms and then compares the accused device to the claims as construed.")

Turning now to the Accused Products, I find that the ROVE(C) and ROVE(V) meet this limitation. As Mr. Kodama explained, in the accused ROVE products, the extension feature extends from the proximal side and has a cylindrical shape.[20] CX-4747C (Kodama) at Q/As 412-414, 488-489. This is illustrated in the photos below.

[20] Dr. Pecht conceded that there is a difference in the size of the extension feature in the ROVE (C) and ROVE (V) relative to the lower portion of the distal member from which it extends. Pecht,



CDX-0001.0159 (marking a cross-section of the cylindrical shape with dashes); *see also* CX-4747C (Kodama) at Q/A 413 ("[A] POSITA would understand that a cylinder can have either a circular or ovoid cross-section.").

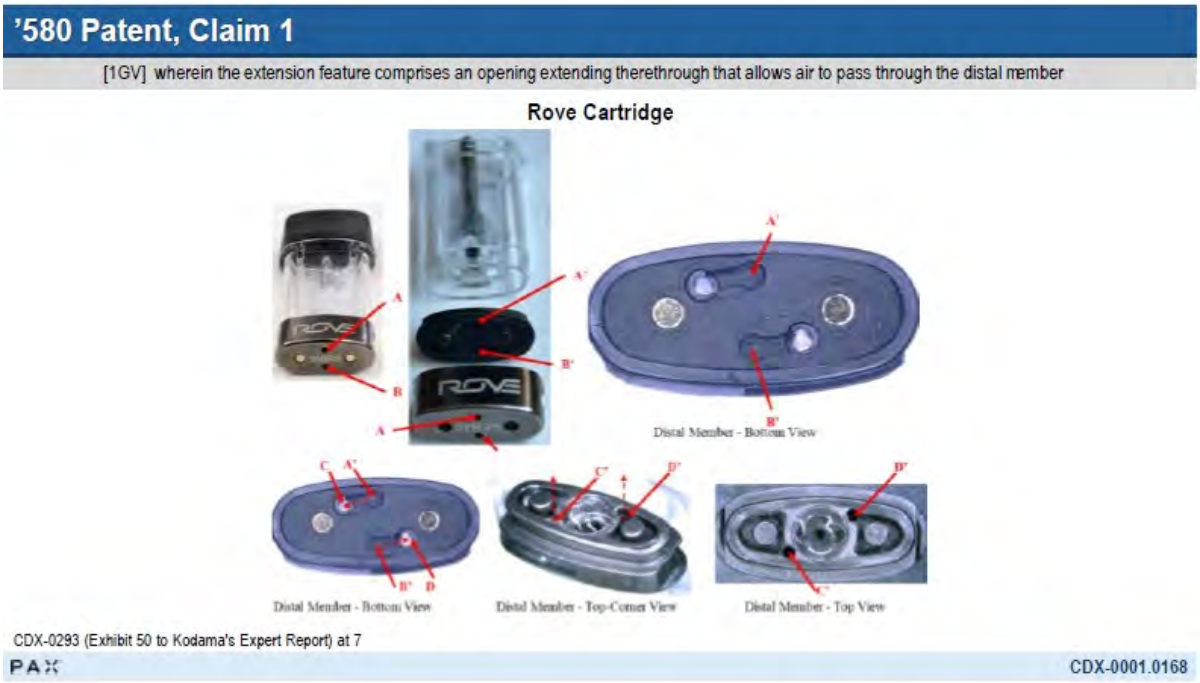
I therefore find that this limitation is satisfied.

iii) Limitation 580.1.g.v

Limitation 580.1.g.v recites "wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member." JX-0003, cl. 1.

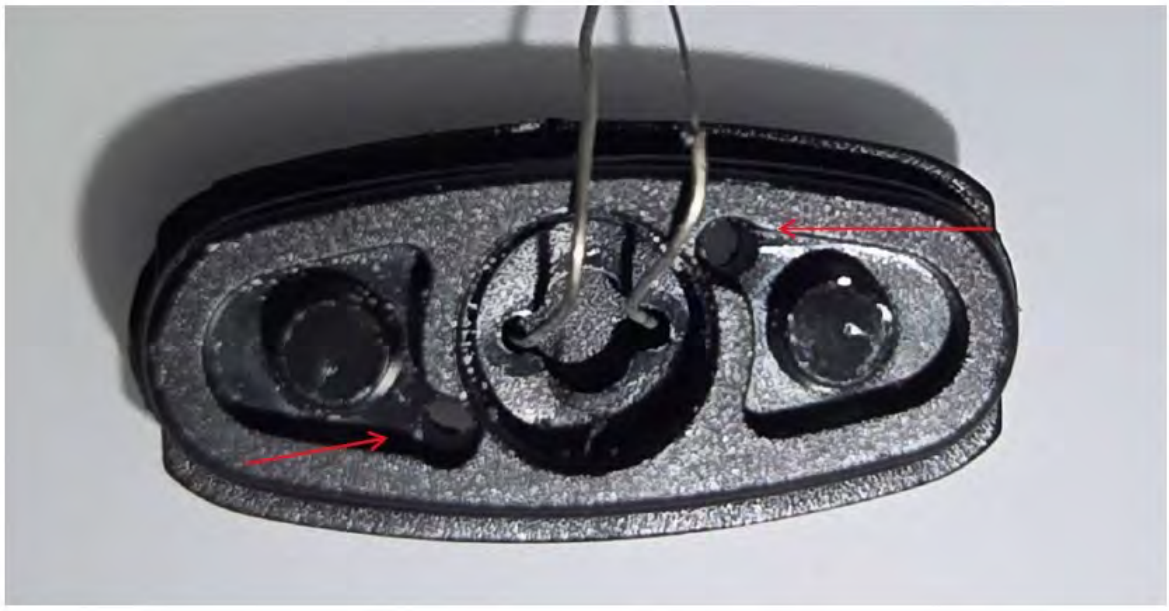
PAX asserts that this limitation is met, while Respondents insist it is not. The record contains conflicting opinions from people of skill. Mr. Kodama testified that the air flows into the holes at the bottom of the distal member, up through the structure, and out the openings in the interior of the extension feature. CX-4747C (Kodama) at Q/A 431. This is allegedly shown in CDX-0001.0168:

Tr. at 272:2-7. "The size difference results in formation of a ledge between [the distal member and the extension feature], on which the lower edge of the cartridge body rests." CIB at 66.



Dr. Pecht, on the other hand, testified that "the openings, which allow air flow, are holes that are not part of the alleged extension feature and do not rise above the surface of the alleged distal member." RX-0474C (Pecht) at Q/A 126.

The claim language requires the extension feature to comprise an opening through which air flows. Dr. Kodama identified those openings as C and D in the above image. CX-4747C (Kodama) at Q/A 431. However, on closer inspection, those openings do not pass through the "extension feature."



RDX-0006 at 12; RX-0474C (Pecht) at Q/A 125 ("there are no air holes that pass through the purported 'extension' feature"). I therefore find that PAX has not met its burden to show that this limitation is present in either the ROVE(C) or ROVE(V).

iv) Limitations 580.1.g.vi – 580.1.h

Respondents do not dispute that the ROVE(C) and ROVE(V) meet these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 446-447, 461-462, 476-477.

v) Conclusion

Accordingly, for the reasons set forth above, the ROVE(C) and ROVE(V) do not infringe claim 1 of the '580 patent.

b) Claim 6

Claim 6 is directed to a vaporizer device comprised of the vaporizer cartridge of claim 1 and "vaporizer body" limitations. JX-0003, cl. 6. In the preceding section, I found the ROVE(V)

to not infringe claim 1 of the ’580 patent. Consequently, the ROVE(V) does not infringe claim 6 of the ’580 patent.

c) Claim 7

Claim 7 depends from claim 1. JX-0003, cl. 7. Since this claim depends from the independent claim addressed above, it cannot be infringed. As such, the ROVE(V) does not infringe claim 7 of the ’580 patent. *See Muniauction*, *Inc. v. Thomson Corp.*, 532 F.3d 1318, 1328-29 n.5 (Fed. Cir. 2008) (“A conclusion of noninfringement as to the independent claims requires a conclusion of noninfringement as to the dependent claims.”)

d) Claim 8

Claim 8 includes the same “wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member” limitation as claim 1. JX-0003, cl. 8. As explained above, the ROVE(V) does not satisfy this limitation. For those same reasons, the ROVE(V) does not infringe claim 8 of the ’580 patent.

e) Claim 10

Claim 10 depends from claim 8. JX-0003, cl. 10. Since this claim depends from the independent claim addressed above, it cannot be infringed. As such, the ROVE(V) does not infringe claim 10 of the ’580 patent.

7. The Redesigned Products

a) STIIIZY-1G-REDESIGN(C)

i) Claim 1

(1) Limitations 580.1.pre – 580.1.g.iii

Respondents do not dispute that the STIIIZY-1G-REDESIGN(C) meets these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 336, 355, 372, 387, 402.

(2) Limitation 580.1.g.iv

Limitation 580.1.g.iv recites "an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member." JX-0003, cl. 1. PAX contends that "the triangular-shaped extension feature performs the same function in substantially the same way to achieve the same result as the claimed cylindrically-shape extension feature."[21, 22] CIB at 56-60. Respondents object on two grounds. First, they contend that PAX's equivalence arguments "read out structural limitations that were expressly included by the patentee during prosecution."[23, 24] RIB at 102-103. Next, Respondents argue that "the differences between a

[21] PAX does not contend that this limitation is met literally. CIB at 56.

[22] In the STIIIZY Redesigned Products, the size of the air tube in the silicone base (*i.e.*, distal member) of the vaporizer cartridge was increased and its shape was changed from cylindrical to triangular. RX-0474C (Pecht) at Q/As 135-139; Pecht, Tr. at 267:4-8.

[23] Respondents seem to suggest that prosecution history estoppel could bar application of the doctrine of equivalents. However, Respondents never raise such a defense in their briefs. *See generally* RIB at 102-109.

[24] Respondents make a similar argument with respect to Mr. Kodama's analysis. RIB at 104-105. They claim that under his equivalence analysis, the shape of the claimed "extension feature" "does not matter" and that "any shape" would satisfy the element so long as air can pass through the distal member. *Id*. This is a mischaracterization of Mr. Kodama's testimony. Mr. Kodama did not state that any shape would meet the "extension feature" limitation. Kodama, Tr. at 121:18-123:19. Rather, when asked by Respondents' counsel whether it was possible for the extension feature to

cylindrical and a triangular shape in the context of the patent are substantial, as can be seen at least through the advantages of one over the other." *Id*. at 106-109.

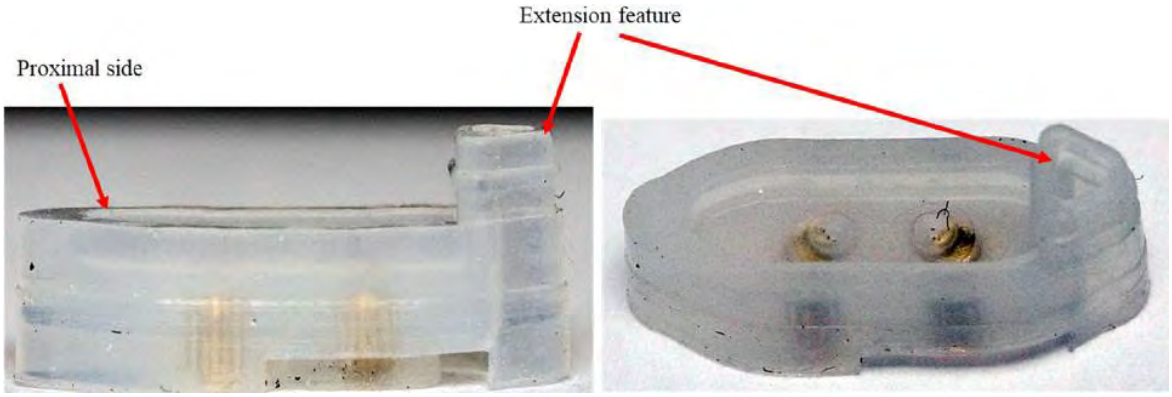
"The doctrine of equivalents allows [a] patentee to claim those insubstantial alterations that were not captured in drafting the original patent claim but which could be created through trivial changes." *Festo Corp. v. Shoketsu Kogyo Kabushiki Co.*, 535 U.S. 722, 733 (2002). It demands a "limitation specific" analysis that asks "whether a substitute element matches the function, way, and result of the claimed element." *VLSI*, 87 F.4th at 1342 (quoting *Warner-Jenkinson*, 520 U.S. at 40).

Here, the patent's disclosure is "dispositive of the function." *Intendis GMBH v. Glenmark Pharm. Inc., USA,* 822 F.3d 1355, 1362 (Fed. Cir. 2016). That function is to allow air to pass through the distal member towards the mouthpiece of the vaporizer cartridge. JX-0003 at 34:65-35:3. This was confirmed by Mr. Kodama, who testified that the extension feature in the claimed invention "defines a portion of an airpath between the bottom cover and the mouthpieces such that it allows the air from the bottom cover to pass through the distal member via the opening and flow to the mouthpiece." CX-4747C (Kodama) at Q/A 419. Dr. Pecht likewise agreed that the function of the extension feature is to allow air to pass through the distal member. Pecht, Tr. at 224:14-17.

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have other cross-sectional shapes, like a diamond or square, Mr. Kodama agreed that those were possibilities *if* the air tube "serves the same function using the same – basically the same way." *Id*. Counsel did not question him about tubes with non-uniform shapes that *could* have a material impact on how air passes through the tube. CRB at 28-29. Moreover, "'[v]itiation' is not an exception to the doctrine of equivalents, but instead a legal determination that 'the evidence is such that no reasonable jury could determine two elements to be equivalent." *Deere & Co. v. Bush Hog, LLC*, 703 F.3d 1349, 1356 (Fed. Cir. 2012). Here, the record does not support such a finding. Rather, the evidence demonstrates that the alleged equivalent is a tube with a consistent cross-section along its length that allows air to pass, just like the claimed "extension feature," except with a different shape.

In the STIIIZY-1G-REDESIGN(C), the extension feature protrudes from the proximal side of the distal member and includes an opening.



CDX-0001.0162. There is an airpath from the bottom cover to the mouthpiece, and the distal member is disposed between the bottom cover and the mouthpiece. CX-4747C (Kodama) at Q/A 419. Thus, just like the cylindrical extension feature in the '580 patent, the triangular extension feature defines a portion of the airpath such that it allows the air from the bottom cover to pass through the distal member and flow to the mouthpiece. *Id*. Dr. Kodama further testified that a person of skill would view the differences as insubstantial. *Id*. "Quite simply, air flows through the triangular tube when a user draws on the mouthpiece, just [like] it does with a cylindrical tube." CIB at 57.

Respondents' noninfringement arguments are premised on an incorrect application of the doctrine of equivalents.[25] They tout certain "advantages" of the triangular shape over a cylindrical shape. RIB at 106-109. Specifically, Respondents claim that [redacted]

[25] Dr. Pecht's analysis suffers from the same flaws. RX-0474C (Pecht) at Q/As 136-142; Pecht, Tr. at 221:222:22, 224:24-225:6, 225:20-24.

[redacted] *Id.* These purported advantages are irrelevant. "It is the limitations and functions of the invention described in the claims, not the elements or functions of the accused device, which establish the reference point for the doctrine of equivalents analysis." *Insta-Foam Prods., Inc. v. Universal Foam Sys., Inc.*, 906 F.2d 698, 702 (Fed. Cir. 1990). Nor is it any function that element could perform in the abstract. *Intendis GMBH*, 822 F.3d at 1362 ("[T]he proper analysis focuses on the claimed element's function in the claimed composition, not a function that element could perform in the abstract divorced from the claimed composition."). As explained above, the only relevant function of the claimed extension feature is to allow air to pass through the distal member.[27] The redesigned extension feature therefore performs the same function as the claimed cylindrical extension feature, in the same way, to achieve the same result.[28]

For these reasons, I find the evidence to establish legal equivalency of the triangular-shaped extension feature.

(3) Limitations 580.1.g.v – 580.1.h

Respondents do not dispute that the STIIIZY-1G-REDESIGN/C) meets these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 436, 451, 466, 481.

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[26] [redacted]

[27] The claim makes no reference to pressure sensing, durability, or thickness of the wall of the extension feature. JX-0003, cl. 1; Pecht, Tr. at 224:18-23, 227:2-12. Likewise, nothing in the claim suggests that the shape of the extension feature was to prevent clogging. *Id.*

[28] Respondents cannot avoid infringement by changing the shape of the claimed extension feature while retaining its essential functionality.

(4) Conclusion

Accordingly, I find that the STIIIZY-1G-REDESIGN(C) infringes claim 1 of the '580 patent.

ii) Claim 7

Claim 7 depends from claim 1, adding the "exposed through" limitations. JX-0003, cl. 7.

PAX asserts that the evidence shows this claim is met. CIB at 67. Although Respondents contend that this claim is not met for the same reasons as claim 1 (RIB at 109), they do not dispute that the additional limitations are present in the STIIIZY-1G-REDESIGN(C). RUCL at 9-10.

The evidence shows that the additional limitation of claim 7 is met. CX-4747 (Kodama) at Q/A 502. Accordingly, I find that the STIIIZY-1G-REDESIGN(C) infringes claim 7 of the '580 patent.

b) STIIIZY-ORIG-1G-REDESIGN

i) Claim 1

(1) Limitations 580.1.pre – 580.1.g.iii

Respondents do not dispute that the STIIIZY-ORIG-1G-REDESIGN meets these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 337, 356, 373, 388, 403.

(2) Limitation 580.1.g.iv

The parties raise the same arguments here as they did for the STIIIZY-1G-REDESIGN(C). CIB at 56-60; RIB at 109-110.

Thus, for the reasons discussed in Section VII.B.7.a.i.2, the evidence shows that this limitation is met. *See* CX-4747C (Kodama) at Q/A 420.

(3) Limitations 580.1.g.v – 580.1.h

Respondents do not dispute that the STIIIZY-ORIG-1G-REDESIGN meets these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/A 437, 452, 467, 482.

(4) Conclusion

Accordingly, I find that the STIIIZY-ORIG-1G-REDESIGN infringes claim 1 of the '580 patent.

ii) Claim 6

Claim 6 is directed to a vaporizer device comprised of the vaporizer cartridge of claim 1 and "vaporizer body" limitations. JX-0003, cl. 6.

Respondents argue that this claim is not met for the same reasons as claim 1. RIB at 110. However, they do not dispute that the "vaporizer body" limitations are present in the STIIIZY-ORIG-1G-REDESIGN. *Id*.; *see also* RUCL at 9.

The evidence shows that the "vaporizer body" limitations are met. CX-4747 (Kodama) at Q/A 502. Accordingly, I find that the STIIIZY-ORIG-1G-REDESIGN infringes claim 6 of the '580 patent.

iii) Claim 7

Claim 7 depends from claim 1, adding the "exposed through" limitations. JX-0003, cl. 7.

Respondents argue that this claim is not met for the same reasons as claim 1. RIB at 110. However, they do not dispute that the additional limitations are present in the STIIIZY-ORIG-1G-REDESIGN. *Id*.; *see also* RUCL at 9-10.

The evidence confirms that the additional limitations are met. CX-4747 (Kodama) at Q/A 503. I therefore find that the STIIIZY-ORIG-1G-REDESIGN infringes claim 7 of the '580 patent.

iv) Claim 8

PAX asserts that the evidence shows this claim is met. CIB at 67-68.

Respondents state that "[they] rely on the same reasoning as discussed in claim 1 to show that claim 8 is not infringed." RIB at 110. They do not dispute the other limitations of the claim. *Id*.; *see also* RUCL at 10 (not disputing 580.8.a.vii or 580.8.b.i.a).

The evidence shows that the STIIIZY-ORIG-1G-REDESIGN practices the limitations of this claim. CX-4747C (Kodama) at Q/As 549, 552, 557.

v) Claim 10

Claim 10 depends from claim 8, adding the "exposed through" limitations. JX-0003, cl. 10.

Respondents argue that "[c]laim 10 depends ultimately from claim 8 and does not infringe for the same reasons." RIB at 110. However, they do not dispute that the STIIIZY-ORIG-1G-REDESIGN meets the additional limitations. *Id*.; *see also* RUCL at 11.

The evidence confirms the "exposed through" limitations are met. CX-4747C (Kodama) at Q/As 563, 567. I therefore find that the STIIIZY-ORIG-1G-REDESIGN infringes claim 10 of the '580 patent.

c) STIIIZY-AIO-REDESIGN

i) Claim 1

(1) Limitations 580.1.pre – 580.1.e

Respondents do not dispute that the STIIIZY-AIO-REDESIGN meets these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 340, 359.

(2) Limitation 580.1.f

The parties rely on their arguments for the "bottom cover" limitation in the '527 patent for this limitation. CIB at 61; RIB at 93, 116.

Thus, for the reasons discussed in Section V.B.1.a.ii., the evidence shows that this limitation is met. *See* CX-4747C (Kodama) at Q/A 376.

(3) Limitations 580.1.g – 5801.g.iii

Respondents do not dispute that the STIIIZY-AIO-REDESIGN meets these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 391, 406.

(4) Limitations 580.1.g.iv

The parties rely on the same arguments they presented for the STIIIZY-1G-REDESIGN(C). CIB at 61; RIB at 116-117.

Thus, for the reason set forth in Section VII.B.7.a.i.2, the evidence shows that this limitation is met. *See* CX-4747C (Kodama) at Q/As 423-424.

(5) Limitations 580.1.g.v – 580.1.h

Respondents do not dispute that the STIIIZY-AIO-REDESIGN meets these limitations. RUCL at 9. The evidence shows that these limitations are met. CX-4747C (Kodama) at Q/As 440, 455, 470, 485.

(6) Conclusion

Accordingly, I find that the STIIIZY-AIO-REDESIGN infringes claim 1 of the '580 patent.

d) ROVE-REDESIGNS

i) Claim 1

(1) Limitations 580.1.pre – 580.1.g.iii

Respondents do not dispute that the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) meet these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 338-339, 357-358, 374-375, 389-390, 404-405.

(2) Limitation 580.1.g.iv

The parties' arguments are the same as those presented for the ROVE(C) and ROVE(V). CIB at 64-67; RIB at 111-116.

Thus, for the reasons set forth in Section VII.B.7.d.i.2, I find that the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) meet this limitation. *See* CX-4747C (Kodama) at Q/As 420-421.

(3) Limitation 580.1.g.v

The parties' arguments are the same as those presented for the ROVE(C) and ROVE(V). CIB at 64-67; RIB at 111-116.

Thus, for the reasons set forth in Section VII.B.7.d.i.3, I find that PAX has not established that the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) satisfy this limitation.

(4) Limitations 580.1.g.vi – 580.1.h

Respondents do not dispute that the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) meet these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 453-454, 461-462, 468-469, 483-484.

(5) Conclusion

Accordingly, I find that the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) do not infringe claim 1 of the ’580 patent.

ii) Claim 6

Claim 6 is directed to a vaporizer device comprised of the vaporizer cartridge of claim 1 and “vaporizer body” limitations. JX-0003, cl. 6. I found above that the ROVE-REDESIGN(V) does not to infringe claim 1 of the ’580 patent. Consequently, the ROVE-REDESIGN(V) does not infringe claim 6 of the ’580 patent.

iii) Claim 7

Claim 7 depends from claim 1, adding the “exposed through” limitations. JX-0003, cl. 7. Since this claim depends from the independent claim addressed above, it cannot be infringed. As such, the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) do not infringe claim 7 of the ’580 patent.

iv) Claim 8

Claim 8 includes the same “wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member” limitation as claim 1. JX-0003, cl. 8. As explained above, the ROVE-REDESIGN(V) does not satisfy this limitation. *See* Section VII.B.7.d.1.3. I therefore find that the ROVE-REDESIGN(V) does not infringe claim 8 of the ’580 patent.

v) Claim 10

Claim 10 depends from claim 8, adding the “exposed through” limitations. JX-0003, cl. 10. Since this claim depends from the independent claim addressed above, it cannot be infringed. As such, the ROVE-REDESIGN(V) does not infringe claim 10 of the ’580 patent.

e) FLARE-REDESIGNS

i) Claim 1

(1) Limitations 580.1.pre – 580.1.g.iii

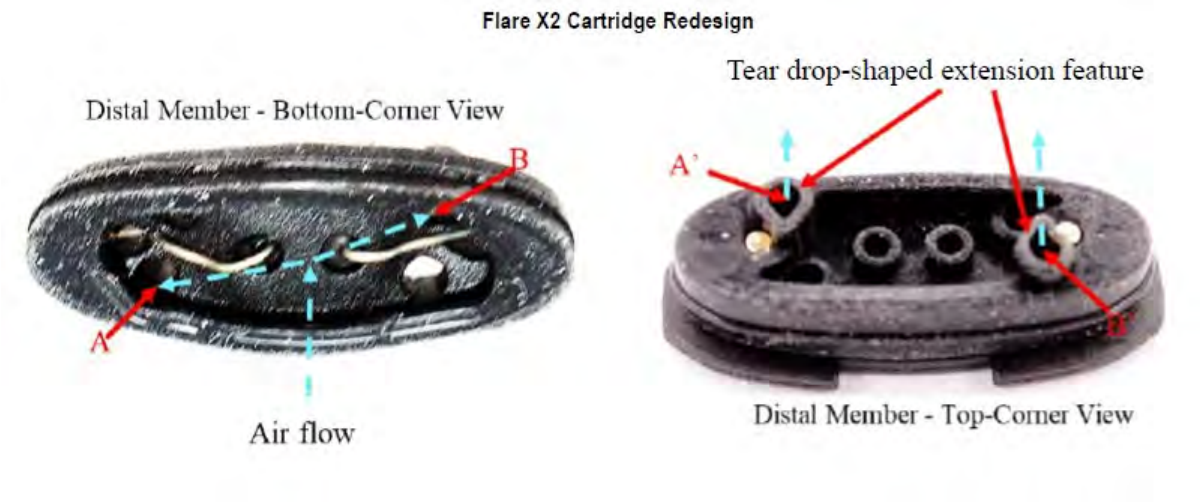
Respondents do not dispute that the FLARE-REDESIGNS(C and V) meet these limitations. RUCL at 8-9. The evidence confirms that these limitations are met. CX-4747C (Kodama) at Q/As 326-327, 341-342, 360-361, 377-378, 392-393, 407-408.

(2) Limitation 580.1.g.iv

PAX asserts that this limitation is met under the doctrine of equivalents. CIB at 62-64; CRB at 33-34. Respondents argue that the differences between a cylindrical shape and a teardrop shape are substantial, citing the testimony by their expert. RIB at 118-119 (citing RX-0474C (Pecht) at Q/As 168-169, 170, 173). However, Dr. Pecht's testimony is wholly conclusory. *See, e.g.*, RX-0474C at Q/A 173.

As discussed above relative to the STIIIZY Redesigns, the only relevant function of the extension feature is to allow air to pass through the distal member.[29] *See* Section VII.B.7.a.i.2. Here, the teardrop-shaped extension feature performs the same function in substantially the same way to achieve the same result as the claimed cylindrical shape extension feature. *See* CX-4747C (Kodama) at Q/A 426. Dr. Kodama explained that just like the claimed invention, the extension feature in the FLARE redesigns "defines a portion of an airpath between the bottom cover and mouthpiece such that it allows the air from the bottom cover to pass through the distal member via the opening and flow to the mouthpiece." *Id*.

[29] Also, like the STIIIZY redesigns, no testing was done to measure the extent to which airflow through the silicon base changed. Zhang, Tr. at 303:24-304:3. Thus, there is no evidence in the record to substantiate Respondents' claim that the teardrop shape "improves the efficiency of airflow and reduce[s] the loss of air pressure of the airflow." RIB at 119.



CDX-0001.0174. He further opined that a person of skill would view the differences as insubstantial because "air can pass through the distal member via both the tear-drop shaped extension feature and the cylindrical extension feature." CX-4747C (Kodama) at Q/A 426.

I therefore find that this limitation is met under the doctrine of equivalents.

(3) Limitations 580.1.g.v – 580.1.h

Respondents do not dispute that the FLARE-REDESIGNS(C and V) meet these limitations. RUCL at 9. The evidence establishes that these limitations are met. CX-4747C (Kodama) at Q/As 441-442, 456-457, 471-472, 486-487.

(4) Conclusion

Accordingly, the FLARE-REDESIGNS(C and V) infringe claim 1 of the '580 patent.

C. Indirect Infringement

The asserted claims of the '580 patent raise substantially the same issues as the asserted claims of the '756 patent. PAX relies on the same unrebutted evidence as presented for the '756 patent. Thus, for the reasons set forth in Section IV.C, Respondents indirectly infringe claims 1, 6-8, and 10 of the '580 patent, both contributorily and by inducement.

D. Technical Prong of the Domestic Industry Requirement

PAX asserts that the '580 DI Products identified below practice certain claims of the '580 patent:

'580 DI Products	Representative Products	Practiced Claims
ERA-05G(C)	ERA-05G(C)	1
ERA-ORIG-05G	ERA-ORIG-05G	1, 6, and 8
ERA-PRO-05G		
ERA-LIFE-05G		
ERA-GO-05G		

CIB at 83.

Respondents take no position on the technical prong of the domestic industry. RIB at 139. As such, Respondents have waived their right to dispute that PAX satisfies the technical prong of the domestic industry requirement.

The evidence shows that the '580 DI Products practice claims 1, 6, and 8 of the '580 patent. Mr. Kodama explained how the ERA-05G(C) and ERA-ORIG-05G products practice the limitations of claim 1. CX-4747C (Kodama) at Q/As 748-772. Mr. Kodama also explained how the ERA-ORIG-05G product practices every limitation of claims 6 and 8. *Id*. at Q/As 742-746, 748-772, 775-785.

For these reasons, I find that the technical prong of the domestic industry requirement is satisfied for the '580 patent.

E. Validity

Respondents assert that the '580 patent is invalid because: (1) Alarcon anticipates claims 1, 6, and 8 (RIB at 119-126); (2) Tucker anticipates claims 1, 6, and 8 (*id.* at 126-132); (3) Alarcon in view of Xiang renders claims 7 and 10 obvious (*id*. at 132-134); (4) Tucker in view of Xiang

renders claims 7 and 10 obvious (*id*. at 134-136); and (5) there is insufficient written description for "a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom cover comprising: a first air opening" (*id.* at 136).

1. Anticipation

a) Alarcon

i) Claims 1 and 8

Claims 1 and 8 of the '580 patent include the same "bottom cover" limitation as claim 1 of the '756 patent. Respondents contend that this limitation is met "for the same reasons as 756.1.h." RIB at 120. I have already addressed the Alarcon reference in Section IV.E.1.a; those findings control here as well. Accordingly, Respondents have not established that Alarcon anticipates either claim 1 or claim 8 of the '580 patent.

ii) Claim 6

Because I found independent claim 1 is not anticipated by Alarcon, dependent claim 6 is also not anticipated by Alarcon.

b) Tucker

i) Claim 1

Respondents submit that Tucker discloses every limitation of claim 1. RIB at 126-129. PAX disputes that the electronic cigarette disclosed in Tucker includes a cartridge that satisfies either the "bottom cover" or the "distal member" limitations. CIB at 70-71.

"Typically, testimony concerning anticipation must be testimony from one skilled in the art and must identify each claim element, state the witnesses' interpretation of the claim element, and explain *in detail* how each claim element is disclosed in the prior art reference." *Whitserve, LLC v. Comput. Packages, Inc.*, 694 F.3d 10, 24 (Fed. Cir. 2012) (emphasis added). Respondents cite

to Dr. Jackson's testimony for the "bottom cover" and "distal member" limitations. RIB at 127. For the "bottom cover" limitation, he opined: "As may be observed in FIGS. 1&2 (excerpted below) and 15 (below), cathode connector piece 37 is installed internal to 'outer tube (or casing) 6' and forms the distalmost outer enclosure of 'first section 70'." RX-0473C (Jackson) at Q/As 519, 1397. And for the "distal member" limitation, he opined: "Tucker (JX-0214) discloses the claimed distal member as, for example, 'gasket 15.'" *Id*. at Q/A 527. He then cites to two images, with little explanation. *Id*. The clear and convincing standard requires more than simply accepting an expert's word, however. *See, e.g., Ecolochem,* 227 F.3d at 1372 (Fed. Cir. 2000) ("Broad conclusory statements regarding the teaching of [] references, standing alone, are not 'evidence.'").

Moreover, the evidence demonstrates that the cathode connector piece 37 does not cover the bottom of the vaporizer device, as required by the claim. The cathode connector piece is the threaded connector at the end of cartridge portion 70 furthest from the mouthpiece. JX-0214; *see also* CX-4750C (Sturges) at Q/A 150. This is illustrated in Figures 3A and 15 of Tucker, which are reproduced below:

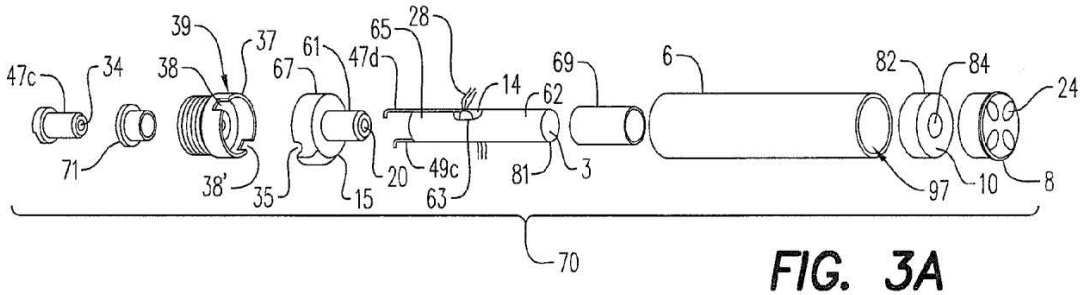


FIG. 3A

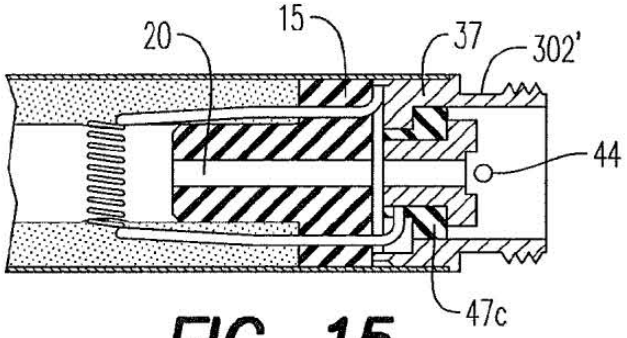


FIG. 15

Id. at FIGS. 3A, 15. As can be seen in these figures, "[t]he cathode connector piece 37 is completely open at the bottom, to allow insertion of a grommet-like structure 71 into which an anode post 47c is inserted." CX-4750C (Sturges) at Q/A 151. Quite simply, the cathode connector piece 37 does not cover anything, just like the structure Dr. Jackson relied on in Alarcon. *See* Jackson, Tr. at 518:7-521:4 ("Q. Now, the – at the threaded portion – at the bottom of the threaded portion of the cathode connector piece 37, I'm going to highlight in green the area between that, that's going to be open, correct? A. Yes."). Dr. Sturges also testified that a person of skill would not view gasket 15 as a recess because "the diameter doesn't expand back out at any point." CX-4750C (Sturges) at Q/A 158; *see id*. at Q/A 159 (providing additional critique of Dr. Jackson's "distal member" analysis).

Accordingly, Respondents have failed to establish by clear and convincing evidence that Tucker anticipates claim 1 of the '580 patent.

ii) Claim 6

Because I found independent claim 1 not anticipated by Tucker, dependent claim 6 is also not anticipated by Tucker.

iii) Claim 8

Claim 8 recites the same "bottom cover" and "distal member" limitations as claim 1. JX-0003, cl. 8. Because I found that Tucker does not disclose these limitations, Tucker does not anticipate claim 8 of the '580 patent.

2. Obviousness

a) Alarcon in view of Xiang

Respondents assert that "a POSITA would be motivated to combine Alarcon and Xiang for the same reasons discussed above with respect to 756.10." RIB at 133. Thus, for the same reasons set forth in Section IV.E.2.c, Respondents have failed to meet their burden to establish that Alarcon in view of Xiang renders claims 7 and 10 of the '580 patent obvious.

b) Tucker in view of Xiang

Respondents assert that Tucker in view of Xiang renders claims 7 and 10 obvious. RIB at 134. They write: "A POSITA would be motivated to combine Tucker and Xiang for substantially the same reasons discussed above with respect to 757.13 and 757.20." *Id*.

I have already determined that Tucker does not disclose the claimed "bottom cover" or "distal member." *See* Section VII.E.1.b. Respondents do not rely on Xiang for these limitations, nor have they set forth any arguments as to how a person of ordinary skill would modify Tucker with Xiang to supply the missing limitations. *See* RIB at 88-90, 135-136. As a result, Respondents have failed to meet their burden to establish that the combination of Tucker and Xiang renders claims 7 and 10 of the '580 patent obvious.

c) Secondary Considerations

Secondary considerations of nonobviousness may rebut a prima facie case of obviousness. Here, where BOE has not made out a prima facie case of obviousness, there is no showing to rebut. Accordingly, I need not consider any secondary considerations of nonobviousness.

3. Written Description

Respondents assert that every asserted claim of the '580 patent is invalid for non-compliance with the written description requirement. RIB at 136. They rely on their § 112 analysis for the '756 patent in support. *Id*. For the same reasons discussed in Section IV.E.3 above, Respondents have not shown by clear and convincing evidence that the asserted claims of the '580 patent are invalid under 35 U.S.C. § 112.

VIII. ECONOMIC PRONG OF THE DOMESTIC INDUSTRY REQUIREMENT

PAX alleges that a domestic industry exists under 19 U.S.C. § 1337(a)(3)(A) and (B). CIB at 90-102; CRB at 45-48. Respondents submit that PAX cannot satisfy the economic prong because "PAX's alleged investments occurred before PAX owned the asserted patents, PAX failed to show a domestic industry existed on the date it filed its complaint, PAX failed to show a domestic industry by patent, PAX presented unreliable data, and PAX presented only activities of a mere importer." RIB at 140.

PAX relies on investments from 2021 to 2023 to prove the existence of a domestic industry. CIB at 87 ("relying on its most recent three years of relevant investments"); CX-4748C (Putnam) at Q/A 46; CX-4745C (Patag) at Q/A 68. Many of these investments occurred before the Asserted Patents issued. *See* JX-0001 (issued June 28, 2022); JX-0002 (issued June 28, 2022); JX-0003 (issued Sept. 26, 2023); JX-0004 (issued Sept. 19, 2023). Respondents argue that any investments

made prior to issuance of the Asserted Patents are not cognizable under sub prongs (A) and (B). RIB at 141; RRB at 56. PAX believes this contention is "incorrect." CRB at 39 n.11.

I addressed this same issue in another investigation. There, the complainant sought to count certain expenses that occurred prior to issuance of the asserted patent for subparts (A) and (B). I found that "19 U.S.C. § 1337(a)(3) requires the Commission consider investments in 'articles protected by the *patent*'" and declined to consider pre-issuance expenses as they relate to these subsections.[30, 31] *Certain Compact Wallets & Components Thereof*, 337-TA-1355, Final ID at 69 (Mar. 15, 2024) ("*Compact Wallets*"). This is because, under a plain reading of the statute, there are no articles protected by the patent before issuance. Thus, consistent with that holding, I find PAX's pre-issuance investments to not be cognizable under subparagraphs (A) and (B) of section 337(a)(3).

"[A] complainant must, as a threshold matter, provide the Commission with sufficient evidence to show that its domestic investment as to the articles protected by [the] patent[s] [are]

[30] While pre-issuance investments in research and development can be considered under subsection (C), no Commission opinion has squarely addressed whether they can be considered for purposes of a domestic industry under 19 U.S.C. § 1337(a)(3)(A) and (B). However, the Commission has stated that it generally "would only examine whether [a complainant's] 'investment in plant and equipment' or 'employment of labor or capital' relates to protected articles." *Certain Integrated Circuit Chips & Prods. Containing Same*, Inv. No. 337-TA-859, Comm'n Op. at 48 (Aug. 11, 2014); *see also Certain Ground Fault Circuit Interrupters & Prods. Containing Same*, Inv. No. 337-TA-739, Comm'n Op. at 78 (June 8, 2012) (interpreting prongs (A) and (B) to concern "investments in plant and labor and capital with respect to the ***articles protected by the patent***") (emphasis added).

[31] On review, the Commission requested the parties brief this very issue but ultimately, the Commission took "no position" on the finding that pre-issuance investments are not cognizable under subsections (A) and (B). *See Compact Wallets*, Comm'n Op. at 14 (July 29, 2024); *see also* EDIS Doc. ID 821724 at 3 (requesting briefing on, *inter alia*, "the basis for considering investments prior to the issuance of a patent (pre-issuance investments) for purposes of a domestic industry under 19 U.S.C. § 1337(a)(3)(A) and (B).")

significant." *Zircon Corp. v. Int'l Trade Comm'n*, 101 F.4th 817, 822 (Fed. Cir. 2024). Here, has PAX failed to provide a basis by which to apportion or reduce its investments to only post-patent expenditures. *See generally* CX-4748C (Putnam); CX-4745C (Patag). Its overinclusive allocations preclude a "meaningful consideration of the relevant investments under section 337." *Certain Replacement Auto. Lamps*, Inv. No. 337-TA-1291, Comm'n Op. at 27 (Mar. 7, 2024). As such, I am precluded from evaluating the significance of PAX's investments.

For this reason, I find that PAX has not met its burden to show that the economic prong of the domestic industry requirement is satisfied.

IX. CONCLUSIONS OF LAW

1. Commission Rule 210.12(a)(7) has been satisfied.

2. The importation or sale requirement of section 337 has been satisfied.

3. PAX is the owner of U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580.

4. The STIIIZY-LIIIL infringes claim 1 of U.S. Patent No. 11,369,756; claims 1, 18, and 22 of U.S. Patent No. 11,766,527; claim 1 of U.S. Patent No. 11,369,757; and claim 1 of U.S. Patent No. 11,759,580.

5. The STIIIZY-1(G)(C) infringes claims 1 and 10 of U.S. Patent No. 11,369,756; claims 1, 10, 18, and 22 of U.S. Patent No. 11,766,527; claims 1 and 13 of U.S. Patent No. 11,369,757; and claims 1 and 7 of U.S. Patent No. 11,759,580.

6. The STIIIZY-ORIG-1 infringes claims 1, 5, and 10 of U.S. Patent No. 11,369,756; claims 1, 5, 10, 11, 17, 18, and 22 of U.S. Patent No. 11,766,527; claims 1, 13, 15, and 20 of U.S. Patent No. 11,369,757; and claims 1, 6-8, and 10 of U.S. Patent No. 11,759,580.

7. The STIIIZY-AIO infringes claim 1 of U.S. Patent No. 11,766,527 and claim 1 of U.S. Patent No. 11,759,580.

8. The FLARE(C) infringes claim 1 of U.S. Patent No. 11,766,527 and claim 1 of U.S. Patent No. 11,759,580.

9. The FLARE(V) infringes claims 1 and 5 of U.S. Patent No. 11,766,527 and claim 1 of U.S. Patent No. 11,759,580.

10. The ROVE(C) infringes claims 1 and 10 of U.S. Patent No. 11,766,527.

11. The ROVE(C) does not infringe U.S. Patent No. 11,759,580.

12. The ROVE(V) infringes claims 1, 5, 10, 11, and 17 of U.S. Patent No. 11,766,527.

13. The ROVE(V) does not infringe U.S. Patent No. 11,759,580.

14. The STIIIZY-1G-REDESIGN(C) infringes claims 1 and 7 of U.S. Patent No. 11,759,580.

15. The STIIIZY-ORIG-1G-RESIGNS infringes claims 1, 6-8, and 10 of U.S. Patent No. 11,759,580.

16. The STIIIZ-AIO-REDESIGN infringes claim 1 of U.S. Patent No. 11,759,580.

17. The FLARE-REDESIGNS infringe claim 1 of U.S. Patent No. 11,759,580.

18. The ROVE-REDESIGNS do not infringe U.S. Patent No. 11,759,580.

19. The STIIIZY Redesigned Products do not infringe U.S. Patent Nos. 11,369,756; 11,369,757; and 11,766,527.

20. Respondents induced infringement of the asserted claims of U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580.

21. Respondents contributorily infringe the asserted claims of U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580.

22. The technical prong of the domestic industry requirement for U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580 has been satisfied.

23. Claims 1 and 5 of U.S. Patent No. 11,369,756 are not invalid under 35 U.S.C § 102 for anticipation.

24. Claims 1 and 15 of U.S. Patent No. 11,369,757 are not invalid under 35 U.S.C § 102 for anticipation.

25. Claims 1, 6, and 8 of U.S. Patent No. 11,759,580 are not invalid under 35 U.S.C § 102 for anticipation.

26. Claims 1, 5 and 10 of U.S. Patent No. 11,369,756 are not invalid under 35 U.S.C § 103 for obviousness.

27. Claims 1, 5, 11, 18, and 22 of U.S. Patent No. 11,766,527 are not invalid under 35 U.S.C § 103 for obviousness.

28. Claims 1, 13, 15, and 20 of U.S. Patent No. 11,369,757 are not invalid under 35 U.S.C § 103 for obviousness.

29. Claims 7 and 10 of U.S. Patent No. 11,759,580 are not invalid under 35 U.S.C § 103 for obviousness.

30. The asserted claims of U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580 are not invalid under 35 U.S.C § 112, ¶ 1 for lack of written description.

31. The economic prong of the domestic industry requirements has not been satisfied with respect to the Asserted Patents.

X. RECOMMENDED DETERMINATION ON REMEDY AND BOND

The Commission's Rules provide that the administrative law judge shall issue a recommended determination concerning the appropriate remedy in the event the Commission finds a violation of section 337 and the amount of bond to be posted by respondents during Presidential review of any Commission remedies. *See* 19 C.F.R. § 210.42(a)(l)(ii).

A. Limited Exclusion Order

The Commission has broad discretion in selecting the form, scope, and extent of the remedy in a section 337 proceeding. *Viscofan, S.A. v. U.S. Int'l Trade Comm'n*, 787 F.2d 544, 548 (Fed. Cir. 1986). A limited exclusion order directed to a respondent's infringing products is among the remedies that the Commission may impose. *See* 19 U.S.C. § 1337(d).

PAX seeks a limited exclusion order that covers "any Accused Product found to infringe that is manufactured by (or on behalf of) or imported by (or on behalf of) any named Respondent." CIB at 113. PAX explains that this remedy should prohibit a third party from importing the Accused Products found to infringe, including but not limited to the Flare X2 and Rove Diamond Series products, "because they are manufactured by (or on behalf of) ALD for purposes of selling them in the U.S." *Id*.

Respondents submit that if a violation is found, the appropriate remedy is limited exclusion order for only those Accused Products found to infringe the Asserted Patents. RIB at 146. To the

extent any of the Redesigned Products are not found to infringe, Respondents request there be an express carve out or certification provision for those products as their non-infringing nature is not readily apparent.[32] *Id*.

Because there has been no violation of section 337, I recommend the Commission not issue a limited exclusion order. Should the Commission determine that a violation has occurred, I recommend entry of a limited exclusion order against the Accused Products found to infringe.

B. Cease and Desist Orders

Section 337(f)(1) provides that the Commission may issue cease and desist orders ("CDOs") to respondents found to be in violation. *See* 19 U.S.C. § 1337(f)(1).

1. The ALD Respondents

PAX argues that CDOs are warranted against ALD because it has significant domestic operations. CIB at 114-116. Respondents claim that ALD "maintains no facilities or offices in the United States other than a rented place where the salespeople can stay when they are on business trip." *Id*. (citing RX-0471C (Zhang) at Q/As 28-29).

"Under Commission precedent, the Commission generally does not issue CDOs directed at foreign respondents . . . that do not maintain inventories of the accused products in the U.S. or conduct domestic operations because of the difficulty in enforcing such an order." *Certain Powered Cover Plates*, Inv. No. 337-TA-1124, Comm'n Op. at 27-28 (July 10, 2020); *see also Certain Road Constr. Machines & Components Thereof*, Inv. No. 337-TA-1088, Comm'n Op. at 52-53 (July 15, 2019) (declining to issue cease and desist order against foreign respondents where

[32] The inclusion of these provisions is now standard. *Certain Footwear Prods.*, Inv. No. 337-TA-936, Comm'n Op. (Remand) at 112 (Sept. 24, 2020).

evidence only showed commercially significant inventory and domestic operations by domestic respondent).

The ALD Respondents do not have significant U.S. operations that could undercut the remedy provided by a limited exclusion order. They maintain no facilities or offices in the United States other than a rented place where salespeople can stay when they are on a business trip. RX-0471C (Zhang) at Q/As 28-29. Further, PAX's claims that ALD "invests substantially in domestic operations" by "sending employees to the United States per 'a very detailed schedule'" and by maintaining a website "targeted to U.S. customers" is not borne out by the evidence. First, Mr. Yu testified that to the best of his recollection, ALD representatives attended only two trade shows in the United States in 2024. JX-0068C (Yu Dep.) at 128:10-19. Second, when asked whether ALD's website is targeted at U.S. customers, Mr. Yu stated that it is "targeting all the English – English-language speaker country, I think, not only US." *Id*. at 155:23-156:14.

I find that PAX has not demonstrated the need for a CDO directed to the ALD Respondents.

2. The STIIIZY Respondents

PAX argues that CDOs are appropriate due to the STIIIZY Respondents' significant commercial inventory of the Accused Products, as well as their commercial operations in the United States. CIB at 116-117.

Respondents do not appear to contest that if a violation is found, a CDO should issue against the STIIIZY Respondents. RIB at 147 (only disputing CDO against ALD); *see also* RPHB at 250 (same).

STIIIZY has stipulated that it maintains inventories of the STIIIZY Accused Products in the United States through [redacted][33] EDIS Doc. ID 834066 at 4. [redacted] keeps approximately [redacted] of inventory at any given time, which supports a finding that the inventory is significant. *See id.* at 5; *see also* JX-0357C; CX-1466C. STIIIZY also has [redacted]. *Id.*; *see also* JX-0145C at 4-7. The record supports a finding that if STIIIZY were to sell its domestic inventory of Accused Products, it would undercut the relief provided by a limited exclusion order. *See Certain Microfluidic Devices*, Inv. No. 337-TA-1068, Comm'n Op. at 27 (Jan. 10, 2020). I therefore recommend that CDOs issue against the STIIIZY Respondents if the Commission concludes there has been a violation of section 337.

C. Bond

Pursuant to section 337(j)(3), the administrative law judge and the Commission must determine the amount of bond to be required of a respondent, during the 60-day Presidential review period following the issuance of permanent relief, should the Commission determine to issue a remedy. The purpose of the bond is to protect the complainant from any injury. 19 U.S.C. § 1337(j)(3); 19 C.F.R. §§ 210.42(a)(1)(ii), 210.50(a)(3).

When reliable price information is available, the Commission has often set the bond by eliminating the differential in sales prices between the domestic product and the imported, infringing product. *Microsphere Adhesives,* Comm'n Op. at 24. In other cases, the Commission has turned to alternative approaches, especially when the level of a reasonable royalty rate could

[33] The Commission has stated that a stipulation by a party that it has a commercially significant inventory of the accused products "is a sufficient basis upon which to issue" a cease and desist order to that party. *Certain Tobacco Heating Articles & Components Thereof*, Inv. No. 337-TA-1199, Comm'n Op. at 51 (Oct. 19, 2021).

be ascertained. *See Certain Integrated Circuit Telecomm. Chips & Prods. Containing Same, Including Dialing Apparatus*, Inv. No. 337-TA-337, Comm'n Op. at 41-43, USITC Pub. No. 2670 (1995). A 100% bond has been required when no effective alternative existed. *Certain Flash Memory Circuits & Prods. Containing Same*, Inv. No. 337-TA-382, USITC Pub. No. 3046, Comm'n Op. at 26-27 (July 1997) (a 100% bond imposed when price comparison was not practical because the parties sold products at different levels of commerce, and the proposed royalty rate appeared to be *de minimis* and without adequate support in the record).

The parties agree that if a violation is found, a 100% bond rate is appropriate. CIB at 117-118; RIB at 147. It is therefore my recommendation that the Commission set bond at 100% during the Presidential review period.

XI. INITIAL DETERMINATION

For the reasons set forth above, it is my Initial Determination that no violation of section 337 of the Tariff Act, as amended, has occurred in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same with respect to U.S. Patent Nos. 11,369,756; 11,369,757; 11,766,527; and 11,759,580.

I hereby certify to the Commission this Initial Determination and the Recommended Determination.

The Secretary shall serve the confidential version of this Initial Determination upon counsel who are signatories to the Protective Order (Order No. 1) issued in this investigation. A public version will be issued later.

Pursuant to 19 C.F.R. § 210.42(h), this Initial Determination shall become the determination of the Commission unless a party files a petition for review pursuant to 19 C.F.R. §

210.43(a) or the Commission, pursuant to 19 C.F.R. § 210.44, orders on its own motion a review of the Initial Determination or certain issues therein.

XII. ORDER

Within seven days of the date of this document, the parties shall jointly submit a single proposed public version with any proposed redactions indicated in red. If the parties submit excessive redactions, they may be required to provide declarations from individuals with personal knowledge, justifying each proposed redaction and specifically explaining why the information sought to be redacted meets the definition for confidential business information set forth in 19 C.F.R. § 201.6(a). To the extent possible, the proposed redactions should be made electronically, in a single PDF file using the "Redact Tool" within Adobe Acrobat. The proposed redactions should be submitted as "marked" but not yet "applied." The proposed redactions should be submitted via email to Moore337@usitc.gov and not filed on EDIS.

Bryan F. Moore
Administrative Law Judge

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
845893	Public	ID/RD - Final on Violation	03/14/2025 12:39 PM	Initial Determination on Violation of Section 337 and Recommended Determination on Remedy and Bond

Service Date: March 14, 2025

/s

Lisa R. Barton
U.S. International Trade Commission
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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of **CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME**	**Investigation No. 337-TA-1392**

NOTICE OF A COMMISSION DETERMINATION TO REVIEW IN PART A FINAL INITIAL DETERMINATION FINDING NO VIOLATION AND, ON REVIEW, TO VACATE AN INITIAL DETERMINATION ON THE ECONOMIC PRONG OF THE DOMESTIC INDUSTRY REQUIREMENT AND REMAND FOR FURTHER PROCEEDINGS

AGENCY: U.S. International Trade Commission.

ACTION: Notice.

SUMMARY: Notice is hereby given that the U.S. International Trade Commission ("Commission") has determined to review in part a final initial determination ("FID") of the presiding administrative law judge ("ALJ"), finding no violation of section 337 of the Tariff Act of 1930, as amended. Among other issues, as discussed below, the Commission reviews the FID's finding that PAX Labs, Inc. ("Complainant") has not satisfied its burden on the economic prong of the domestic industry requirement. On review, the Commission has determined to vacate this finding and to remand for further proceedings consistent with the Commission's determination.

FOR FURTHER INFORMATION CONTACT: B. Rashmi Borah, Esq., Office of the General Counsel, U.S. International Trade Commission, 500 E Street S.W., Washington, D.C. 20436, telephone (202) 205-2518. Copies of non-confidential documents filed in connection with this investigation may be viewed on the Commission's electronic docket (EDIS) at *https://edis.usitc.gov*. For help accessing EDIS, please email EDIS3Help@usitc.gov. General information concerning the Commission may also be obtained by accessing its Internet server at *https://www.usitc.gov*. Hearing-impaired persons are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on (202) 205-1810.

SUPPLEMENTARY INFORMATION: The Commission instituted this investigation on March 6, 2024, based on a complaint filed by Complainant. 89 FR 16025-26 (Mar. 6, 2024). The complaint, as supplemented, alleges violations of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. 1337 ("section 337"), in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same by reason of infringement of certain claims of U.S. Patent Nos. 11,369,756 ("the '756 patent"); 11,766,527 ("the '527

patent"); 11,369,757 ("the '757 patent"); and 11,759,580 ("the '580 patent") (together, the "Asserted Patents"). *Id.* The complaint further alleges that a domestic industry exists. *Id.* The Commission's notice of investigation named as respondents STIIIZY IP LLC f/k/a STIIIZY, LLC; STIIIZY, Inc. d/b/a Shryne Group Inc. (collectively, "STIIIZY"); ALD Group Limited; and ALD Hong Kong Holdings (collectively, "ALD") (together, "Respondents") *Id*. The Office of Unfair Import Investigations is not participating in the investigation. *Id.*

The Commission previously terminated the investigation as to claims 4 and 21 of the '527 patent. Order No. 11 (July 11, 2024), *unreviewed by* Comm'n Notice (July 30, 2024). The Commission also terminated the investigation as to claims 2, 3, 6-9, and 11-17 of the '756 patent; claims 3-8, 10-12, 14, and 17-19 of the '757 patent; claims 2-3, 6-9, 12-16, 19, 20, 24, 25, and 27-29 of the '527 patent; and claims 2-5, 9, 12-15, and 19 of the '580 patent. Order No. 20 (Sept. 6, 2024), *unreviewed by* Comm'n Notice (Oct. 7, 2024).

The ALJ held an evidentiary hearing from October 21-23, 2024.

After the hearing, the Commission terminated the investigation as to claims 2, 9, and 16 of the '757 patent; claims 23, 26, and 30 of the '527 patent; and claims 11, 16-18, and 20 of the '580 patent. Order No. 32 (Nov. 8, 2024), *unreviewed by* Comm'n Notice (Dec. 10, 2024).

As of the issuance of the FID, the remaining asserted claims were: claims 1, 5, and 10 of the '756 patent; claims 1, 5, 10, 11, 17, 18, and 22 of the '527 patent; claims 1, 13, 15, and 20 of the '757 patent; and claims 1, 6-8, and 10 of the '580 patent.

On March 6, 2025, the ALJ issued the FID finding no violation of section 337. The FID finds that: (1) all asserted claims are infringed by at least one representative accused products; (2) none of the asserted claims are invalid under 35 U.S.C. §§ 102, 103, and/or 112, ¶ 1; and (3) Complainant has satisfied the technical prong of the domestic industry requirement for all Asserted Patents. FID at 111-13. The FID finds, however, that Complainant has not satisfied the economic prong of the domestic industry requirement for any of the Asserted Patents. *Id.*

The FID also includes the ALJ's recommended determination ("RD") on remedy, the public interest, and bonding should the Commission find a violation of section 337. Specifically, the RD recommends that the Commission issue a limited exclusion order barring entry of STIIIZY's and ALD's products that infringe the asserted claims of the Asserted Patents. The RD also recommends issuing a cease and desist order directed to STIIIZY, but not to ALD, because ALD does not maintain significant commercial operations in the United States. The RD further recommends that the Commission set a bond of 100 percent for any importations of infringing products during the period of Presidential review.

On March 18, 2025, Complainant filed a petition seeking review of the following findings: (1) that certain accused products do not infringe the asserted claims of the'580 patent; (2) that certain redesigned products do not infringe the asserted claims of the '756, '527, or '757 patent; and (3) that Complainant has not satisfied the economic prong of the domestic industry requirement. On the same day, Respondents filed a petition seeking review of the following

findings: (1) that certain redesigned products infringe the asserted claims of the ’580 patent under the doctrine of equivalents; (2) that claims 1, 6, or 8 of the ’580 patent are not invalid as anticipated; and (3) that Respondents failed to meet their burden to show that a skilled artisan would have been motivated to combine certain prior art references. Respondents also ask the Commission to determine: (1) whether Complainant’s investments made while the Complainant was a licensee should be counted under subsections (A) or (B) of the economic prong of the domestic industry requirement; (2) whether Complainant fails to satisfy the economic prong of the domestic industry requirement because Complainant’s domestic industry expenditures are based on activities that are illegal under the Controlled Substances Act; and (3) whether Complainant demonstrated that it had a domestic industry on the date the complaint was filed. On March 26, 2025, Complainant and Respondents filed their respective petition responses.

On March 31, 2025, Professor William J. McNichol, Jr., an adjunct professor at Rutgers Law School, submitted a response to the Commission’s *Federal Register* notice seeking public interest submissions. *See* 90 Fed. Reg. 11851-52 (Mar. 12, 2025). On April 7, 2025, the Complainant and ALD filed their respective submissions on the public interest pursuant to Commission Rule 210.50(a)(4). 19 C.F.R. § 210.52(a)(4).

Having examined the record of this investigation, including the FID and the parties’ submissions, the Commission has determined to review the FID in part. Specifically, the Commission has determined to review the FID’s finding that (1) certain accused products do not infringe the ’580 patent; (2) certain redesigned products infringe the ’580 patent; and (3) Complainant has not satisfied its burden as to the economic prong of the domestic industry requirement. The Commission has determined not to review the remainder of the FID.

As explained in the remand order issued concurrently herewith, the Commission has determined that the FID errs by stating as a bright-line rule that “pre-issuance investments [are not] cognizable under subparagraphs (A) and (B) of section 337(a)(3).” FID at 110. Accordingly, the Commission has determined to vacate and remand for further proceedings the FID’s finding that Complainant has not satisfied its burden on the economic prong of the domestic industry requirement. The other findings selected for review remain under Commission review pending the remand.

The Commission vote for this determination took place on May 16, 2025.

The authority for the Commission’s determination is contained in section 337 of the Tariff Act of 1930, as amended (19 U.S.C. 1337), and in Part 210 of the Commission’s Rules of Practice and Procedure (19 CFR Part 210).

By order of the Commission.



Lisa R. Barton
Secretary to the Commission

Issued: May 16, 2025

Certain Oil Vaporizing Devices, Components Thereof, and Products Containing the Same; Inv. No. 337-TA-1392 (Violation)

337-1392 Violation

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
851435	Public	Notice	05/16/2025 02:26 PM	Commission Determination to Review in Part a Final Initial Determination Finding No Violation and...

Service Date: May 16, 2025

/s

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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of **CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME**	**Investigation No. 337-TA-1392**

ORDER: REMAND OF THE INITIAL DETERMINATION IN PART

On March 6, 2024, the Commission instituted this investigation under section 337 based on a complaint filed by Complainant PAX Labs Inc. ("Complainant"). The complaint alleges a violation of section 337 based on the importation, sale for importation, or the sale in the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same that infringe one or more of the asserted claims of U.S. Patent Nos. 11,369,756 ("the '756 patent"); 11,766,527 ("the '527 patent"); 11,369,757 ("the '757 patent"); and 11,759,580 ("the '580 patent") (collectively, "the Asserted Patents"). 89 Fed. Reg. 16025-26 (Mar. 6, 2024). The complaint further alleges that a domestic industry exists. *Id.* The notice of investigation names as respondents STIIIZY IP LLC f/k/a STIIIZY, LLC, STIIIZY, Inc. d/b/a Shryne Group Inc., ALD Group Limited, and ALD Hong Kong Holdings Limited (collectively, "Respondents"). *Id.* The Office of Unfair Import Investigations is not named as a party. *Id.*

The Commission previously terminated the investigation as to claims 4 and 21 of the '527 patent. Order No. 11 (July 11, 2024), *unreviewed by* Comm'n Notice (July 30, 2024). The Commission also terminated the investigation as to claims 2, 3, 6-9, and 11-17 of the '756 patent; claims 3-8, 10-12, 14, and 17-19 of the '757 patent; claims 2-3, 6-9, 12-16, 19, 20, 24, 25, and 27-29 of the '527 patent; and claims 2-5, 9, 12-15, and 19 of the '580 patent. Order No. 20

(Sept. 6, 2024), *unreviewed by* Comm'n Notice (Oct. 7, 2024).

The presiding administrative law judge ("ALJ") held an evidentiary hearing from October 21-23, 2024.

After the hearing, the Commission terminated the investigation as to claims 2, 9, and 16 of the '757 patent; claims 23, 26, and 30 of the '527 patent; and claims 11, 16-18, and 20 of the '580 patent. Order No. 32 (Nov. 8, 2024), *unreviewed by* Comm'n Notice (Dec. 10, 2024).

On March 6, 2025, the ALJ issued the final initial determination ("FID"), finding that no violation of section 337 had occurred with respect to any of the remaining asserted claims. FID at 117. The ALJ found that all asserted claims are infringed by at least one representative accused product; none of the asserted claims are invalid under 35 U.S.C. §§ 102, 103, and/or 112, ¶ 1; and Complainant has satisfied the technical prong of the domestic industry requirement for all Asserted Patents. *Id.* at 111-13. However, the ALJ found that Complainant has not satisfied the economic prong of the domestic industry requirement for any of the Asserted Patents. *Id.* at 109-11.

On March 18, 2025, Complainant and Respondents filed their respective petitions for review. On March 26, 2025, Complainant and Respondents filed their respective responses to the petitions.

As stated in the accompanying notice, the Commission has determined to review the FID in part. Specifically, the Commission has determined to review the FID's finding that (1) certain accused products do not infringe the '580 patent; (2) certain redesigned products infringe the '580 patent; and (3) Complainant has not satisfied its burden as to the economic prong of the domestic industry requirement. The Commission has determined not to review the remainder of the FID.

The Commission has determined to vacate the FID's finding that Complainant has not satisfied its burden on the economic prong of the domestic industry requirement and remand for further proceedings consistent with this order. We conclude that the FID errs by stating that "pre-issuance investments [are not] cognizable under subparagraphs (A) and (B) of section 337(a)(3)." FID at 110. Section 337(a)(3) provides for the establishment of a domestic industry through investments or employment "with respect to articles protected by the patent." Nothing in the statute suggests that the Commission can consider only investments in those articles that occur after the articles are legally protected under the Patent Act. Consistent with the statute, the Commission has credited pre-patent issuance investments towards a showing of domestic industry in several previous investigations under subparagraphs (A), (B), and (C). *See, e.g.*, *InterDigital Commc'ns, LLC v. U.S. Int'l Trade Comm'n*, 707 F.3d 1295, 1299 (Fed. Cir. 2013); *Certain Electronic Nicotine Delivery Systems and Components Thereof*, Inv. No. 337-TA-1139, Final Initial Determination (Dec. 13, 2019); *unreviewed in relevant part by* Comm'n Op. (Apr. 20, 2020); *Certain Marine Sonar Imaging Devices, Including Downscan and Sidescan Devices, Products Containing the Same, and Components Thereof*, Inv. No. 337-TA-921, Comm'n Op. (Jan. 6, 2016); *Certain Multiple Mode Outdoor Grills and Parts Thereof*, 337-TA-895, Final Initial Determination at 85-94 (Sept. 26, 2014); *unreviewed in relevant part by* Comm'n Notice (Dec. 8, 2014); *Certain Kinesiotherapy Devices and Components Thereof*, Inv. No. 337-TA-823, Comm'n Op. (June 17, 2013); *Certain Coenzyme Q10 Products and Methods of Making Same*, Inv. No. 337-TA-790, Initial Determination (Sept. 27, 2012), *unreviewed in relevant part by* Comm'n Op. at 1 n.1 (Jan. 11, 2013); *Certain Video Game Systems and Controllers*, Inv. No. 337-TA-743, Comm'n Op. (Apr. 14, 2011).

Here, there is no dispute that the domestic industry products satisfy the technical prong of

the domestic industry requirement. FID at 28, 61, 72, 104. The ALJ should evaluate whether the economic prong of the domestic industry requirement is satisfied with respect to the products that satisfy the technical prong of the domestic industry requirement, not limited by whether those investments were made post-patent issuance, consistent with Commission precedent.

Accordingly, the Commission hereby ORDERS that:

1. On remand, the ALJ shall consider whether Complainant's alleged domestic industry investments were made with respect to the articles protected by the patent (*i.e.*, the products that the FID found satisfy the technical prong of the domestic industry requirement), not limited by whether those investments were made post-patent issuance, and determine whether Complainant has satisfied the economic prong of the domestic industry requirement with regard to articles protected by each of the Asserted Patents. The ALJ may take, at the ALJ's discretion, additional briefing from the parties to conduct further proceedings consistent with this order.

2. The ALJ shall issue a remand initial determination ("RID") expeditiously and shall extend the target date for completion of the investigation pursuant to 19 C.F.R. § 210.51(a)(1).

3. The remand initial determination shall become final 45 days after issuance absent Commission review.

4. The parties may petition for review of the RID within ten days after service of the RID. Any party may file a response to the petition(s) within five business days after service of the petition(s).

5. The Secretary to the Commission shall serve a copy of this Order upon each of the Complainant and Respondents.

By order of the Commission.



Lisa R. Barton
Secretary to the Commission

Issued: May 16, 2025

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
851438	Public	Order, Commission	05/16/2025 02:28 PM	Order: Remand of the Initial Determination in Part

Service Date: May 16, 2025

/s

Lisa R. Barton
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PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	**Inv. No. 337-TA-1392**

REMAND INITIAL DETERMINATION

Administrative Law Judge Bryan F. Moore

(July 18, 2025)

Appearances:

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PUBLIC VERSION

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PUBLIC VERSION

LIST OF ABBREVIATIONS

The following abbreviations may be used in this Remand Initial Determination:

CX	Complainants' exhibit
CIB	Complainants' initial post-hearing brief
CRB	Complainants' reply post-hearing brief
CPHB	Complainants' pre-hearing brief
CRS	Complainants' remand submission
RX	Respondents' exhibit
RIB	Respondents' initial post-hearing brief
RRB	Respondents' reply post-hearing brief
RPHB	Respondents' pre-hearing brief
RRS	Respondents' remand submission
Dep.	Deposition
JX	Joint Exhibit
Tr.	Transcript

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

In the Matter of	
CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	**Inv. No. 337-TA-1392**

REMAND INITIAL DETERMINATION

Administrative Law Judge Bryan F. Moore

(July 18, 2025)

Pursuant to the notice of investigation and the Commission's May 16, 2025, remand order, this is the remand initial determination in the matter of Certain Oil Vaporizing Devices, Components Thereof, and Products Containing the Same, Investigation No. 337-TA-1392.

For the reasons set forth below, it is my initial determination that the economic prong of the domestic industry requirement has been satisfied.

I. INTRODUCTION

A. Procedural History

On March 6, 2024, the Commission instituted this investigation based on a complaint filed by Complainant PAX Labs, Inc. ("PAX"). 89 *Fed. Reg.* 16,025-026. The complaint, as supplemented, alleges violations of section 337 in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same by reason of infringement of certain claims of U.S. Patent Nos. 11,369,756 ("the '756 patent"); 11,766,527 ("the '527 patent"); 11,369,757 ("the '757 patent"); and 11,759,580 ("the '580 patent) (together, the "Asserted Patents"). *Id*. The complaint further alleges that a domestic industry exists. *Id*. The Commission's

notice of investigation named as respondents STIIIZY IP LLC f/k/a STIIIZY, LLC; STIIIZY, Inc. d/b/a Shryne Group Inc. (collectively, "STIIIZY"); ALD Group Limited; and ALD Hong Kong Holdings (collectively, "ALD") (together, "Respondents"). *Id*. The Office of Unfair Import Investigations is not participating in the investigation. *Id*.

During the proceeding, the Commission terminated the investigation as to claims 4 and 21 of the '527 patent. Order No. 11, *unreviewed by* Comm'n Notice (July 30, 2024). The Commission also terminated the investigation as to claims 2-3, 6-9, and 11-17 of the '756 patent; claims 3-8, 10-12, 14, and 17-19 of the '757 patent; claims 2-3, 6-9, 12-16, 19-20, 24-25, and 27-29 of the '527 patent; and claims 2-5, 9, 12-15, and 19 of the '580 patent. Order No. 20, *unreviewed by* Comm'n Notice (Oct. 7, 2024).

An evidentiary hearing was held from October 21, 2024, to October 23, 2024.

After the hearing, the Commission terminated the investigation as to claims 2, 9, and 16 of the '757 patent; claims 23, 26, and 30 of the '527 patent; and claims 11, 16-18, and 20 of the '580 patent. Order No. 32, *unreviewed by* Comm'n Notice (Dec. 10, 2024).

On March 6, 2025, I issued the final initial determination in this investigation, finding no violation of section 337. *See* EDIS Doc. ID 845174 ("Final ID").

PAX petitioned for review of the Final ID on March 18, 2025. *See* EDIS Doc. ID 846153. On that same day, Respondents filed a contingent petition for review. EDIS Doc. ID 846146. On March 26, 2025, PAX and Respondents filed their respective petition responses. EDIS Doc. ID 846970 (PAX); EDIS Doc. ID 846969 (Respondents). On May 16, 2025, the Commission determined to review the Final ID in part. EDIS Doc. ID 851435 ("Notice to Review"). Specifically, the Commission determined to review the Final ID's finding that (1) certain accused products do not infringe the '580 patent; (2) certain redesigned products do not infringe the '580

patent; and (3) PAX has not satisfied its burden as to the economic prong of the domestic industry requirement. *Id*. at 3. The Commission determined not to review the remaining findings and determinations in the Final ID. *Id*. The unreviewed matters became the Commission's final determination by operation of Commission regulation. *See* 19 C.F.R. § 210.42(h).

On review, the Commission determined that the Final ID erred by stating as a bright-line rule that "preissuance investments [are not] cognizable under subparagraphs (A) and (B) of section 337(a)(3)." Notice to Review at 3 (citing Final ID at 110). The Commission vacated and remanded for further proceedings the Final ID's finding that PAX has not satisfied its burden on the economic prong of the domestic industry requirement. *Id*.

In the remand order, the Commission stated:

> On remand, the ALJ shall consider whether Complainant's alleged domestic industry investments were made with respect to the articles protected by the patent (*i.e.*, the products that the FID found satisfy the technical prong of the domestic industry requirement), not limited by whether those investments were made post-patent issuance, and determine whether Complainant has satisfied the economic prong of the domestic industry requirement with respect to articles protected by each of the Asserted Patents.

EDIS Doc. ID 851438 at 4 ("Remand Order").

I held a case management conference on May 28, 2025, to discuss the remand proceeding. EDIS Doc. ID at 853280 ("CMC Tr."). The Parties were ordered to file a 10-page brief to summarize any issues they deemed relevant to the remand. CMC Tr. at 6:12-7:3. On June 9, 2025, PAX and Respondents filed their respective remand submissions. EDIS Doc. ID 853244 (PAX); EDIS Doc. ID 853223 (Respondents). Shortly thereafter, the target date was extended to November 18, 2025. Order No. 36 (June 11, 2025), *unreviewed by* Comm'n Notice (July 7, 2025).

B. The Domestic Industry Products

The domestic industry products ("DI Products") are:

DI Products	Asserted Patents			
	'756 Patent	'757 Patent	'527 Patent	'580 Patent
ERA-05G(C) [CPX-0009]	✓	✓	✓	✓
ERA-1G(C) [CPX-0008]	✓		✓	
ERA-ORIG-05G [CPX-0001 + CPX-0009]	✓	✓	✓	✓
ERA-ORIG-1G [CPX-0001 + CPX-0008]	✓		✓	
ERA-PRO-05G [CPX-0002 + CPX-0009]	✓	✓	✓	✓
ERA-PRO-1G [CPX-0002 + CPX-0008]	✓		✓	
ERA-LIFE-05G [CPX-0003 + CPX-0009]	✓	✓	✓	✓
ERA-LIFE-1G [CPX-0003 + CPX-0008]	✓		✓	
ERA-GO-05G [CPX-0004 + CPX-0009]	✓	✓	✓	✓
ERA-GO-1G [CPX-0004 + CPX-0008]	✓		✓	

Final ID at 4-5. "In the DI Products, an Era vaporizer is formed by inserting an Era cartridge into an Era battery. The Era cartridges include the ERA-05G(C) and ERA-1G(C). The Era batteries include the ERA-ORIG(B), ERA-PRO(B), ERA-LIFE(B), and ERA-GO(B). Any Era battery can be combined with any Era cartridge to form an Era vaporizer." *Id*. at 5.

The Commission did not review the Final ID's finding that the DI products satisfy the technical prong of the domestic industry requirement. Notice to Review at 3.

II. LEGAL STANDARD

Section 337(a)(3) identifies criteria for determining the existence of a domestic industry: For purposes of paragraph (2), an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned –

> (A) significant investment in plant and equipment;
>
> (B) significant employment of labor or capital; or
>
> (C) substantial investment in its exploitation, including engineering, research and development, or licensing.

19 U.S.C. §1337(a)(3). Because the statutory criteria are listed in the disjunctive, satisfaction of any one of them is sufficient to meet the economic prong. *Lashify, Inc. v. Int'l Trade Comm'n*, 130 F.4th 948, 957–958 (Fed. Cir. 2025) ("*Lashify*"); *see also Interdigital Commc'ns v. Int'l Trade Comm'n*, 707 F.3d 1295, 1303 n.4 (Fed. Cir. 2013)*; Certain Variable Speed Wind Turbines & Components Thereof*, Inv. No. 337-TA-376, Comm'n Op. at 15, USITC Pub. No. 3003 (Nov. 1996) ("*Wind Turbines*").

III. DISCUSSION

PAX asserts that it has made significant investments in plant and equipment and labor or capital relating to the "research, development, design, engineering, procurement and supplier qualification, product and technical customer support, and quality control of the DI Products" to satisfy the requirements of 19 U.S.C. § 1337(a)(3)(A) and (B). CIB at 86. Respondents contend that PAX has failed to meet the economic prong of the domestic industry requirement. RIB at 139-140.

A. Overview of PAX's Domestic Industry

PAX was initially formed as Ploom, Inc. in 2007 by founders James Monsees and Adam Bowen in San Francisco, who were seeking to create a safer alternative to smoking. CPHB at 90; CX-4745 (Patag WS) at Q/A 11. It introduced its first loose-leave vaporizer in 2012 and later developed a battery and cartridge vaporizing system. Compl., ¶ 3. PAX and JUUL Labs, Inc. originate from the same company. *Id*. PAX was spun out of JUUL in 2017, with JUUL retaining the nicotine product line and PAX being assigned the cannabis and hemp product lines. *Id*.; *see also* CX-4745C (Patag WS) at Q/A 11.

PAX is a market leader in the design and development of premium plant derived oil-based vaporization technologies and devices in the United States. CPHB at 90; CIB at 87; CX-4745C

(Patag WS) at Q/As 19, 109-110. PAX has sold a variety of oil vaporizing devices over the years, with slight variations in design and functions. Compl, ¶ 3. This innovation was "made possible by [a] . . . long history of investments in plant, capital, equipment and labor, the vast majority of which has been made in the U.S." CX-4748C (Putnam WS) at Q/A 34. Nearly all research, development, design, engineering, as well as procurement and supplier qualification work for PAX's DI products is performed by U.S. employees in facilities in the United States. CX4745C (Patag WS) at Q/As 19, 109-11; CX-4748C (Putnam WS) at Q/A 40. In fact, "the DI Products were entirely designed in the United States by PAX Labs engineers." CX-4748C (Putnam WS) at Q/A 40.

PAX sells ERA batteries online directly to consumers in states in which PAX has co-manufacturers or brand partners filling pods for sales in dispensaries. CX-4745C (Patag WS) at Q/A 85. PAX also sells ERA batteries to wholesale distributors for sales into smoke shops and vape shops in the states in which PAX's pods are available in dispensaries. *Id*.

PAX does not fill its pods. CX-4745 (Patag WS) at Q/A 86; Patag, Tr. at 51:3-5 ("The company, PAX, only sells the hardware. It only sells empty pods. After that, we don't own the pods anymore."). PAX's wholly-owned subsidiary, [redacted], partners with co-manufacturers who are state-licensed cannabis processors or brand partners who are state-licensed cannabis processors. JX-0056C (Patag Dep.) at 23:8-11; *see also id*. at 18:12-19:6; Patag, Tr. at 39:20-23, 41:17-20. The co-manufacturers or brand partners purchase and fill the empty pods from [redacted] and sublicense PAX's intellectual property, such as formulations and processing know-how, trademarks, and packaging design. CX-4745C (Patag WS) at Q/A 12; Patag, Tr. at 41:13-16; JX-0056C (Patag Dep.) at 24:14-18, 25:8-18; JX-0108C at Interrogatory 7. Brand partners then co-brand and sell the pods into licensed dispensaries or pharmacies licensed by the state to sell medical cannabis. *See* JX-0108C at Interrogatory 7.

B. Respondents' Arguments

Respondents raise several arguments as to why "PAX has not met its burden of establishing a domestic industry as to the economic prong." RIB at 139. I address these arguments below.

1. Pre-Ownership Investments

Respondents argue that "PAX had no right or ability before January 2024 to contribute to its own domestic industry *with respect to the Asserted Patents* because PAX did not own the Asserted Patents." RIB at 144 (emphasis in original). Respondents write: "Only Juul, as the owner of the Asserted Patents between 2021 and 2023, could have sued for infringement and establish a domestic industry with respect to the Asserted Patents during that time." *Id*. PAX contests this assertion, arguing that it is "directly contrary to precedent."[1] CRB at 38.

The evidence is uncontested that PAX did not own the Asserted Patents prior to January 2024. JX-0419C; *see also* Compl, Apps. A-1 ('756 patent), B-1 ('757 patent), C-1 ('527 patent), D-1 ('580 patents); CX-0079-CX-0082; Patag, Tr. at 42:13-15, 42:19-22. Nor is there a dispute that all investments toward a domestic industry were incurred while PAX was an exclusive licensee to the Asserted Patents. CRS at 2 n.4; Patag, Tr. at 42:3-12, 43:1-5. The question is whether investments made while PAX was an exclusive licensee of the Asserted Patents are cognizable. The Commission has "consistently held that the domestic industry inquiry under section 337 is not limited to the activities of the patent owner, but also involves the activities of any licensees." *Wind Turbines*, Comm'n Op. at 20 (Nov. 1997); *see also Certain Prods. Having Laminated Packaging*

[1] Respondents take issue with PAX's reliance on investigations under subsection (C). While the issue here is satisfaction of the domestic industry requirement under subsections (A) and (B), each subsection relates "to the articles protected by the patent." *See Interdigital Commc'ns*, 707 F.3d at 1297-98 (Fed. Cir. 2013). Indeed, in its Remand Order, the Commission did not distinguish among the subsections. Remand Order at 3 ("Consistent with the statute, the Commission has credited pre-patent issuance investments towards a showing of domestic industry in several previous investigations under subparagraphs (A), (B), and (C).").

& Components Thereof, Inv. No. 337-TA-874, Comm'n Op. at 15 (Sept. 3, 2013) ("a licensor may rely upon a licensee's domestic activities and investments"); *Certain Static Random Access Memories*, Inv. No. 337-TA-341, Order No. 5 (Dec. 30, 1992) ("The owner of a patent is not the only possible complainant. A licensed domestic producer of an article that is protected by a U.S. patent may be the complainant."). The Commission Rules similarly provide that a complainant may satisfy the domestic industry requirement through the domestic operations of its licensees. 19 C.F.R. § 210.12(a)(6(ii) ("[T]he complaint shall … include a detailed description of the domestic industry affected, *including the relevant operations of any licensees*.") (emphasis added); § 210.12(a)(7) ("For every intellectual property based complaint (regardless of the type of intellectual property right involved, [the complaint shall] include a showing that at least one complainant is the owner or exclusive licensee of the subject intellectual property."). As discussed *supra*, JUUL was not permitted to engage in business involving cannabis products. *See* JX-0421; JX-0422C. Thus, if JUUL had sought to enforce its rights in the Asserted Patents, it necessarily would have needed to rely on the investments of PAX in the DI Products. It therefore stands to reason that PAX would be able to rely on those same investments in establishing a domestic industry. As PAX noted, "[t]here is no legal or policy basis to grant Respondents' extraordinary request to prohibit significant domestic industry investments under Prongs A and B simply because they were made while PAX Labs was an exclusive licensee and before it owned the asserted patents." CRS at 2. I agree.

2. Look-Back Period

PAX claims that since at least 2017, it has conducted significant activities in the United States in connection with developing and bringing its DI Products to market. CIB at 87. However, PAX is only relying on its most recent three years of investments in research and development,

design, engineering, testing, manufacturing, procurement and supplier qualification, product and technical customer support, third-party logistics and warehousing, and quality control of the DI Products. *Id*. (citing CX-4748C (Putnam WS) at Q/A 46; CX-4745C (Patag WS) at Q/A 68).

Respondents assert that a single year (*i.e.*, 2023) should be used for the look-back period. RIB at 141; *see also* RPHB at 249. They contend that PAX's three-year look-back period is "divorced from the realities of PAX's business and does not support a showing of a domestic industry on the date the complaint was filed." *Id*. This single sentence is the extent of Respondents' argument in its prehearing brief. *See* G.R. 11.2 ("Any contentions not set forth in detail in the pre-hearing brief shall be deemed abandoned or withdrawn, except for contentions of which a party is not aware and could not be aware in the exercise of reasonable diligence at the time of filing the pre-hearing brief."). The arguments in Respondents' post-hearing brief are just as conclusory.[2] *See* RIB at 141-142. At the pre-hearing conference, I cautioned the parties that "[c]onclusory arguments will result in waiver" and arguments "must be made in full." Tr. at 15:11-15. Respondents disregarded this advisement. As such, I find these arguments waived.

"The relevant date at which to determine whether the domestic industry exists or is in the process of being established is the filing date of the complaint." *Certain Televisions, Remote Controls, Components Thereof*, Inv. No. 337-TA-1263, Comm'n Op. at 20 (Nov. 30, 2022), *citing Motiva, LLC v. Int'l Trade Comm'n*, 716 F.3d 596, 601 n.6 (Fed. Cir. 2014) (affirming use of the complaint filing date to determine whether complainant demonstrated an industry exists or is in the process of being established). While that date is the focus of the domestic industry analysis, complainants routinely rely on periods of time before the complaint was filed to support their domestic industry claim. *See, e.g.*, *Hyosung TNS Inc. v. Int'l Trade Comm'n*, 926 F.3d 1353, 1362

[2] The same holds true for Respondents' Remand Submission. *See* RRS at 6.

(Fed. Cir. 2019) ("We see no legal error in the ITC's conclusion that a past investment may, by virtue of its connection to ongoing field service and assembly expenses, support a finding that the economic prong of the domestic industry requirement is met."); *Certain Gas Spring Nailer Prods. & Components Thereof*, Inv. No. 337-TA-1082, Comm'n Op. at 82 n.18 (Apr. 28, 2020) ("*Gas Spring Nailer Prods.*") ("The Commission finds that this time frame is reasonable because those past expenditures relate to Kyocera's investments in R&D and engineering of the DI products and because complainant continued to make such investments until the complaint was filed."); *Certain Television Sets, Television Receivers, Television Tuners, & Components Thereof,* Inv. No. 337-TA-910, Comm'n Op. at 68 (Oct. 30, 2015) ("*Television Sets*") ("Past expenditures may be considered to support a domestic industry claim so long as those investments pertain to the complainant's industry with respect to the articles protected by the asserted IP rights and the complainant is continuing to make qualifying investments at the time the complaint is filed."); *Certain Kinesiotherapy Devices & Components Thereof*, Inv. No. 337-TA-823, Comm'n n Op. at 30 (July 12, 2013) (finding expenses related to a predecessor product "relevant to domestic industry" even though they were incurred more than two years prior to the day the complaint was filed); *Certain Elec. Dig. Media Devices & Components Thereof*, Inv. No. 337-TA-796, Comm'n Op. at 100-02 (Sep. 6, 2013) (crediting expenses incurred over a six-year period from 2006 through the first quarter of 2012).

In the vaporizer industry, "[a] product cannot be sold unless it is first researched, designed, developed, engineered, tested and otherwise supported." CIB at 91. Thus, the DI Products sold in the United States up to the filing of the complaint would necessarily have been researched, developed, designed, engineered, tested and otherwise supported prior to being sold and the unrebutted evidence shows that said research, development, design, engineering, and testing

occurred in 2021, 2022, and 2023. CX-4745C (Patag WS) at Q/As 20, 45, 57, 59, 68, 96; CX-4748C (Putnam WS) at Q/As 53, 69-70. Dr. Kline, Respondents' economic expert, acknowledged that products sold in 2024 could benefit from earlier investments in the product. Klein, Tr. at 330:4-331:4. And, as PAX notes: "It makes no sense that PAX can sell DI Products up to the filing of the complaint in January 2024 and not rely on the activity relating to research, development, design, engineering, testing, quality control, and product and technical customer support for those products that occurred in 2021, 2022 and 2023." CPHB at 96. I therefore find PAX's three-year look-back period, from 2021 through 2023, to be reasonable.[3]

3. Allocation Methodology

PAX uses a sales-based methodology to allocate its total expenses to the DI products and the claimed domestic industry activities. *See, e.g.*, CIB at 90-102; CRB at 45-48; CRS at 4-5; CX-4745C (Patag WS) at Q/As 91-96; CX-4748C (Putnam WS) at Q/As 45, 81. "Respondents do not dispute that a sales-based allocation is a method the Commission accepts." RRB at 58. Respondents nevertheless argue against such an approach here. They claim that "PAX had the

[3] While there was a decline in PAX's investments from 2021 to 2023, the evidence nevertheless shows consistent investments through the domestic industry timeframe identified by PAX. *See Television Sets,* Comm'n Op. at 68 ("[W]here production, development or sales of protected articles have declined or even ceased entirely, a domestic industry may nevertheless be established based on past significant or substantial investments relating to the protected articles provided that complainant continues to maintain ongoing qualifying activities under section 337(a)(3) at the time the complaint is filed."). As Mr. Patag explained, "the employees still at PAX Labs at the end of 2023 continued working on the DI Products at least through the filing of the Complaint." CX-4745C (Patag WS) at Q/A 45. As for the decline in investments, both Dr. Putnam and Mr. Patag attributed PAX's decline in investments to competitors entering the market at prices significantly lower than PAX's prices. CX-4748C (Putnam WS) at Q/As 104, 106-107; CX-4749C (Putnam Rebuttal WS) at Q/A 24; CX-4745C (Patag WS) at Q/A 67. According to PAX, the loss of sales "prevent[ed] PAX from being able to continue to make investments in its DI Products at levels it invested in past period." CRB at 44; *see also* CX-4745C (Patag WS) at Q/As 66-67; CX-4748C (Putnam WS) at Q/As 104, 106; CX-4749C (Putnam Rebuttal WS) at Q/A 24.

necessary information to more precisely allocate its investments" yet "PAX chose to broadly apply a sales-based allocation so that its investments ballooned."[4, 5] *Id*. at 57; *see also* RRS at 7.

"[A] complainant is not obligated to use a particular allocation methodology." *Certain High-Density Fiber Optic Equip. & Components Thereof*, Inv. No. 337-TA-1194, Comm'n Op. at 65 (Aug. 23, 2021) ("*High-Density Fiber Optic Equip.*"). Rather, "all that is required is the use of reasonable allocations for the purposes of establishing the economic prong of the domestic industry requirement." *Certain Solid State Storage Drives, Stacked Elecs. Components., & Prods. Containing Same*, Inv. No. 337-TA-1097, Comm'n Op. at 21 (June 29, 2018). The Commission has previously explained that "[t]he use of a sales-based allocation is one acceptable way to determine the numerical value of domestic industry investments for each Asserted Patent." *Certain Carburetors & Prods. Containing Such Carburetors*, Inv. No. 337-TA-1123, Comm'n Op. at 17 (Oct. 28, 2019) ("*Carburetors*"); *Certain Collapsible Sockets for Mobile Elec. Devices & Components Thereof*, Inv. No. 337-TA-1056, Comm'n Op. at 16 (July 9, 2018) ("When only pre-complaint activities are considered, … the Commission finds that a sales-based allocation of percent is appropriate."); *see also Certain Ink Cartridges & Components Thereof*, Inv. No. 337-

[4] Whether a complainant satisfies the economic prong is not analyzed according to a rigid mathematical formula. *Certain Male Prophylactic Devices,* Inv. No. 337-TA-546, Comm'n Op. at 39 (Aug. 1, 2007) ("*Male Prophylactic Devices*"). And a complainant does not "need to define or quantify the industry itself in absolute mathematical terms." *Certain Stringed Musical Instruments*, Inv. No. 337-TA-586, Comm'n Op. at 26 (May 16, 2008) ("*Stringed Musical Instruments*") ("A precise accounting [of the complainant's domestic investments] is not necessary, as most people do not document their daily affairs in contemplation of patent litigation.").

[5] Notably, Respondents did not offer an alternative allocation methodology in their post-hearing briefing. *See Certain High Density Fiber Optic Equip.*, Comm'n Op. at 65 (noting that the respondents did not suggest an alternative method and "in the absence of a better alternative, it is reasonable . . . for the ID to adopt the sales allocation approach suggested by [complainant's] economic expert"). Any such arguments are now waived. *See* G.R. 14.2.

TA-946, Initial Det. at 67 (Oct. 28, 2015), *aff'd* by Notice (Dec. 14, 2015) (accepting reasonable and appropriate allocation methodologies, such as sales-based allocations).

I find the approach PAX used to be reasonable under the facts of this investigation. Mr. Patag, PAX's Corporate Controller, testified that PAX does not track its domestic expenditures at a product-specific, project-specific level, or the stock keeping unit (SKU) level. CX-4745C (Patag WS) at Q/A 84; *see also* CX4748C (Putnam WS) at Q/A 52 ("Like most companies, PAX Labs does not make discrete investments in plant and equipment for use with just one product, and does not track such expenses on a product-by-product basis."). Only inventory is tracked at a SKU level. *Id*. Mr. Patag explained that for DI employee salary and benefit information, Mr. [redacted], PAX's former Director of Mechanical Engineering, and Mr. [redacted], PAX's former VP of Software, allocated an "employee's time based on either Mr. [redacted] or Mr. [redacted] own personal knowledge of that employee's time as their supervisor or that employee's supervisor's knowledge of the given employee." CX-4745C (Patag WS) at Q/A 43; CX-4748C (Putnam WS) at Q/A 79. Allocations for capital fixed assets "were made based on the use of equipment supported by vendor invoices kept in [PAX's] accounting records," discussions regarding "how such assets were used and how much of that use was for the DI Products," and then each machine was depreciated across 60 months, or 5 years, "as is done in the ordinary course of business." CX-4745C (Patag WS) at Q/A 95; *see also* CX-4748C (Putnam WS) at Q/A 66. Dr. Putnam, PAX's economic expert, took the expenditures supplied by Mr. Patag and applied a sales-based allocation to determine the portion of investment attributable to the DI Products. CX-4748C (Putnam WS) at Q/A 45. He testified:

> I divided U.S. sales revenue of the DI Products by PAX Labs' total U.S. revenue for all products over the same time period. From 2021 through 2023, PAX Labs generated about $[redacted] in revenue within the United States, of which the DI Products accounted for about $[redacted], or about [redacted]% of total U.S. revenue.

Id. at Q/A 52; *see also* JX-0059C; JX-0060C.

Respondents also fault Dr. Putnam for allegedly failing to allocate PAX's domestic investments on a patent-by-patent basis. RIB at 141, 145-146. They claim that "PAX's analysis does not distinguish between DI vaporizers used with 0.5-gram from those that use 1.0-gram cartridges." RIB at 141. The record demonstrates otherwise. *See, e.g.*, CX-0487C; CX-489C; JX-0319C; CX-4748C at Q/A 90; Putnam, Tr. at 68:8-70:5, 79:16-85-6. The DI vaporizer/battery can be and is used interchangeably with any PAX 0.5- and 1.0-gram cartridge. CX-4746C (Oar WS) at Q/A 56 ("All Era cartridges can work with all Era batteries – in other words, each Era cartridge can combine with each Era battery without limitation."). As a result, 100% of PAX's investments in its DI vaporizers/batteries are attributable to all the Asserted Patents. *See, e.g., Zircon Corp. v. Int'l Trade Comm'n*, 101 F.4th 817, 824 (Fed. Cir. 2024) ("In cases in which all the domestic industry products practice all the asserted patents, it follows from the language of section 337 and our case law that the complainant could satisfy the economic prong as to all asserted patents based on the entire product group."); *Certain Sleep-Disordered Breathing Sys.*, Inv. No. 337-TA-890, Remand ID at 30-31 (Nov. 10, 2016) ("The domestic industry relating to each patent may be the same domestic industry if both patents are practiced in a single product or in all of the products claimed to be part of the domestic industry."). This means that each DI vaporizer/battery will, in combination with the 0.5-gram pods, practice each of the Asserted Patents. However, the same does not hold true for the 1.0-gram pod. The 1.0-gram pod only practices the '757 and '580 patents, so less than 100% of all DI investments are attributable to a domestic industry for these patents. Putnam, Tr. at 70:6-9. As such, Dr. Putnam broke down PAX's qualifying expenses on a patent-by-patent basis. JX-0319C; CX-0487C; CX-0489C; CX-4748C (Putnam WS) at Q/A 90; Putnam, Tr. at 68:8-70:5, 79:16-85:6.

4. "Mere Importer" Activities

Respondents contend that PAX's investments include activities akin to a mere importer.[6] RIB at 140; *see also* RRS at 10. They write: "[M]any of PAX's investments in labor, equipment, warehousing, customer support, and logistics, resemble those of a mere importer and should be excluded from consideration." *Id*. at 146. These types of conclusory arguments constitute waiver under my Ground Rules. G.R. 14.2. Accordingly, Respondents have waived this argument.

C. Nature of PAX's Domestic Activities

1. § 1337(a)(3)(A) – Plant and Equipment

a) Plant

PAX's headquarters is located at 660 Alabama St., 2nd Floor, San Francisco, CA. CX-4745C (Patag WS) at Q/A 27. The Alabama St. location is "the central location for PAX Labs' activities supporting the Domestic Industry Products in the U.S." *Id*.; *see also* CX-4748C (Putnam WS) at Q/A 48. PAX's headquarters occupies one floor of a building with a total of 11,555 square feet of space.[7] *Id.*; *see also* JX-0343C-JX-0345; JX-0349C; JX-0353C. From 2018 through

[6] Respondents continue to advance this argument despite the Federal Circuit's recent decision in *Lashify*. In that decision, the Federal Circuit expanded the scope of activities that may be used to establish a domestic industry under section 337 to include employment of labor or capital for "sales, marketing, warehousing, quality control, or distribution," the very activities Respondents insist should be excluded. *Lashify*, 130 F.4th 959.

[7] Respondents contend that Dr. Putnam incorrectly allocated the expenses for the 660 Alabama St. facility. RRB at 56-57. They also imply that PAX included in its calculations space where activities such as "legal, HR, and Finance activities" are performed. *Id*. at 57. Dr. Putnam addressed both issues at the hearing. He testified: "Mr. Kline references Mr. Patag's declaration, which was filed at the start of the investigation, and which divides the square footage of 660 Alabama St. between lab space (where qualifying DI activities such as R&D took place) and non-lab space. This was a conservative initial approach to determining how much of the 660 Alabama facility should be allocated to the DI Products. Based upon further investigation to identify the activities that take place at the 660 Alabama facility, I conclude[d] that a number of qualifying activities, such as procurement, occurred outside the lab space. For that reason, I found the sales-based allocation of [redacted]% more appropriate and economically sound that Mr. Patag's [redacted]% allocation." CX-4748C

February 2022, PAX also rented laboratory space at 505 Alabama St., San Francisco, CA 94110. CX-4745C (Patag WS) at Q/A 24; CX-4748C (Putnam WS) at Q/A 48; *see also* JX-0317C; JX-0346C–JX-348C. The 505 Alabama location was a 3,750 square foot space. CX-4745C (Patag WS) at Q/A 30; CX-4748C (Putnam WS) at Q/A 48. In addition, from November 2019 through October 2021, PAX subleased an 8,800 square foot laboratory and related space at 470 Alabama St., San Francisco, CA 945110. CX-4745C (Patag WS) at Q/A 24, 33; CX-4748C (Putnam WS) at Q/A 48; *see also* JX-0317C; JX-0350C–JX-0351C. With respect to these three facilities,[8] the evidence shows the following:

Name	Square Footage	Investments from 2021 Through 2023
PAX Headquarters at 660 Alabama St.	11,555	$[redacted] (rent & utilities)
505 Alabama Facility	3,750	$[redacted] (rent & utilities)
407 Alabama Facility	8,800	$[redacted] (rent & utilities)

CX-4748C (Putnam WS) at Q/A 51; JX-0317C.

Thus, PAX invested a total of $[redacted] in rent and utilities associated with its facilities. *Id*. Dr. Putnam then applied the [redacted]% sales-based allocation to PAX's total plant investments and found that, from 2021 through 2023, PAX invested $[redacted] in 2021, $[redacted] in 2022, and [redacted] in 2023, for a total of $[redacted] attributable to the DI Products. CX-4748C (Putnam WS) at Q/As 52-53; JX-0317C-JX-0318C.

(Putnam WS) at 57; *see also* CX-4745C (Patag WS) at Q/A 93. Notably, Respondents did not cross-examine either Dr. Putnam or Mr. Patag on these alleged inconsistencies.

[8] Respondents claim that "[i]t was inappropriate for PAX to include plant investments for buildings PAX stopped using well before filing the complaint and before the Asserted Patents issued." RIB at 142. Even though the leases for the 470 Alabama St. and 505 Alabama St. plants ended, they did so during the three-year look-back period and thus, are properly included in PAX's plant investments.

b) Equipment

In addition to PAX's plant investments, the evidence shows that PAX invests in equipment relating to its DI Products. As noted above, PAX does not fill its pods, but rather [redacted], including proprietary filling machines and laser engravers.[9] *See* JX-0056C (Patag Dep.) at 24:14-18, 25:8-18; *see also* JX-0064C. PAX is not relying on the cost of the filling machines themselves, only its investments in assembling, servicing, and tooling the filling machines that are necessary to fill the pods. CIB at 93 (citing JX-0064C). As PAX explained: "[T]he DI Products will not function or work without being filled with something, and filling cannot occur without the proprietary filling machines." *Id*. at 94; *see also* JX-0058 at ¶ 11; JX-0108C at Interrogatory 7. PAX also relies on investments and expenses related to the laser engravers it provides to co-manufacturers and brand partners as pods are required to be engraved to comply with various regulatory requirements set out by each state where the co-manufacturers and brand partners operate and sell the pods. *Id*. (citing JX-0064C; 4 CCR §§ 17402, 17404, 17406 (California labeling requirements); 1 CCR §§ 212-3-3-1005, 212-3-3-1010, 212-3-3-1015, 212-3-3-1020 (Colorado labeling requirements); Mass. Gen. Laws Ann. Ch. 94G § 4 (Massachusetts labeling requirements); N.Y. Comp. Codes, R. & Regs. Tit. 9, § 128 (New York labeling requirements)).

Allocations were made based on the use of each piece of equipment in which PAX invested (*i.e.*, whether the equipment was used solely on DI Products) and then each machine was depreciated across 60 months. CX-4745C (Patag WS) at Q/A 59; JX-0064C; CX-4748C at Q/As

[9] "No expenses or expenditures of [redacted] for oil-filling activity downstream of PAX Labs was included in PAX Labs' calculation of its DI." CIB at 90.

63-64. The evidence demonstrates that PAX's domestic equipment expenditures were $[redacted] in 2021, $[redacted] in 2022, and $[redacted] in 2023. JX-0316C. Applying the 39.3 allocation percentage to PAX's equipment expenses results in investments of $[redacted] in 2021, $[redacted] in 2022, and $[redacted] in 2023 attributable to the DI Products. CX-4748C (Putnam WS) at Q/A 69; JX-0316C. Thus, from 2021-2023, PAX invested $[redacted] on equipment attributable to the DI Products. *Id*.

c) Conclusion

The evidence supports that PAX's DI investments under subparagraph (A) total $1,829,598. JX-0314C; CX-4748C (Putnam WS) at Q/A 70.

2. § 1337(a)(3)(B) – Labor or Capital

a) Labor

PAX is generally organized into ten divisions: [redacted]. CX-4745C (Patag WS) at Q/A 12. Six of those divisions—[redacted]—relate to PAX's research and development, testing, engineering, and product and technical support for its products sold in the United States. *Id.* at Q/A 19; *see also* CX-4746C (Oar WS) at Q/As 70-71. These six divisions are based in PAX's headquarters at 660 Alabama St. in San Francisco, CA. *Id*. at Q/As 24, 27. From 2020 to 2022, PAX also had a software division that developed and maintained the PAX software app for use with the Era Pro device. *Id.* at Q/A 46. This division was based at PAX's headquarters. *Id*. at Q/A 27.

PAX incurs numerous expenses in connection with its employees, such as salary, wages, bonuses, benefits, and payroll taxes. JX-0061C; JX-0062C. PAX has also incurred expenses for

technical customer support and third-party logistics, quality control and warehousing from contract vendors.[10, 11] *See* JX-0063C; CX-4589C–CX-4599C; JX-0314C. However, PAX is only relying on labor costs associated with R&D, engineering, design, procurement and supplier qualification, and quality control. CX-4745C (Patag WS) at Q/A 43; JX-0061C; JX-0062C; CX-04746C (Oar WS) at Q/As 68-76; CX-4748C (Putnam WS) at Q/A 79.

The evidence shows that for the period of 2021-2023, PAX's total investment in employee wages and benefits was $[redacted], with $[redacted] in 2021, $[redacted] in 2022, and $[redacted] in 2023.[12] CX-4748C (Putnam WS) at Q/A 77; JX-0315C. The evidence also shows

[10] The contract vendors were involved in quality control and technical customer support for the DI Products. CX-4745C (Patag WS) at Q/As 22-23. The Commission has previously credited such expenses. *See, e.g.*, *Male Prophylactic Devices*, Comm'n Op. at 24 (May 2008) ("The relevant domestic activities to be considered may include those of a complainant's subcontractor."); *Certain Audible Alarm Sys. for Divers*, Inv. No. 337-TA-365, Comm'n Op. at 41 (June 6, 1995) ("Nor is it necessary that a plant be owned rather than leased, [or] that labor be directly employed rather than subcontracted"). Moreover, the Federal Circuit's recent opinion in *Lashify* held that section 337 "covers significant use of 'labor' and 'capital' without any limitation on the use within an enterprise to which those items are put, *i.e.*, the enterprise function they serve." *Lashify*, 130 F.4th 958. The Court expressly stated: "There is no exclusion from labor when the human activity employed is for sales, marketing, warehousing, quality control, or distribution, which are common aspects of providing goods or services." *Id*. at 959.

[11] Dr. Putnam categorized PAX's expenditures related to its contract vendors as expenditures on labor, as opposed to capital expenditures. CX-4748C (Putnam WS) at Q/A 75. He explained: "PAX Labs outsourced certain specialized services to organize and enhance its domestic business, and spent resources on labor inherent in the provision of those services." *Id.* In his view, "[t]he correct way to conceptualize contract vendors is: how would one categorize these expenses if the services were performed in-house?" *Id*. Thus, because the contract vendors, like PAX's in-house employees, are primarily service providers, he categorized them as labor expenses. *Id*.

[12] Respondents challenge PAX's allocation of [redacted]' time. RRB at 59 (arguing that timecard evidence shows he stopped working on software for the DI products). However, Mr. Patag explained: "[F]or software employees like [redacted], the timecards ended in 2022 because that was when development of PAX Labs application ended which is when capitalization of the software employees' time ended. … [redacted] was one of the employees that stayed on to help with the maintenance and upkeep of the app until the end of 2022. At that point, he moved over to e-commerce and website development to continue to perform those software maintenance and support activities. While Mr. [redacted] time on the software project ended in 2022, he was still working on the DI Products after that in his other position." CX-4745C (Patag WS) at Q/A 108. Were Mr. [redacted] time removed from the labor calculations, it would reduce the total DI investment

that PAX's total investment in its contract vendors was $[redacted], with $[redacted] in 2021, $[redacted] in 2022, and $[redacted] in 2023. JX-0315C. Of this, PAX's investment in labor attributable to the DI Products was $[redacted] in 2021, $[redacted] in 2022, and $[redacted] in 2023.[13] CX-4748C (Putnam WS) at Q/A 82; JX-0314C-JX-0315C. Thus, from 2021-2023, PAX made domestic labor investments of $[redacted] in connection with its DI Products. JX-0314C.

b) Capital

In this investigation, PAX's expenditures on equipment and expenditures on capital are the same. JX-0314C ("As I have explained, under the facts of this investigation, and as is often the case, PAX Labs' expenditures on equipment and expenditures on capital are the same."). As detailed in Section III.B.1.b *supra*, the evidence shows that between 2021 and 2023, PAX made capital investments of $[redacted] in connection with the DI Products. *Id*.

c) Conclusion

The evidence thus supports that PAX's DI investments under subparagraph (B) total $[redacted]. JX-0314C.

D. Significance of PAX's Domestic Activities

PAX asserts that its investments are both qualitatively and quantitively significant. CIB at 102. Respondents contend that "PAX cannot show that its alleged investments in Prongs A or B

in labor by approximately $[redacted] (or [redacted]% of expenditures during the look-back period). CX-4748C (Putnam WS) at Q/A 88. Given PAX's total investment of $[redacted], a reduction of [redacted]% is nominal at best and does not materially affect the significance analysis.

[13] Dr. Putnam relied on the allocations undertaken by Mr. [redacted], with assistance from Messrs. [redacted] for those employees not directly supervised by Mr. [redacted]. *Id*. at 79.

related to PAX's domestic industry products were significant at the time the complaint was filed." RIB at 143.[14]

1. Quantitative Significance

"A finding of domestic industry cannot hinge on a threshold dollar value or require a rigid formula; rather, the analysis requires a holistic review of all relevant considerations that is very context dependent." *Wuhan Healthgen Biotech. Corp. v. Int'l Trade Comm'n*, 127 F.4th 1334, 1339 (Fed. Cir. 2025); *see also Bally/Midway Mfg. Co. v. Int'l Trade Comm'n*, 714 F.2d 1117, 1123 (Fed. Cir. 1983) ("There is nothing in the statute which requires that an industry must be of any particular size."); *Stringed Musical Instruments*, Comm'n Op. at 25-26 (to establish a domestic industry, a complainant need not eclipse some "minimum monetary expenditure.").

One method of assessing significance is to consider "the value added to the product from a complainant's activities in the United States." *Carburetors*, Comm'n Op. at 18; *see also Wuhan Healthgen Biotech.*, 127 F.4th at 1339 ("We also recognized the value added by domestic operations as a quantitative factor in the assessment."). As PAX notes, "virtually all R&D, design, engineering, and procurement and supplier qualification work associated with its products is performed by U.S. employees in PAX's facilities in the U.S." CRB at 48; *see also* CX-4745C (Patag WS) at Q/As 19-24, 109-110; Cx-4748 (Putnam WS) at Q/A 40; CX-4746 (Oar WS) at Q/As 70-71. The Commission has previously concluded that investments were significant on this basis. *See Certain Apparatus & Methods of Opening Containers*, Inv. No. 337-TA-1255, Initial Det., at 34-35 (Dec. 20, 2021) (explaining that when all of the economic activity related to a

[14] Respondents rely on Mr. Kline's testimony in support. *See* RIB at 143; RRB at 59-60. However, Mr. Klein's analysis only focused on those investments that occurred in 2023. RX-0475C at Q/A 40. This approach was rejected in Section III.2.

domestic industry product takes place within the United States the investments are quantitatively significant), *unreviewed by* Comm'n Notice (Feb. 3, 2022)); *Gas Spring Nailer Prods.*, Comm'n Op. at 83 (Apr. 28, 2020) (finding quantitative significance where "all, i.e., 100 percent, of Kyocera's R&D and engineering expenditures relating to complainant's [domestic industry products] occurs in the United States"), *vacated and remanded on other grounds*, *Kyocera Senco Indus. Tools v. Int'l Trade Comm'n*, 22 F.4th 1369 (Fed. Cir. 2022).

Comparing a complainant's domestic expenditures to its foreign expenditures is another possible measure of significance. Here, PAX's foreign expenditures relating to plant and equipment totaled approximately $[redacted] and its foreign expenditures relating to labor or capital totaled $[redacted] in 2021-2023. JX-0321C. "For plant and equipment expenses, PAX Labs' U.S. expenditures on the DI Products account for [redacted]% of PAX Labs' U.S. plus foreign-incurred expenditures."[15] CX-4748C at Q/A 95; *see also* JX-0321C. And "PAX Labs' U.S. DI investments in labor or capital account for [redacted]% of PAX Labs' domestic plus foreign-incurred expenditures." *Id*. at Q/A 96; *see also* JX-0321C. I therefore find PAX has shown significance on this ground.

2. Qualitative Significance

I find that PAX has established that its investments are qualitatively significant. As Mr. Patag testified: "Almost all of [PAX's investments in plant, capital, and labor] have been made in the U.S. and all of the DI Products were designed and developed in the US and continue to be supported by US employees for quality and reliability control." CX-4745C (Patag WS) at Q/A 110.

[15] Adjusting the total overall investments to account for the 1.0-gram pod not practicing the '757 and '580 patents "yields only marginally different results than for the DI Products that practice the '756 and '527 patents." CRS at 8. For example, PAX's domestic investments under subsection (A) for the '757 and '580 patents compared to its foreign expenditures is [redacted]% and [redacted]% for subsection (B). *Id*. at 9; *see also* JX-0321C; JX-0319C.

Mr. Patag further noted: "These investments are essential to the success of the DI Products and the DI Products are essential to the success of PAX Labs as a whole." *Id*. Thus, without PAX's domestic investments, the DI Products would not exist. *See, e.g.*, *Certain Movable Barrier Operator Sys. & Components Thereof*, Inv. No. 337-TA-1118, Comm'n Op. at 33 (Jan. 12, 2021) (explaining that "[q]ualitative factors may include . . . whether the complainant's domestic activities . . . are crucial to its domestic industry products" and finding that the complainant's investments were qualitatively significant "because they support R&D, engineering, product development, and technical services that are 'critical' and 'foundational'" to the domestic industry products).

IV. INITIAL DETERMINATION ON REMAND

For the reasons set forth above, it is my initial determination that PAX has satisfied the economic prong of the domestic industry requirement under 19 U.S.C. §§ 1337(a)(3)(A) and 1337(a)(3)(B).

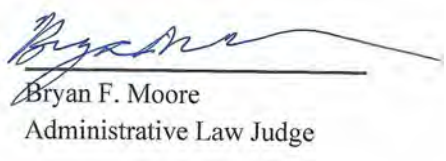
I hereby certify to the Commission this remand initial determination.

The Secretary shall serve the confidential version of this remand initial determination upon counsel who are signatories to the Protective Order (Order No. 1) issued in this investigation. A public version will be issued later.

Pursuant to 19 C.F.R. § 210.42(h), this remand initial determination shall become the determination of the Commission unless a party files a petition for review pursuant to 19 C.F.R. § 210.43(a) or the Commission, pursuant to 19 C.F.R. § 210.44, orders on its own motion a review of the remand initial determination or certain issues therein.

V. ORDER

Within seven days of the date of this document, the parties shall jointly submit a single proposed public version with any proposed redactions indicated in red. If the parties submit excessive redactions, they may be required to provide declarations from individuals with personal knowledge, justifying each proposed redaction and specifically explaining why the information sought to be redacted meets the definition for confidential business information set forth in 19 C.F.R. § 201.6(a). To the extent possible, the proposed redactions should be made electronically, in a single PDF file using the "Redact Tool" within Adobe Acrobat. The proposed redactions should be submitted as "marked" but not yet "applied." The proposed redactions should be submitted via email to Moore337@usitc.gov and not filed on EDIS.



Bryan F. Moore
Administrative Law Judge

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
858076	Public	ID/RD - Final on Violation	07/30/2025 08:45 AM	Remand Initial Determination

Service Date: July 30, 2025

/s

Lisa R. Barton
U.S. International Trade Commission
500 E Street, S.W.
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CERTIFICATE OF SERVICE

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UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of **CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME**	**Investigation No. 337-TA-1392**

NOTICE OF A COMMISSION DETERMINATION TO REVIEW AND, ON REVIEW, TO AFFIRM A REMAND INITIAL DETERMINATION FINDING THAT COMPLAINANT HAS SATISFIED THE ECONOMIC PRONG OF THE DOMESTIC INDUSTRY REQUIREMENT; REQUEST FOR BRIEFING ON REMEDY, THE PUBLIC INTEREST, AND BONDING

AGENCY: U.S. International Trade Commission.

ACTION: Notice.

SUMMARY: Notice is hereby given that the U.S. International Trade Commission ("Commission") has determined to review a remand initial determination ("RID") of the presiding administrative law judge ("ALJ"), finding that PAX Labs, Inc. ("Complainant") satisfied the economic prong of the domestic industry requirement under section 337 of the Tariff Act of 1930, as amended. On review, the Commission has determined to affirm the RID's finding that Complainant satisfied the economic prong of the domestic industry requirement under section 337(a)(3)(A) and (B).[1] The Commission requests written submissions from the parties, interested government agencies, and other interested persons on the issues of remedy, the public interest, and bonding, under the schedule set forth below.

FOR FURTHER INFORMATION CONTACT: B. Rashmi Borah, Esq., Office of the General Counsel, U.S. International Trade Commission, 500 E Street S.W., Washington, D.C. 20436, telephone (202) 205-2518. Copies of non-confidential documents filed in connection with this investigation may be viewed on the Commission's electronic docket (EDIS) at *https://edis.usitc.gov*. For help accessing EDIS, please email EDIS3Help@usitc.gov. General information concerning the Commission may also be obtained by accessing its Internet server at *https://www.usitc.gov*. Hearing-impaired persons are advised that information on this matter can be obtained by contacting the Commission's TDD terminal on (202) 205-1810.

[1] Commissioner Johanson concurs with the Commission's finding of a domestic industry under subsection 337(a)(3)(B) based on alternative reasoning as set forth in his separate views in this investigation, and he takes no position on Complainant's investments under 337(a)(3)(A).

SUPPLEMENTARY INFORMATION: The Commission instituted this investigation on March 6, 2024, based on a complaint filed by Complainant. 89 FR 16025-26 (Mar. 6, 2024). The complaint, as supplemented, alleges violations of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. 1337 ("section 337"), in the importation into the United States, the sale for importation, or the sale within the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same by reason of infringement of certain claims of U.S. Patent Nos. 11,369,756 ("the '756 patent"); 11,766,527 ("the '527 patent"); 11,369,757 ("the '757 patent"); and 11,759,580 ("the '580 patent") (together, the "Asserted Patents"). *Id.* The complaint further alleges that a domestic industry exists. *Id.* The Commission's notice of investigation named as respondents STIIIZY IP LLC f/k/a STIIIZY, LLC; STIIIZY, Inc. d/b/a Shryne Group Inc. (collectively, "STIIIZY"); ALD Group Limited; and ALD Hong Kong Holdings (collectively, "ALD") (together, "Respondents") *Id*. The Office of Unfair Import Investigations is not participating in the investigation. *Id.*

The Commission previously terminated the investigation as to claims 4 and 21 of the '527 patent. Order No. 11 (July 11, 2024), *unreviewed by* Comm'n Notice (July 30, 2024). The Commission also terminated the investigation as to claims 2, 3, 6-9, and 11-17 of the '756 patent; claims 3-8, 10-12, 14, and 17-19 of the '757 patent; claims 2-3, 6-9, 12-16, 19, 20, 24, 25, and 27-29 of the '527 patent; and claims 2-5, 9, 12-15, and 19 of the '580 patent. Order No. 20 (Sept. 6, 2024), *unreviewed by* Comm'n Notice (Oct. 7, 2024).

The ALJ held an evidentiary hearing from October 21-23, 2024.

After the hearing, the Commission terminated the investigation as to claims 2, 9, and 16 of the '757 patent; claims 23, 26, and 30 of the '527 patent; and claims 11, 16-18, and 20 of the '580 patent. Order No. 32 (Nov. 8, 2024), *unreviewed by* Comm'n Notice (Dec. 10, 2024).

As of the issuance of the final initial determination ("FID"), the remaining asserted claims were: claims 1, 5, and 10 of the '756 patent; claims 1, 5, 10, 11, 17, 18, and 22 of the '527 patent; claims 1, 13, 15, and 20 of the '757 patent; and claims 1, 6-8, and 10 of the '580 patent.

On March 6, 2025, the ALJ issued the FID finding no violation of section 337. The FID finds that: the accused STIIIZY-LIIIL, the STIIIZY-1G(C), and the STIIIZY-ORIG-1 products infringe at least one claim of each Asserted Patent; the accused STIIIZY-AIO, the FLARE(C), and the FLARE(V) products each infringe at least one asserted claim of the '527 and '580 patents; the accused ROVE(C) and ROVE(V) products each infringe at least one asserted claim of the '527 patent; the accused STIIIZY Redesigned Products and FLARE-REDESIGNS infringe at least one claim of the '580 patent; the ROVE(C) and ROVE(V) products do not infringe the asserted claims of the '580 patent; and the accused ROVE-REDESIGNS do not infringe any asserted claim. The FID further finds that Respondents induced infringement and contributorily infringed all asserted claims, none of the asserted claims are invalid under 35 U.S.C. §§ 102, 103, and/or 112, ¶ 1, and Complainant has satisfied the technical prong of the domestic industry requirement for all Asserted Patents. The FID finds, however, that

Complainant has not satisfied the economic prong of the domestic industry requirement for any of the Asserted Patents. *Id.*

The FID also includes the ALJ's recommended determination ("RD") on remedy, the public interest, and bonding should the Commission find a violation of section 337. Specifically, the RD recommends that the Commission issue a limited exclusion order barring entry of STIIIZY's and ALD's products that infringe the asserted claims of the Asserted Patents. The RD also recommends issuing a cease and desist order directed to STIIIZY, but not to ALD, because ALD does not maintain significant commercial operations in the United States. The RD further recommends that the Commission set a bond of 100 percent for any importations of infringing products during the period of Presidential review.

On March 18, 2025, Complainant filed a petition seeking review of the following findings: (1) that certain accused products do not infringe the asserted claims of the'580 patent; (2) that certain redesigned products do not infringe the asserted claims of the '756, '527, or '757 patent; and (3) that Complainant has not satisfied the economic prong of the domestic industry requirement. On the same day, Respondents filed a petition seeking review of the following findings: (1) that certain redesigned products infringe the asserted claims of the '580 patent under the doctrine of equivalents; (2) that claims 1, 6, or 8 of the '580 patent are not invalid as anticipated; and (3) that Respondents failed to meet their burden to show that a skilled artisan would have been motivated to combine certain prior art references. Respondents also asked the Commission to determine: (1) whether Complainant's investments made while the Complainant was a licensee should be counted under subsections (A) or (B) of the economic prong of the domestic industry requirement; (2) whether Complainant fails to satisfy the economic prong of the domestic industry requirement because Complainant's domestic industry expenditures are based on activities that are illegal under the Controlled Substances Act; and (3) whether Complainant demonstrated that it had a domestic industry on the date the complaint was filed. On March 26, 2025, Complainant and Respondents filed their respective petition responses.

On March 31, 2025, Professor William J. McNichol, Jr., an adjunct professor at Rutgers Law School, submitted a response to the Commission's *Federal Register* notice seeking public interest submissions. *See* 90 Fed. Reg. 11851-52 (Mar. 12, 2025). On April 7, 2025, the Complainant and ALD filed their respective submissions on the public interest pursuant to Commission Rule 210.50(a)(4). 19 C.F.R. § 210.52(a)(4).

On May 16, 2025, the Commission issued a notice indicating that it was reviewing the FID's findings that: (1) certain accused products do not infringe the '580 patent; (2) certain redesigned products infringe the '580 patent; and (3) Complainant has not satisfied its burden as to the economic prong of the domestic industry requirement. *See* Comm'n Not. at 3 (May 16, 2025). On review, the Commission determined that "the FID errs by stating as a bright-line rule that 'pre-issuance investments [are not] cognizable under subparagraphs (A) and (B) of section 337(a)(3).'" *Id.* The Commission remanded the investigation and directed the ALJ to "consider whether Complainant's alleged domestic industry investments were made with respect to the articles protected by the patent (*i.e.*, the products that the FID finds satisfy the technical prong of

the domestic industry requirement), not limited by whether those investments were made post-patent issuance." Remand Order at 4 (May 16, 2025). The other issues remain under review.

On June 9, 2025, Complainant and Respondents submitted their respective remand briefs. The ALJ did not provide for the parties to file reply briefs.

On July 18, 2025, the ALJ issued the RID finding that Complainant has satisfied the economic prong of the domestic industry requirement under section 337(a)(3)(A) and (B).

On July 30, 2025, Respondents submitted a petition for review of the RID. Respondents request review of the RID's finding that Complainant was an exclusive licensee to the Asserted Patents before June 28, 2022, and that investments made before that date should count towards Complainant's domestic industry. On August 6, 2025, Complainant submitted a response to Respondents' petition for review.

Having examined the record of this investigation, including the RID and the parties' submissions, the Commission has determined to review the RID. First, the Commission has determined to supplement the following sentence on page 7 of the RID: "Nor is there a dispute that all investments toward a domestic industry were incurred while [Complainant] was an exclusive licensee to the Asserted Patents." The Commission notes that Respondents dispute whether Complainant was an exclusive licensee to the Asserted Patents before the Asserted Patents issued. However, Respondents raised this argument for the first time in their remand submission, and accordingly, this argument is waived. *See, e.g.*, *Certain Fitness Devices, Streaming Components Thereof, and Systems Containing Same*, Inv. No. 337-TA-1265, Comm'n Op. at 19-20 (Mar. 23, 2023) (finding arguments not made in the pre-hearing brief to be waived). Furthermore, the Commission has determined to modify the following sentence on page 14 of the RID: "The 1.0-gram pod only practices the '757 and '580 patents, so less than 100% of all DI investments are attributable to a domestic industry for these patents" to read: "The 1.0-gram pod is not alleged to practice the '757 and '580 patents, so less than 100% of all DI investments are attributable to a domestic industry for these patents."

The Commission otherwise affirms the RID's finding that Complainant has satisfied the economic prong of the domestic industry requirement under section 337(a)(3)(A) and (B), including its subsidiary finding that Complainant was an exclusive licensee when it made its domestic industry investments. The Commission finds that the RID reflects a holistic approach to the domestic industry analysis consistent with the Federal Circuit's recent holding in *Wuhan Healthgen Biotechnology Corp. v. Int'l Trade Comm'n*, 127 F.4th 1334, 1339 (Fed. Cir. 2025); *see also Lashify, Inc. v. Int'l Trade Comm'n*, 130 F.4th 948, 963 (Fed. Cir. 2025).

In connection with the final disposition of this investigation, the statute authorizes issuance of, *inter alia,* (1) an exclusion order that could result in the exclusion of the subject articles from entry into the United States; and/or (2) cease and desist orders that could result in the respondents being required to cease and desist from engaging in unfair acts in the importation and sale of such articles. Accordingly, the Commission is interested in receiving written

submissions that address the form of remedy, if any, that should be ordered. If a party seeks exclusion of an article from entry into the United States for purposes other than entry for consumption, the party should so indicate and provide information establishing that activities involving other types of entry either are adversely affecting it or likely to do so. For background, see *Certain Devices for Connecting Computers via Telephone Lines*, Inv. No. 337-TA-360, USITC Pub. No. 2843, Comm'n Op. at 7-10 (Dec. 1994).

The statute requires the Commission to consider the effects of that remedy upon the public interest. The public interest factors the Commission will consider include the effect that an exclusion order and cease and desist orders would have on: (1) the public health and welfare, (2) competitive conditions in the U.S. economy, (3) U.S. production of articles that are like or directly competitive with those that are subject to investigation, and (4) U.S. consumers. The Commission is therefore interested in receiving written submissions that address the aforementioned public interest factors in the context of this investigation.

If the Commission orders some form of remedy, the U.S. Trade Representative, as delegated by the President, has 60 days to approve, disapprove, or take no action on the Commission's determination. *See* Presidential Memorandum of July 21, 2005, 70 FR 43251 (July 26, 2005). During this period, the subject articles would be entitled to enter the United States under bond, in an amount determined by the Commission and prescribed by the Secretary of the Treasury. The Commission is therefore interested in receiving submissions concerning the amount of the bond that should be imposed if a remedy is ordered.

WRITTEN SUBMISSIONS: Parties to the investigation, interested government agencies, and any other interested parties are encouraged to file written submissions on the issues of remedy, the public interest, and bonding. Such submissions should address the recommended determination by the ALJ on remedy and bonding.

In its initial submission, Complainant is also requested to identify the remedy sought and to submit proposed remedial orders for the Commission's consideration. Complainant is further requested to state the dates that the Asserted Patents expire, to provide the HTSUS subheadings under which the accused products are imported, and to supply the identification information for all known importers of the products at issue in this investigation. All initial written submissions, from the parties and/or third parties/interested government agencies, and proposed remedial orders from the parties must be filed no later than close of business on **October 1, 2025**. All reply submissions must be filed no later than the close of business on **October 8, 2025**. Opening submissions from the parties are limited to **25** pages. Reply submissions from the parties are limited to **15** pages. All submission from third parties and/or interested government agencies are limited to **10** pages. No further submissions on any of these issues will be permitted unless otherwise ordered by the Commission.

Persons filing written submissions must file the original document electronically on or before the deadlines stated above pursuant to 19 CFR 210.4(f). Submissions should refer to the investigation number (**Inv. No. 337-TA-1392**) in a prominent place on the cover page and/or the

first page. (*See* Handbook for Electronic Filing Procedures, *https://www.usitc.gov/documents/handbook_on_filing_procedures.pdf*). Persons with questions regarding filing should contact the Secretary, (202) 205-2000.

Any person desiring to submit a document to the Commission in confidence must request confidential treatment by marking each document with a header indicating that the document contains confidential information. This marking will be deemed to satisfy the request procedure set forth in Rules 201.6(b) and 210.5(e)(2) (19 CFR 201.6(b) & 210.5(e)(2)). Documents for which confidential treatment by the Commission is properly sought will be treated accordingly. Any non-party wishing to submit comments containing confidential information must serve those comments on the parties to the investigation pursuant to the applicable Administrative Protective Order. A redacted non-confidential version of the document must also be filed with the Commission and served on any parties to the investigation within two business days of any confidential filing. All information, including confidential business information and documents for which confidential treatment is properly sought, submitted to the Commission for purposes of this investigation may be disclosed to and used: (i) by the Commission, its employees and Offices, and contract personnel (a) for developing or maintaining the records of this or a related proceeding, or (b) in internal investigations, audits, reviews, and evaluations relating to the programs, personnel, and operations of the Commission including under 5 U.S.C. Appendix 3; or (ii) by U.S. government employees and contract personnel, solely for cybersecurity purposes. All contract personnel will sign appropriate nondisclosure agreements. All nonconfidential written submissions will be available for public inspection on EDIS.

The Commission vote for this determination took place on September 17, 2025.

The authority for the Commission's determination is contained in section 337 of the Tariff Act of 1930, as amended (19 U.S.C. 1337), and in Part 210 of the Commission's Rules of Practice and Procedure (19 CFR Part 210).

By order of the Commission.



Lisa R. Barton
Secretary to the Commission

Issued: September 17, 2025

Certain Oil Vaporizing Devices, Components Thereof, and Products Containing the Same;
Inv. No. 337-TA-1392 (Violation)

337-1392 Violation

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
862213	Public	Notice	09/17/2025 03:55 PM	Commission Determination to Review and, on Review, to Affirm a Remand Initial Determination Findi...

Service Date: September 17, 2025

/s

Lisa R. Barton
U.S. International Trade Commission
500 E Street, S.W.
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CERTIFICATE OF SERVICE

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PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION
Washington, D.C.

In the Matter of **CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME**	**Investigation No. 337-TA-1392**

COMMISSION OPINION

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PUBLIC VERSION

I. INTRODUCTION

On May 16, 2025, the Commission determined to review in part the final initial determination ("FID") issued by the presiding administrative law judge ("ALJ") on March 6, 2025. Comm'n Not. at 3 (May 16, 2025). Further, on September 17, 2025, the Commission determined to review the remand initial determination ("RID") issued on July 18, 2025. 90 Fed. Reg. at 45411. On review of the RID, the Commission affirmed, with modifications, the RID's finding that Complainant has satisfied the economic prong of the domestic industry requirement under subsections 337(a)(3)(A) and (B). *Id*. at 45411-12.[1]

Now, upon review of the remaining issues selected for Commission review, the Commission finds that the ROVE(C) and ROVE-REDESIGN(C) infringe claims 1 and 7 of the 11,759,580 ("the '580 patent"), and the ROVE(V) and ROVE-REDESIGN(V) infringe claims 1, 6-8, and 10 of the '580 patent. Furthermore, the Commission affirms with additional reasoning the FID's finding that the STIIIZY-1G-REDESIGN(C) infringes claims 1 and 7 of the '580 patent, the STIIIZY-ORIG-1G-REDESIGN infringes claims 1, 6-8, and 10 of the '580 patent, and the STIIIZY-AIO-REDESIGN infringes claim 1 of the '580 patent.

Therefore, the Commission has determined that there has been a violation of section 337 of the Tariff Act of 1930, as amended, 19 U.S.C. § 1337 ("section 337"), with respect to U.S. Patent Nos. 11,369,756 ("the '756 patent"); 11,766,527 ("the '527 patent"); 11,369,757 ("the '757 patent"); and the '580 patent (together, the "Asserted Patents"). Other than with respect to the economic prong of the domestic industry requirement, the Commission did not review the

[1] Commissioner Johanson found that the Complainant has satisfied the economic prong of the domestic industry requirement under subsection 337(a)(3)(B) and took no position as to subsection 337(a)(3)(A). *See* Separate Views of Commissioner David S. Johanson, EDIS Doc. ID 862212, Sept. 17, 2025.

FID's findings with respect to the '756, the '527, and '757 patents, and therefore adopts the FID's findings with respect with respect to those patents.

Having found a violation of section 337, the Commission has determined to issue a limited exclusion order ("LEO") against respondents STIIIZY IP LLC f/k/a STIIIZY, LLC of Los Angeles, CA and STIIIZY, Inc. d/b/a Shryne Group Inc. of Los Angeles, CA (collectively, "STIIIZY"); and ALD Group Limited of Shenzhen, China and ALD Hong Kong Holdings Limited of Hong Kong (collectively, "ALD") (together, "Respondents") and cease and desist orders ("CDOs") against respondent STIIZY, as set forth below. The Commission finds that the public interest factors do not preclude the issuance of these remedial orders. The Commission has determined that a bond of one hundred percent (100%) is required for infringing products imported during the Presidential review period, based on the value of the entered goods at the time of importation. This opinion sets forth the Commission's reasoning in support of that determination.

II. BACKGROUND

A. Procedural History

On March 6, 2024, the Commission instituted this investigation under section 337 based on a complaint filed by complainant PAX Labs, Inc. ("Complainant"). The complaint alleges a violation of section 337 based on the importation, sale for importation, or the sale in the United States after importation of certain oil vaporizing devices, components thereof, and products containing the same that infringe one or more of the asserted claims of the Asserted Patents. 89 Fed. Reg. 16025-26 (Mar. 6, 2024). The complaint further alleges that a domestic industry exists. *Id.* The notice of investigation names Respondents as respondents. *Id.* The Office of Unfair Import Investigations is not named as a party. *Id.*

PUBLIC VERSION

The Commission previously terminated the investigation as to claims 4 and 21 of the '527 patent. Order No. 11 (July 11, 2024), *unreviewed by* Comm'n Notice (July 30, 2024). The Commission also terminated the investigation as to claims 2, 3, 6-9, and 11-17 of the '756 patent; claims 3-8, 10-12, 14, and 17-19 of the '757 patent; claims 2-3, 6-9, 12-16, 19, 20, 24, 25, and 27-29 of the '527 patent; and claims 2-5, 9, 12-15, and 19 of the '580 patent. Order No. 20 (Sept. 6, 2024), *unreviewed by* Comm'n Notice (Oct. 7, 2024).

The ALJ held an evidentiary hearing from October 21-23, 2024.

After the hearing, the Commission terminated the investigation as to claims 2, 9, and 16 of the '757 patent; claims 23, 26, and 30 of the '527 patent; and claims 11, 16-18, and 20 of the '580 patent. Order No. 32 (Nov. 8, 2024), *unreviewed by* Comm'n Notice (Dec. 10, 2024). As of the issuance of the FID, claims 1, 5, and 10 of the '756 patent; claims 1, 5, 10, 11, 17, 18, and 22 of the '527 patent; claims 1, 13, 15, and 20 of the '757 patent; and claims 1, 6-8, and 10 of the '580 patent remain in this Investigation.

On March 6, 2025 the ALJ issued the FID, finding that no violation of section 337 had occurred with respect to any of the remaining asserted claims. The FID finds that each of the accused products except for the ROVE-REDESIGN(C) and ROVE-REDESIGN(V) infringed at least one asserted claim. The FID also finds that all asserted claims are valid, and that Complainant has satisfied the technical prong of the domestic industry requirement. However, the FID finds that Complainant has not satisfied the economic prong of the domestic industry requirement for any of the Asserted Patents.

The FID also includes the ALJ's recommended determination ("RD") on remedy, the public interest, and bonding should the Commission find a violation of section 337. The RD recommends, if the Commission finds a violation, issuing an LEO barring entry of the accused

products that infringe asserted claims of the Asserted Patents. The RD also recommends issuing a CDO against STIIIZY, but not against ALD, because ALD does not maintain significant domestic operations in the United States. The RD also recommends that the Commission set a bond of 100 percent for any importations of infringing products during the period of Presidential review.

On March 18, 2025, Complainant filed a petition for review of certain of the FID's findings.[2] Also on March 18, 2025, Respondents filed a contingent petition for review of certain of the FID's findings.[3] On March 26, 2025, Complainant and Respondents filed their respective responses to the petitions for review.[4]

On March 31, 2025, Professor William J. McNichol, Jr., an adjunct professor at Rutgers Law School, submitted a response to the Commission's post-RD *Federal Register* notice seeking public interest submissions. Non-Confidential Submission of Comments on the Public Interest by William J. McNichol. Jr., EDIS Doc. ID 847235 (Mar. 31, 2025); *see* 90 Fed. Reg. 11851-52 (Mar. 12, 2025).

On April 7, 2025, Complainant and ALD filed their respective submissions on the public interest pursuant to Commission Rule 210.50(a)(4).[5] 19 C.F.R. § 210.52(a)(4).

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[2] Complainant's Petition for Review of the Initial Determination on Violation of Section 337 (Mar. 18, 2025) ("CPFR").

[3] Respondents' Contingent Petition for Review of Initial Determination (Mar. 19, 2025) ("RPFR").

[4] Complainant's Response to Respondents' Petition for Review of Initial Determination (Mar. 26, 2025) ("CRPFR"); Respondents' Response to Complainant PAX Labs, Inc.'s Petition for Review of Initial Determination (Mar. 26, 2025) ("RRPFR").

[5] Complainant's Statement on Public Interest (Apr. 7, 2025) ("Compl. PI Statement"); ALD's Submission on the Public Interest (Apr. 7, 2025). STIIIZY did not submit a public interest statement.

PUBLIC VERSION

On May 16, 2025, the Commission determined to review the FID's findings that: (1) certain accused products do not infringe the '580 patent; (2) certain redesigned products infringe the '580 patent; and (3) Complainant has not satisfied its burden as to the economic prong of the domestic industry requirement. *See* Comm'n Not. at 3 (May 16, 2025). Regarding the issue of the economic prong of the domestic industry requirement, the Commission determined that "the FID errs by stating as a bright-line rule that 'pre-issuance investments [are not] cognizable under subparagraphs (A) and (B) of section 337(a)(3).'" *Id*. The Commission vacated the FID's finding that Complainant had not satisfied its burden on the economic prong of the domestic industry requirement and remanded the issue to the ALJ for further proceedings. The Commission directed the ALJ to "consider whether Complainant's alleged domestic industry investments were made with respect to the articles protected by the patent (*i.e.*, the products that the FID finds satisfy the technical prong of the domestic industry requirement), not limited by whether those investments were made post-patent issuance." Remand Order at 4 (May 16, 2025). The other FID findings selected for review remained under Commission review pending the remand.

On July 18, 2025, the ALJ issued the RID finding that Complainant has satisfied the economic prong of the domestic industry requirement under subsections 337(a)(3)(A) and (B). On July 30, 2025, Respondents submitted a petition requesting review of the RID.[6] On August 6, 2025, Complainant submitted a response to Respondents' petition for review.[7]

[6] Respondents' Petition for Review of Remand Initial Determination (July 30, 2025).

[7] Complainant PAX Labs, Inc.'s Response to Respondents' Petition for Review of Remand Initial Determination (Aug. 6, 2025).

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On September 17, 2025, the Commission determined to review the RID's finding that Complainant has satisfied the economic prong of the domestic industry requirement under prongs (A) and (B). 90 Fed. Reg. at 45411. On review, the Commission affirmed, with modifications, the RID's finding that Complainant has satisfied the economic prong under subsections (A) and (B), including the RID's subsidiary finding that Complainant was an exclusive licensee when it made its domestic industry investments. *Id*. at 45411-12. Specifically, the Commission found that Respondents waived their argument that Complainant was not an exclusive licensee to the Asserted Patents at the time it made its domestic industry investments by not raising it until their remand submission. *Id.* The Commission also clarified that the accused 1.0 gram cartridges were not alleged to practice the '757 and '580 patents. *Id.* at 45412.[8]

On September 30, 2025, Professor McNichol, Jr. submitted a second comment on the public interest. Second Non-Confidential Submission of Comments on the Public Interest, EDIS Doc. ID 863388 (Sept. 30, 2025).

On November 17, 2025, the parties filed their initial briefs on remedy, bonding, and the public interest.[9] On November 24, 2025, the parties filed their respective responses.[10] No other responses were received.

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[8] Commissioner Johanson concurred with the Commission's finding that Complainant has satisfied the economic prong of the domestic industry requirement under subsection (B) with alternate reasoning, and he took no position on subsection (A). Separate Views of Commissioner Johanson, EDIS Doc. ID 862212 (Sept. 17, 2025).

[9] Complainant PAX Labs, Inc.'s Submission on Remedy, the Public Interest, and Bonding (Nov. 17, 2025) ("Compl. RBPI"); Respondents' Submission on Remedy, the Public Interest, and Bonding (Nov. 17, 2025) ("Resp. RBPI").

[10] Complainant PAX Labs, Inc.'s Response to Respondents' Submission on Remedy, the Public Interest, and Bonding (Nov. 24, 2025) ("Compl. RBPI Response"); Respondents' Response to

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The Commission's opinion addresses the remaining FID findings that were selected for review pertaining to infringement of the '580 patent, as well as the issues of remedy, bonding, and the public interest.

B. The Asserted Patents

The four Asserted Patents are all entitled "Leak-Resistant Vaporizer Device" and all name the same six inventors. FID at 5. The Asserted Patents all share a common specification, and all claim priority to Provisional App. No. 62/398,494, filed on September 22, 2016. *Id.* at 5-6. The Asserted Patents are all directed to "leak-resistant vaporizer cartridges and apparatuses adapted for use with oil-based vaporizable materials including cannabis oils." *See, e.g.*, JX-0003 ('580 patent) at Abstract. The Asserted Patents note that cannabis oils "may be particularly oily and/or viscous . . . for which evaporation of the liquid material may result in a sticky residue that may impair the operation of the vaporizer." *Id.* at 1:62-64. Thus, the claims of the Asserted Patents seek to "prevent or reduce leakage of particularly viscous vaporizable materials such as cannabis oils/extracts." *Id.* at 2:26-27.

The asserted claims are all apparatus claims directed to the mechanical components of vaporizing devices.[11] Figure 3B of the '580 patent shows an exemplary vaporizer cartridge:

Complainant PAX Labs, Inc.'s Submission on Remedy, the Public Interest and Bonding (Nov. 24, 2025) ("Resp. RBPI Response").

[11] The claims are not directed to any cannabis oils, but only to the mechanical components of (unfilled) vaporizer devices.

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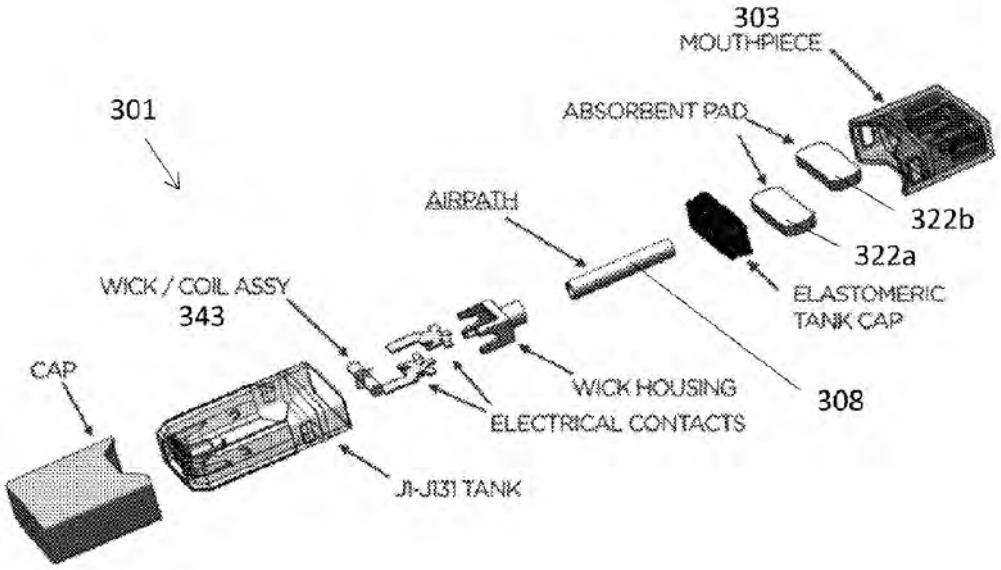


FIG. 3B

JX-0003 ('580 patent) at FIG. 3B.

As relevant to the infringement discussion below, claim 1 of the '580 is as follows[12]:

Claim	Claim Language
580.1.pre	A vaporizer cartridge comprising:
580.1.a	a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end
580.1.b	a mouthpiece coupled to the proximal body end, where the mouthpiece comprises an outlet;
580.1.c	a reservoir configured to hold a vaporizable material
580.1.d	a vaporization chamber comprising:
580.d.i	a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;
580.d.ii	a housing piece configured to house at least a portion of he heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and
580.d.iii	an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;
580.1.e	an extension wire extending from the heater;
580.1.f	a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening; and

[12] The table includes the parties' labels for each claim limitation.

580.1.g	a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:
580.1.g.i	a proximal side;
580.1.g.ii	a distal side opposite the proximal side
580.1.g.iii	a lateral side extending between the proximal side and the distal side;
580.1.g.iv	an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member;
580.1.g.v	wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member;
580.1.g.vi	wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and
580.1.g.vii	wherein at least a portion of the extension wire extends at least partially through the distal member;
580.1.h	wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover.

C. The Accused Products

The notice of investigation defines the scope of the investigation and the accused products as follows: "Vaporizing devices capable of vaporizing oils, components thereof and products containing the same" where the components of a vaporizing device are "a mouthpiece, a cartridge body, an atomizer, a distal member, a bottom cover, a vaporizer body including a cartridge receiver," as well as a "battery," and where products containing the same are cartridge and battery components "sold in combination with a power charging device in which the [cartridge] or battery would each be one component of the downstream product." 89 Fed. Reg. at 16025.

The FID describes the accused products as "product categories, most of which have numerous variants that 'differ only in ways that are immaterial to infringement, such as differences in oil flavor or cosmetic appearance.'" FID at 4 (citing Complainant's Post-Hearing Brief at 4-8). The following table lists the parties' agreed-upon representative accused products:

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Representative Accused Products	Asserted Patents			
	'756 patent	'757 patent	'527 patent	'580 patent
STIIIZY-1G(C)	✓	✓	✓	✓
STIIIZY-ORIG-1G	✓	✓	✓	✓
STIIIZY-LIIIL	✓	✓	✓	✓
STIIIZY-AIO			✓	✓
ROVE(C)			✓	✓
ROVE(V)			✓	✓
FLARE(C)			✓	✓
FLARE(V)			✓	✓
STIIIZY-1G-REDESIGN(C)				✓
STIIIZY-ORIG-1G-REDESIGN				✓
STIIIZY-AIO-REDESIGN				✓
ROVE-REDESIGN(C)				✓
ROVE-REDESIGN(V)				✓
FLARE-REDESIGN(C)				✓
FLARE-REDESIGN(V)				✓

See JX-0459 (Representative Products Stipulation); *see also* FID at 4.

D. The Domestic Industry Products

Complainant relied on several products from its "Era" line to satisfy the domestic industry requirement. As with the accused products, the FID describes the domestic industry products as "product categories, with some having numerous variants that 'differ only in ways that are immaterial to practicing the Asserted Patents.'" *Id.* at 5; *see also* Joint Statement Identifying Accused Products, EDIS Doc. ID 825968 (July 15, 2024). The FID further explains that "[i]n the [domestic industry products], an Era vaporizer is formed by inserting an Era cartridge into an Era battery . . . . Any Era battery can be combined with any Era cartridge to form an Era vaporizer." *Id.* The following table lists the representative domestic industry products in this investigation:

Domestic Industry Products	Asserted Patents			
	'756 patent	'757 patent	'527 patent	'580 patent
ERA-05G(C)	✓	✓	✓	✓

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ERA-1G(C)	✓		✓	
ERA-ORIG-05G	✓	✓	✓	✓
ERA-ORIG-1G	✓		✓	
ERA-PRO-05G	✓	✓	✓	✓
ERA-PRO-1G	✓		✓	
ERA-LIFE-05G	✓	✓	✓	✓
ERA-LIFE-1G	✓		✓	
ERA-GO-05G	✓	✓	✓	✓
ERA-GO-1G	✓		✓	

JX-0459 (Representative Products Stipulation); *see also* FID at 5.

III. COMMISSION REVIEW OF THE FINAL ID

When the Commission reviews an initial determination, in whole or in part, it reviews the determination *de novo*. *Certain Electronic Stud Finders, Metal Detectors and Electrical Scanners*, Inv. No. 337-TA-1221, Comm'n Op. at 9 (Feb. 15, 2022) (citations omitted), *aff'd, Zircon Corp. v. Int'l Trade Comm'n*, 101 F.4th 817 (Fed. Cir. 2024). Upon review, the "Commission has 'all the powers which it would have in making the initial determination,' except where the issues are limited on notice or by rule." *Certain Electronic Devices, Including Streaming Players, Televisions, Set Top Boxes, Remote Controllers, and Components Thereof* ("*Streaming Players*"), Inv. No. 337-TA-1200, Comm'n Op. at 7 (Nov. 10, 2021) (citations omitted), *aff'd, Roku, Inc. v. Int'l Trade Comm'n*, 90 F.4th 1367 (Fed. Cir. 2024). With respect to the issues under review, "the Commission may affirm, reverse, modify, vacate, or remand for further proceedings, in whole or in part, the initial determination of the administrative law judge." 19 C.F.R. § 210.45(c). The Commission also "may take no position on specific issues or portions of the initial determination," and "may make any finding or conclusions that in its judgment are proper based on the record in the proceeding." *Id.*; *see also Beloit Corp. v. Valmet Oy*, 742 F.2d 1421, 1423 (Fed. Cir. 1984).

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IV. ANALYSIS

The Commission's findings, conclusions, and supporting analysis follow. The Commission affirms and adopts the FID's findings, conclusions, and supporting analysis that are not inconsistent with the Commission's opinion.

The two issues that remain under Commission review concern infringement of the '580 patent. Section 337 prohibits "the importation into the United States, the sale for importation, or the sale within the United States after importation . . . of articles that infringe a valid and enforceable United States patent . . . ." 19 U.S.C. § 1337(a)(1)(B). Direct infringement includes making, using, offering to sell, or selling a patented invention or importing a patented invention into the United States, without consent of the patent owner. 35 U.S.C. § 271(a).

To prove direct infringement, the plaintiff must establish by a preponderance of the evidence that one or more claims of the asserted patent read on the accused product or process, either literally or under the doctrine of equivalents. *Advanced Cardiovascular Sys., Inc. v. Scimed Life Sys., Inc.*, 261 F.3d 1329, 1336 (Fed. Cir. 2001). Each limitation in a patent claim is considered material and essential to an infringement determination. *See London v. Carson Pirie Scott & Co.*, 946 F.2d 1534, 1538 (Fed. Cir. 1991). "Literal infringement of a claim exists when each of the claim limitations reads on, or in other words is found in, the accused device." *Allen Eng. Corp. v. Bartell Indus.*, 299 F.3d 1336, 1345 (Fed. Cir. 2002). If any claim limitation is found to be absent from the accused product or process, then there is no literal infringement. *Bayer AG v. Elan Pharm. Research Corp.*, 212 F.3d 141, 1247 (Fed. Cir. 2000).

"[A] product or process that does not literally infringe upon the express terms of a patent claim may nonetheless be found to infringe if there is 'equivalence' between the elements of the accused product or process and the claimed elements of the patented invention." *Warner-Jenkinson Co. v. Hilton Davis Chemical Co.*, 520 U.S. 17, 21 (1997). "The 'essential inquiry' in

determining whether there has been infringement under this doctrine is whether 'the accused product or process contains elements identical or equivalent to each claimed element of the patented invention.'" *Am. Calcar, Inc. v. Am. Honda Motor Co.,* 651 F.3d 1318, 1338 (Fed. Cir. 2011) (quoting *Warner-Jenkinson,* 520 U.S. at 40). An element in the accused device is equivalent to a claim limitation if the only differences between the two are insubstantial to one of ordinary skill in the art. *Wavetronix LLC v. EIS Elec. Integrated Sys.*, 573 F.3d 1343, 1360 (Fed. Cir. 2009); *AquaTex Indus. v. Techniche Sols.*, 419 F.3d 1374, 1382 (Fed. Cir. 2005). To assess insubstantiality, a court considers whether an element of the accused product "performs substantially the same function in substantially the same way to obtain the same result" as the patented invention. *Am. Calcar,* 651 F.3d at 1338; *see also Voda v. Cordis Corp.*, 536 F.3d 1311, 1326 (Fed. Cir. 2008). A patentee alleging infringement under the doctrine of equivalents must submit particularized evidence as to equivalence and must explain specifically why the difference between the claimed invention and what the accused product actually does is "insubstantial." *Id*.

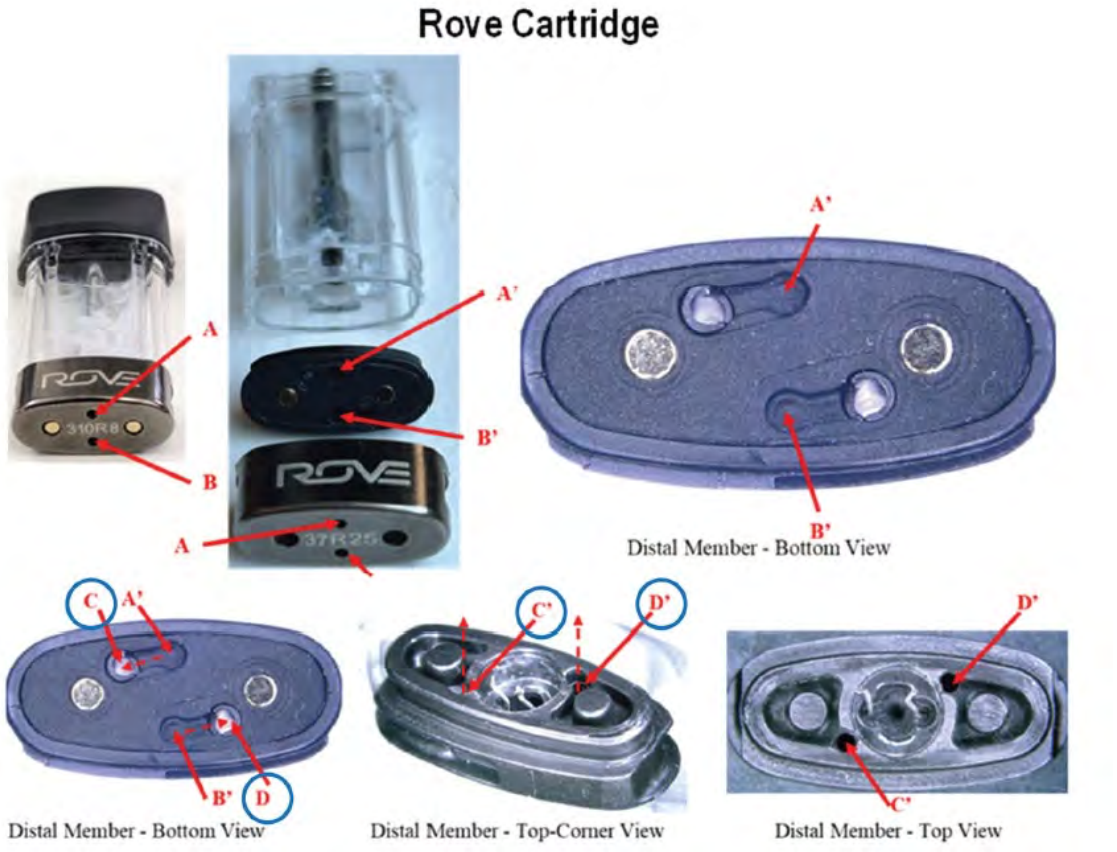
A. The Accused ROVE Products Satisfy the Limitation "An Opening Extending Therethrough"

The Commission reviewed the FID's finding that the ROVE(C), ROVE(V), ROVE-REDESIGN(C), and ROVE-REDESIGN(V) (collectively, "ROVE Products") do not infringe any of asserted claims 1, 6-8, and/or 10 of the '580 patent. Comm'n Not. at 3 (May 16, 2025). The FID finds that Complainant failed to establish that these products satisfy the limitation identified by the parties as 580.1.g.v., which reads "wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member." FID at 88-90. On review, the Commission finds that the ROVE Products satisfy limitation 580.1.g.v. Furthermore, because no other limitations of the asserted claims of the '580 patent are in dispute,

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the Commission determines that the ROVE(C) and ROVE-REDESIGN(C) infringe claims 1 and 7 of the '580 patent, and the ROVE(V) and ROVE-REDESIGN(V) infringe claims 1, 6-8, and 10 of the '580 patent.

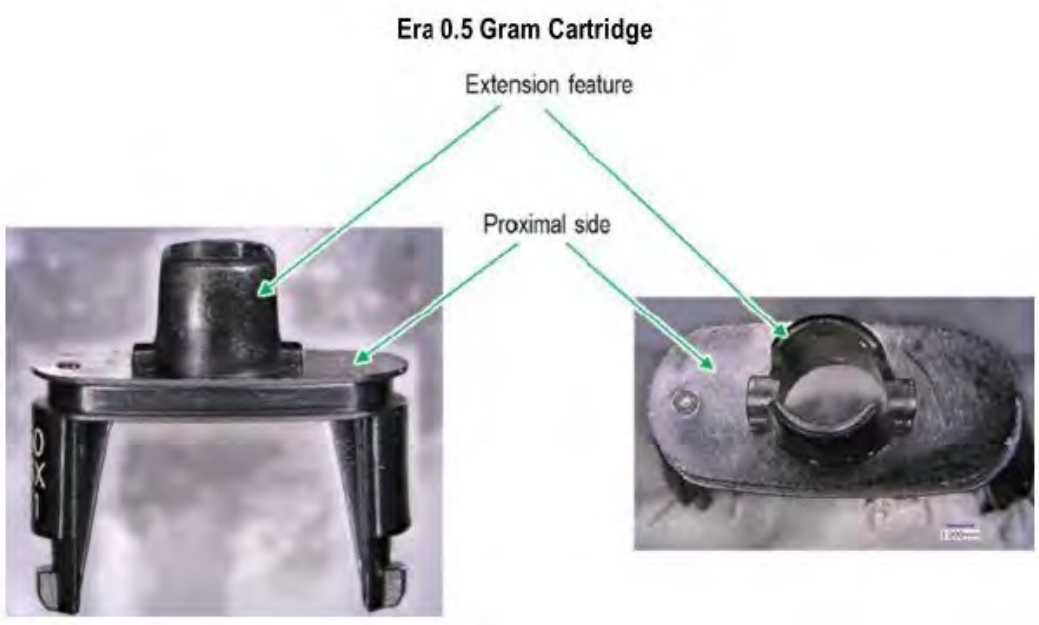
The FID finds that Complainant did not meet its burden to show that the ROVE Products contain an "opening extending therethrough" the extension feature, as required by limitation 580.1.g.v. FID at 89. The FID notes that Complainant's expert "testified that the air flows into the holes at the bottom of the distal member, up through the structure, and out the openings in the interior of the extension feature." *Id*. at 88 (citing CX-4747C (Kodama Witness Statement) at Q/A 431). The FID further notes that "[t]he claim language requires the extension feature to comprise an opening through which air flows," and that "[Complainant's expert] identified those openings as C and D" in the corresponding demonstrative, reproduced below:



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Id. at 89 (citing CDX-0001.0168).

The FID cites testimony from Respondents' expert, however, that the identified air holes "do not rise above the surface of the alleged distal member," and that "[t]here are no air holes that pass through the purported 'extension' feature." *Id.* at 89-90 (citing RX-0474C (Pecht Witness Statement) at Q/A 125-26). The FID appears to be referencing Respondents' expert testimony comparing the openings in the ROVE Products to openings in the domestic industry products, such as the Era 0.5 gram cartridge, which has "an alleged extension feature that rises from (protrudes from) the purported distal member," as shown below:



Id. (citing RX-0474C (Pecht Witness Statement) at Q/A 126).

Based on this evidence, the FID concludes that "on closer inspection, those openings do not pass through the 'extension feature.'" *Id.* Therefore, the FID finds, Complainant "has not met its burden to show that [] limitation [580.1.g.v] is present" in any of the ROVE Products. *Id.* at 90, 100. Accordingly, the FID finds that the ROVE(C) and ROVE-REDESIGN(C) do not

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infringe claims 1 and 7 of the '580 patent, and that the ROVE(V) and ROVE-REDESIGN(V) do not infringe claims 1, 6-8, and 10 of the '580 patent. *Id.* at 112.

In its petition for review, Complainant claimed that the FID ignores that Respondents did not contest limitation 580.1.g.v in their Ground Rule 14.1 Identification of Undisputed Claim Limitations. CPFR at 5 (citing EDIS Doc. ID 836279 at 9 (Nov. 1, 2024)). Complainant also argued that the FID misconstrues its expert's testimony and refers to the wrong openings in its analysis. Specifically, Complainant asserted, its expert testified as follows:

> Q431. **Does the Rove Cartridge satisfy element [1Gv]?**
>
> A431. Yes, as shown on slide CDX-0001.0168, air enters through the air openings labeled A and B at the bottom portion of the bottom cover. The holes lead to the air chamber areas labeled A' and B'. The air chamber areas labeled A' and B' are on the bottom of the distal member. Air flows from A' to a hole labeled C, passes through the distal member, and flows out of the opening labeled C' of the extension feature on the top of the distal member. Air flows from B' to a hole labeled D, passes through the distal member, and flows out the opening labeled D' of the extension feature on the top of the distal member.

Id. at 6 (citing CX-4747C (Kodama Witness Statement)) at Q/A 431). Based on this testimony, Complainant argued that the FID identifies the wrong openings in the demonstrative above because the FID identifies "C instead of C' and D instead of D'." *Id.* at 5. Complainant argued that "[t]he openings C' and D' *do*, in fact, pass through the extension feature," and that the FID errs in "ignoring the portions of the openings extending up through the extension feature—the portions labeled C' and D'." *Id.* at 7 (emphasis in original). In response, Respondents argued that Complainant merely "identified several alleged openings, but not any opening extending therethrough that allows air to pass through the distal member, as required by the asserted claims of the '580 patent." RRPFR at 4.

On review, the Commission finds that the FID's findings were erroneous. First, the Commission finds that the FID identifies the wrong openings in its discussion of the ROVE

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Products and, thus, misconstrues Complainant's expert's testimony. As discussed above, the FID identifies C and D as the claimed openings (FID at 89), but this is inaccurate because C and D represent only one view of the identified openings. The expert's testimony tracks a path for air flow through the distal member: entering at points A and B; following the pathways labeled A' and B' to points C and D and exiting out through points C' and D'. CX-4747C (Kodama Witness Statement) at Q/A 431; *see* FID at 89.

Second, the Commission finds unpersuasive Respondents' argument that Complainant's expert merely identified several holes that do not extend through the extension feature.[13] RRPFR at 4-5. Contrary to Respondents' argument, Complainant's expert tracked two pathways for two different openings, which both extend through the distal member: one opening begins with A, follows a path into a chamber labeled A' and C, and then exits through C'; the other opening begins with B, follows a path into a chamber labeled B' and D, and exits through D'. CX-4747C (Kodama Witness Statement) at Q/A 431.

Third, the Commission disagrees with the FID's finding that the limitation is not satisfied because the identified holes "are not part of the alleged extension feature and do not rise above the surface of the alleged distal member." FID at 89; RRPFR at 7. Based on a review of the images of the ROVE Products above, both openings C' and D' extend through the extension feature, which is all the claim requires. Nothing in the claims requires that the opening rise *above* the distal member.[14] As long as the extension feature contains an opening through which

[13] Respondents also raised this "several holes" theory for the first time in its response to the petition for review; thus, it is waived.

[14] As discussed above, it seems the FID mistakenly referenced the ERA cartridges, which have openings that extend both through and above the distal member, and applied that requirement to the ROVE Products. The FID's reasoning is a clear example of importing a "limitation" from a commercial embodiment into the claims of the patent. *See Zenith Labs. v. Bristol-Myers Squibb*

air can flow, the limitation is satisfied. As discussed above, Respondents do not dispute that the identified openings "allow air flow." RRPFR at 7.

Respondents' only other basis for disputing whether the ROVE Products infringe any of claims 1, 6-8 and/or 10 was its arguments regarding limitation 580.1.g.iv and the corresponding limitation in claim 8; all other limitations of the asserted claims are undisputed with respect to the ROVE Products. The FID finds that the ROVE Products satisfy limitation 580.1.g.iv, and the Commission did not separately review that finding. Accordingly, because no other claim limitations are disputed, the Commission finds that the ROVE(C) and ROVE-REDESIGN(C) infringe claims 1 and 7 of the '580 patent; and ROVE(V) and ROVE-REDESIGN(V) infringe claims 1, 6-8, and 10 of the '580 patent.

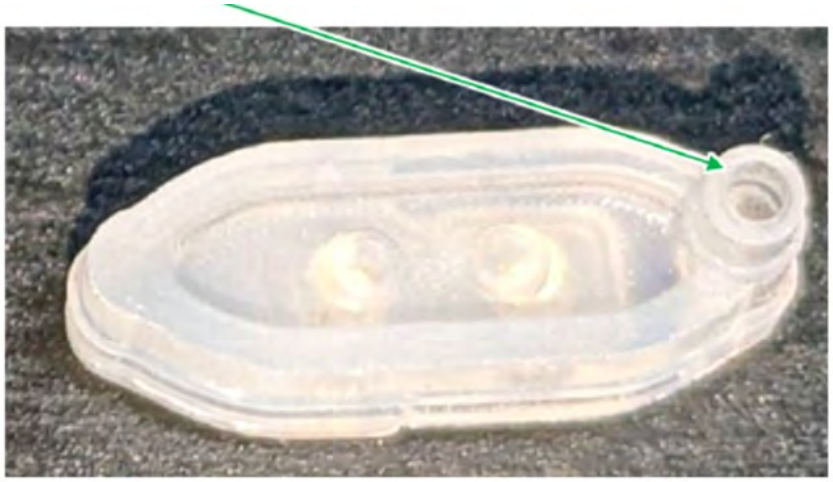
B. The Accused STIIIZY Redesigned Products Satisfy the Limitation "An Extension Feature Having a Cylindrical Shape" Under the Doctrine of Equivalents

The Commission reviewed the FID's finding that the STIIIZY-1G-REDESIGN(C), STIIIZY-ORIG-1G-REDESIGN, and the STIIIZY-AIO-REDESIGN (collectively, "the STIIIZY Redesigned Products") infringe the asserted claims of the '580 patent under the doctrine of equivalents. Comm'n Not. at 3 (May 16, 2025). On review, the Commission affirms this finding with additional reasoning. The FID correctly finds that the STIIIZY Redesigned Products practice the claimed extension feature under the doctrine of equivalents. FID at 95. However, the FID expressly discusses only the "function" portion of the function-way-result test established in *Warner-Jenkinson* and does not address the "way" and "result" requirements with

Co., 19 F.3d 1418, 1423 (Fed. Cir. 1994) ("As we have repeatedly said, it is error for a court to compare in its infringement analysis the accused product or process with the patentee's commercial embodiment or other version of the product or process; the only proper comparison is with the claims of the patent.").

adequate particularity. Accordingly, the Commission supplements the FID's finding on this issue with additional reasoning that addresses the "way" and "result" portions of the test.

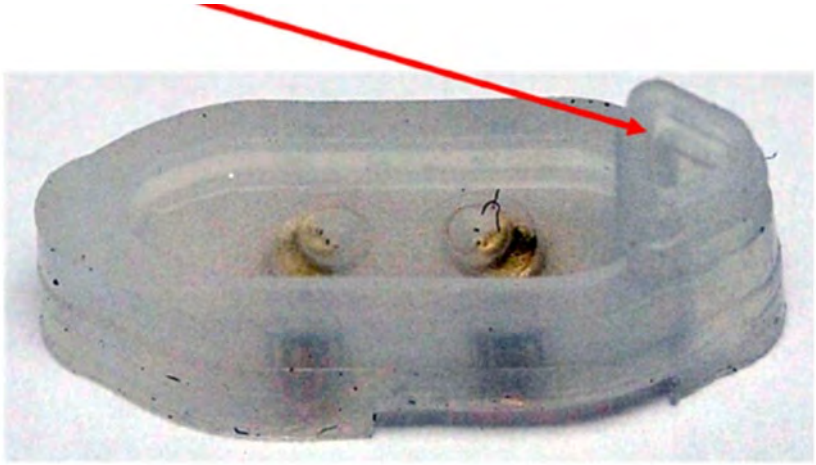
The relevant limitation is 580.1.g.iv, which reads: "an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member." The original STIIIZY accused products have a cylindrical extension feature, as shown below:



Excerpt from CDX-0001.157 (showing top view of extension feature of the original STIIIZY-1G cartridge). Neither party disputes that the original STIIIZY accused products satisfy this limitation.

The STIIIZY Redesigned Products have a triangular extension feature, as shown below:

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Excerpt from CDX-0001.162 (showing top view of extension feature of STIIIZY-1G-REDESIGN cartridge).

Complainant argued that, for purposes of the doctrine of equivalents, "the only relevant function of the extension feature is allowing air to pass through the distal member . . . ." Complainant's Post-Hearing Brief at 57. Complainant further argued that its expert explained the "way" and "result" as follows: "air flows through the triangular tube when a user draws on the mouthpiece, just [as] it does with a cylindrical tube." *Id.* (citing CX-4747C (Kodama-WS), Q/A419-420, 424).

The FID finds that the function of the extension feature is "to allow air to pass through the distal member towards the mouthpiece of the vaporizer cartridge." FID at 93 (citing JX-0003 at 34:65-35:3). The FID determines that "[t]he evidence [establishes] legal equivalency of the triangular-shaped extension feature." *Id.* at 93-95. The Commission has determined to adopt the FID's finding that the function of the redesigned triangular extension feature is equivalent to the function of the claimed cylindrical extension feature.

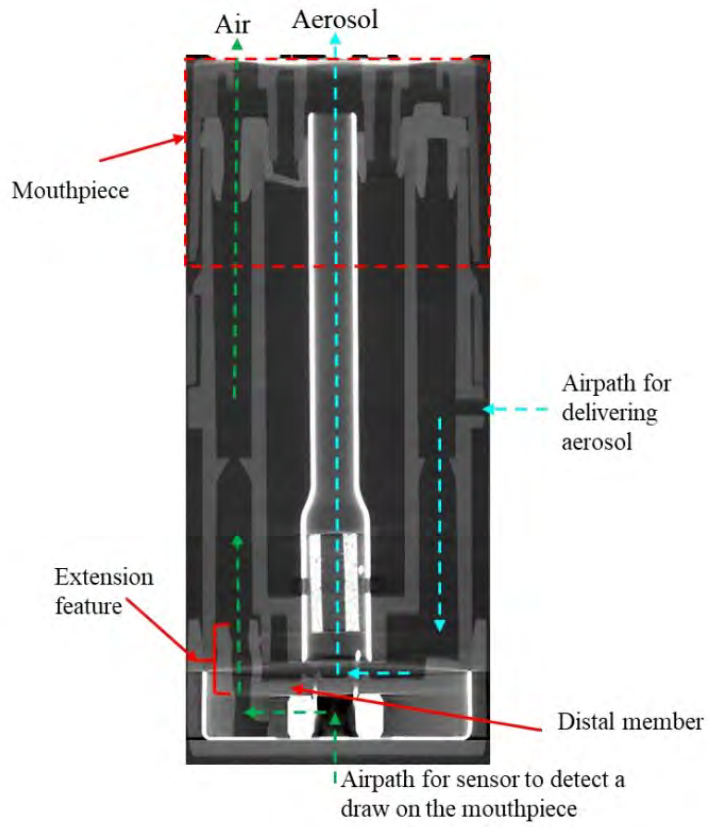
The Commission finds, however, that FID neglected to explicitly analyze the "way" and "result" in addition to the "function" in finding infringement under the doctrine of equivalents.

See Mylan Inst. LLC v. Aurobindo Pharma Ltd., 857 F.3d 858, 868 (Fed. Cir. 2017) (reversing infringement determination that did not consider the "way" portion of the function-way-result test); *see also Lab. Corp. America Holdings v. Qiagen Sci., LLC*, 148 F.4th 1350, 1359 (Fed. Cir. 2025) ("Such matching requires that ***each of*** function, way, and result be substantially the same.") (emphasis added). The Federal Circuit also requires "specificity and completeness of proof" for a finding of infringement under the doctrine of equivalents, with particular emphasis on the "way" requirement. *VLSI Tech. LLC v. Intel Corp.*, 87 F.4th 1332 (Fed. Cir. 2023). On review, the Commission finds that there is substantial evidence in the record establishing that the triangular extension feature performs in the same way and with the same result as the claimed cylindrical extension feature, and that the shape of the triangular extension feature is an insubstantial difference from the claimed cylindrical extension feature.

Complainant's expert explained that "[t]he extension feature defines a portion of the airpath such that it allows the air from the bottom cover to pass through the distal member and flow to the mouthpiece" CX-4747C (Kodama Witness Statement) at Q/A 419. Complainant's expert also testified that "[c]onfiguring the extension feature to have a triangular shape instead of a cylindrical shape has no material impact on the performance of the function of the extension feature. The air can pass through the distal member via both the triangular extension feature and the cylindrical extension feature." *Id.* Complainant's expert further explained that:

> When there is a draw on the mouthpiece, air enters into the cartridge from the air opening on the side of the cartridge and flows along the blue airpath through the [vaporization] chamber to deliver the aerosol to the mouthpiece. At the same time, air also enters into the cartridge from the air opening at the bottom of the cartridge and flows along the green airpath through the extension feature of the distal member to the mouthpiece, which triggers the pressure sensor to detect the draw on the mouthpiece. As shown in the slide, before flowing up to the mouthpiece, the air in the blue airpath flows above the distal member while the air in the green airpath flows under the distal member. The two airpaths are physically separate from each other.

Id. at Q/A 493. Complainant's expert provided the following graphic of the air paths in relation to the extension feature:



Id.; *see also* CX-4124. This testimony shows that changing the shape of the extension feature from a cylindrical shape to a triangular shape does not affect the air paths or the result: users can draw air through the device and receive the aerosol with either extension feature. *Id.* In other words, the "only differences between the two are insubstantial." *Voda v. Cordis Corp.*, 536 F.3d 1311, 1326 (Fed. Cir. 2008). This is a straightforward application of the doctrine of equivalents involving an insubstantial shape change, similar to what the Federal Circuit has recognized in the past. *Id.* at 1326-27.

At the hearing, Respondents' expert agreed that the claim discusses only allowing air to pass, and acknowledged that both the cylindrical and triangular extension features enable this

function. Tr. (Pecht) at 224:14-225:6. [redacted]

However, the Federal Circuit has previously held that alleged improvements upon the claimed invention do not preclude a finding of infringement under the doctrine of equivalents. *Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp.*, 320 F.3d 1339, 1352 (Fed. Cir. 2003); *Insta-Foam Prods., Inv. v. Universal Foam Sys*., 906 F.2d 698, 702 (Fed. Cir. 1990) ("[I]nfringement under the doctrine of equivalents is not precluded merely because the accused device performs functions in addition to those performed by the claimed device."). Accordingly, the evidence establishes that the accused triangular extension feature performs the same function in the same way to achieve the same result as does the claimed invention, which is sufficient to find equivalency. *See Insta-Foam,* 906 F.2d at 702.

Furthermore, the facts in this investigation are distinguishable from cases such as *Tronzo v. Biomet, Inc*., 156 F.3d at 1154 (Fed. Cir. 1998). Specifically, Complainant distinguished this investigation from *Tronzo* and other district court cases relied on by Respondents because, in those cases, experts had testified that any shape would satisfy the claim limitation, whereas, here, Complainant's expert did not testify that any shape would satisfy the "cylindrical shape" limitation.[15] CRPFR at 4; Tr. (Kodama) at 121:18-123:19. Rather, Complainant's expert explained that a triangular shape could satisfy the claim limitation under the function-way-result

[15] For comparison, the expert testimony in question in *Tronzo* was "when either a hemispherical cup or a trapezoidal cup *or any other shape* cup . . ." would satisfy the claim limitation at issue, because "the body doesn't look at the shape of the cup . . . ." *Tronzo*, 156 F.3d at 1160.

test. *Id.* We also disagree with Respondents that the FID imposed a "uniform cross section" requirement on the claim limitation. RPFR at 12-13. As Complainant explained, this was merely a characterization of the structural similarity between the claimed cylindrical shape and the disclosed triangular shape. CRPFR at 6-7.

Accordingly, the Commission finds that Complainant has established that the STIIIZY Redesigned Products satisfy limitation 580.1.g.iv under the doctrine of equivalents, because the triangular extension feature is an insubstantial difference from the claimed cylindrical extension feature that has the same function, functions in the same way, and with the same result, as the claimed feature. Respondents did not dispute any other limitations of the asserted claims of the '580 patent with respect to the STIIIZY Redesigned Products.[16] Therefore, the Commission finds that the STIIIZY-1G-REDESIGN(C) infringes claims 1 and 7 of the '580 patent; the STIIIZY-ORIG-1G-REDESIGN infringes claims 1, 6-8, and 10 of the '580 patent; and the STIIIZY-AIO-REDESIGN infringes claim 1 of the '580 patent.

C. Summary

On review, the Commission finds that the ROVE(C) and ROVE-REDESIGN(C) infringe claims 1 and 7 of the '580 patent; and ROVE(V) and ROVE-REDESIGN(V) infringe claims 1, 6-8, and 10 of the '580 patent. Further, the Commission affirms with supplemental reasoning the FID's findings that the STIIIZY-1G-REDESIGN(C) infringes claims 1 and 7 of the '580 patent; the STIIIZY-ORIG-1G-REDESIGN infringes claims 1, 6-8, and 10 of the '580 patent; and the STIIIZY-AIO-REDESIGN infringes claim 1 of the '580 patent. The Commission has not

[16] Respondents initially disputed whether the STIIIZY-AIO-REDESIGN satisfied limitation 580.1.f, which requires a "bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening . . . . " *See* Respondents' Post-Hearing Brief at 93, 116. The FID finds that the STIIIZY-AIO-REDESIGN satisfied this limitation. FID at 99. Respondents did not separately petition for review of this finding, thus abandoning the issue. *See* 19 C.F.R. § 210.43(b)(4).

reviewed and therefore adopts the remainder of the FID's findings on infringement with respect to the Asserted Patents. Thus, the Commission finds that each of the accused products infringes at least one asserted claim of one Asserted Patent, as summarized below:

Representative Accused Product	Asserted Patent(s) Infringed
STIIIZY-1G(C)	'756 patent: claims 1 and 10 '527 patent: claims 1, 10, 18, and 22 '757 patent: claims 1 and 13 '580 patent: claims 1 and 7
STIIIZY-ORIG-1G	'756 patent: claims 1, 5, and 10 '527 patent: claims 1, 5, 10-11, 17-18, and 22 '757 patent: claims 1, 13, 15, and 20 '580 patent: claims 1, 6-8, and 10
STIIIZY-LIIIL	'756 patent: claim 1 '527 patent: claims 1, 18, and 22 '757 patent: claim 1 '580 patent: claim 1
STIIIZY-AIO	'527 patent: claim 1 '580 patent: claim 1
ROVE(C)	'527 patent: claims 1 and 10 '580 patent: claims 1 and 7
ROVE(V)	'527 patent: claims 1, 5, 10-11, and 17 '580 patent: claims 1, 6-8, and 10
FLARE(C)	'527 patent: claim 1 '580 patent: claim 1
FLARE(V)	'527 patent: claims 1 and 5 '580 patent: claim 1
STIIIZY-1G-REDESIGN(C)	'580 patent: claims 1 and 7
STIIIZY-ORIG-1G-REDESIGN	'580 patent: claims 1, 6-8, and 10
STIIIZY-AIO-REDESIGN	'580 patent: claim 1
ROVE-REDESIGN(C)	'580 patent: claims 1 and 7
ROVE-REDESIGN(V)	'580 patent: claims 1, 6-8, and 10
FLARE-REDESIGN(C)	'580 patent: claim 1
FLARE-REDESIGN(V)	'580 patent: claim 1

The FID also finds that Complainant has satisfied the importation requirement, all of the asserted claims are valid, and that Complainant has satisfied the technical prong of the domestic industry requirement. The Commission did not review those findings. FID at 111-13; *see* Comm'n Not. at 3 (May 16, 2025). Furthermore, the Commission has found that Complainant

has satisfied the economic prong of the domestic industry requirement under subsections 337(a)(3)(A) and (B). *See* 90 Fed. Reg. at 45412. Accordingly, the Commission finds that Complainant has shown a violation of section 337 by Respondents.

V. REMEDY, THE PUBLIC INTEREST, AND BONDING

A. Remedy

The Commission has "broad discretion in selecting the form, scope, and extent of the remedy." *Philip Morris Products S.A. v. Int'l Trade Comm'n*, 63 F.4th 1328, 1339-1340 (Fed. Cir. 2023).

1. Limited Exclusion Order

Section 337(d)(1) provides that "[i]f the Commission determines, as a result of an investigation under this section, that there is a violation of this section, it shall direct that the articles concerned, imported by any person violating the provision of this section, be excluded from entry into the United States, unless, after considering the [public interest], it finds that such articles should not be excluded from entry." 19 U.S.C. § 1337(d)(1).

The RD recommends issuing an LEO for any Accused Product found to infringe the Asserted Patents. RD at 114. The RD further recommends any LEO include an express carve out or certification provision for products found to be non-infringing, as their non-infringing nature "is not readily apparent." *Id.*

Complainant supports the RD's recommendation to issue an LEO with respect to both STIIIZY and ALD. Compl. RBPI at 1-2. However, Complainant argues that the LEO should not contain a standard certification provision because Respondents raised this argument for the first time in their post-hearing brief, thereby waiving it. *Id.* at 2. Furthermore, Complainant argues that, if the STIIIZY Redesigned Products are found to infringe one or more claims of the '580 patent, there will be no non-infringing Accused Products. *Id.* Complainant also argues that

Respondents have "interfered with [Complainant's] abilities to pursue important discovery both against them and at least one third party represented by the same counsel . . . and their request for a certification procedure opens the door to possible circumvention of any remedies that may issue, including a[n] LEO." *Id.* at 2-3.

Respondents do not dispute that an LEO as to both STIIIZY and ALD would be appropriate if the Commission finds that a violation of section 337 has occurred. Resp. RBPI at 25. Respondents did not argue for a standard certification provision in their initial submission or in earlier briefing. *See id.* However, in their response to Complainant's submission, Respondents state that an LEO should issue "with a certification provision and/or express carve out for any products found not to infringe." Resp. RBPI Response at 7.

The Commission has determined to issue an LEO against both STIIIZY and ALD, including the standard certification provision in the LEO. Even though all accused products, including redesigns, have been found to infringe at least one Asserted Patent, that does not negate the usefulness of the standard certification provision. The provision may be useful for any future product that ostensibly falls within the scope of the LEO, but is adjudicated by Customs or the Commission as not subject to exclusion. In such circumstances, the certification provision allows an importer to certify to Customs that such product has been adjudicated as not excluded from entry under the terms of the LEO. *See Certain Composite Aerogel Insulation Materials & Methods for Manufacturing the Same*, Inv. No. 337-TA-1003, Comm'n Op., 2018 WL 8648369, at *40 (Feb. 22, 2018) ("As the Commission has previously stated, [Customs] only accepts a certification that the goods have been previously determined by [Customs] or the Commission not to violate the exclusion order.").

2. Cease and Desist Order

Section 337(f)(1) provides that in addition to, or in lieu of, the issuance of an exclusion order, the Commission may issue a CDO as a remedy for violation of section 337. *See* 19 U.S.C. § 1337(f)(1). CDOs are generally issued when, with respect to the imported infringing products, respondents maintain commercially significant inventories in the United States or have significant domestic operations that could undercut the remedy provided by an exclusion order. *See, e.g.*, *Certain Tobacco Heating Articles and Components Thereof*, Inv. No. 337-TA-1199, Comm'n Op. at 49 (Sept. 29, 2021) ("*Tobacco Heating Articles*"), *aff'd, Philip Morris Products S.A.*, 63 F.4th at 1332; *Certain Audio Players and Controllers, Components Thereof, and Products Containing Same*, Inv. No. 337-TA-1191, Comm'n Op. at 26 (Jan. 6, 2022) ("*Audio Players*"), *aff'd, Sonos, Inc. v. Int'l Trade Comm'n*, 2024 WL 1507605 (Fed. Cir. Apr. 8, 2024). Complainants bear the burden on this issue. "A complainant seeking a cease and desist order must demonstrate, based on the record, that this remedy is necessary to address the violation found in the investigation so as to not undercut the relief provided by the exclusion order." *Tobacco Heating Articles*, Comm'n Op. at 49-50 (citations omitted); *Audio Players*, Comm'n Op. at 26-27 (citations omitted); *see also* H.R. REP. No. 100-40, at 160 (1987).

The RD recommends issuing CDOs against STIIIZY, noting that STIIIZY does not contest that CDOs should issue against it. RD at 115. The RD notes that STIIIZY has stipulated that it maintains inventories of the accused products in the United States through [redacted] *Id.* at 116. The RD finds that [redacted] worth of inventory in the United States at any time, which supports a finding that the inventory is significant and

that, if STIIIZY were to sell its domestic inventory of accused products, it would undercut the relief provided by an LEO. *Id.*

However, the RD finds that Complainant has not demonstrated the need for CDOs against ALD. The RD notes that "[ALD does] not have significant U.S. operations that could undercut the remedy provided by a limited exclusion order." *Id.* at 115. The only facility that ALD maintains in the United States is a "rented place where salespeople can stay when they are on a business trip." *Id.* Furthermore, the RD notes that ALD's domestic activities were limited to "two trade shows in the United States in 2024," and that the evidence indicated that ALD's website is not specifically targeting U.S. customers. *Id.* Therefore, the RD concludes that "[ALD does] not have significant U.S. operations that could undercut the remedy provided by a [LEO]." *Id.*

Complainant agrees with the RD's recommendation to issue CDOs against STIIIZY. Complainant argues that the RD errs by ignoring the extent of ALD's U.S. connections and online activities, which allegedly "confirms that [ALD's] domestic operations were not only already significant but also expected to grow." Compl. RBPI at 6. Complainant also argues that the RD ignores that ALD has "multiple manufacturing and supply agreements with U.S.-based companies based in the United States, including [redacted]" *Id.* at 7. Under these agreements, ALD allegedly sells the Accused Products to various customers, including [redacted] for importation into the United States. *Id.*

Furthermore, Complainant argues that recent developments demonstrate that ALD has commercially significant inventory and significant domestic operations in the United States. *Id.* at 9. For example, Complainant argues that shortly before the FID issued, Cilicon+, which is alleged to be a brand of ALD, updated its website to purportedly show "that [ALD] now [has]

warehouses located in the USA and provide[s] faster delivery times, lower shipping costs, and consistent local support." *Id.* Complainant includes several exhibits with its initial brief on remedy, bonding, and the public interest, that allegedly show the changes to the Cilicon+ website, and claims that these were not available until after the parties' post-hearing briefs were filed in November 2024. *Id.* Complainant also states that the website and Cilicon+'s social media pages advertise a new facility in Alhambra, California, as well as a "U.S. lab" to test its products. *Id.* at 10. Based on these statements, Complainant argues that there is enough circumstantial evidence to demonstrate that ALD has commercially significant inventories and significant domestic operations in the United States, and that such evidence has previously been enough to support issuance of CDOs. *Id.* (citing *Certain Crystalline Cefadroxil Monohydrate*, Inv. No. 337-TA-293, Comm'n Op. at 6 (June 1, 1991); *Certain Arrowheads with Deploying Blades and Components Thereof and Packaging Therefor*, Inv. No. 337-TA-977, Comm'n Op. at 18-19 (Apr. 28, 2017)). Finally, Complainant claims that the Cilicon+ website provides guidance to U.S. customers on how to set up legal dispensaries in several states. *Id.* at 11.

Respondents do not contest that CDOs are appropriate against STIIIZY. Resp. RBPI at 25. Regarding CDOs against ALD, Respondents argue that Complainant has waived any argument that ALD has a commercially significant inventory in the United States by failing to raise it in its post-hearing brief. Resp. RBPI Response at 4 (citing Complainant's Post-Hearing Brief at 114-16). Furthermore, Respondents argue that the Commission should decline to consider Complainant's new exhibits because they were not included in the record, and Respondents never had an opportunity to challenge the accuracy or admissibility of those exhibits, or offer their own rebuttal exhibits. *Id.* at 5. Respondents also argue that the RD

correctly finds that ALD's domestic operations are limited and would not undercut the remedy provided by a limited exclusion order. *Id.*

The Commission agrees with the RD's recommendation to issue CDOs against STIIIZY, but not against ALD. As discussed above, STIIIZY stipulated that it maintains commercially significant inventory in the United States, and STIIIZY does not dispute that a CDO is appropriate if the Commission finds a violation of section 337 has occurred. Accordingly, CDOs are appropriate against STIIIZY.

As for ALD, Complainant has not met its burden to show that ALD has either commercially significant inventory or significant domestic operations. We agree with the RD's finding that Complainant's evidence that was presented before the ALJ regarding ALD's activities in the United States are insufficient to establish that it has significant domestic operations. RD at 115. As Respondents point out, Complainant did not argue until its remedy, bonding, and public interest submission that ALD has commercially significant inventory in the United States. Furthermore, Complainant does not meaningfully dispute that, based on the evidence currently in the record, ALD's domestic operations related to the infringing products are limited. *See* Compl. RBPI at 6-9. As the RD explains, ALD's domestic operations are limited to one rented facility where salespeople can stay when they are on business trips, and attendance at two trade shows in 2024. RD at 115.

Furthermore, Complainant has presented new evidence after the close of the record before the ALJ, and argues that there was a change in Respondents' domestic operations sufficient to warrant a CDO. Compl. RBPI at 9-12; Exs. 1-9, 13. Namely, Complainant newly alleges that the Cilicon+ activities establish ALD's commercially significant inventory, in addition to significant domestic operations. The Commission acknowledges Respondents'

concern that their only opportunity to challenge the relevance, accuracy, or admissibility of these exhibits was in their responsive brief on remedy, the public interest, and bond. Respondents' RBPI Response at 4. However, whether this information could have been presented before the ALJ or is based on newly developed facts where Respondents should have had a fair opportunity to challenge is irrelevant under the facts of this investigation. Here, the Commission finds that Complainant fails to show that this new evidence is sufficiently related to any of the infringing products. Specifically, it is not clear from these exhibits what relationship, if any, Cilicon+ has to any of the infringing products in this investigation. The exhibits also do not clearly identify ALD's connection to the referenced warehouses and facilities. Thus, the new exhibits do not establish either that ALD maintains commercially significant inventory of infringing products, or that ALD has significant domestic operations as to the infringing products.

Accordingly, the Commission has determined to issue a CDO against STIIIZY, but not against ALD.

B. Public Interest

Section 337 requires the Commission, upon finding a violation of section 337, to issue an LEO "unless, after considering the effect of such exclusion upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, it finds that such articles should not be excluded from entry." 19 U.S.C. § 1337(d)(l). Similarly, the Commission must consider these public interest factors before issuing a CDO. 19 U.S.C. § 1337(f)(1).

Under appropriate facts and circumstances, the Commission may determine that no remedy should issue because of the adverse impacts on the public interest. *See, e.g.*, *Certain Fluidized Supporting Apparatus & Components Thereof*, Inv. Nos. 337-TA-182/188, USITC

Pub. 1667, Comm'n Op. at 1-2, 23-25 (Oct. 1984) (finding that the public interest warranted denying complainant's requested relief); *see Philip Morris Products S.A.*, 63 F.4th at 1339-1340 (the Commission has "wide latitude for judgment and the courts will not interfere except where the remedy selected has no reasonable relation to the unlawful practices found to exist") (citation omitted)). Moreover, when the circumstances of a particular investigation require, the Commission has tailored its relief in light of the statutory public interest factors. For example, the Commission has allowed continued importation for ongoing medical research, exempted service parts, grandfathered certain infringing products, and delayed the imposition of remedies to allow affected third-party consumers to transition to non-infringing products. *E.g.*, *Certain Microfluidic Devices*, Inv. No. 337-TA-1068 Comm'n Op. at 1, 22-48, 53-54 (analyzing the public interest, discussing applicable precedent, and ultimately issuing a tailored LEO and a tailored CDO); *Certain Road Milling Machines & Components Thereof*, Inv. No. 337-TA-1067, Comm'n Op. at 32-33 (July 18, 2019) (exempting service parts); *Certain Baseband Processor Chips & Chipsets, Transmitter, & Receiver (Radio) Chips, Power Control Chips, & Prods. Containing Same, Including Cellular Tel. Handsets*, 337-TA-543, USITC Pub. No. 4258, Comm'n Op. at 150-151 (Oct. 2011) (grandfathering certain products); *Certain Personal Data & Mobile Comm'n Devices & Related Software*, 337-TA-710, USITC Pub. No. 4331, Comm'n Op., at 72-73, 80-81 (June 2012) (delaying imposition of remedy).

The statute requires the Commission to consider and make findings on the public interest in every case in which a violation is found regardless of the quality or quantity of public interest information supplied by the parties. 19 U.S.C. § 1337(d)(l), (f)(l). Thus, the Commission publishes a notice inviting the parties as well as interested members of the public and interested

government agencies to gather and present evidence on the public interest at multiple junctures in the proceeding. 19 U.S.C. § 1337(d)(l) & (f)(l).

Respondents have not put forth any arguments specifically addressing why the public interest factors should preclude issuing remedial orders against them. Instead, Respondents have consistently argued that Complainant is engaged in a criminal conspiracy under the Controlled Substances Act, based on a stipulation earlier in the investigation that approximately [redacted] percent of its domestic industry products will be filled with cannabis oils. Respondents' Memorandum of Points and Authorities in Support of Respondents' Motion for Summary Determination that PAX Fails to Satisfy the Domestic Industry Economic Prong (Aug. 21, 2024); Respondents' Pre-Hearing Brief at 217-46[17]; ALD Respondents' Submission on the Public Interest (Apr. 7, 2025); RPFR at 31-64; Resp. RBPI at 2; *see also* JX-0177C at 2 (Stipulation of the Parties (July 24, 2024)). The Commission has also received two public submissions from Professor McNichol, Jr., expressing the same concern.

Neither Respondents' submission nor the two public submissions explain why the ability of the domestic industry products to be used with cannabis oils is relevant to the public interest analysis, which assesses the effect of excluding the infringing products on the statutory public interest factors. As the Federal Circuit has explained, the statute "require[s]" exclusion of infringing articles "upon the finding of a Section 337 violation absent a finding that the effects" of such exclusion upon "one of the statutorily-enumerated public interest factors counsel otherwise." *Spansion, Inc. v. Int'l Trade Comm'n,* 629 F.3d 1331, 1358 (Fed. Cir. 2010). Here, the submissions do not demonstrate how excluding the Respondent's infringing products would

[17] The ALJ struck this argument from Respondents' Pre-Hearing Brief. Order No. 29 at 1-2 (Oct. 18, 2024).

adversely impact the statutory public interest factors, which is what the Commission is required to consider. Respondents' submissions also fail to account for the similar capability of their infringing products to be filled with cannabis oils. Furthermore, Respondents' assertions of a criminal conspiracy involving Complainant or its products are not supported by record evidence. *See* Order No. 22 at 2 n.2 (Oct. 8, 2024) ("[Complainant] has not been accused of violating the Controlled Substances Act by the U.S. government."). Accordingly, the Commission finds that the arguments presented here concerning the domestic industry products' use of cannabis oils fail to demonstrate that excluding Respondents' infringing products would adversely impact the public interest factors.

For the reasons specified below, the Commission finds that the public interest factors do not preclude issuance of remedial orders in this investigation.

1. Public Health and Welfare

Neither the Respondents nor the public submissions have put forth any arguments specifically addressing why the remedial orders would adversely impact the public health and welfare. The Commission finds that remedial orders in this investigation would not affect public health and welfare. Complainant states that the Accused Products, while capable of vaporizing oils for medical purposes, are "not essential to, and do not implicate, any public health, safety, or welfare concerns in the United States." Compl. RBPI at 13; *see also* Compl. PI Statement at 2.

2. Competitive Conditions in the United States

Neither the Respondents nor the public submissions have put forth any arguments specifically addressing why the remedial orders would adversely impact competitive conditions in the United States. The Commission finds that remedial orders would not have an adverse effect on competitive conditions in the U.S. economy. Complainant claims that it has the capacity to supply vaporizer cartridges and vaporizers to customers in the United States, along

with other third parties who can supply similar products, and there is no evidence on the record to the contrary. Compl. RBPI at 15.

3. The Production of Like or Directly Competitive Articles in the United States

Neither the Respondents nor the public submissions have put forth any arguments specifically addressing why the remedial orders would adversely impact the production of like or directly competitive articles in the United States. The Commission finds that the production of like or directly competitive articles in the United States would not be affected by the remedial orders. Complainant states that there are several like or directly competitive articles in the United States, including Complainant's own products, as well as other vaporizers from third parties such as Airgraft and G-Pen. *Id.*

4. United States Consumers

Neither the Respondents nor the public submissions have put forth any arguments specifically addressing why the remedial orders would adversely impact United States consumers. The Commission finds that the remedial orders would not have an adverse effect on U.S. consumers. As discussed above, Complainant states that, along with third-party supplies, it has the capacity to supply U.S. consumers with vaporizer cartridges and vaporizers, and there is no evidence in the record to the contrary. *Id.*

C. Bonding

If the Commission enters an exclusion order or a cease and desist order, a respondent may continue to import and sell its products during the 60-day period of Presidential review under a bond in an amount determined by the Commission to be "sufficient to protect the complainant from any injury." 19 U.S.C. § 1337(j)(3); see also 19 C.F.R. § 210.50(a)(3). When reliable price information is available in the record, the Commission has often set the bond in an

amount that would eliminate the price differential between the domestic product and the imported, infringing product. *See Streaming Players*, Comm'n Op. at 41-42 (citations omitted); *Tobacco Heating Articles*, Comm'n Op. at 77 (citations omitted). The Commission also has used a reasonable royalty rate to set the bond amount where a reasonable royalty rate could be ascertained from the evidence in the record. *See, e.g., id.* Where the record establishes that the calculation of a price differential is impractical or there is insufficient evidence in the record to determine a reasonable royalty, the Commission has imposed a 100 percent bond. *See, e.g., id*.

The RD recommends a 100 percent bond because the parties agree that, if a violation is found, a 100 percent bond is appropriate. RD at 117; *see also* Complainant's Post-Hearing Brief at 117-18; Respondents' Post-Hearing Brief at 147. The RD notes that a 100 percent bond has been imposed in previous investigations where a price comparison was not practical and when there was no support in the record for a proposed royalty rate. *Id.*

Complainant requests a bond of 100 percent on imports of infringing articles subject to the proposed LEO and a 100 percent bond for further sales subject to the proposed CDO. Compl. RBPI at 18. Complainant states that Respondents agree that a 100 percent bond is appropriate if the Commission finds a violation of section 337 has occurred. *Id.* Complainant notes that the price difference between the Accused Products and the domestic industry products vary from [redacted] percent to [redacted] percent. *Id.* at 19. Complainant further notes that the Asserted Patents have not been licensed, therefore there is no evidence relating to a reasonable royalty rate for comparison purposes. *Id.*

As discussed below, Respondents do not dispute that a 100 percent bond rate is appropriate, and specifically for STIIIZY, a 100 percent bond rate of the "entered (not filled with marijuana oil) value of the Accused Products is appropriate." Resp. RBPI at 25. Complainant

opposes this argument and instead claims that "at the time of sale after importation, the bond should be set at 100 [percent] of the 'value' of the product sold (sales price) with respect to any bond for the CDO. If the infringing product sold retail after importation is a filled cartridge and has a higher value than unfilled wholesale . . . the bond should be based on that higher value, filled retail product sold after importation." *Id.* at 15. Complainant explains that, if the bond is only set to 100 percent of the non-filled entered value, "[t]his injury will only increase because infringing imports are likely to surge as the Target Date approaches if sales after importation receive a bond rate of only 100 [percent] of the imported non-filled entered value of the infringing imports." *Id.* Finally, Complainant argues that Respondents "do not offer any explanation or basis for capping the 100 [percent] bond at the non-filled infringing products' entered value rather than the value of the infringing product filled and sold after importation." *Id.*

The Commission has determined to enter a 100 percent bond as recommended in the RD,[18] and further determines that the bond should reflect the entered value of the Accused Products at the time of importation. The Commission expresses bond amount as "a percentage of the entered value, even though the entered value may be less than the importer's U.S. selling price," because any other method would cause "significant administrative difficulties" for Customs. *Certain Hardware Logic Emulation Systems and Components Thereof,* Inv. No. 337-TA-383, Commission Opinion at 2 n.4 (Oct. 28, 1997). Furthermore, Complainant has waived its argument that the 100 percent bond should reflect the value of the product as sold, after it has

[18] We note that the RD does not specify whether its recommendation reflects 100 percent of the entered value of the infringing products at the time of importation, or 100 percent of the value of the product as sold, which Complainant argues includes the value of the product filled with cannabis oil. *See* RD at 116-17; Compl. RBPI Resp. at 15.

been filled with cannabis oil. In both its pre- and post-hearing briefs, Complainant discussed only the price differential between the unfilled products and did not request a higher bond reflecting the price of the accused products after they have been filed with oil. *See* Complainant's Pre-Hearing Brief at 127-30; Complainant's Post-Hearing Brief at 117-18. In its initial brief on remedy, bonding, and public interest, Complainant was aware that Respondents agreed only that a 100 percent bond based on the "entered value of [Respondents'] accused products (i.e., empty devices) is appropriate." Compl. RBPI at 18 (citing Respondents' Post-Hearing Brief at 147). However, Complainant did not explicitly request a higher bond that reflects the value of the *filled* pods or explain why it was entitled to a higher bond, until its responsive RBPI brief. Compl. RBPI Response at 14.

Furthermore, Complainant's request to have the 100 percent bond reflect the price of the filled Accused Products, rather than empty pods, conflicts with its response to Respondents' public interest arguments. Complainant previously argued that the asserted claims of the Asserted Patents are not necessarily directed to cannabis oils, and the claims do not mention cannabis or cannabis oils, or require the products to be filled with any oil. Compl. RBPI Response at 4. Thus, the addition of an oil is not what makes the accused products infringing devices. The same logic should apply here – the 100 percent bond should not be inflated by filling the pods with cannabis oil, or any other kind of oil, when filling the pods has no bearing on infringement.

Thus, the Commission has determined to enter a 100 percent bond against all Respondents, reflecting 100 percent of the value of the entered goods at the time of importation, rather than the value of the goods sold after being filled with cannabis oil.

PUBLIC VERSION

VI. CONCLUSION

The Commission has considered all of the other arguments by the parties and does not find them persuasive. Therefore, for the reasons set forth herein, the Commission determines that Complainant has established a violation of section 337 by Respondents with respect to claims 1, 5, and 10 of the '756 patent; claims 1, 5, 10, 11, 17, 18, and 22 of the '527 patent; claims 1, 13, 15, and 20 of the '757 patent; and claims 1, 6-8, and 10 of the '580 patent. Accordingly, the investigation is terminated with a finding of violation of section 337. The Commission determines that the appropriate remedy is an LEO against Respondents and a CDO against STIIIZY, the public interest does not preclude that remedy, and the bond during the period of Presidential review is set at one hundred percent (100%) of the entered value at the time of importation.

By order of the Commission.



Lisa R. Barton
Secretary to the Commission

Issued: February 3, 2026

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
871272	Public	Opinion, Commission	02/03/2026 11:07 AM	Commission Opinion

Service Date: February 03, 2026

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US011369756B2

(12) **United States Patent**
Hatton et al.

(10) **Patent No.: US 11,369,756 B2**
(45) **Date of Patent: *Jun. 28, 2022**

(54) **LEAK-RESISTANT VAPORIZER DEVICE**

(71) Applicant: **JUUL Labs, Inc.**, San Francisco, CA (US)

(72) Inventors: **Nicholas Jay Hatton**, Oakland, CA (US); **Steven Christensen**, San Mateo, CA (US); **Esteban Leon Duque**, San Francisco, CA (US); **Ariel Atkins**, San Francisco, CA (US); **James Monsees**, San Francisco, CA (US); **Adam Bowen**, San Mateo, CA (US)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/204,148**

(22) Filed: **Mar. 17, 2021**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 15/396,584, filed on Dec. 31, 2016.

(60) Provisional application No. 62/398,494, filed on Sep. 22, 2016.

(51) **Int. Cl.**

A61M 11/00	(2006.01)
A24F 40/40	(2020.01)
A61M 11/04	(2006.01)
A61M 15/06	(2006.01)
A24F 40/10	(2020.01)
A61M 15/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A61M 11/00*** (2013.01); ***A24F 40/40*** (2020.01); ***A61M 11/042*** (2014.02); ***A61M 15/06*** (2013.01); *A24F 40/10* (2020.01); *A61M 15/0021* (2014.02); *A61M 2205/8206* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,671,185	A	5/1928	Flynn
1,950,542	A	3/1934	Daniel
2,900,989	A	8/1959	Glenn
4,945,931	A	8/1990	Gori
6,516,796	B1	2/2003	Cox et al.
6,637,430	B1	10/2003	Voges et al.
7,284,553	B2	10/2007	Hochrainer
7,802,569	B2	9/2010	Yeates et al.

(Continued)

FOREIGN PATENT DOCUMENTS

AT	507187 A4	3/2010
CA	2920973 C	9/2018

(Continued)

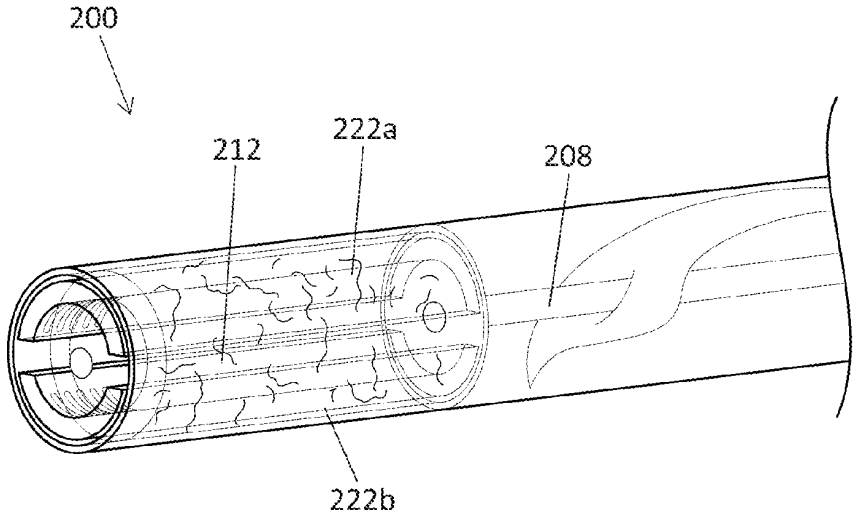
Primary Examiner — Phu H Nguyen

(74) *Attorney, Agent, or Firm* — Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C.

(57) **ABSTRACT**

Vaporizer cartridges and vaporizer apparatuses, and methods for making, using and delivering vapor to a user, that are leak-resistant for use with cannabinoids. In particular, described herein are leak-resistant vaporizer cartridges and apparatuses adapted for use with oil-based vaporizable materials including *Cannabis* oils.

17 Claims, 26 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

8,528,569 B1 9/2013 Newton
8,714,161 B2 5/2014 Liu et al.
8,752,545 B2 6/2014 Buchberger
8,833,364 B2 9/2014 Buchberger
8,899,240 B2 12/2014 Mass
8,948,578 B2 2/2015 Buchberger
9,010,335 B1 4/2015 Scatterday
9,078,474 B2 7/2015 Thompson
9,089,166 B1 7/2015 Scatterday
9,155,336 B2 10/2015 Liu
9,247,773 B2 2/2016 Memari et al.
9,289,014 B2 3/2016 Tucker et al.
9,351,522 B2 5/2016 Safari
9,364,025 B2 6/2016 Liu
9,427,022 B2 8/2016 Levin et al.
9,497,998 B2 11/2016 Chen
9,510,623 B2 12/2016 Tucker et al.
9,526,272 B2 12/2016 Liu
9,648,908 B1 5/2017 Rinehart et al.
9,668,520 B2 6/2017 Boldrini et al.
9,668,522 B2 6/2017 Memari et al.
9,681,688 B1 6/2017 Rinehart et al.
9,763,475 B2 9/2017 Liu
9,763,478 B2 9/2017 Cameron et al.
9,770,055 B2 9/2017 Cameron et al.
9,795,168 B2 10/2017 Zhu
9,833,021 B2 12/2017 Perez et al.
9,844,234 B2 12/2017 Thorens et al.
9,861,135 B2 1/2018 Chen
9,877,519 B2 1/2018 Xiang
9,918,496 B2 3/2018 Kane et al.
9,955,726 B2 5/2018 Brinkley et al.
9,986,762 B2 6/2018 Alarcon et al.
10,058,128 B2 8/2018 Cameron et al.
10,070,668 B2 9/2018 Li et al.
10,080,387 B2 9/2018 Phillips et al.
10,085,481 B2 10/2018 Verleur et al.
10,085,486 B2 10/2018 Cameron
10,130,123 B2 11/2018 Hatton et al.
10,131,532 B2 11/2018 Murison et al.
10,159,282 B2 12/2018 Monsees et al.
10,206,429 B2 2/2019 Davis et al.
10,279,934 B2 5/2019 Christensen et al.
10,299,513 B2 5/2019 Perez et al.
10,383,368 B2 8/2019 Larson
10,426,199 B2 10/2019 Tumer et al.
10,492,542 B1 12/2019 Worm et al.
2003/0154991 A1 8/2003 Fournier et al.
2007/0215168 A1 9/2007 Banerjee et al.
2009/0255534 A1 10/2009 Patemo
2010/0186757 A1 7/2010 Crooks et al.
2010/0200008 A1 8/2010 Taieb
2012/0018529 A1 1/2012 Gammon et al.
2012/0318882 A1 12/2012 Abehasera
2013/0192615 A1 8/2013 Tucker et al.
2013/0199528 A1 8/2013 Goodman et al.
2013/0312742 A1 11/2013 Monsees et al.
2014/0041655 A1 2/2014 Barron et al.
2014/0041658 A1 2/2014 Goodman et al.
2014/0150810 A1 6/2014 Hon
2014/0158129 A1 6/2014 Pratt et al.
2014/0182612 A1 7/2014 Chen
2014/0202454 A1 7/2014 Buchberger
2014/0238421 A1 8/2014 Shapiro
2014/0261399 A1 9/2014 Murphy
2014/0290677 A1 10/2014 Liu
2014/0345635 A1 11/2014 Rabinowitz et al.
2014/0355969 A1 12/2014 Stern
2015/0007836 A1 1/2015 Xu et al.
2015/0040929 A1 2/2015 Hon
2015/0136158 A1 5/2015 Stevens et al.
2015/0144147 A1 5/2015 Li et al.
2015/0150305 A1 6/2015 Shenkal
2015/0157054 A1 6/2015 Liu
2015/0164147 A1 6/2015 Verleur et al.
2015/0181941 A1 7/2015 Liu
2015/0184846 A1 7/2015 Liu
2015/0189919 A1 7/2015 Liu
2015/0201674 A1 7/2015 Dooly et al.
2015/0208729 A1 7/2015 Monsees et al.
2015/0216236 A1 8/2015 Bless et al.
2015/0223521 A1 8/2015 Menting et al.
2015/0223522 A1 8/2015 Ampolini et al.
2015/0245654 A1 9/2015 Memari et al.
2015/0245655 A1 9/2015 Memari et al.
2015/0245657 A1 9/2015 Memari et al.
2015/0245665 A1 9/2015 Memari et al.
2015/0245666 A1 9/2015 Memari et al.
2015/0245667 A1 9/2015 Memari et al.
2015/0245668 A1 9/2015 Memari et al.
2015/0257451 A1 9/2015 Brannon et al.
2015/0272217 A1 10/2015 Chen
2015/0282530 A1 10/2015 Johnson et al.
2015/0289565 A1 10/2015 Cadieux et al.
2015/0305406 A1 10/2015 Li et al.
2015/0313287 A1 11/2015 Verleur et al.
2015/0320116 A1 11/2015 Bleloch et al.
2015/0327595 A1 11/2015 Scatterday
2015/0328415 A1 11/2015 Minskoff et al.
2015/0342258 A1 12/2015 Chen
2015/0366267 A1 12/2015 Liu
2016/0000147 A1 1/2016 Li et al.
2016/0000149 A1 1/2016 Scatterday
2016/0007655 A1 1/2016 Li et al.
2016/0044965 A1 2/2016 Liu
2016/0073692 A1 3/2016 Alarcon et al.
2016/0081394 A1 3/2016 Alarcon et al.
2016/0095357 A1 4/2016 Burton
2016/0100632 A1 4/2016 Debono et al.
2016/0120226 A1 5/2016 Rado et al.
2016/0120227 A1 5/2016 Levitz et al.
2016/0128384 A1 5/2016 Luciani
2016/0129205 A1 5/2016 Shahaf et al.
2016/0135504 A1 5/2016 Li et al.
2016/0150823 A1 6/2016 Liu
2016/0150824 A1 6/2016 Memari et al.
2016/0157524 A1 6/2016 Bowen et al.
2016/0174611 A1 6/2016 Monsees et al.
2016/0193434 A1 7/2016 Gleixner et al.
2016/0198767 A1 7/2016 Verleur
2016/0198769 A1 7/2016 Liu
2016/0198770 A1 7/2016 Alarcon
2016/0213866 A1 7/2016 Tan
2016/0219934 A1 8/2016 Li et al.
2016/0219937 A1 8/2016 Rado
2016/0235120 A1 8/2016 Liu
2016/0235125 A1 8/2016 Safari
2016/0249684 A1 9/2016 Liu
2016/0262452 A1 9/2016 Zhu
2016/0262459 A1 9/2016 Monsees et al.
2016/0278163 A1 9/2016 Chen
2016/0286860 A1 10/2016 Flayler
2016/0286863 A1 10/2016 Lin
2016/0286865 A1 10/2016 King et al.
2016/0302487 A1 10/2016 Chen
2016/0309785 A1 10/2016 Holtz
2016/0324217 A1 11/2016 Cameron
2016/0325055 A1 11/2016 Cameron
2016/0331022 A1 11/2016 Cameron
2016/0331023 A1 11/2016 Cameron
2016/0331024 A1 11/2016 Cameron
2016/0331025 A1 11/2016 Cameron
2016/0331026 A1 11/2016 Cameron
2016/0331034 A1 11/2016 Cameron
2016/0331037 A1 11/2016 Cameron
2016/0332754 A1 11/2016 Brown et al.
2016/0334847 A1 11/2016 Cameron
2016/0337141 A1 11/2016 Cameron
2016/0337444 A1 11/2016 Cameron
2016/0338413 A1 11/2016 Li et al.
2016/0345621 A1 12/2016 Li et al.
2016/0356751 A1 12/2016 Blackley
2016/0360789 A1 12/2016 Hawes et al.
2016/0363570 A1 12/2016 Blackley

(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0363917	A1	12/2016	Blackley
2016/0366936	A1	12/2016	Liu
2016/0366943	A1	12/2016	Li et al.
2016/0366945	A1	12/2016	Rado
2016/0366947	A1	12/2016	Monsees et al.
2016/0367925	A1	12/2016	Blackley
2016/0370335	A1	12/2016	Blackley
2016/0374399	A1	12/2016	Monsees et al.
2017/0006922	A1	1/2017	Wang et al.
2017/0013885	A1	1/2017	Qiu
2017/0018000	A1	1/2017	Cameron
2017/0020188	A1	1/2017	Cameron
2017/0020195	A1	1/2017	Cameron
2017/0020196	A1	1/2017	Cameron
2017/0020197	A1	1/2017	Cameron
2017/0035110	A1	2/2017	Keen
2017/0042229	A1	2/2017	Liu
2017/0042246	A1	2/2017	Lau et al.
2017/0049153	A1	2/2017	Guo et al.
2017/0055586	A1	3/2017	Liu
2017/0055588	A1	3/2017	Cameron
2017/0071249	A1	3/2017	Ampolini et al.
2017/0108210	A1	4/2017	Meinhart et al.
2017/0112193	A1	4/2017	Chen
2017/0119057	A1	5/2017	Liu
2017/0119060	A1	5/2017	Li et al.
2017/0196265	A1	7/2017	Liu
2017/0196272	A1	7/2017	Li et al.
2017/0208857	A1	7/2017	Branton et al.
2017/0224013	A1	8/2017	Huang
2017/0231282	A1	8/2017	Bowen et al.
2017/0231286	A1	8/2017	Borkovec et al.
2017/0245546	A1	8/2017	Huang et al.
2017/0259170	A1	9/2017	Bowen et al.
2017/0347706	A1	12/2017	Aoun et al.
2017/0360093	A1	12/2017	Fernando
2018/0016040	A1	1/2018	Ewing et al.
2018/0022516	A1	1/2018	Liu
2018/0064169	A1	3/2018	Biel et al.
2018/0160733	A1	6/2018	Leadley et al.
2018/0161525	A1	6/2018	Liu et al.
2018/0168227	A1	6/2018	Fraser et al.

FOREIGN PATENT DOCUMENTS

CN	101263935	A	9/2008
CN	100589726	C	2/2010
CN	201430916	Y	3/2010
CN	204180941	U	3/2015
CN	204217907	U	3/2015
CN	204426692	U	7/2015
CN	105249536	A	1/2016
CN	105962419	A	9/2016
DE	202015009688	U1	3/2019
EP	0535695	A2	4/1993
EP	1093936	A1	4/2001
EP	2789248	A1	10/2014
EP	3031339	A1	6/2016
EP	3143884	A2	4/2017
EP	3158883	A2	4/2017
EP	3195738	A2	7/2017
EP	3024344	B1	9/2018
EP	3313215	B1	6/2019
EP	3409597	B1	6/2019
KR	20110006928	U	7/2011
KR	200461404	Y1	7/2012
KR	200462610	Y1	9/2012
KR	20120006582	U	9/2012
KR	200473510	Y1	8/2014
KR	101541750	B1	8/2015
KR	101634882	B1	6/2016
KR	200481405	Y1	10/2016
KR	101774283	B1	9/2017
KR	101995956	B1	7/2019
WO	WO-2006021153	A1	3/2006
WO	WO-2009135729	A1	11/2009
WO	WO-2010045671	A1	4/2010
WO	WO-2010118644	A1	10/2010
WO	WO-2012040512	A2	3/2012
WO	WO-2012134117	A2	10/2012
WO	WO-2012173322	A1	12/2012
WO	WO-2012174677	A1	12/2012
WO	WO-2013089358	A1	6/2013
WO	WO-2013089551	A1	6/2013
WO	WO-2014020953	A1	2/2014
WO	WO-2014071747	A1	5/2014
WO	WO-2014101734	A1	7/2014
WO	WO-2014185937	A1	11/2014
WO	WO-2015070398	A1	5/2015
WO	WO-2015070405	A1	5/2015
WO	WO-2015106440	A1	7/2015
WO	WO-2015128665	A1	9/2015
WO	WO-2015144057	A1	10/2015
WO	WO-2015149311	A1	10/2015
WO	WO-2015149403	A1	10/2015
WO	WO-2015154309	A1	10/2015
WO	WO-2015157900	A1	10/2015
WO	WO-2015161407	A1	10/2015
WO	WO-2015161553	A1	10/2015
WO	WO-2015161557	A1	10/2015
WO	WO-2015165081	A1	11/2015
WO	WO-2015165083	A1	11/2015
WO	WO-2015165105	A1	11/2015
WO	WO-2015172331	A1	11/2015
WO	WO-2015172368	A1	11/2015
WO	WO-2015176230	A1	11/2015
WO	WO-2015176580	A1	11/2015
WO	WO-2015180061	A1	12/2015
WO	WO-2015180088	A1	12/2015
WO	WO-2015184747	A1	12/2015
WO	WO-2015188295	A1	12/2015
WO	WO-2015192377	A1	12/2015
WO	WO-2015196463	A1	12/2015
WO	WO-2016000206	A1	1/2016
WO	WO-2016000214	A1	1/2016
WO	WO-2016019353	A1	2/2016
WO	WO-2016023212	A1	2/2016
WO	WO-2016023824	A1	2/2016
WO	WO-2016026104	A1	2/2016
WO	WO-2016029344	A1	3/2016
WO	WO-2016061730	A1	4/2016
WO	WO-2016061859	A1	4/2016
WO	WO-2016074229	A1	5/2016
WO	WO-2016090303	A1	6/2016
WO	WO-2016090602	A1	6/2016
WO	WO-2016095220	A1	6/2016
WO	WO-2016106476	A1	7/2016
WO	WO-2016106500	A1	7/2016
WO	WO-2016108694	A1	7/2016
WO	WO-2016109931	A1	7/2016
WO	WO-2016115701	A1	7/2016
WO	WO-2016103202	A1	8/2016
WO	WO-2016119098	A1	8/2016
WO	WO-2016119101	A1	8/2016
WO	WO-2016119167	A1	8/2016
WO	WO-2016119225	A1	8/2016
WO	WO-2016122417	A1	8/2016
WO	WO-2016123764	A1	8/2016
WO	WO-2016123780	A1	8/2016
WO	WO-2016123781	A1	8/2016
WO	WO-2016127360	A1	8/2016
WO	WO-2016127406	A1	8/2016
WO	WO-2016141508	A1	9/2016
WO	WO-2016145611	A1	9/2016
WO	WO-2016149932	A1	9/2016
WO	WO-2016154798	A1	10/2016
WO	WO-2016172898	A1	11/2016
WO	WO-2016179828	A1	11/2016
WO	WO-2016184247	A1	11/2016
WO	WO-2016201602	A1	12/2016
WO	WO-2016202304	A1	12/2016
WO	WO-2017001818	A1	1/2017
WO	WO-2017001819	A1	1/2017
WO	WO-2017021536	A2	2/2017

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	WO-2017028167	A1	2/2017
WO	WO-2017035720	A1	3/2017
WO	WO-2017055799	A1	4/2017
WO	WO-2017055802	A1	4/2017
WO	WO-2017055803	A1	4/2017
WO	WO-2017066955	A1	4/2017
WO	WO-2017070871	A1	5/2017
WO	WO-2017082728	A1	5/2017
WO	WO-2017093452	A1	6/2017
WO	WO-2017093535	A1	6/2017
WO	WO-2017107546	A1	6/2017
WO	WO-2017109448	A2	6/2017
WO	WO-2017113106	A1	7/2017
WO	WO-2017124662	A1	7/2017
WO	WO-2017137554	A1	8/2017
WO	WO-2017153270	A1	9/2017
WO	WO-2017156696	A1	9/2017
WO	WO-2017163046	A1	9/2017
WO	WO-2017163050	A1	9/2017
WO	WO-2017163051	A1	9/2017
WO	WO-2017163052	A1	9/2017
WO	WO-2017166263	A1	10/2017

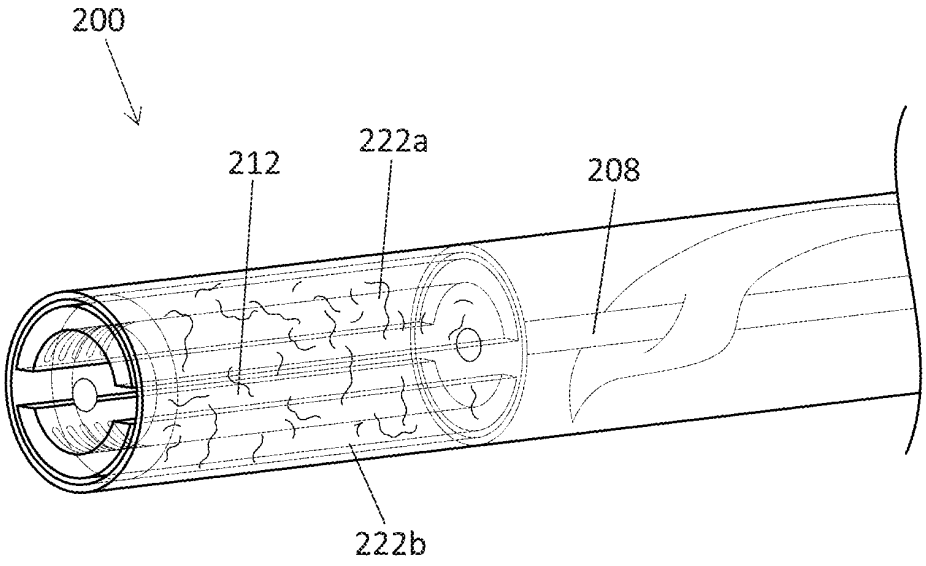


FIG. 1

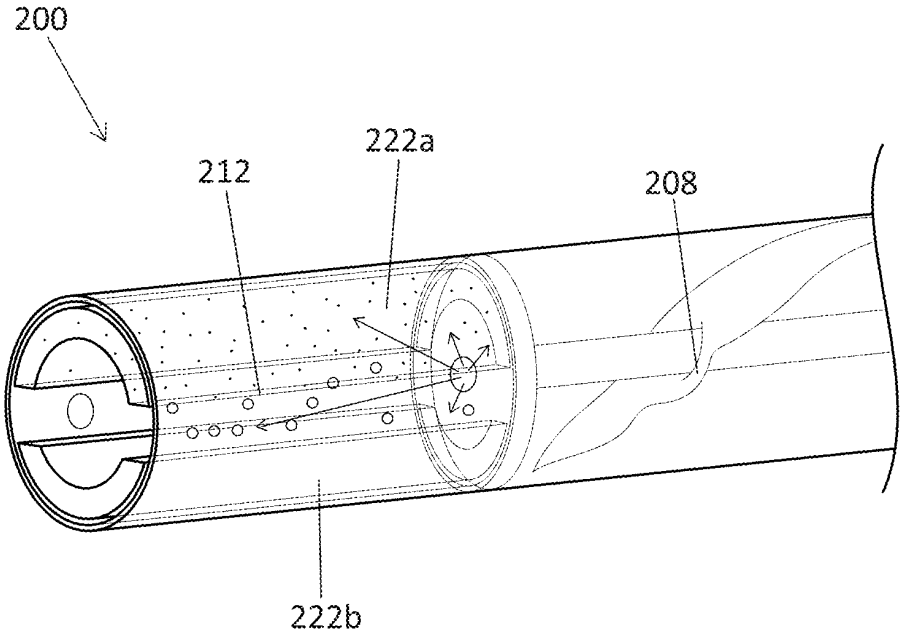


FIG. 2

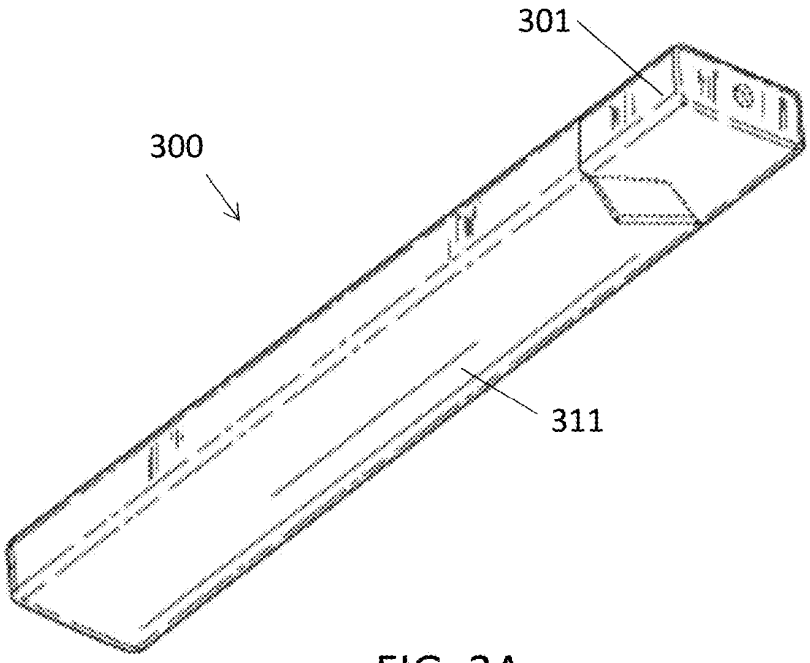

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311

FIG. 3A

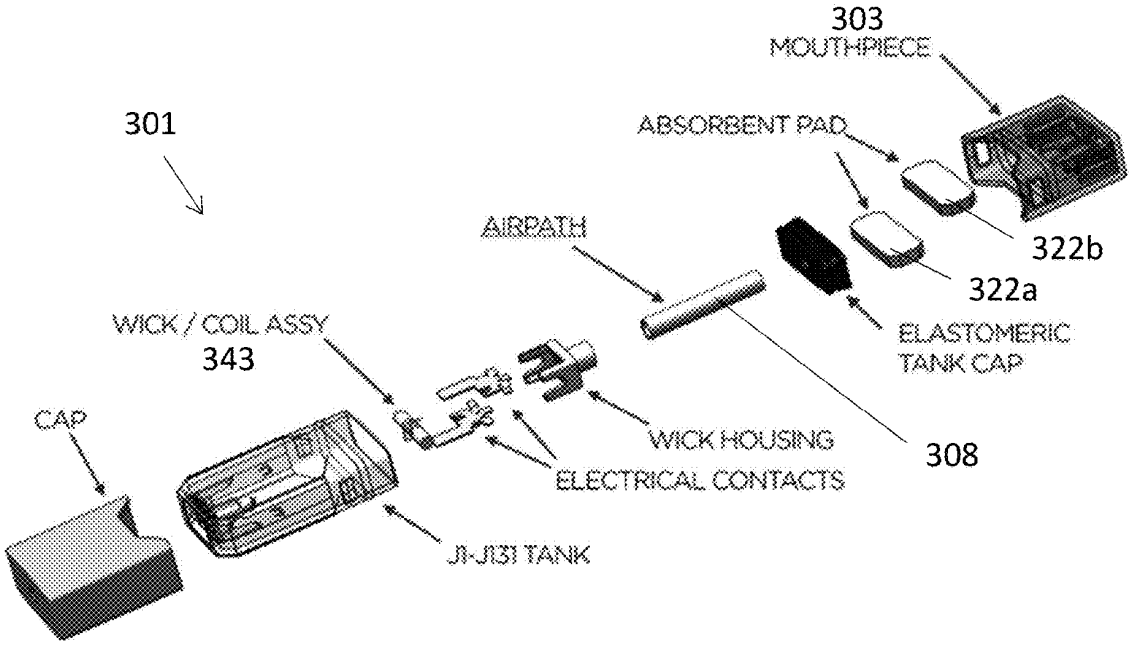

303
MOUTHPIECE
301
ABSORBENT PAD
AIRPATH
322b
322a
ELASTOMERIC
TANK CAP
WICK / COIL ASSY
343
CAP
WICK HOUSING
308
ELECTRICAL CONTACTS
JI-JI3I TANK

FIG. 3B

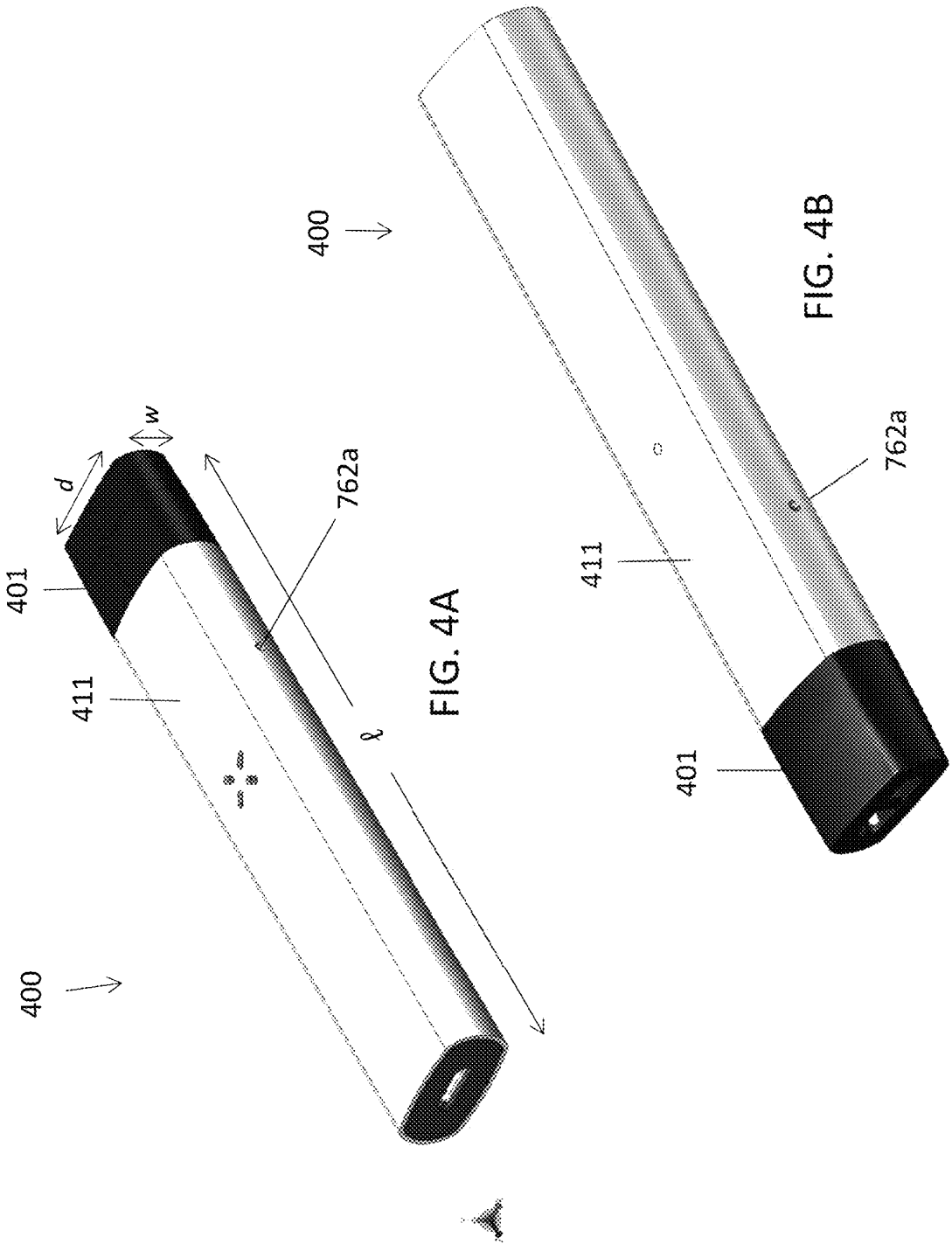


FIG. 4A

FIG. 4B

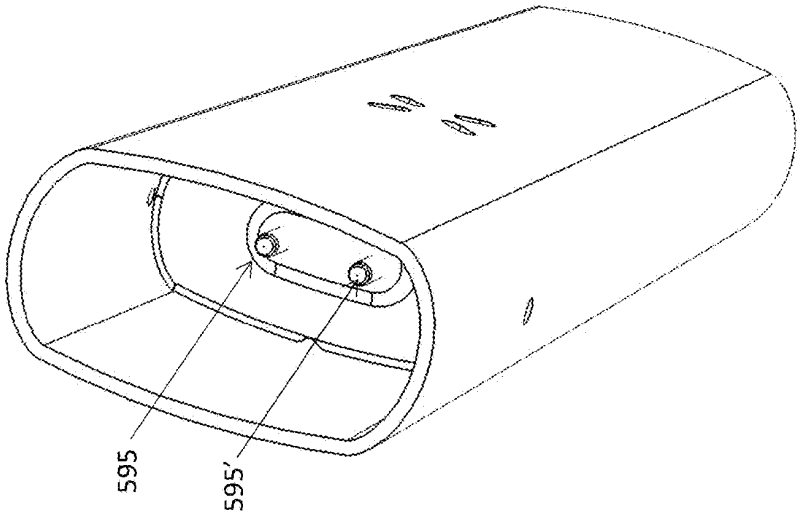


FIG. 5C

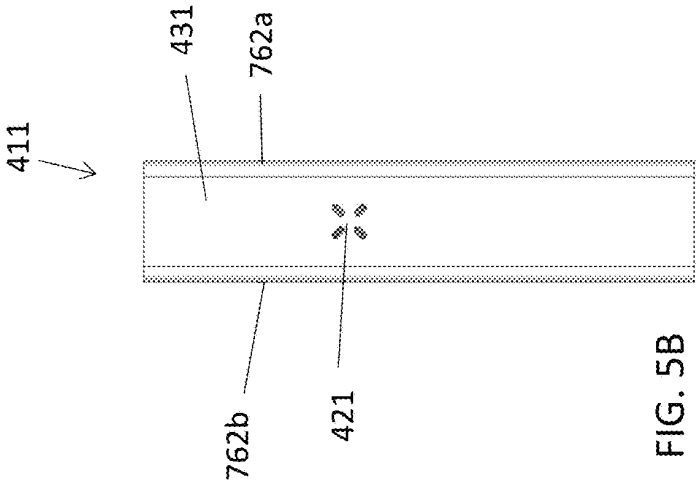


FIG. 5B

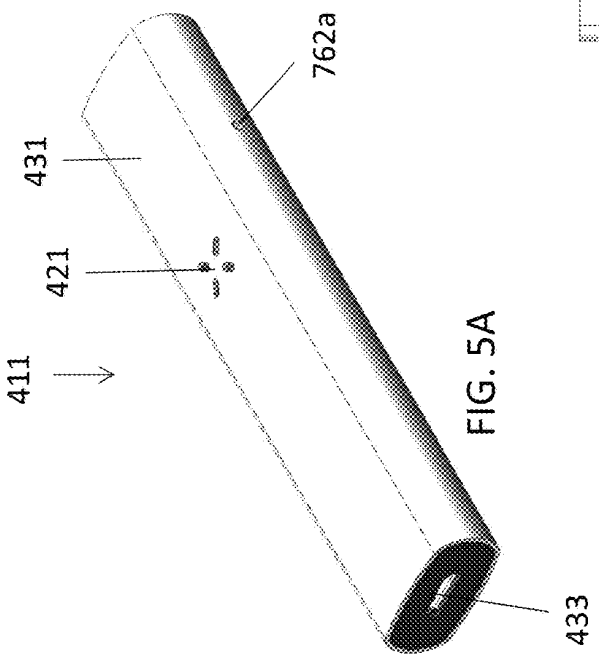


FIG. 5A

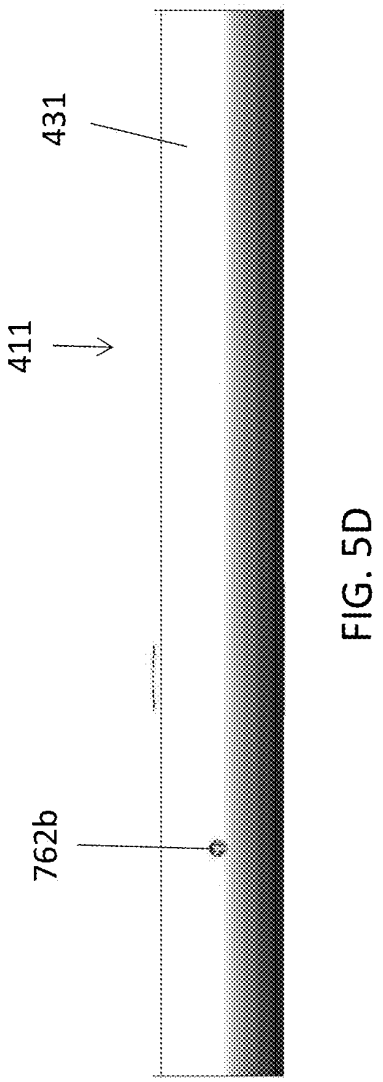


FIG. 5D

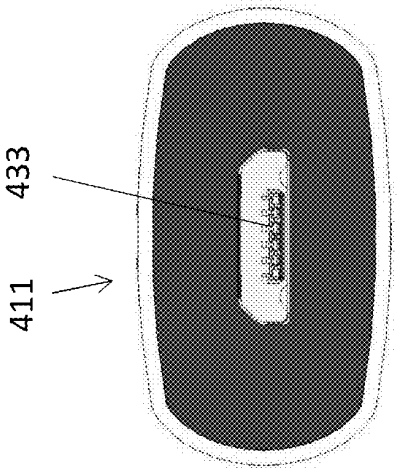


FIG. 5F

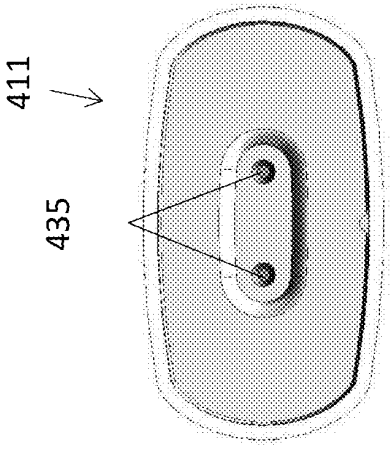


FIG. 5E

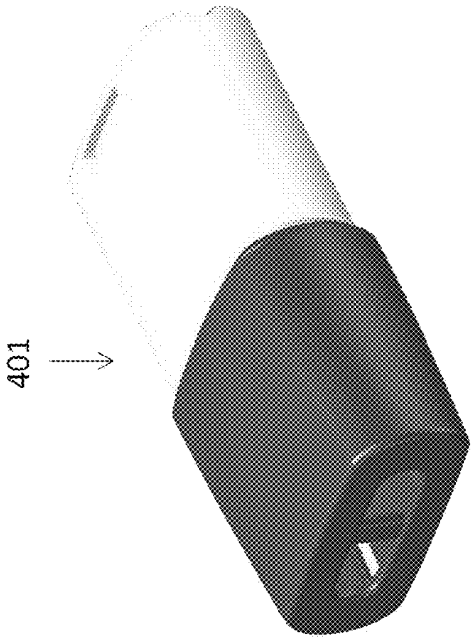


FIG. 6C

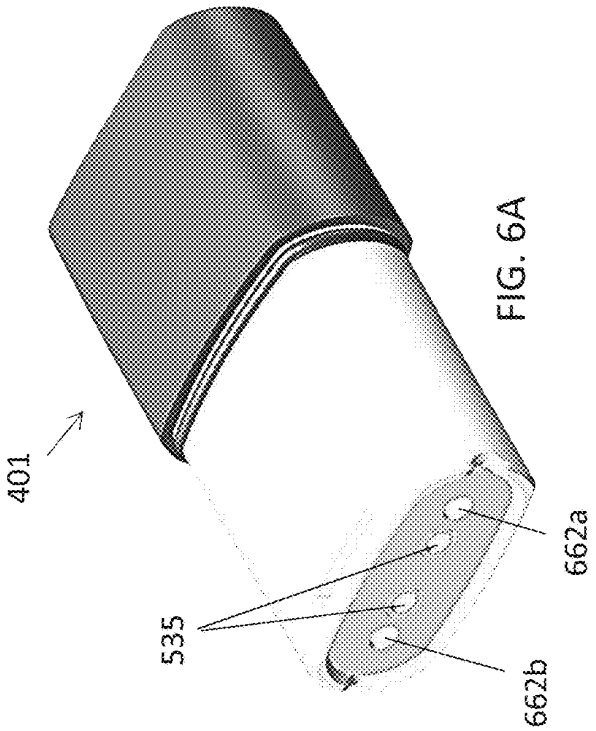


FIG. 6A

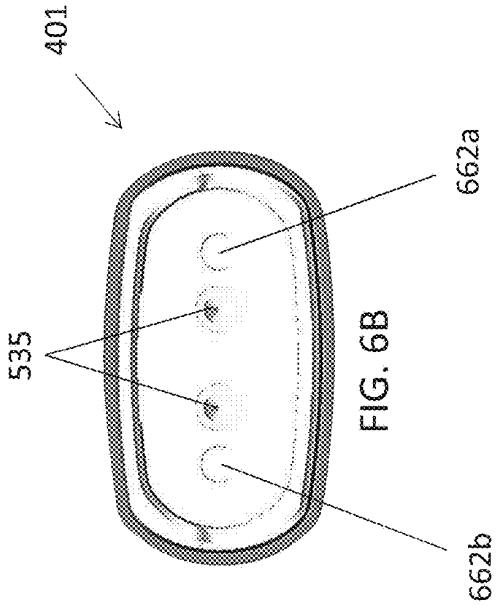


FIG. 6B

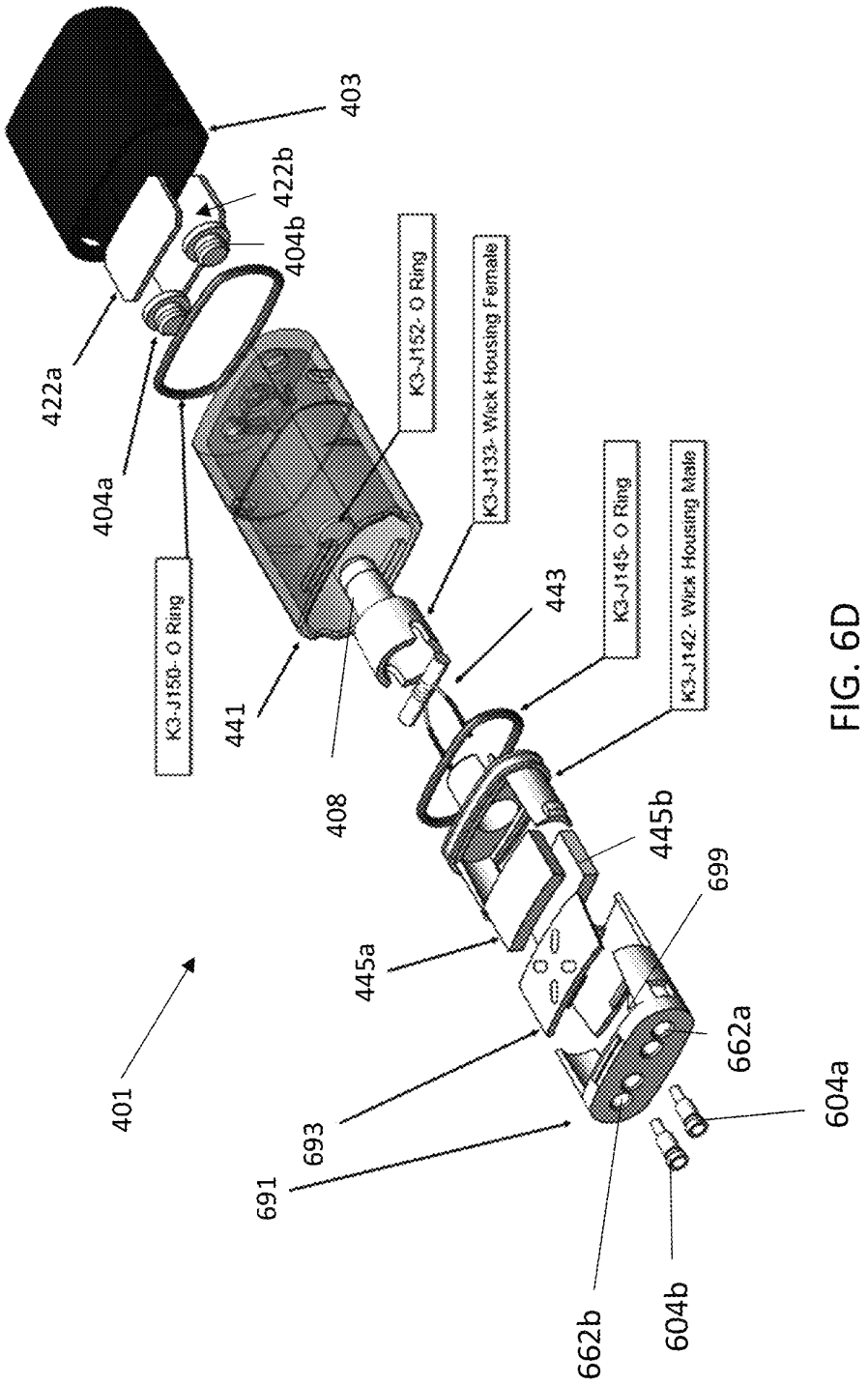

403
422b
404b
422a
404a
K3-J152- O Ring
K3-J133- Wck Housing Female
K3-J150- O Ring
443
K3-J145- O Ring
K3-J142- Wck Housing Male
441
408
445b
699
445a
662a
604a
401
693
691
662b
604b

FIG. 6D

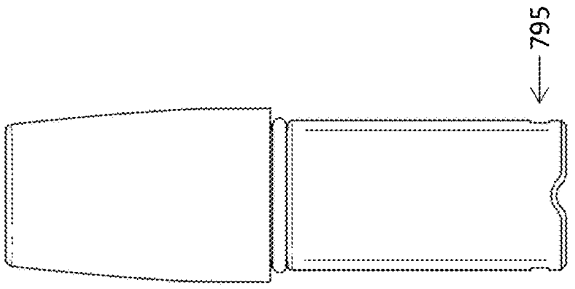


FIG. 7D

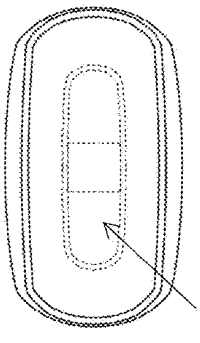


FIG.7F

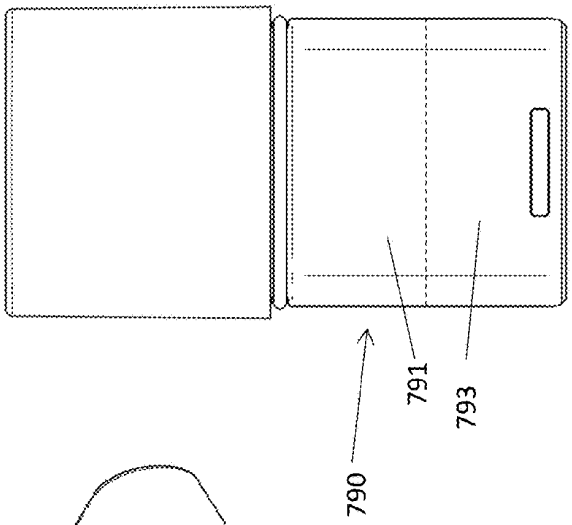


FIG. 7C

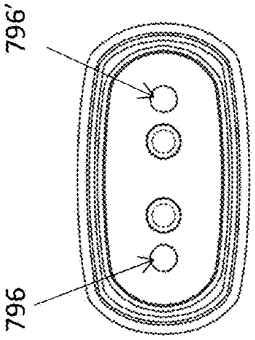


FIG. 7E

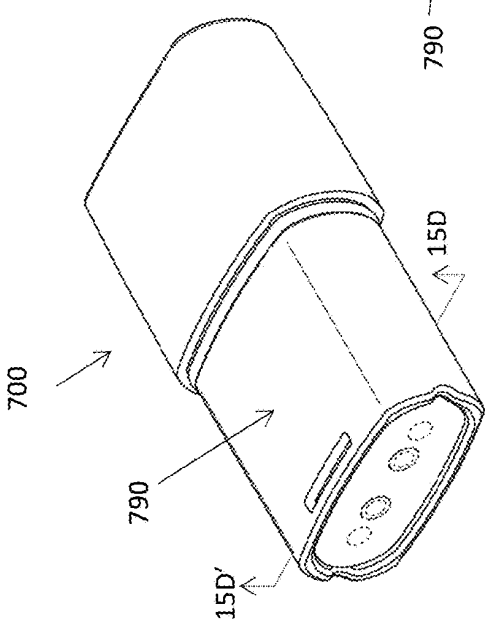


FIG. 7A

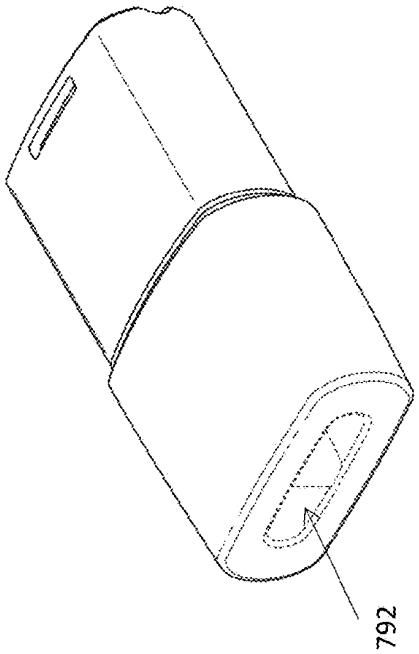


FIG. 7B

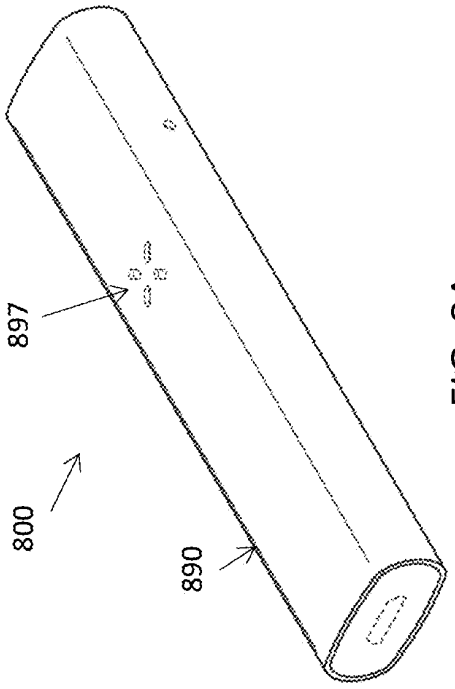


FIG. 8A

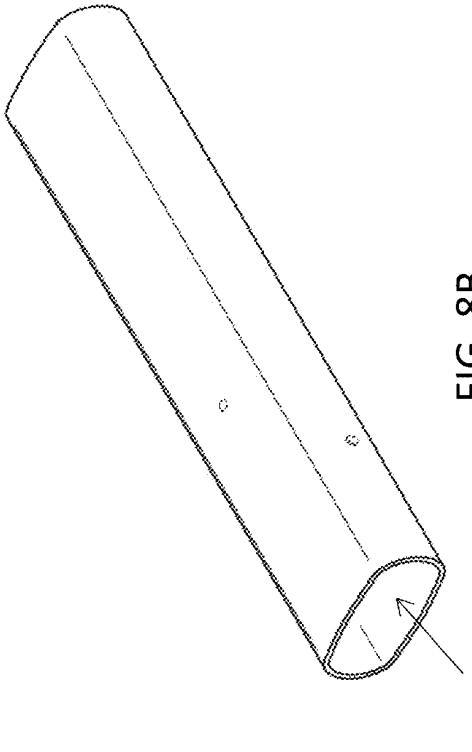


FIG. 8B

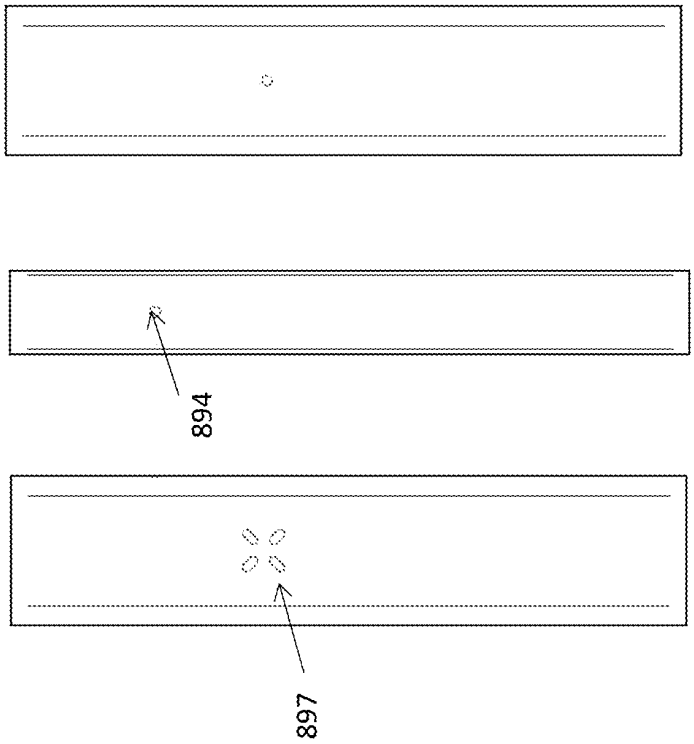


FIG. 8C

FIG. 8D

FIG. 8E

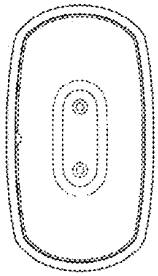


FIG. 8G

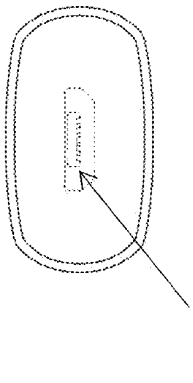


FIG. 8F

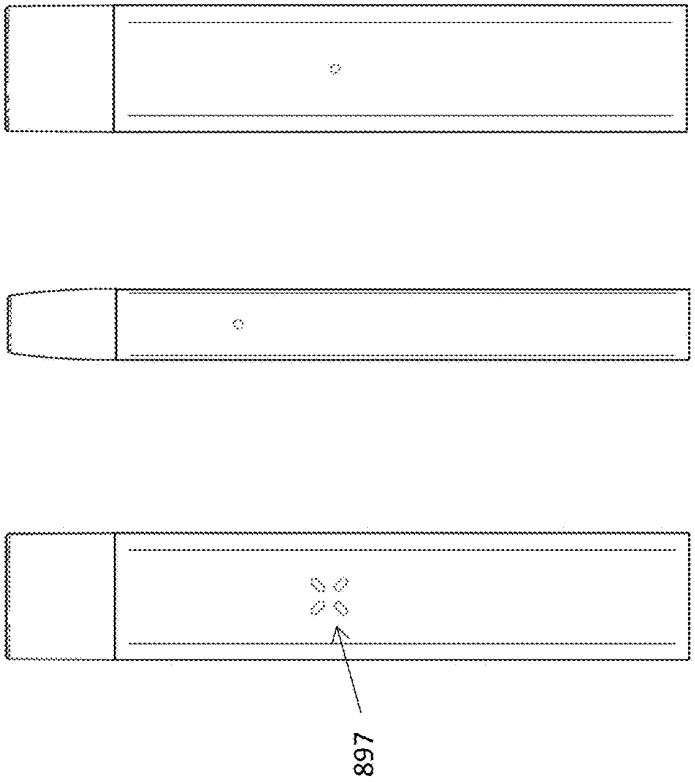


FIG. 9C

FIG. 9D

FIG. 9E

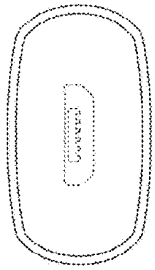


FIG. 9F

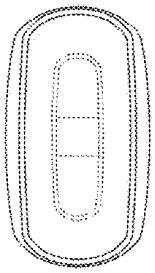


FIG. 9G

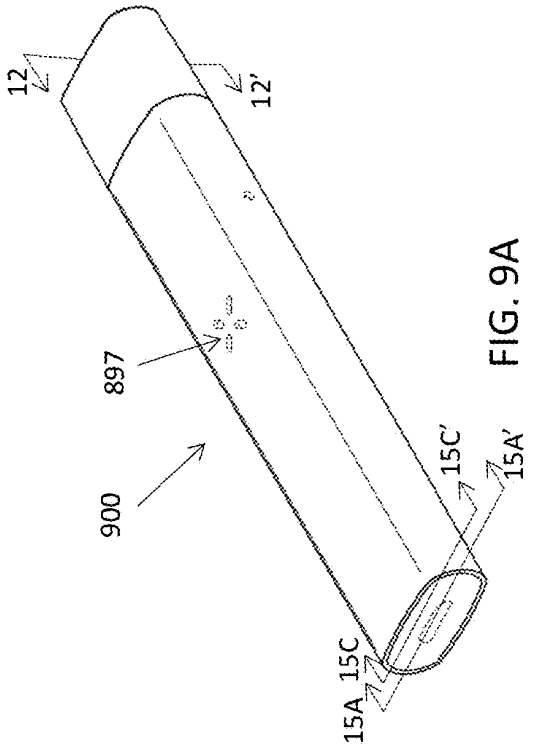


FIG. 9A

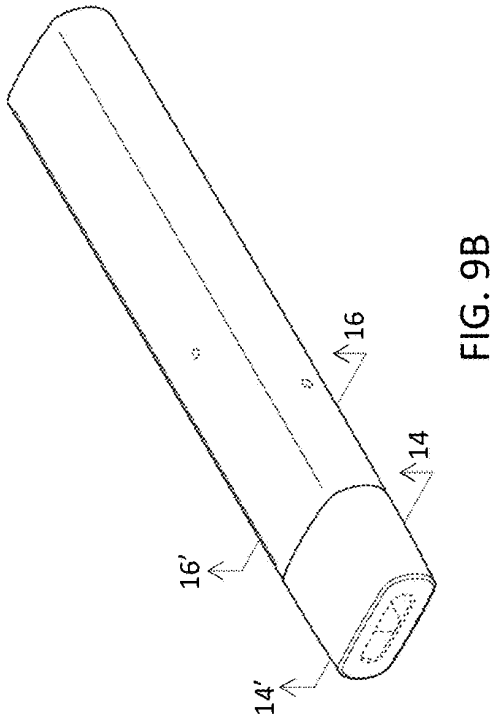


FIG. 9B

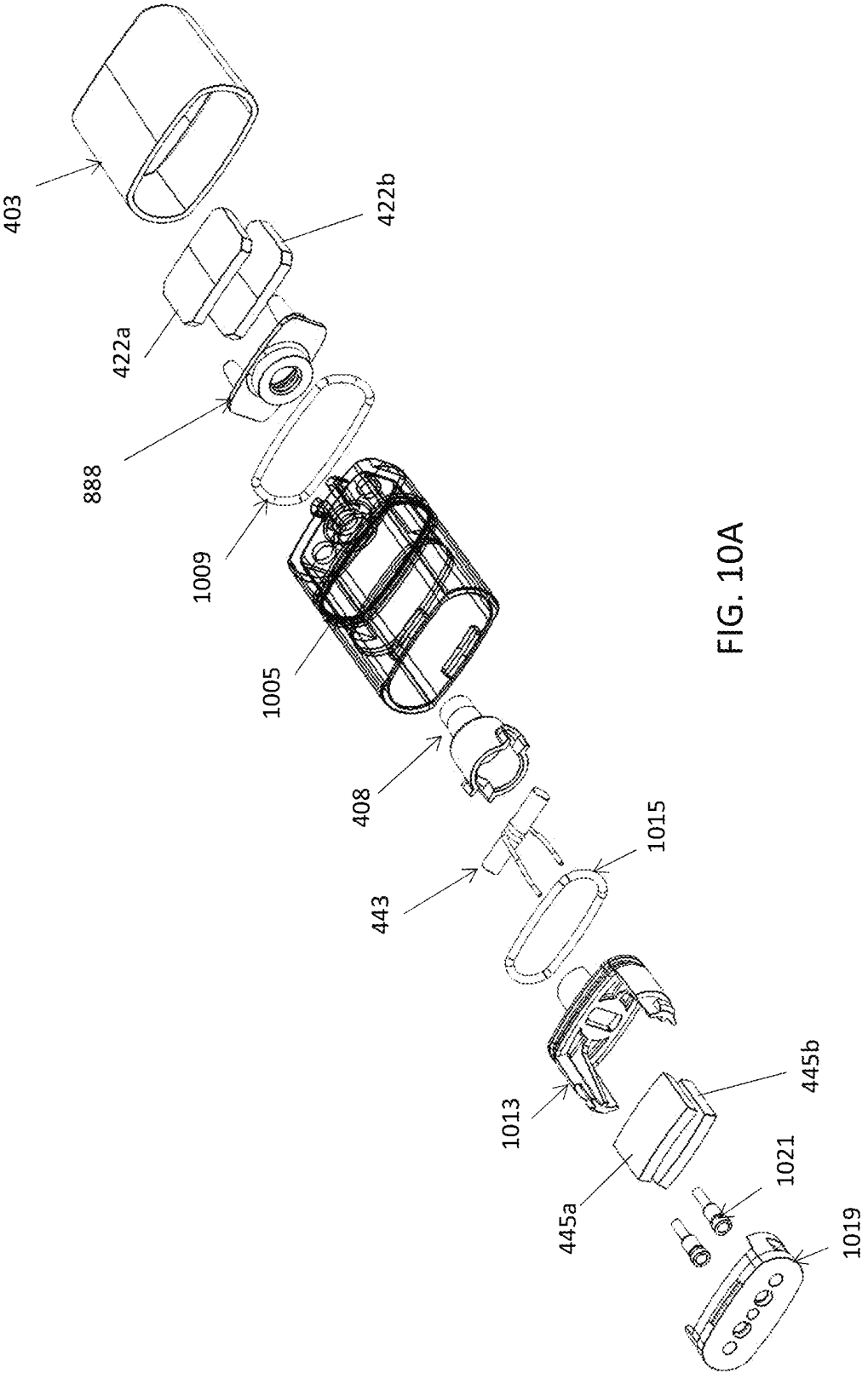

403
422b
422a
888
1009
1005
408
443
1015
1013
445b
445a
1021
1019

FIG. 10A

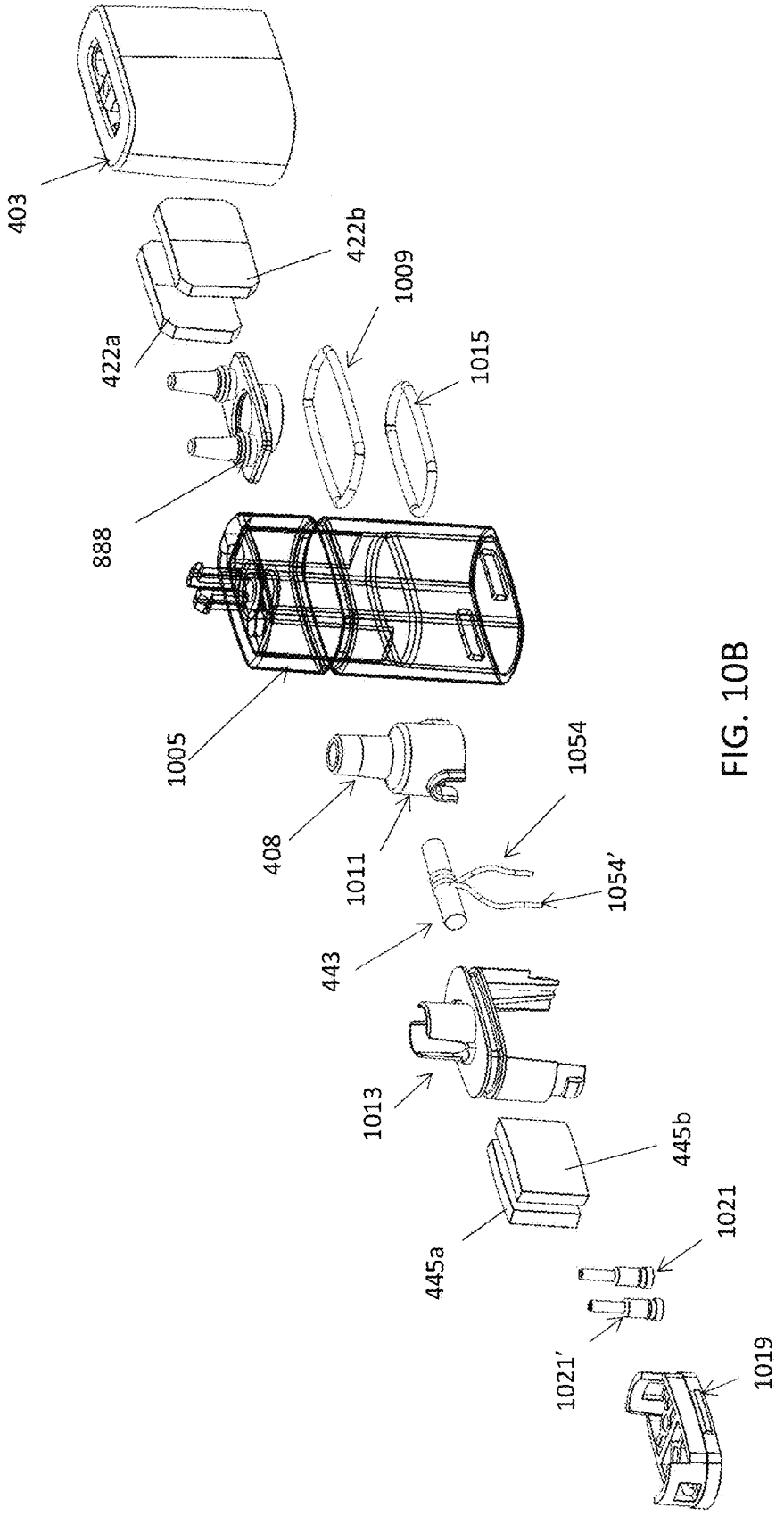

403
422b
1009
422a
1015
888
1005
1054
408
1011
1054'
443
1013
445b
445a
1021
1021'
1019

FIG. 10B

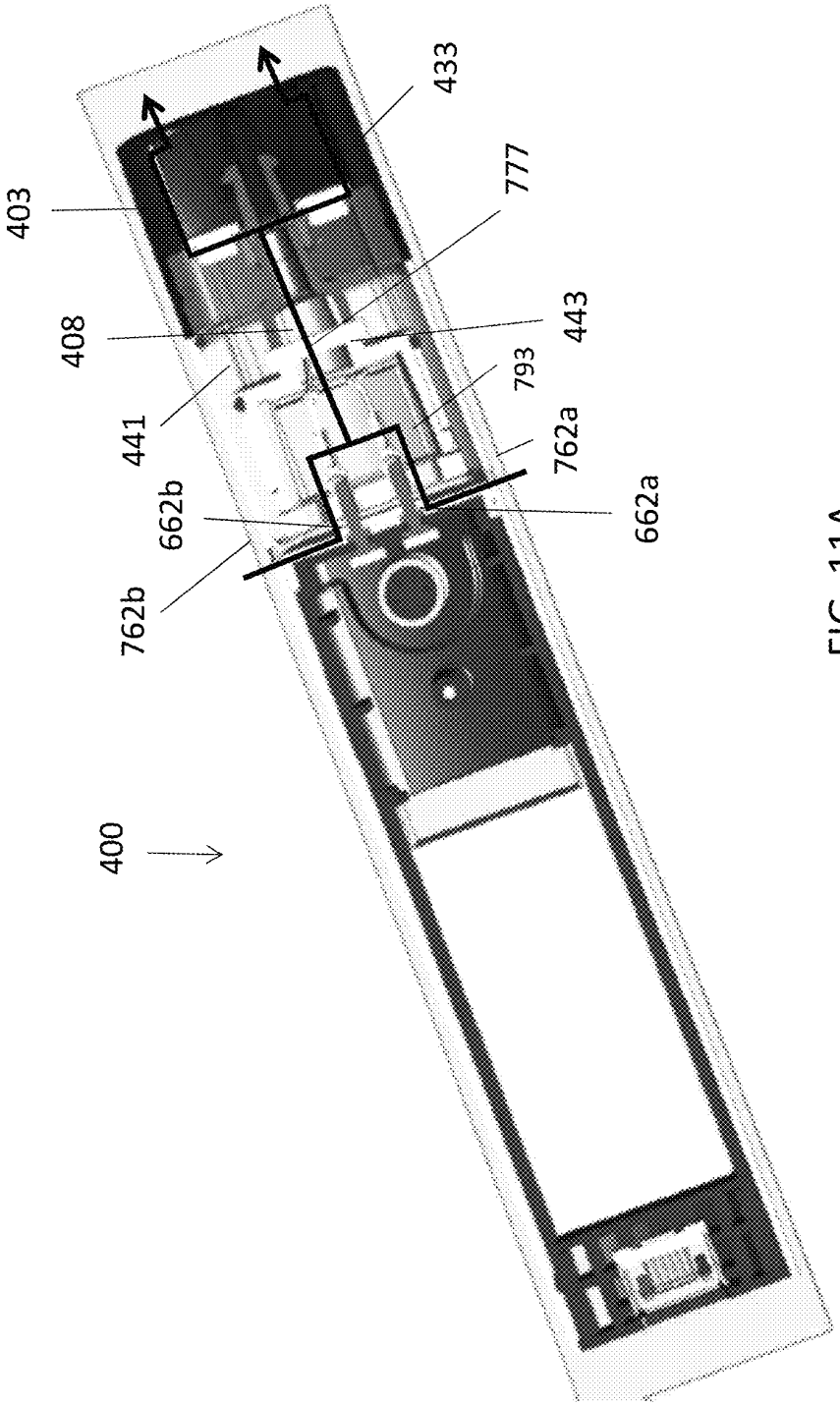


FIG. 11A

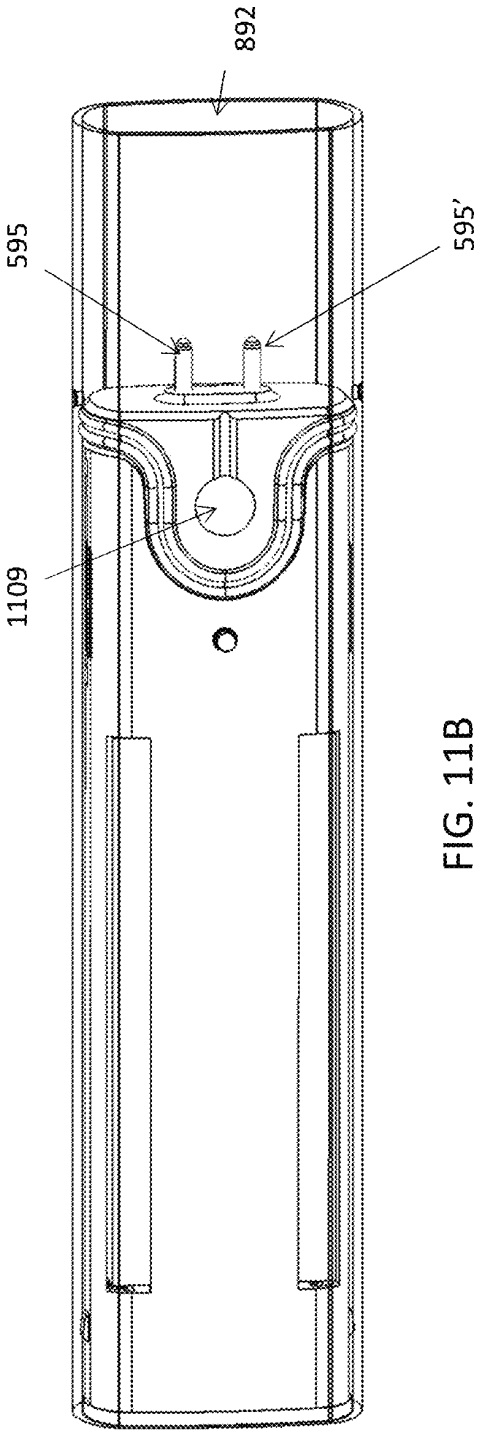


FIG. 11B

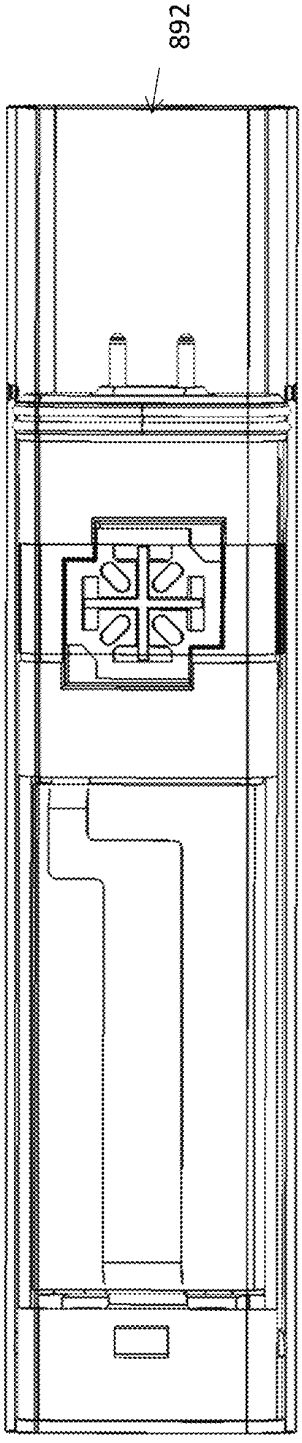


FIG. 11C

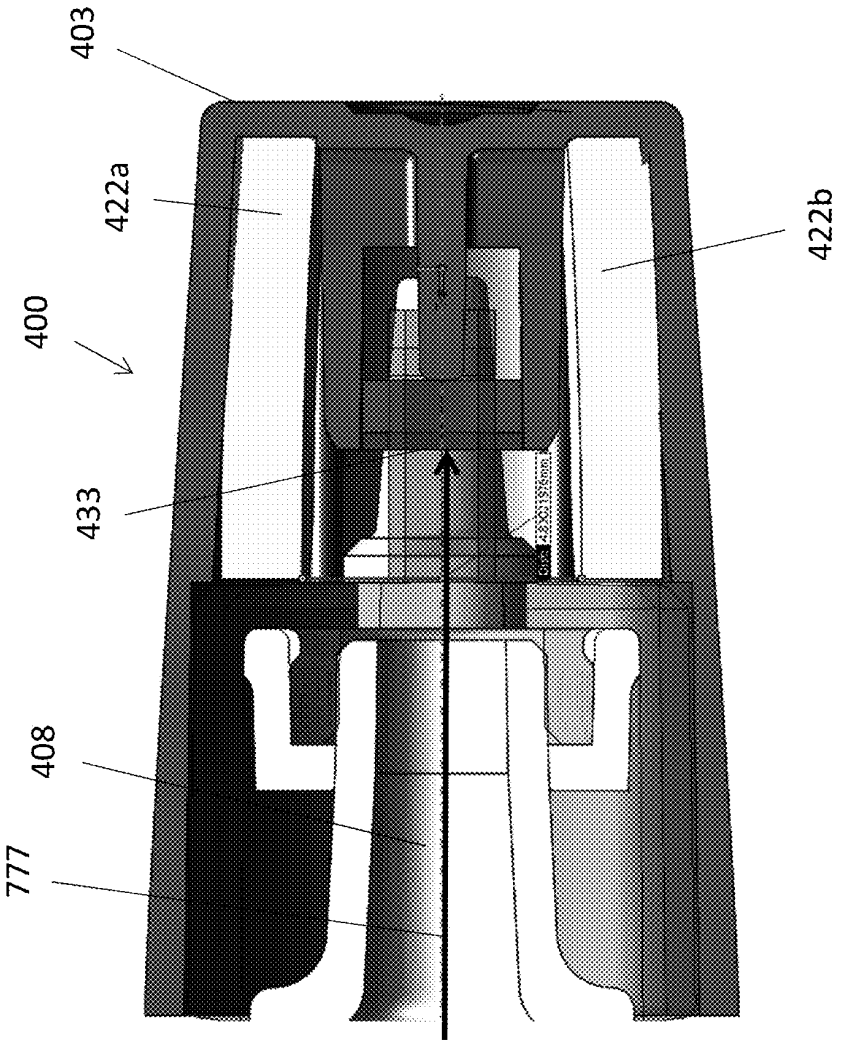


FIG. 12

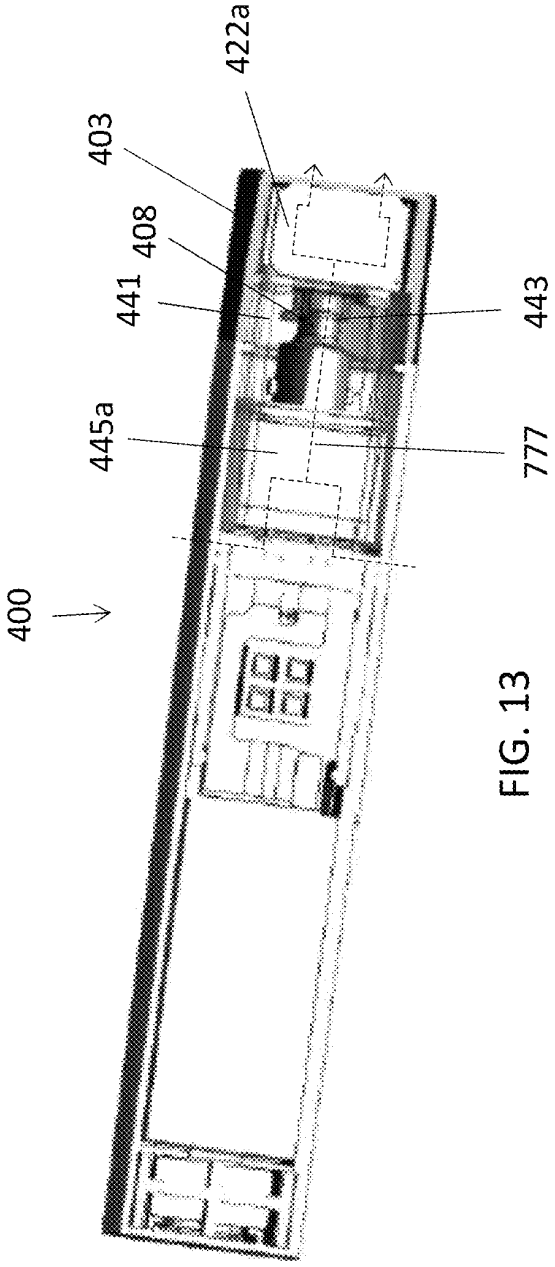


FIG. 13

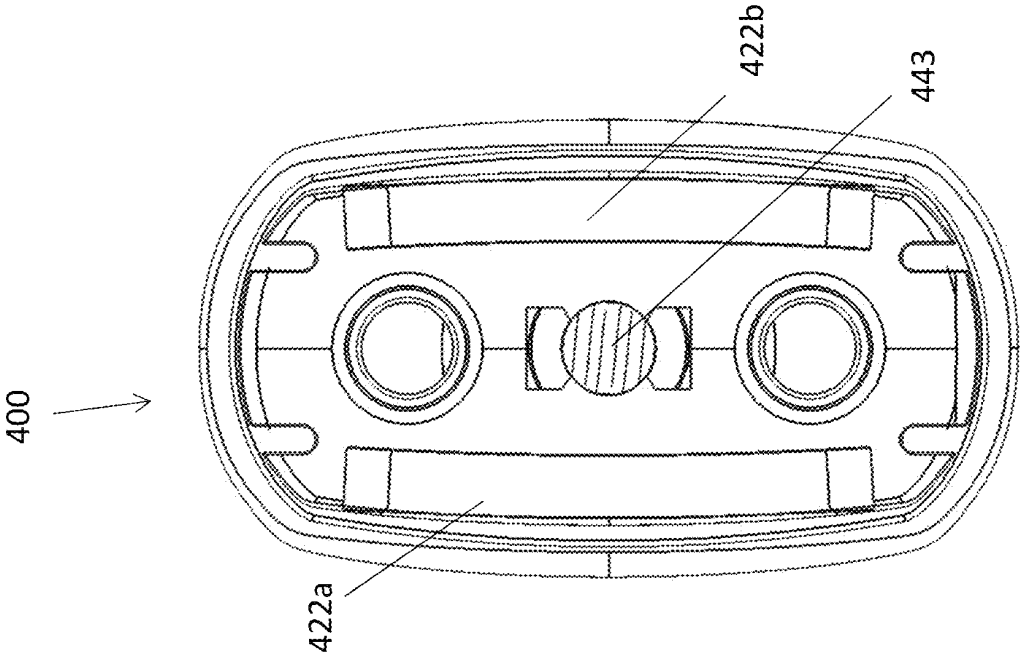


FIG. 14

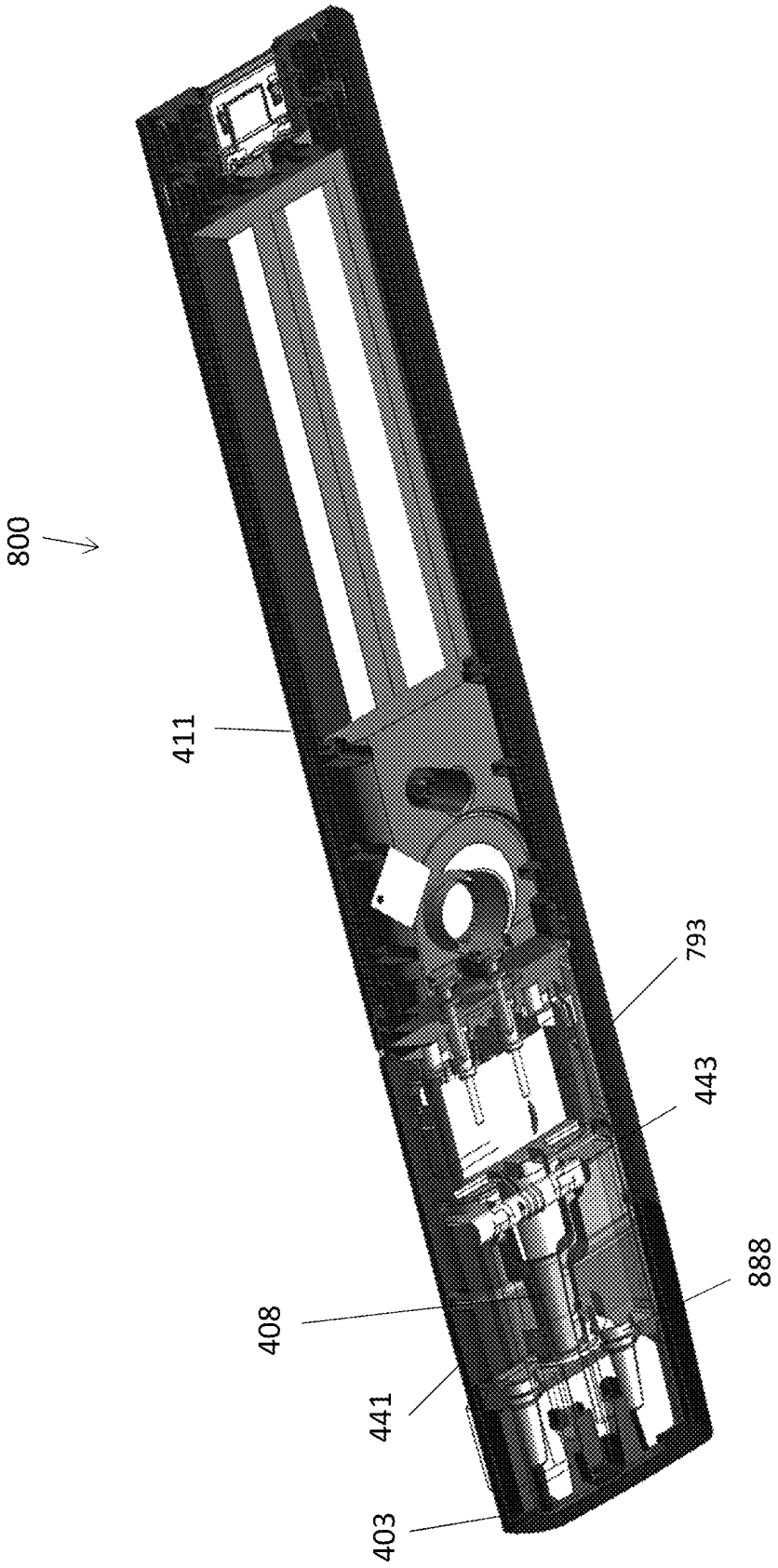


FIG. 15A

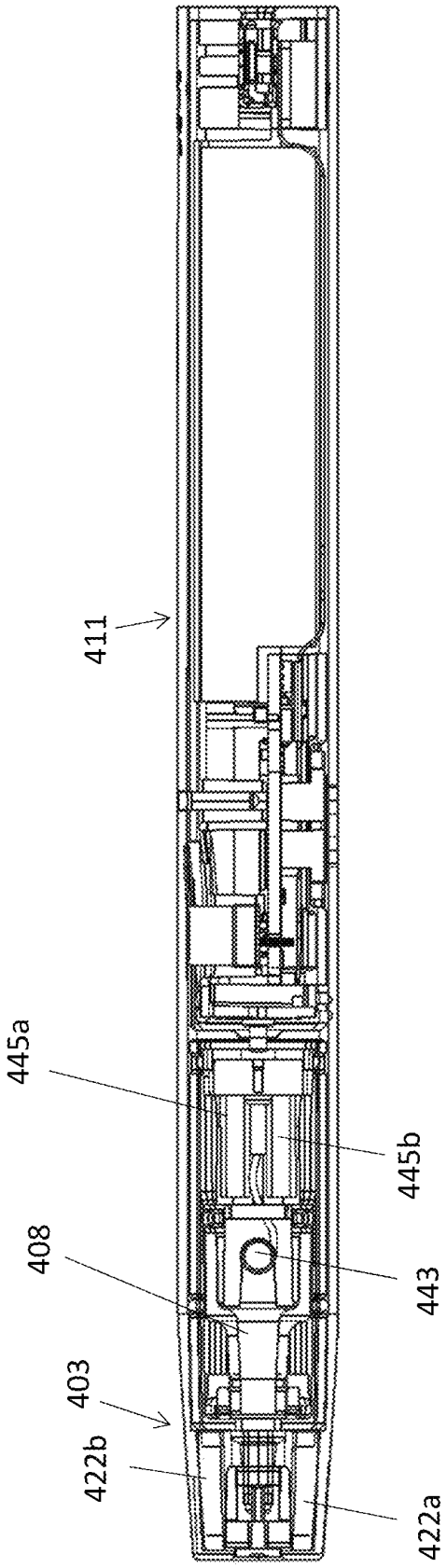


FIG. 15B

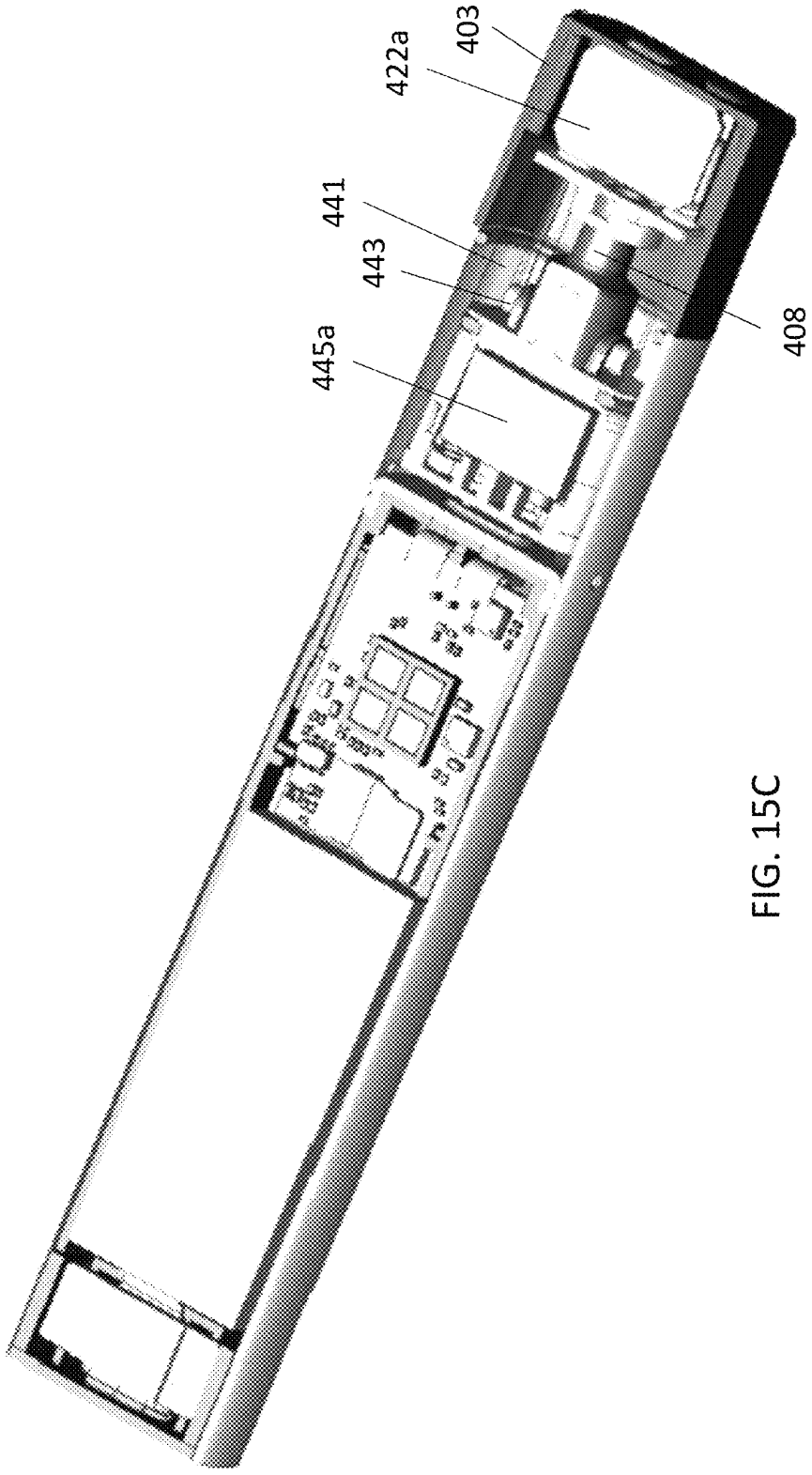


FIG. 15C

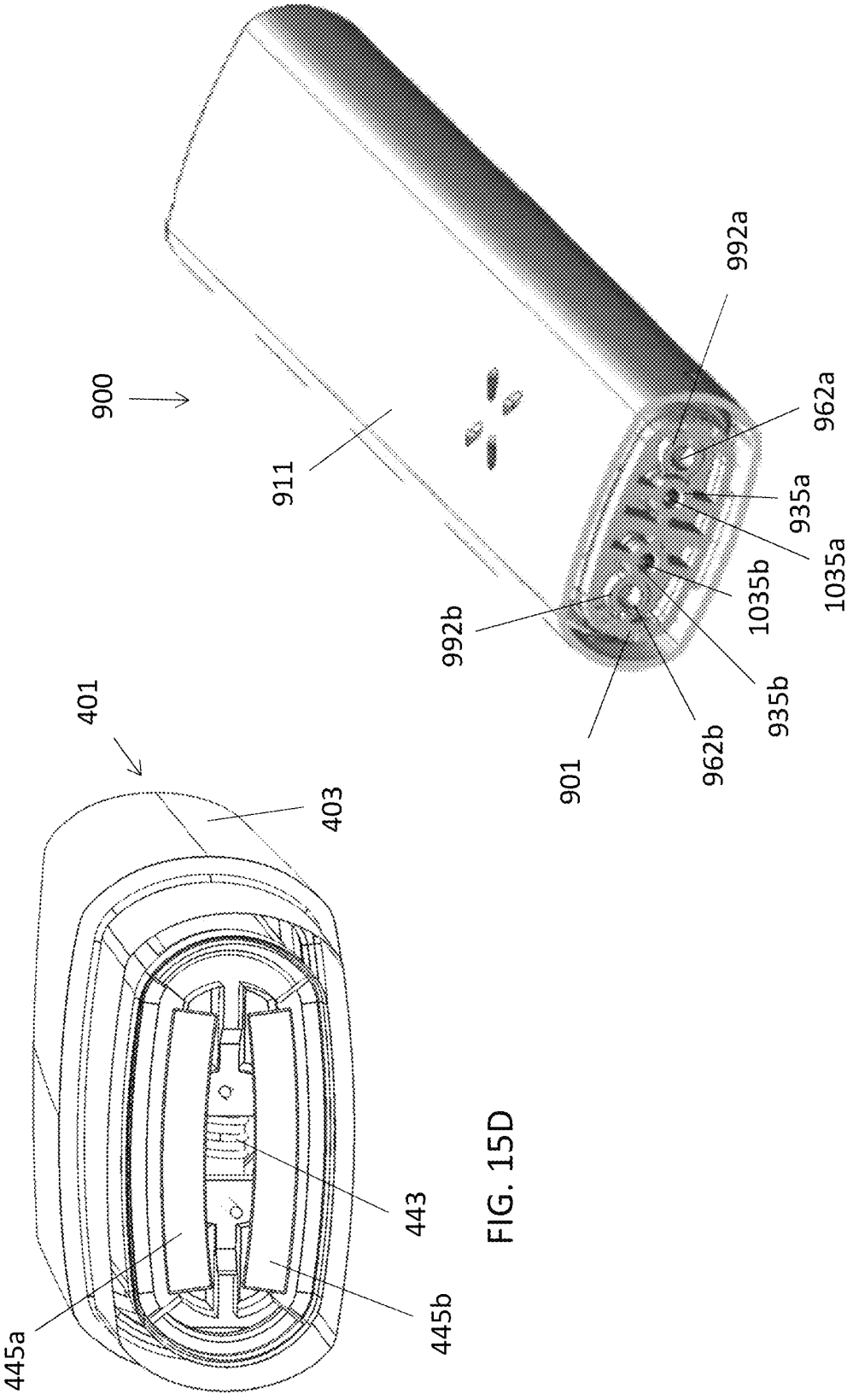


FIG. 16

FIG. 15D

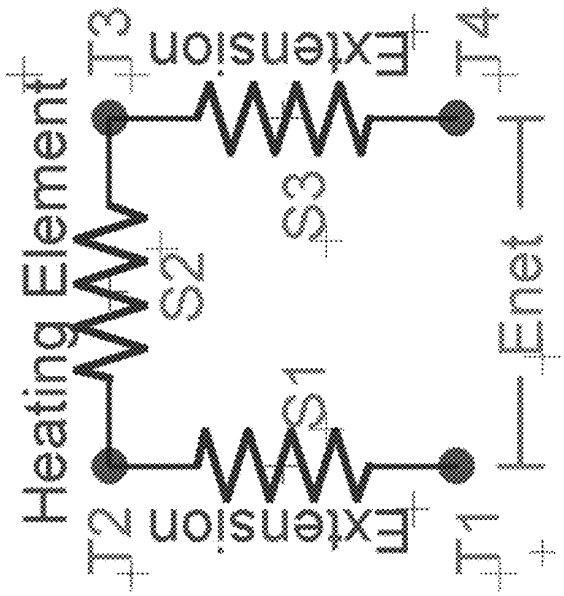

Heating Element
T3
Extension
T4
S3
S2
Enet
S1
T2
Extension
T1

FIG. 17

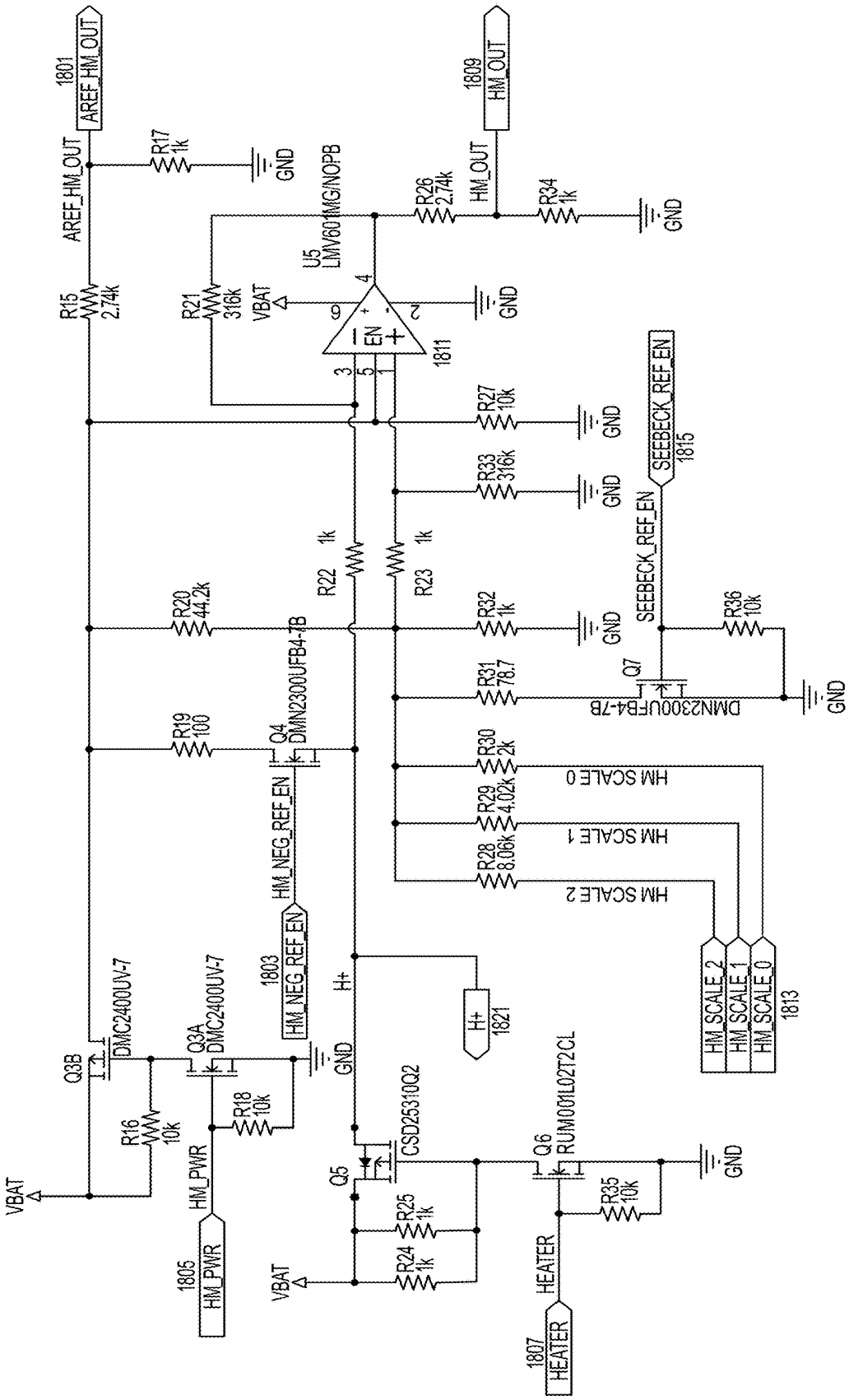

1801
AREF_HM_OUT
R17
1k
GND
1809
HM_OUT
R26
2.74k
R34
1k
U5
LMV601MG/NOPB
R15
2.74k
R21
316k
VBAT
1811
EN
R27
10k
R33
316k
SEEBECK_REF_EN
1815
R22
1k
R23
1k
R20
44.2k
R32
1k
R36
10k
Q7
DMN2300UFB4-7B
R31
78.7
R19
100
Q4
DMN2300UFB4-7B
R30
2k
R29
4.02k
R28
8.06k
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM_NEG_REF_EN
1803
H+
1821
HM_SCALE_2
HM_SCALE_1
HM_SCALE_0
1813
Q3B
DMC2400UV-7
Q3A
DMC2400UV-7
R16
10k
R18
10k
HM_PWR
CSD25310Q2
Q5
Q6
RUM001L02T2CL
R35
10k
R25
1k
R24
1k
HEATER
1805
HM_PWR
1807
HEATER
VBAT

FIG. 18

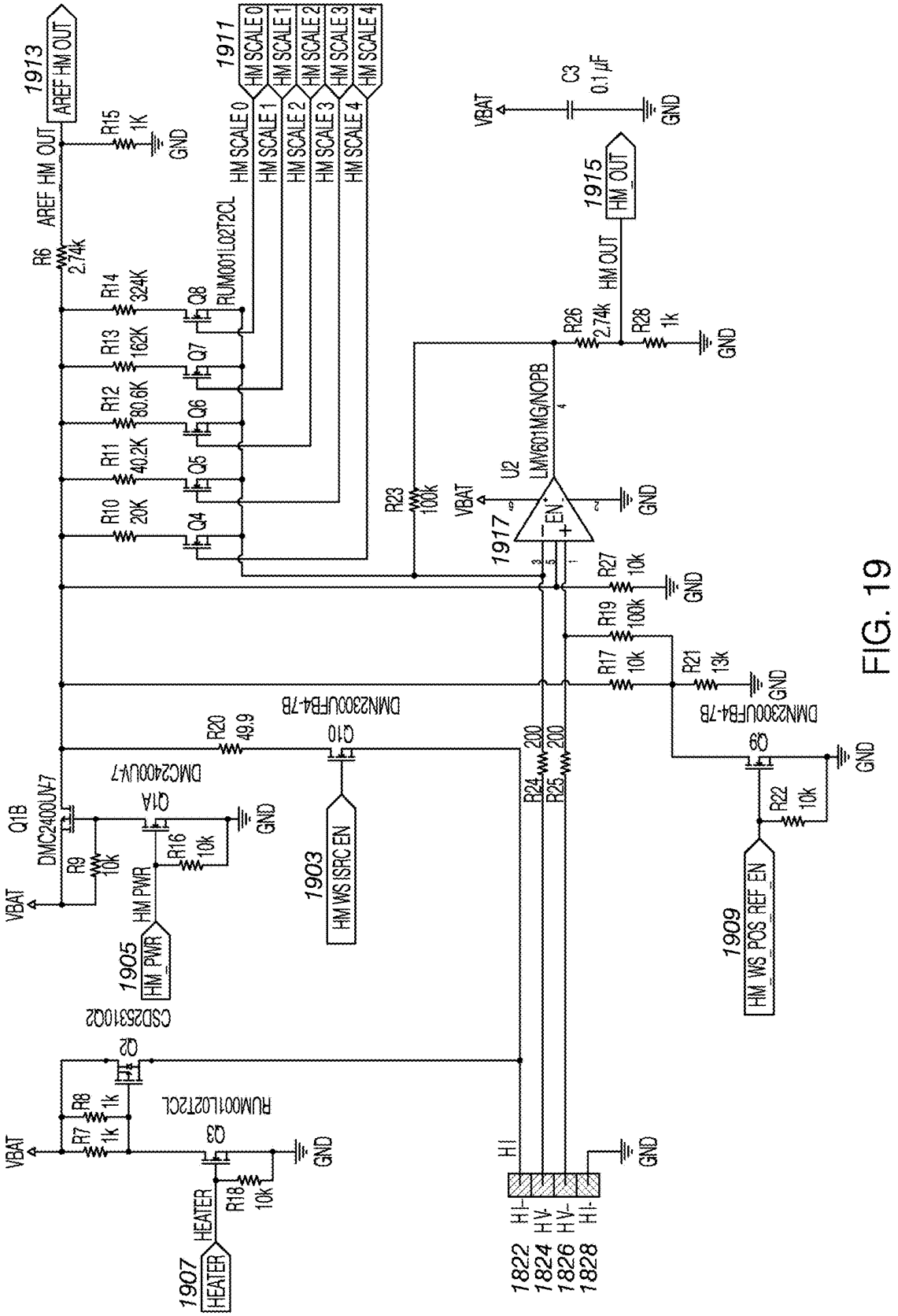

1913
AREF HM OUT
R15
1K
GND
R6
2.74k
R14
324K
R13
162K
R12
80.6K
R11
40.2K
R10
20K
1911
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM SCALE 3
HM SCALE 4
Q8
Q7
Q6
Q5
Q4
RUM001L02T2CL
C3
0.1 µF
VBAT
1915
HM_OUT
HM OUT
R26
2.74k
R28
1k
U2
LMV601MG/NOPB
R23
100k
1917
EN
R27
10k
R19
100k
R17
10k
R21
13k
DMN2300UFB4-7B
R20
49.9
C10
R24
200
R25
200
Q9
R22
10k
1909
HM_WS_POS_REF_EN
Q1B
DMC2400UV-7
Q1A
R9
10k
R16
10k
HM PWR
1905
HM_PWR
1903
HM WS ISRC EN
CSD25310Q2
Q2
R8
1k
R7
1k
RUM001L02T2CL
Q3
R18
10k
HEATER
1907
HEATER
H1
H1-
HV-
HV-
H1-
1822
1824
1826
1828

FIG. 19

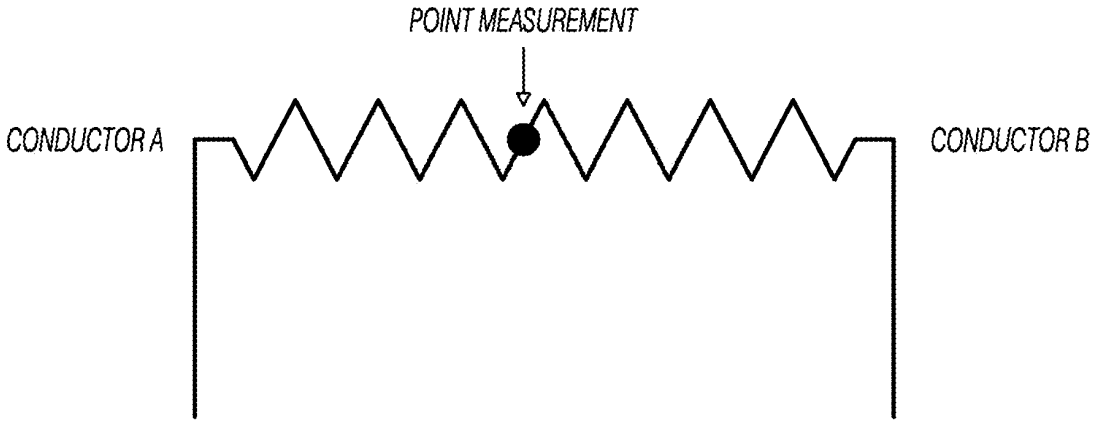


FIG. 20A

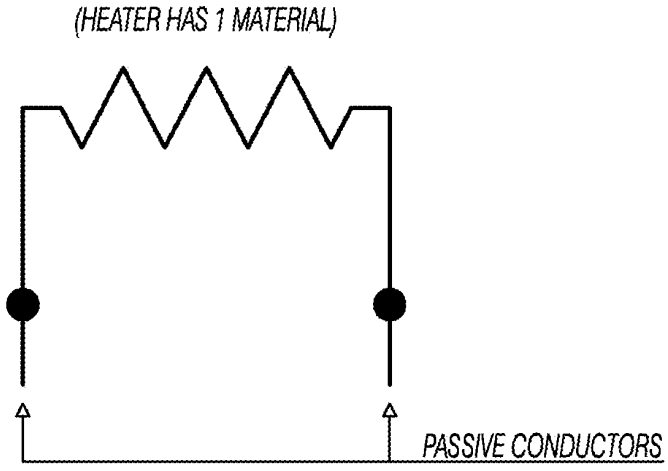


FIG. 20B

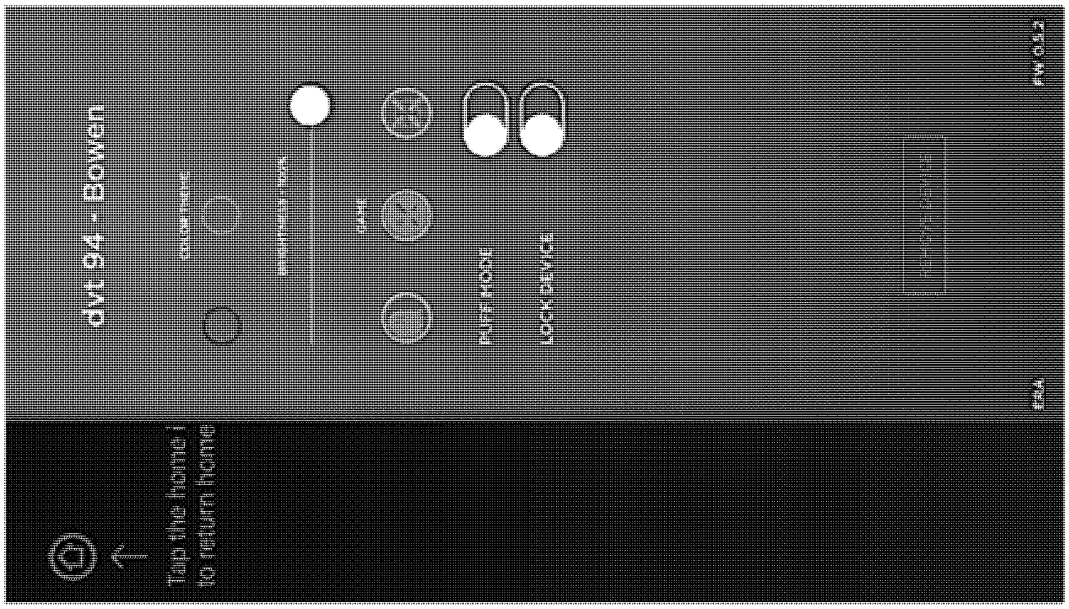

dvt 94 - Bowen
Tap the home i
to return home
PUFF MODE
LOCK DEVICE

FIG. 22

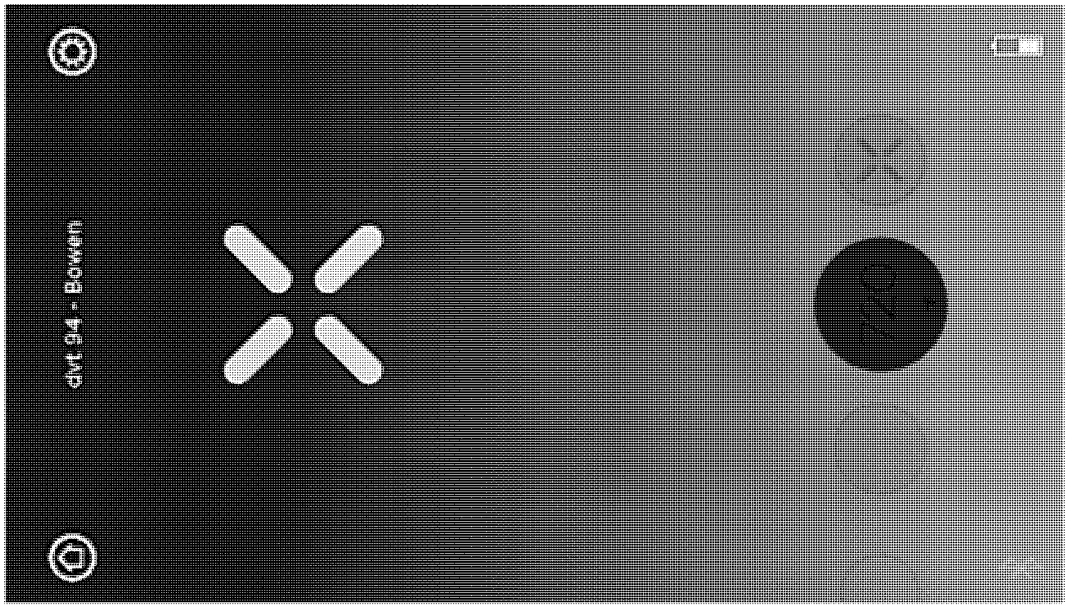

dvt 94 - Bowen

FIG. 21

LEAK-RESISTANT VAPORIZER DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation of U.S. patent application Ser. No. 15/396,584, titled "LEAK-RESISTANT VAPORIZER DEVICE," filed on Dec. 31, 2016, which claims priority to U.S. Provisional Patent Application No. 62/398,494, filed on Sep. 22, 2016 and entitled "VAPORIZER APPARATUSES FOR USE WITH CANNABINOIDS", the disclosure of each of which is incorporated herein by reference in its entirety.

INCORPORATION BY REFERENCE

All publications and patent applications mentioned in this specification are herein incorporated by reference in their entirety to the same extent as if each individual publication or patent application was specifically and individually indicated to be incorporated by reference.

FIELD

Described herein are vaporizer apparatuses, including vaporizer or vaporization devices and vaporizer systems, and methods for making, using and delivering vapor to a user. In particular, vaporizer apparatuses adapted for use with oil-based vaporizable materials including *Cannabis* oils.

BACKGROUND

Electronic devices that produce an inhalable aerosol (e.g., inhalable aerosol devices or alternatively referred to as vaporizers, vaporizer devices, vaporization devices, electronic vaping devices, etc.) typically utilize a vaporizable material that is heated to create an aerosol vapor capable of delivering an active ingredient to a user. Vaporizers have been described for vaporizing solids (herbs, tobacco, *Cannabis*, etc.), liquids (extracts, waxes, etc.) and combinations of both solids and liquids.

Current market inhalable aerosol devices often consist of a tank or cartridge, vaporizable liquid in the tank or cartridge, an air tube, and a wick/coil subassembly that generates the vapor. Air commonly enters the cartridge through the distal end of the product and is forced through the heated zone where the immediate air becomes fully saturated. As the vapor continues its way through the air tube, it comes in contact with cooler surfaces, causing moisture to collect throughout its use. Depending on the complexity of the air path, particle deposition can add to the existing condensation. As a result, some of the liquid can work its way from the tank or cartridge holding the liquid to other areas of the vaporizer, including the mouthpiece and/or the electronics, causing user dissatisfaction and/or problems with the electronic circuitry.

Conventional vaporizers for aqueous (e.g., water, glycerol, etc.) based vaporizable materials do not manage condensation and leakage of the liquid vaporizable material particularly well, and this problem is particularly acute for oils such as *Cannabis* extract oils, in which the liquid material may be particularly oily and/or viscous, and for which evaporation of the liquid material may result in a sticky residue that may impair the operation of the vaporizer.

Further, vaporization of *Cannabis* extract liquids may be more technically difficult than vaporization of other liquids (such as nicotine solutions).

For example, conventional e-cigarettes may address moisture build-up by integrating a filter pad in line with air flow. However, having a filter pad in line with the air flow can impede or restrict the air flow as the user draws on the mouthpiece. Moreover, this restriction to draw incrementally climbs as the filter becomes more saturated throughout, often requiring the user to change his or her draw accordingly and increasing the possibility of drawing liquid of the product and into the user's mouth.

In addition, the control of the temperature when vaporizing *Cannabis* extracts may require a high degree of precision. Virtually all vaporizers currently available today would benefit from a higher degree of precision in power management and control of the heater (atomizer). In particular, vaporizers well suited for vaporizing *Cannabis* (e.g., liquid *Cannabis* extract solutions) may benefit from precise and accurate control of the heater forming the vapor.

It would also be beneficial to provide cartridges that do not roll and may rest in a small number of secure positions (e.g., cartridges having non-circular cross-sections) and to provide an immediate approximate (visual) estimate of the amount of material consumed.

Finally, it would be particularly beneficial to provide pre-loaded and tightly controllable cartridges for use in consuming *Cannabis* extract liquids that prevent or reduce leakage of particularly viscous vaporizable materials such as *Cannabis* oils/extracts.

Accordingly, described herein are vaporizers (including vaporizer cartridges) and methods of operating and using them addresses the issues raised above.

SUMMARY OF THE DISCLOSURE

In general, described herein are apparatuses such as devices and systems for vaporizing a material (including, in particular, but not limited to, *Cannabis* extract liquids) and method of using them. For example, described herein are vaporizers, cartridges for use with such vaporizers, and vaporizer control systems.

Described herein are vaporizer cartridges that are pre-loaded (filled) with a *Cannabis* vaporizer material. The vaporizable *Cannabis* material is typically a liquid material, and may be a *Cannabis* extract liquid (*Cannabis* "oil"). Also described herein are vaporizers with or without cartridges that are adapted for use with *Cannabis* liquid extracts. Either or both the vaporizer base (which mates with the vaporizer cartridge to form the vaporizer device) and vaporizer cartridge may be adapted specifically for use with *Cannabis* liquid extracts, although any of the apparatuses and methods described herein may be operated with other vaporizable materials, including nicotine solutions and/or solutions having no active ingredient at all (e.g., just including a carrier such as polyether compounds like polyethylene glycol and/or glycerol, or the like, and flavorants).

For example, a cartridge as described herein may include a vaporizable material such as *Cannabis* oil. *Cannabis* oils present particular challenges when vaporized using a cartridge and/or a handheld vaporizer device. For example, *Cannabis* oil is relatively "sticky" and may be viscous, particularly once it dries out. Thus, leakage may be a more serious consideration and challenge compared to other aqueous vaporizable materials. In particular, leakage of *Cannabis* oil may result in clogging of the device and disturbing the electrical components, particularly the electrical contacts,

which may be otherwise "gummed up" by leaked oil. The dried oil is not only sticky, but may also be electrically insulative, and may disrupt the electrical control of the vaporizer. Described herein are apparatuses and methods to prevent or control leakage and to avoid disruption of electrical contacts between cartridges containing the *Cannabis* extract and the rest of the vaporizer.

For example, the apparatuses described herein may include one or more electrical contacts (e.g., between the cartridge and the vaporizer base) referred to herein as wiping or scraping contacts. These electrical connections may be configured so that as a connection/contact is made between two electrically conductive surfaces, the contact (e.g., on the cartridge and/or the vaporizer base) scrapes the mating surface of the other contact to remove any vaporizable material, including vaporizable material that has dried on the contact. For example, a contact may include a canister with one or more extensions (e.g., wipers, knives, fingers, or scrapers) that are driven against and across the mating surface of the opposite electrical contact to scrape away any leaked vaporizable material (including dried-on material). The complimentary electrical contact may be a pin (including a pogo-pin) electrically conductive connector that is scraped as it enters into the canister by the wiper/scraper(s) therein. Thus, in general, the electrical contact in the vaporizer base may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer cartridge and/or the electrical contact in the vaporizer cartridge may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer base to remove contaminating material. Thus either contact may include a scraping projection (e.g., edge, blade, wire, etc.) that is driven across the opposite surface. Typically two or more contacts are included in the vaporizer cartridge, and each of them may be configured as a scraping or wiping contact. In some variations, it may be desirable to have the scrapers on the connectors of the cartridge, although the scrapers may be present on the vaporizer base instead or in addition.

Any of the cartridges described herein may include a tank or storage region within the cartridge and/or forming a portion of the body of the cartridge. In particular, all or a portion of the cartridge (including the tank) may be clear, transparent and/or translucent so that the level of vaporizable material within the tank can be seen by a user. The tank may be prefilled or fillable. The tank may be sealed closed at the top (near the mouthpiece, which may cover the top of the cartridge). The mouthpiece may be plastic and may be secured over the tank by a snap fit, a friction fit, and adhesive, or the like. For example, the distal end of the elongate and flattened tubular body is configured to be secured by a friction fit within a vaporizer body. As described in greater detail herein, one or more absorbent members, (e.g., sponges, pads, felts, etc.) may be included in the mouthpiece between the tank and the mouthpiece, to prevent leakage of vaporizable material from contacting the portion of the mouthpiece where the user applies her or his lips. The tank may be sealed, e.g., by a tank seal that covers the one or more openings for filling the tank. In some variations, rather than one or more small plugs (which may be difficult to install) the tank may be sealed by a multi-seal component (e.g., a single piece) that seals between the mouthpiece and the top of the tank as and closes off two or more openings into the tank.

During inhalation through the apparatus, the user may draw on the mouthpiece (by inhaling/sucking on the mouthpiece) to draw air through the mouthpiece. The device may be turned on by one or more of: a control on the device (e.g., on an outer surface of the device), but installing the cartridge into the vaporizer base, detecting inhalation, detecting lip contact with the mouthpiece. In some variations, the device is turned on, and the heater rises to an initial set temperature, when the device is in a ready to turn on state and when the user draws on the mouthpiece. The vaporizer may be placed in a ready to turn on state by connecting (or detecting connection of) a cartridge and/or by a switch or control on the outside of the apparatus and/or by the battery level being sufficient to operate the device.

Once the device is turned on, it may be operated by drawing on the mouthpiece to cause the temperature to cause the vaporizer heater (the atomizer) to heat to the desired temperature setting (which may be preset, selected from a plurality of pre-set temperatures or may be user selectable, including using a computer or other device having a processor and user interface that communicates with the device, either wirelessly or via a wired connection, such as a smartphone wirelessly communicating with the device).

Drawing on the mouthpiece typically causes airflow to enter the cartridge receiver region of the vaporizer base through one or more (e.g., two) air openings that are positioned through the wall of the cartridge receiver near a base of the cartridge receiver. Air may pass into the cartridge receiver and up through the cartridge via one or more openings in the base (bottom) of the cartridge. The air may then pass into a heater connector region that also includes one or more (e.g., two, parallel) absorbent pads or sponges for absorbing any leakage of vaporizable material that may enter into this air-filled heater connector region, which is also open to the vaporizing chamber across which a wick and heating coil is extended to form vapor. The two absorbent pads positioned in this air region positioned on the long axis of the cartridge, against the major faces of the cartridge body so that they don't block the air path into the vaporization chamber from the opening(s) at the base. These absorbent pads (e.g., sponges) may prevent dripping or leakage of the fluid from the vaporization chamber (e.g., off of the wick) even when the heater is not being heated. In order to prevent leakage should the absorbent pads not be sufficient, the opening into the base of the air chamber may include a rim or boss on the inner surface (within the heater connector region at the base of the cartridge) that prevents small amounts of fluid (e.g., vaporization fluid such as *Cannabis* oil) to drip out of the opening(s) into the cartridge (e.g., the air chamber of the cartridge).

The air path from the vaporization chamber to the mouthpiece may have a minimum diameter that is slightly larger than previously described. For example, the minimum diameter of the air path between the vaporization chamber and the mouthpiece may be about 1.5 mm or greater, about 1.6 mm or greater, than about 1.7 mm or greater, than about 1.8 mm or greater, than about 1.9 mm or greater, than about 2 mm or greater, than about 2.1 mm or greater, than about 2.2 mm or greater, than about 2.3 mm or greater, than about 2.4 mm or greater, than about 2.5 mm or greater, etc. For example the minimum diameter may be 2.0 mm or greater.

In any of the variations described herein, the apparatus may include a wick as part of the atomizer (heater). In variations for use with *Cannabis* oil the wick may be larger than typical cartridge wicks and may have a slightly larger pore size, because of the higher viscosity of the *Cannabis* oil as compared to other (including nicotine) aqueous vaporization solutions. For example, the wick may be larger than 1.5 mm in diameter (e.g., about 1.9 mm or larger, about 2.0 mm or larger, about 2.1 mm or larger, about 2.2 mm or

larger, about 2.3 mm or larger, about 2.4 mm or larger, about 2.5 mm or larger, etc., including between about 1.8 mm and about 5 mm, between about 1.9 mm and about 4 mm, between about 2 mm and about 4 mm, etc.). The wick may generally extend across the vaporization chamber, e.g., along or perpendicular to the long axis of the cartridge, and between either the major or minor sides (in oval or flattened cartridges). The wick material may be any appropriate material, particularly those that are biocompatible, have a sufficient pore size, compatible with *Cannabis* oils and may be resistant to heat up to the maximum heating temperature of the apparatus (e.g., will not degrade or combust significantly at temperatures up to about 450° C., 500° C., 550° C., 600° C., 650° C., etc.). For example, the wick may be made of a silica material (e.g., fiberglass).

In any of the heaters described herein, the heater (atomizer) may include a heating coil that may be wrapped around the wick for conductive heating. In any of the variations described herein convective heating of the liquid material (e.g., *Cannabis* oil) wicked by the wick. The heating coil may be any appropriate material, but in particular, electrically resistive materials such as nichrome or other resistive materials, particularly those which change their resistance with heat (e.g., having a resistance that increases linearly and predictably with temperature over the desired range of temperatures, e.g., between 30° C. and 600° C., etc., including stainless steel, titanium, nickel, alloys of nickel, etc.).

The cartridge may have any desired shape or configuration. In some variations it may be beneficial in particular to have a shape that is cylindrical, and particularly a flattened cylinder, such as an approximately oval shape, with curved sides. Two of the sides (though curved) may be major sides, having a larger diameter, and two may be minor sides (though curved), having a smaller diameter. The flattened shape may prevent rolling when the device is placed on its side. In some variations the mouthpiece may extend in a slightly tapered shape. The tank may form a central region of the cartridge, bounded by the mouthpiece at one end (at the top) and the air chamber (at the bottom). A central cannula may form the air path between the vaporization chamber and the mouthpiece. The vaporization chamber and cannula may be surrounded by the tank, and may be visible through the walls of the tank (e.g., the vaporization chamber and cannula may be opaque, transparent or translucent). One or more seals, including o-rings, may be used to seal and secure the mouthpiece from the tank and the air chamber (base of the cartridge) from the tank. For example an inner seal may be between the mouthpiece and the outer wall of the tank (which may include a channel or track for the seal/o-ring) and a second seal (o-ring) may be positioned in an inner wall of the tank between the tank and the walls forming the air chamber and/or vaporization chamber at the base of the cartridge.

In any of the variations described herein it may be useful to provide an indication of the amount of the cartridge vaporized, which may be approximately correlated to the dose of the vaporizable material delivered. In any of the apparatuses described herein, the apparatus may include an output (e.g., LED, LCD or other display, etc.) on the apparatus or on a device in communication (e.g., wireless communication) with the apparatus such as a smartphone, laptop, desktop, pad, or the like. The output may indicate a qualitative and/or quantitative amount of the dose of vapor delivered from a particular cartridge. Dose may be determined using the processor of the apparatus to indicate approximately how much of the material, e.g., *Cannabis* oil, has been consumed based on the power applied to the heater and the duration of heating. A qualitative output may be provided by sequentially illuminating (and/or changing the intensity and/or color of illumination) of a plurality of LEDs. In another example a 'status bar' showing consumption or dose delivered from a cartridge may be displayed on the apparatus body (e.g., the vaporizer body) or another device (e.g., smartphone) in communication therewith. For example, a plurality of LEDs (RGB) may be illuminated to provide qualitative feedback to a user on the operation of the vaporizer. Upon inserting a cartridge, the vaporizer apparatus may display using the LEDs an illumination corresponding to the intensity of the inhalation and/or the progression of consumption of vaporizable material from the cartridge. The processor in the vaporizer apparatus may estimate a dose based on the power applied to the vaporizer and the duration of heating and/or the duration of draw (inhalation). For example, the power applied*duration of draw may be accumulated by the processor, and the value output. In some variations the output may be provided for display on the body of the apparatus (e.g., by illuminating a sequence of LEDs. This may provide immediate visual feedback to the user.

The apparatuses, and particularly the cartridges, described herein may be adapted specifically for use with oils such as *Cannabis* oils. As discussed above, existing cartridges are poorly suited for use with *Cannabis* oils, as they may leak. Leaking of *Cannabis* oils is both messy and detrimental to the operation of the vaporizer, as the leaked *Cannabis* oils may disrupt the electrical connections driving vaporization and may clog or jam the operation of the apparatus. The cartridges described herein may include a number of specific modifications that address these issues; individually, these modifications may be helpful, but as will be described below, in combination these features have proven surprisingly effective at providing a robustly leak-resistant and reliable cartridge when using an oil such as a *Cannabis* oil.

For example a cartridge device for holding a vaporizable cannabinoid material without leaking (e.g., that is substantially leak-resistant) may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having a width and a diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

In particular the combination of the flattened elongate body shape (which may be oval or rectangular) along with the enlarged and enclosed overflow leak chamber (typically having an open volume of greater 0.5× or greater the tank volume) at the distal end, and one or more (e.g., two, three, four, etc.) openings into the overflow leak chamber, which may preferably include a lip region around the openings inside the overflow leak chamber. The use of absorbents pads positioned within the overflow leak chamber (e.g., positioned off-axis, along a major wall of the overflow leak chamber, such as the wall extending in the diameter) provides an effective leakage barrier even when changing altitudes or when the user misuses the cartridge, e.g., user-

induced failure modes such as biting or squeezing the mouthpiece, and/or blowing into the mouthpiece. Surprisingly, other combinations of such features are less effective, particularly in user-induced failure modes. For example, otherwise similar cylindrical devices, e.g., having a width and diameter that are equivalent or nearly equivalent (e.g., a diameter less than 1.2×, or greater than 0.8×, the width) may show greater leakage compared to more flattened devices; the addition of one or more absorbent pads, particularly along the long wall of an overflow leak chamber) show an even greater reduction in leakage.

The one or more openings into the overflow leak chamber may be present on any surface of the cartridge, including through the distal end of the overflow leak chamber. Although placement of the opening at the distal end may otherwise result in an increase in leakage of the highly viscous oil from the cartridge, including the leak chamber and the absorbent pad(s) prevents or reduces leakage. In addition, the one or more openings may be surrounded by a lip within the leak chamber. The lip may have a height above the inner wall of the chamber that is 0.3 mm or greater (e.g., 0.5 mm or greater, 0.7 mm or greater, 0.8 mm or greater, 0.9 mm or greater, 1 mm or greater, 1.2 mm or greater, 1.3 mm or greater, 1.4 mm or greater, 1.5 mm or greater, 2 mm or greater, etc.).

The one or more absorbent pads may be positioned within the overflow leak chamber along the diameter, off-axis relative to an air flow path through overflow leak chamber from the opening to the air path.

In general, the overflow leak chamber may be relatively large, e.g., the volume of the overflow leak chamber (including the absorbent pad(s)) may be between 0.4 and 1.5× the volume of the tank (reservoir). In particular, the volume of the overflow leak chamber may be between 0.4 and 1× the volume of the tank (e.g., 0.4× or greater, 0.5× or greater, 0.6× or greater, 0.7× or greater, etc. than the volume of the tank). Alternatively, this may be described as the length of the overflow leak chamber along the distal to proximal axis relative to the length of the tank, and may be between 0.4× and 2× the length of the tank along the distal to proximal axis (e.g., between 0.4× and 1×, between 0.5× and 2×, between 0.5× and 1.5×, etc.), typically 0.4× or greater. In general, the overflow leak chamber may be enclosed within the distal end of the elongate and flattened tubular body.

In general, the cartridges described herein may be configured for insertion (e.g., by friction fitting) into a vaporizer body. Thus, the cartridge, and particularly the distal end of the cartridge, may be adapted to be inserted securely into the re-usable vaporizer device. The cartridge may therefore have straight (e.g., flat) or inwardly tapered sides and may include one or more friction-engagement regions that couple within the vaporizer. In some variations the distal end region of the cartridge may include a channel, rim, lip, ridge, protrusion, etc. that may engage with a complimentary region in the vaporizer (e.g., in a cartridge receiver in the vaporizer body). Thus, the cartridge may be configured to 'snap' fit into the vaporizer body. For example, the distal end of the elongate and flattened tubular body may include a lip or rim configured to snap into a vaporizer body.

The cartridge may also include one or more (e.g., a pair) of electrical contacts on the distal end of the cartridge (e.g., on the distal end of the overflow leak chamber) in electrical communication with the heater. These electrical contacts may also be configured and adapted to prevent or ameliorate the effects of leakage of oil from the cartridge. For example, the electrical contacts may comprise scraping contacts (also referred to as wiping or wiper contacts), which may include an edge or edge to scrape against the contact (e.g., pogo pin) from the vaporizer before (and/or separately from) making electrical contact. For example, the pair of electrical contacts may comprise pin receptacles. These pin receptacles may include an outer scraping edge with an inner conductive surface.

In any of the variations described herein, the tank may include a cannabinoid solution (e.g., a *Cannabis* oil solution). Thus, the cartridge may be pre-filled with a *Cannabis* oil. The tank volume may be configured to hold between about 0.2 mL and about 2 mL or more of oil. For example, the tank may be configured to hold between about 0.4 mL and about 1.2 mL (e.g., between about 0.4 mL and 0.8 mL, etc.)

The mouthpiece may be configured to fit over the proximal end of the elongate and flattened tubular body, and may be in fluid communication with the air path through the tank. The mouthpiece may include an internal volume; one or more absorbent pads may be positioned within this internal volume. The one or more mouthpiece absorbent pads within the mouthpiece may generally be off-axis relative to the air path (leaving a central air path that is not occluded by the absorbent pads). For example, the mouthpiece absorbent pads may be off-axis relative to an air flow path from the air path and out of the mouthpiece. The mouthpiece absorbent pads may be positioned on the sides of the mouthpiece (e.g., the major sides, corresponding to the diameter of the mouthpiece). The absorbent pad(s) may be between a proximal end of the mouthpiece and the elongate and flattened tubular body.

In any of the devices described herein the air path may extend through the cartridge, from the distal end (e.g., the opening(s) into the overflow leak chamber), past the heater, through and/or around the tank, and out of the mouthpiece. In some variations, the air path comprises a cannula extending through the tank. In general, the elongate body may be transparent or translucent, and any material in the tank may be visible; when the device includes a cannula running through the tank this may also be visible.

The absorbent pads in the overflow leak chamber may be the same material and/or dimensions as those (if present) in the mouthpiece, or they may be different materials and/or dimensions. The one or more absorbent pads may be made of a sponge or felt material. The one or more absorbent pads may comprise a pair of flat absorbent pads arranged in parallel. For example, the one or more absorbent pads may comprise a cotton material. The one or more absorbent pads may be rectangular.

As mentioned, the one or more absorbent pads in the overflow leak chamber may be a pair of absorbent pads positioned within the overflow leak chamber off-axis relative to an air flow path through the overflow leak chamber from the opening to the air path.

The heater (e.g., wick and coil) may be positioned within the air path so that it is parallel, transverse or oblique to the air path. For example, the heater may extend across the air path in a transverse direction.

The elongate and flattened tubular body may have an oval cross-section or a rectangular cross-section transverse to the distal to proximal axis, and may be any appropriate size. For example, the elongate tubular housing may be between about 1 cm and 10 cm long (e.g., between about 2 cm and 7 cm long, etc.). It may be particularly beneficial to have the elongate tubular housing be somewhat short and compact (e.g., less than 8 cm, less than 7 cm, less than 6 cm, less than 5.5 cm, less than 5 cm, etc.)

The sizes of the openings into the air path (through the overflow leak chamber, e.g., at the distal end of the cartridge) may be configured to allow relatively easy draw through the cartridge, while preventing leakage out of the overflow leak path. Leaking may occur from the heater (e.g., the exposed wick) which is inserted through the wall of the tank; the air path within the cartridge is open and continuous, which would otherwise allow the material to leak. Thus, for example, the size of the one or more openings may be specified within a range identified as allowing sufficient air flow without permitting excessive leaking. For example, in some variations, the diameter of the opening(s) into the overflow leak chamber is/are between 0.1 mm and 5 mm (e.g., between 0.1 mm and 3 mm, between about 0.1 mm and 2 mm, etc.).

The tank portion of the device may be filled by an opening beneath the mouthpiece, which may be sealed or plugged. For example, the cartridge may include a plug between the mouthpiece and the elongate and flattened tubular body, wherein the plug closes off the tank of the elongate and flattened tubular body.

Any of the cartridge devices for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece on the proximal end of the elongate and flattened tubular body; an enclosed overflow leak chamber at a distal end of the elongate and flattened tubular body, The device of claim **1**, wherein a length of the overflow leak chamber along the distal to proximal axis is 0.5 times or greater than a length of the tank along the distal to proximal axis; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path proximal to the overflow leak chamber; an opening through the distal end of the overflow leak chamber, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

For example, a cartridge device for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body, wherein a length of the overflow leak chamber along the distal to proximal axis is between 0.5 and 2 times a length of the tank along the distal to proximal axis; an air path extending proximally from the overflow leak chamber through the tank to the mouthpiece, wherein the air path comprises a cannula extending through the middle of the tank; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** show moisture and vapor deposition on a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **3**A and **3**B show a vaporization device with a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **4**A and **4**B show an exemplary vaporization device. This exemplary device includes two pairs of absorbent filter pads, as described herein. FIGS. **4**A and **4**B show a cartridge placed within the reusable component of the device.

FIGS. **5**A-**5**F illustrate the vaporizer body (e.g., a reusable component of the vaporizer device of FIGS. **4**A and **4**B). FIG. **5**A is a bottom perspective view; FIG. **5**B is a front view, FIG. **5**C is a top perspective view (looking into the cartridge receiver region including electrical contacts), FIG. **5**D is a side view, FIG. **5**E is a top view, and FIG. **5**F is a bottom view, showing the electrical connection to a charger or other wired electrical connection.

FIGS. **6**A-**6**D illustrate the cartridge of the device of FIGS. **4**A and **4**B. FIG. **6**A is a bottom perspective view, FIG. **6**B is a bottom view, FIG. **6**C is a top perspective view (showing the opening into the mouthpiece) and FIG. **6**D is an exploded view of the cartridge of FIG. **6**A.

FIGS. **7**A-**7**F illustrate an alternative view of a cartridge as described herein. FIG. **7**A shows a bottom perspective view; FIG. **7**B is a top perspective view; FIG. **7**C is a front view; FIG. **7**D is a side view; FIG. **7**E is a bottom view; and FIG. **7**F is a top view.

FIGS. **8**A-**8**G show a variation of a vaporizer base of a vaporizer apparatus into which a cartridge such as the one shown in FIGS. **7**A-**7**F may be inserted. FIG. **8**A is a bottom perspective view; FIG. **8**B is a top perspective view showing the cartridge receiver portion of the vaporizer base; FIGS. **8**C, **8**D and **8**E show front, side and back views, respectively of the vaporizer base; and FIGS. **8**F and **8**G show bottom and top views, respectively of the vaporizer base.

FIGS. **9**A-**9**G show an assembled vaporizer apparatus including a vaporizer cartridge such as the one shown in FIGS. **7**A-**7**F that has been fully seated and retained in a vaporizer base such as the one shown in FIGS. **8**A-**8**G. FIGS. **9**A and **9**B show bottom perspective and top perspective views, respectively of the assembled vaporizer apparatus; FIGS. **9**C, **9**D and **9**E show front, side and back views, respectively of the assembled vaporizer apparatus; FIGS. **9**F and **9**G show bottom and top views, respectively, of the vaporizer apparatus.

FIG. **10**A is an exploded view of the cartridge of FIGS. **7**A-**7**F with the components arranged in line.

FIG. **10**B is an alternative exploded view of the cartridge of FIGS. **7**A-**7**F, showing the component parts positioned adjacent to each other at the approximate vertical position for assembly.

FIG. **11**A is a semi-transparent view (in which the outer casing of the vaporizer base, mouthpiece, and cartridge housing have been a made transparent) showing the air path through the assembled vaporizer apparatus such as the one shown in FIGS. **7**A-**9**G.

FIGS. **11**B and **11**C show front and back views, respectively, of an example of a vaporizer base with the outer housing (case or shell) made transparent, showing the cartridge receiving end including connectors and air entry port therein.

FIG. **12** is an enlarged view of a section through a midline of the proximal (top) region of a cartridge (as shown by

dashed line **12-12'** in FIG. **9**A), showing the air path from the vaporization chamber to the mouthpiece openings.

FIG. **13** is a section through the midline of a vaporizer apparatus (including a vaporizer base into which a vaporizer cartridge has been coupled), showing the air path during inhalation (puffing, drawing, etc.).

FIG. **14** show a section through a cartridge, just beneath the mouthpiece (as shown by dashed line **14'-14'** in FIG. **9**B) showing the arrangement of the distal pair of absorbent pads offset from the airflow path.

FIG. **15**A is a section through the midline of an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **15**A-**15**A').

FIG. **15**B is another section through an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **12-12'**).

FIG. **15**C shows another section through the assembled vaporizer apparatus (through line **15**C-**15**C' in FIG. **9**B).

FIG. **15**D is a section through a cartridge (through line **15**D-**15**D' of a cartridge such as the one shown in FIG. **7**A) showing a pair of overflow filter pads that are off-axis relative to the airflow path of the device.

FIG. **16** is a section through another of another exemplary vaporization device (at line **16-16'** in FIG. **9**B), near the base of the cartridge and inserted into the cartridge receiver of the vaporizer base.

FIG. **17** is an electrical schematic of a heating element and connectors showing the Seebeck coefficients for a simplified model of the components of the heating circuit.

FIG. **18** is a Seebeck measurement circuit for a vaporizer apparatus correcting for the Seebeck effect, configured as a two-terminal sensing circuit.

FIG. **19** is another example of a Seebeck measurement circuit for a vaporizer apparatus, configured as a four-terminal (four-point) circuit.

FIGS. **20**A and **20**B illustrate two examples of heating coils comprising different component conductors coupled to result in resistive heater from which a temperature measurement may be determined using a Seebeck sensing circuit as described herein.

FIG. **21** is one example of a user interface (UI) for interacting with the apparatuses described herein using an external controller (e.g., smartphone, pad, etc.)

FIG. **22** is another example of a US for interacting with an apparatus as described herein.

DETAILED DESCRIPTION

The apparatuses and methods described herein generally include forming a vapor from a material (including in particular, liquid and oil-type plant materials) using a vaporization device. The vapor may be delivered for inhalation by a user. These apparatuses may be particularly adapted for use with an oil-based vaporizable material, including *Cannabis* oils.

The vaporizer apparatuses, including cartridges (vaporizer cartridges) and reusable vaporizers bases described herein may be used with any appropriate vaporizable material, including aqueous vaporizable materials. These apparatuses may be particularly well adapted for use with viscous, oil-based vaporizable materials, including *Cannabis* oils. For example, any of the cartridges described herein may be used (e.g., filled) with a vaporizable material comprising viscous liquid such as a *Cannabis* oil. In some variations the *Cannabis* oil comprises between 40-100% *Cannabis* oil extract. The viscous oil may include a carrier for improving vapor formation, such as propylene glycol, glycerol, etc., at between 0.01% and 25% (e.g., between 0.1% and 22%, between 1% and 20%, between 1% and 15%, etc.). In some variations the vapor-forming carrier is 1,3-Propanediol. A *Cannabis* oil may include a cannabinoid or cannabinoids (natural and/or synthetic), and/or a terpene or terpenes. For example, any of the vaporizable materials described herein may include one or more (e.g., a mixture of) cannabinoid including one or more of: CBG (Cannabigerol), CBC (Cannabichromene), CBL (Cannabicyclol), CBV (Cannabivarin), THCV (Tetrahydrocannabivarin), CBDV (Cannabidivarin), CBCV (Cannabichromevarin), CBGV (Cannabigerovarin), CBGM (Cannabigerol Monomethyl Ether), Tetrahydrocannabinol, Cannabidiol (CBD), Cannabinol (CBN), one or more Endocannabinoids (e.g., anandamide, 2-Arachidonoylglycerol, 2-Arachidonyl glyceryl ether, N-Arachidonoyl dopamine, Virodhamine, Lysophosphatidylinositol), and/or a synthetic cannabinoids such as one or more of: JWH-018, JWH-073, CP-55940, Dimethylheptylpyran, HU-210, HU-331, SR144528, WIN 55,212-2, JWH-133, Levonantradol (Nantrodolum), and AM-2201. The oil vaporization material may include one or more terpene, such as Hemiterpenes, Monoterpenes (e.g., geraniol, terpineol, limonene, myrcene, linalool, pinene, Iridoids), Sesquiterpenes (e.g., humulene, farnesenes, farnesol), Diterpenes (e.g., cafestol, kahweol, cembrene and taxadiene), Sesterterpenes, (e.g., geranylfarnesol), Triterpenes (e.g., squalene), Sesquarterpenes (e.g., ferrugicadiol and tetraprenylcurcumene), Tetraterpenes (lycopene, gamma-carotene, alpha- and beta-carotenes), Polyterpenes, and Norisoprenoids. For example, an oil vaporization material as described herein may include between 20-80% cannabinoids (e.g., 30-90%, 40-80%, 50-75%, 60-80%, etc.), 0-40% terpenes (e.g., 1-30%, 10-30%, 10-20%, etc.), and 0-25% carrier (e.g., polyethylene glycol).

In any of the oil vaporization materials described herein (including in particular, the cannabinoid-based vaporization materials, the viscosity may be within a predetermined range. The range may be between about 30 cP (centipoise) and 115 KcP (kilocentipoise). For example, the viscosity may be between 40 cP and 113 KcP. Outside of this range, the vaporizable material may fail to wick appropriately to form a vapor as described herein. In particular, the oil may be made sufficiently thin to both permits wicking at a rate that is useful with the apparatuses described herein, while also limiting leaking (e.g., viscosities below that of ~40 cP might result in problems with leaking).

For example, FIGS. **7**A-**7**F illustrate one example of a cartridge that is adapted for use with a viscous oil-based vaporizable material (having a viscosity at room temperature of between 40 cP and 113 KcP), such as a *Cannabis* oil. In this example, the cartridge **700** includes a flattened body that is approximately oval in cross-sectional area (see, e.g., FIGS. **7**E and **7**F showing top and bottom views) and includes a mouthpiece that is attached over a clear body forming a reservoir region holding the vaporizable material. The body **790** may be transparent, translucent or opaque. The mouthpiece may include one or more openings **792** at the proximal end (top) out of which vapor may be inhaled, by drawing breath through the device. The bottom may also include a locking feature (e.g., tab, indent, magnetic lock, etc.) for coupling and securing the cartridge within a cartridge receiver of a vaporizer base, such as the reusable vaporizer base **800** shown in FIGS. **8**A-**8**G. In this example, the body may be elongate and may include an outer shell or cover **890**; the proximal end of the vaporizer base may include an opening forming a cartridge receiver **892**. The cartridge receiver may include one or more opening there-

through (e.g., lateral openings) to allow airflow therein, as described in more detail below. Any of these cartridges may also or alternatively include a rim, ridge, channel, protrusion, lip, etc. along the distal end region for engaging a complimentary portion of the vaporizer device. For example, in FIG. **7**D, the cartridge include a channel or lip **795** at the distal end which may engage with a deflectable or deformable tab or protrusion in the cartridge receiving portion of the vaporizer; this may provide a snap fit. In general, the cartridge may fit within the cartridge receiver of the vaporizer by a friction fit. The snap-fit may provide audible and/or tactile confirmation that the cartridge is held in position. This fit may also lock or hold the cartridge within the receiver, but still allow it to be easily withdrawn to remove the cartridge.

As shown in FIG. **7**C, the elongate and flattened body **790** may contain within it the tank region **791** (e.g., holding the vaporizable oil material) and a distal overflow leak chamber **793**. These structures may be formed by the internal components within the elongate and tubular body, as shown below.

FIGS. **10**A and **10**B show exploded view of a cartridge as described herein. In this example, the apparatus includes a cartridge body **1005** that may be clear (transparent), opaque and/or translucent. The cartridge body may form a reservoir for the liquid vaporizable material, and particularly for a viscous liquid vaporizable material such as the cannabinoid oils described herein. The cartridge may include an outer seal (e.g., o-ring **1009**) that seals the mouthpiece **403** over the body **1005**. The reservoir (tank) may be sealed on the top (at the proximal end) under the mouthpiece by a single-piece plug **888** that covers multiple openings which may be used for filling the tank. The vaporization chamber may be formed at the bottom (distal end) of the cartridge; in exemplary cartridges described herein the vaporization chamber is formed from a cannula and housing piece **1011** that includes opening into which the wick (wick portion of wick and coil **443**) passes into the chamber; the walls forming the vaporization chamber separate it from the tank and mate with a back piece **1013** that forms the bottom (distal end) of the tank within the cartridge body. This piece is also sealed (e.g., by an o-ring **1015**) to the cartridge body from within the cartridge body, as shown. An air chamber is then formed between the bottom of the cartridge **1019** and the back piece **1013** of the tank. One or more (e.g., two) air openings **796**, **796'** through this bottom **1019** allow air to pass (after entering the cartridge receiver through one or more openings **894** in the side) into the distal end of the cartridge, into the air chamber region and then up through an opening into the vaporization chamber. The piece forming the bottom of the cartridge **1019** may also accommodate or include one or more (e.g., two) electrical connectors that are configured to mate with the connectors on the vaporizer base. As mentioned, these contacts may be wiper or scraping contacts. In FIGS. **10**A and **10**B, they are shown as cans **1021**, **1021'** having openings into which the pins project to form an electrical contact.

The vaporizer body typically includes a battery and one or more control circuits housed within the cover **890**. The control circuitry may control the heater, which in this example, is present in the cartridge. The heater may generally include a heating coil (resistive heater) in thermal contact with the wick; additional connectors formed of a different material (e.g., conductive material) may connect the heater coil to the electrical contacts on the base of the cartridge; although this may lead to inaccuracies in detecting and controlling temperature electrically, as described below, the control circuitry may include one or more additional circuits, such as Seebeck measurement circuits, that correct for offsets and other inaccuracies in the determination of temperature and therefore the power applied to the apparatus. The control circuitry may also include and may control and/or communicate with a batter regulator (which may regulate the battery output, regulate charging/discharging of the battery, and may provide alerts to indicate when the battery charge is low, etc.). The co control circuitry may also include and may control and/or communicate with an output, such as a display, one or more LEDs, one or more LCDS, a haptic output, or any combination of these. In the example shown in FIGS. **7**A-**9**G, the apparatus includes only four (RGB) LEDs **897**, arranged in a pattern (e.g., a circular, spiral or floral pattern; other patterns may include linear patterns). Any of the apparatuses described herein may also include a wireless communication circuitry that is part of, connected and/or controlled by the control circuitry. The apparatus may be configured to wireless communicate with a remote processor (e.g., smartphone, pad, wearable electronics, etc.); thus the apparatus may receive control information (e.g., for setting temperature, resetting a dose counter, etc.) and/or output information (dose information, operational information, error information, temperature setting information, charge/battery information, etc.).

The apparatus may also include one or more inputs, such as an accelerometer, a lip sensing input, a contact input, or the like. In particular, described herein are vaporizer apparatuses in which the device does not include any visible buttons, switches or external user input on an outer surface of the cartridge or vaporizer base. Instead, the input may be an accelerometer (coupled to, part of, and/or controlled by the control circuitry). The accelerometer and any accelerometer control circuitry may be configured to detect tapping on the apparatus (e.g., the case) and/or rolling of the apparatus (e.g., around the long axis or the short axis of the device). In some variations the apparatus may also include circuitry for sensing/detecting when a cartridge is connected and/or removed from the vaporizer base. For example, cartridge-detection circuitry may determine when a cartridge is connected to the device based on an electrical state of the electrical contacts within the cartridge reliever in the vaporizer base. For example, FIG. **5**C illustrates the two electrical contacts **595**, **595'**. Without a cartridge inserted into the apparatus the circuit is open (e.g., between **595** and **595'**) with the cartridge inserted, the electrical contacts (shown as pins **595**, **595'** in FIGS. **5**D and **11**B) engage with the contacts (such as wiping contracts, described above, which scrape to remove leaked and/or dried vaporizable material on the electrode contact surfaces). The controller (via a separate or integrated cartridge-detection circuit) may determine that a cartridge has been inserted when the resistance between these contacts changes to within a recognizable range (from the open circuit). Other cartridge detectors may be used alternatively or additionally, including a trip switch (which is activated when the cartridge is present), or the like. Any of the apparatuses described herein may also include one or more breath detectors, including a pressure sensor **1109** (e.g., microphone coil) having a connection to the inside of the cartridge receiver, as shown in FIG. **11**B.

The vaporizer body may also include a connector **899** at the distal end for coupling the device to a charger and/or data connection. The internal battery may be charged when coupling the device to a connector; alternatively other electrical connectors and/or inductive charging may be used.

FIGS. **9**A-**9**G illustrate an example of an apparatus (vaporizer apparatus) in which the cartridge **700** has been inserted completely into the vaporizer body **800**. The resulting device is small, lightweight, hand-held and may be safely stored in a pocket, purse, or the like.

In operation, the user may (once charged sufficiently), may activate the vaporizer by being drawing (inhaling) through the mouthpiece. The device may detect a draw (e.g., using a pressure sensor, flow sensors, or the like, including a sensor configured to detect a change in temperature or power applied to a heater element, e.g., anemometer detection) and may increase the power to a predetermined temperature preset. The power may be regulated by the controller by detecting the change in resistance of the heating coil and using the temperature coefficient of resistivity to determine the temperature. As described in greater detail below, the temperature determination and/or power applied may be optionally corrected in cases where there are different electrically conductive materials connecting the resistive heater to the power supply/power, in which the Seebeck effect may be an issue, using a sensing circuit to estimate and compensate for this potential source of inaccuracy.

In any of the apparatuses described herein, the temperature may be adjusted or selected by the user. As mentioned, in some variations the apparatus does not include an exterior control or user input, but still allows the user to select the temperature from among a plurality (e.g., two or more, three or more, etc.) of pre-set heating/vaporizing temperatures above 100° C. This may be achieved by allowing the user to coordinate (in time, e.g., within 60 seconds, within 50 seconds, within 40 seconds, within 45 seconds, within 40 seconds, within 30 seconds, within 20 seconds, within 10 seconds, between 1 second and 60 seconds, between 2 seconds and 60 seconds, between 3 seconds and 60 seconds, etc.) a pair of distinct inputs that are based detection of inputs that are internal to the apparatus (e.g., not from controls on the surface of the apparatus), such detection an accelerometer input (e.g., tapping, such as one or more, e.g. 3 or more, taps, rotations of the device in the long axis, etc.) within a predefined time after removing the cartridge and/or inserting the cartridge. For example, the apparatus may enter into a temperature selection mode to allow a user to select the temperature by removing the cartridge after shaking the apparatus (e.g., for 1 or more seconds, e.g., 2 or more seconds, etc.). Once in a temperature selection mode, the user may select from among a number (e.g., 4) or pre-set temperatures by tapping the housing of the device to cycle through the pre-set temperatures, which may be displayed on an output (e.g., LED, monitor, LCD, etc.) on the apparatus.

Any other input on the device that is not (or not connected to) a button, and particularly an external button, may be used in a predetermined activation sequence (e.g., pattern of taps detected by the accelerometer, insertion/removal of cartridge, etc.) or in a set of sequential independent actuations. For example, the apparatus may enter into a temperature selection mode after removing and inserting a cartridge three times in quick successions (e.g., within 5 seconds of each step). In any of the variations described herein, merely shaking the apparatus may display information about the status of the device (e.g., the charge) using the output; the additional non-button input (e.g., removing the cartridge and/or inserting the cartridge) within the predetermined time may then allow the operating temperature to be selected.

In some variations, the apparatus includes multiple (e.g., 4) presets, and an optional additional preset (e.g., 5th preset or more) that may be user-settable. Alternatively or additionally, an external controller (smartphone, pad, computer, etc.) in may communicate with the apparatus to allow setting and/or selecting the operating temperature.

In on example, the apparatus may be operated to allow the user to select the operating temp (set mode) by shaking the device with a cartridge inserted. In some variations this may then change the display (e.g., multi-colored LEDs on the surface of the device), for example, displaying battery life using the multiple LEDs arranged (e.g., in an X pattern **897**, see, e.g., FIG. **8**C). While in this state, removing cartridge enters temp set mode. The device automatically cycles through the 4 (+1 or more, when user defined) presets. The user may then choose one by reinserting the pod at appropriate time. In some variations, the preset temperatures are: 270° C., 320° C., 370° C., 420° C. In some variations the user may modify or include an additional preset within a temp range around each preset, e.g.: within an operational range of between 270-420° C.

As mentioned above, any of the apparatuses described herein may be operated with an external processor to receive input and/or output to control operation of the device. For example, the vaporizer apparatus may be operated with an application software ("app") that allows control of the temperature or other functional setting and/or allows storage, display and/or transmission of operational and/or use information, including dose information. As described herein, an approximate estimate for dose may be determined based on the power applied to the heater (resistive coil) during inhalation (over time), e.g., power applied to coil multiplied by time of draw. This approximate 'dose' estimate may be accumulated over the use of a particular cartridge (e.g., once a cartridge is inserted, it may be accumulated and/or displayed until the cartridge is removed, roughly amounting to a "session" with that cartridge).

For example, FIGS. **21** and **22** illustrate exemplary user interfaces for an application software that allows the user to set and or adjust the pre-set temperatures of the apparatus. In FIG. **21**, the user may select the per-set temperature. FIG. **22** illustrates the use of the app to control the appearance and activity of the apparatus. For example, the user may lock/unlock the apparatus, and track usage (e.g., by does estimation).

In any of the apparatuses described herein the apparatus may allow the user to play one or more interactive "games" with the device. For example, any of these apparatuses may include an entertainment mode that may be entered by manipulating the device (e.g., by tapping, shaking, rotating, puffing in a predetermined pattern, etc.). In general, the entertainment mode may include one or more presentations (e.g., LED light displays, tones/music, patterns of vibrations, or combinations of these) and/or games. The device may be configured to allow selection of the presentation states or game states (games) to be played, or it may randomly select one. In general the games may be interactive, allowing the user to provide input, e.g., via the one or more inputs, such as movement of the device, via motions sensing, touching the device, via a button and/or capacitive sensor (e.g., lip sensing, etc.), puff/airflow sensing, inserting and/or removing the cartridge, etc.

For example, the entertainment mode may include a game such as a pattern-following game, wherein the device presents an output (e.g., one or more LEDS illuminated in a pattern and/or color), and the device (e.g. controller) may determine if a response entered by the user on the input correlates with a predetermined response. In general, the same controller used to control the heater may be used to control the entertainment mode including the games. Alter-

natively a separate controller may be used, and may communicate with the controller controlling the heater.

The one or more games may include a memory game. For example, in a memory game the device may presents an output sequence and determines if a sequence of responses entered by the user on the input correlates with a predetermined sequence of responses. The one or more games may include a triggered output game wherein the device presents an output in response to a predetermined user input. For example, the device may illuminate a series differently positioned and/or colored LEDs based on the angle or movement that the user holds the device.

The one or more games may include a chance type game, wherein the device is configured to display a random pattern of one or more of colors, tones or vibrations, in response to a predetermined user input. The entertainment mode may include a display game wherein the output comprises a plurality of LEDs and wherein the device is configured to cycle the LEDs through a predetermined sequence of colors in response to a predetermined user input. The entertainment mode may include a tone game wherein the output comprises a plurality of tones and wherein the device is configured to play a predetermined sequence of tones in response to a predetermined user input.

As mentioned, the device may be configured to be toggled between the normal mode and the entertainment mode by applying one or more predetermined user manipulations to the input. For example, the device may be rotated. In some variations, the device input comprises an accelerometer, and the device may be configured to be toggled between the normal mode and the entertainment mode by rolling or rotating the device (e.g., three or more times) in one or more directions.

In addition to or alternative to the games, the entertainment mode may include an entertainment output (display) that is triggered upon entering into the entertainment mode. For example, as mentioned, the entertainment output may include one or more of: a display of a plurality of colors and/or patterns on the output, a tone or series of tones, a vibration or series of vibrations.

Leak Prevention

Any of the apparatuses described herein may be configured to prevent or reduce leakage of the vaporizable material. As mentioned, leaking an oil-based (and particularly cannabinoid oils) is particularly troublesome in a vaporizer because the vaporizable material may dry as a sticky, tarry substance that is both messy and may disrupt operation of the apparatus, particular the reusable (e.g., vaporizer base) portion.

For example, any of the apparatuses described herein may include one or more absorbent pads or members that are oriented to prevent leakage without disrupting the airflow or formation of vapor. In general, moisture and particles from the vapor can be deposited on a filter pad that is off-axis relative to the vapor path. The vaporization device may be a handheld vaporization device.

As described above, any of the vaporization apparatuses (device and systems) may comprise a heating element, including a resistive heating element. The heating element may heat the material such that the temperature of the material increases. Vapor may be generated as a result of heating the material.

In some cases, a vaporization device may have an "atomizer" or "cartomizer" configured to heat an aerosol forming solution (e.g., vaporizable material). The vaporizable material may be heated to a sufficient temperature such that it may vaporize (e.g., between 200° C. and 500° C., e.g., between 250-450° C., between 270-420° C., etc.). The apparatus or method may include one or more pre-set vaporization temperatures and the apparatus or method may control (via controller including feedback logic) the temperature to a predetermined and/or selected temperature.

An atomizer may comprise a small heating element configured to heat and/or vaporize at least a portion of the vaporizable material and a wicking material that may draw a liquid vaporizable material into the atomizer (e.g., heater). When the apparatus includes a wicking material, the wicking material may comprise silica fibers, cotton, ceramic, hemp, stainless steel mesh, and/or rope cables. The wicking material may be configured to draw the liquid vaporizable material in to the atomizer without a pump or other mechanical moving part. A resistance wire may be wrapped around the wicking material and then connected to a positive and negative pole of a current source (e.g., energy source). The resistance wire may be a coil. When the resistance wire is activated, the resistance wire (or coil) may have a temperature increase as a result of the current flowing through the resistive wire to generate heat. The heat may be transferred to at least a portion of the vaporizable material through conductive, convective, and/or radiative heat transfer such that at least a portion of the vaporizable material vaporizes.

Alternatively or in addition to the atomizer, the vaporization device may be configured as a "cartomizer" to generate an aerosol from the vaporizable material for inhalation by the user. The cartomizer may comprise a cartridge and an atomizer. The cartomizer may comprise a heating element surrounded by a liquid-soaked poly-foam that acts as holder for the vaporizable material (e.g., the liquid). The cartomizer may be reusable, rebuildable, refillable, and/or disposable. The cartomizer may be used with a tank for extra storage of a vaporizable material.

Air may be drawn into the vaporization device to carry the vaporized aerosol away from the heating element, where it then cools and condenses to form liquid particles suspended in air, which may then be drawn out of the mouthpiece by the user. For example, any of the apparatuses described herein may include a draw channel or passage. The draw channel may be in fluid communication with the heater so that vapor formed by the heater passes into the draw channel, which is also in fluid communication with the mouthpiece, which may be integrated with the device (including a cartridge).

One or more aspects of the vaporization device may be designed and/or controlled in order to deliver a vapor with one or more specified properties to the user. For example, aspects of the vaporization device that may be designed and/or controlled to deliver the vapor with specified properties may comprise the heating temperature, heating mechanism, device air inlets, internal volume of the device, and/or composition of the material.

Energy may be required to operate the heating element. The energy may be derived from a battery in electrical communication with the heating element. Alternatively, a chemical reaction (e.g., combustion or other exothermic reaction) may provide energy to the heating element.

The term "aerosol" may generally refer to a colloid of fine solid particles or liquid droplets in air or another gas. In general, the aerosols described herein are liquid aerosols of primarily (e.g., >80%, >85%, >90%, >95%) liquid particles in air. The liquid or solid particles in an aerosol may have varying diameters of average mass that may range from monodisperse aerosols, producible in the laboratory, and containing particles of uniform size, to polydisperse colloidal systems, exhibiting a range of particle sizes. As the sizes

of these particles become larger, they have a greater settling speed which causes them to settle out of the aerosol faster, making the appearance of the aerosol less dense and to shorten the time in which the aerosol will linger in air. Interestingly, an aerosol with smaller particles will appear thicker or denser because it has more particles. Particle number has a much bigger impact on light scattering than particle size (at least for the considered ranges of particle size), thus allowing for a vapor cloud with many more smaller particles to appear denser than a cloud having fewer, but larger particle sizes.

A vapor may generally refer to a substance in the gas phase at a temperature lower than its critical point. As used herein, a vapor may include a liquid aerosol. For convenience the term vapor and aerosol, which may generally refer to liquid aerosols, may be used interchangeably herein, as is common in the art of electronic vaporization devices.

The methods and apparatuses described herein have a wide range of applications for inhalation of an active substance, such as botanicals, pharmaceuticals, nutraceuticals, or any other substance for inhalation to provide a benefit or sensation to an end user. In some embodiments, the devices described herein include a tank having a liquid containing an active ingredient, such as nicotine, *Cannabis*, or a cannabinoid.

The term "*Cannabis*" refers to plants of the genus *Cannabis* and loose-leaf products or extracts thereof. As mentioned above, the term "cannabinoid" refers to plant based or synthetic chemical compounds capable of acting on cannabinoid receptors and inducing a biological effect. Cannabinoids include acids, salts, and bioactive stereo isomers. Exemplary cannabinoids include tetrahydrocannabinol (THC), cannabigerolic acid (CBGA), cannabigerol (CBG), tetrahydrocannabinolic acid (THCA), cannabichromene (CBC), cannabicyclol (CBL), cannabivarin (CBV), cannabichromevarin (CBCV), cannabigerovarin (CBGV), cannabigerol Monomethyl Ether (CBGM), delta-8-tetrahydrocannabinol (D8THC), delta-9-tetrahydrocannabinol (D9THC), tetrahydrocannabivarin (THCV), cannabinolic acid (CBNA), Cannabinol (CBN), cannabidiolic acid (CBDA), Cannabidivaric acid (CBDVA), cannabidiol (CBD), cannabichromenic acid (CBCA), Cannabichromene (CBC), or cannabicyclolic acid (CBLA) and/or any salt or stereo isomer of the above.

The devices described herein for generating an inhalable aerosol may include a body having a battery, a cartridge or tank including or configured to include the vaporizable material, at least input (e.g., in some variations without any input on an outer surface of the apparatus, e.g., "button less"), and circuitry for controlling the device.

An exemplary vaporization device **200** is shown in FIGS. **1** and **2**. The vaporization device **200** includes two filter pads **222***a,b*. The filter pads **222***a,b* are positioned off of the central axis of the air path **212**. As the vapor travels down the air tube **208** and begins to return to liquid state, both condensation and particle aggregation will occur. As the vapor exits the air tube **208** into the air path **212**, the moisture (see FIG. **1**) and larger particles (see FIG. **2**) can filter onto the pads **222***a,b* (i.e., via gravity) without interfering with the user's draw on the device.

The one or more pads for use with any of the embodiments described herein (including pads **222***a,b*) can be made of an absorbent material. The absorbent material can both wick moisture quickly and allow it to disperse quickly therethrough. Thus, the absorbent material can be hydrophilic. Exemplary materials include cotton, e.g., a non-woven cotton lintner paper, felt, cellulose, or hydrophilic polymers. Further, the one or more pads can be curved, as shown in FIGS. **1** and **2** or can be substantially flat panels. In some embodiments, the one or more pads can each be made of two or more thin sheets of layered material.

The one or more pads can be positioned within or proximate to the mouthpiece so as to capture moisture just prior to inhalation by the user. Further, in some embodiments, as shown in FIGS. **1** and **2**, the one or more pads can be pushed up against the interior surface of the vaporizer so as to minimize interference with other components of the vaporizer. In other embodiments, the one or more pads can be pulled away from the interior walls so as to maximize the surface area available for moisture absorption. The pads can be rectangular, circular, ovoid, triangular, square, or other shape. The shape and size of the pads can be chosen so as to minimize interference with the air path while maximizing moisture and particle collection.

Another exemplary vaporizer **300** utilizing moisture deposition pads **322***a,b* is shown in FIGS. **3**A and **3**B. The vaporizer **300** includes a cartridge **301** that is attachable to a reusable component **300** (which can include the electronics to power the device, etc.). As shown in FIGS. **3**A and **3**B, the cartridge **301** can include a tank **302**, a heater assembly **343**, an air tube **308**, and a mouthpiece **303**. The pads **322***a,b* can be rectangular, flat, and positioned in parallel within the mouthpiece **303** on either side of the air tube **308** (i.e., off-axis with the air tube **308**). The vaporizer **300** can further include any of the features described in U.S. application Ser. No. 15/053,927, titled "VAPORIZATION DEVICE SYSTEMS AND METHODS," filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1, the entirety of which is incorporated by reference herein.

Another exemplary vaporizer **400** that can utilize one or more pads is shown in FIGS. **4**A-**6**B. As shown in FIGS. **4**A and **4**B, the vaporizer **400** includes a reusable component **411** and a cartridge **401**. The diameter of device **400** is greater than the width (e.g., greater than 1.2×, 1.3×, 1.4×, 1.5×, 1.6×, 1.7×, 1.8×1.9×, etc.), making the device have a substantially long and flat appearance and feel.

Referring to FIGS. **5**A and **5**B, the reusable component **411** includes a shell **431**, which can include the electronics for operating the vaporizer. Further, the reusable component **411** can include a visual indicator **421**, such as an LED, for signaling the operating status of the vaporizer **400**. The distal end of the reusable component **411** (shown in FIG. **5**F) includes a charging element **433** configured for charging the device. Further, the proximal end of the device (FIG. **5**E) includes contacts **435** for maintaining an electrical connection with the cartridge **401**.

The cartridge **401** is shown in FIGS. **6**A-**6**D. As best shown in the exploded view of FIG. **6**D the cartridge **401** includes a tank **441** configured to hold a liquid vaporizable material therein, a heater (e.g. a wick and coil assembly) **443** configured to heat the vaporizable material in the tank **441**, and an air tube **408** extending from the tank to a mouthpiece **403**. Contacts **535** are configured to connect with contacts **435** on the reusable component **411** to provide power to activate the wick and coil assembly **443**. At the distal end of the cartridge the walls of the elongate and flattened tubular body **441** and a bottom cover piece **691** form an overflow leak chamber **699**, which is shown with a pair of absorbent pads **495***a,b* are positioned along the long walls (along the diameter) of the overflow leak chamber. An option felt cover **693** may be included (also acting as an absorbent member).

As shown in FIGS. **4**A-**5**D, the device **400** further includes openings, configured as air inlets **762***a,b*, on the side of the shell **431**. The air inlets are proximate to openings

(air inlets) **662***a,b* on the distal end of the cartridge **401** (see FIGS. **6**A and **6**B) opening into the overflow leak chamber (not visible). Referring to FIG. **11**A (which is a cross-section of the device **400** at the center), the air flow path **777** from inlets **762***a,b* to inlets **662***a,b*, extends through the tube **408** until it reaches the stop **433** (see FIG. **12**) and then divides into two separate paths that extend along the inner surface of the mouthpiece **402** (between the pads **422***a,b*) and out through the outlets of the mouthpiece **403**.

As shown in FIGS. **6**D and **12-14**, parallel absorbent pads **422***a,b* can be positioned within the mouthpiece **403**. The absorbent pads **422***a,b* are rectangular and parallel with one another. The absorbent pads **422***a,b* are positioned substantially parallel to the flat side of the device **400** (parallel with the plane of the length **1** and width w in FIG. **4**A) and parallel with one another. In some embodiments, the pads **422***a,b* can be biased fully against the inside walls of the mouthpiece **403** so as to easily capture liquid that rolls along the walls. A distance between the two pads **422***a,b* can be, for example, between 3 and 6 mm, such as between 4 and 5 mm, e.g., approximately 4.8 mm. The gap between the absorbent pads **422***a,b* advantageously prevents the pads from interfering with the air flow path when a user draws on the mouthpiece **403**.

Further, as shown in FIGS. **6**D, **12** and **13** in some embodiments, over-flow pads **445***a,b* are positioned proximate to the tank **441**, i.e., within an overflow leak chamber below the tank, to absorb liquid that may leak out of the tank **441** during use. The over-flow pads **445***a,b* can be similarly placed parallel to one another and/or against the sides of the shell **431** as described above with respect to pads **422***a,b*.

FIG. **13** (which is a cross-section of the device **400** through the pads **422***a,b* and **445***a,b*) shows the air flow path **777** in dotted lines relative to the placement of the pads **442***a,b* and **445***a,b*. The air path **777** extends alongside all of the pads **422***a,b* without extending therethrough. That is, the pads **422***a,b* and **445***a,b* extend off-axis relative to the air path **777** and do not interfere with user draw. However, the pads **422***a,b* and **445***a,b* are positioned so that the air path **777** travels along, besides, and/or in contact with the pads **422***a,b* and **445***a,b* for an extended period of time so as to allow maximum absorption of liquid.

In use (i.e., when the user draws on the device), the device **400** can be held horizontally with the width, w, in the vertical direction and the diameter, d, in the horizontal direction. As such, at least one of the pads **422***a,b* and/or **445***a,b* will be substantially horizontal while the user draws on the device, ensuring that gravity will pull any moisture or particles down onto the lower pad **422***a,b* and/or **445***a,b*. Further, having two pads **422***a,b* and/or **445***a,b* advantageously ensures that moisture will be caught whether the user holds the device with pad **422***a* or **445***a* on top or **422***b* or **445***b* on top. This can both prevent interference with the electronics of the device and prevent the user from getting any liquid from the tank in his or her mouth when drawing on the device.

Referring to FIGS. **15**A-**15**D, exemplary device **800** is similar to device **400** (similar reference numbers are therefore used) except that it includes a single plug **888** in the proximal section of the cartridge **801** (i.e., as opposed to the two tank seals **604***a,b* shown in FIG. **6**D). The plug **888** is configured to simultaneously seal both outlets of the mouthpiece **403** while also sealing around the tube **408**.

Although sets of absorbent pads are shown and described with respect to the embodiments herein, only a single off-axis (i.e. "off air path") pad can be used in each location. Likewise, more than two (e.g., 3, 4, 5, or more) off-axis pads, such as strips of absorbent material, may be used. Similarly, only a single set of pads can be used.

In some embodiments, the absorbent pads can be located only in the cartridge area (i.e., in the disposable portion). In other embodiments, additional absorbent pads can also be used in the reusable portion of the device.

The wick for use with any of the embodiments herein can be large to handle higher viscosity liquids (e.g., liquids with cannabinoids). For example, the wick can be greater than 1.5 mm in diameter, such as approximately 2 mm in diameter.

Referring to FIG. **16**, in some embodiments, the openings (also referred to as air inlets) **962***a,b* to the cartridge **901** can include a protective annular ring **992***a,b* or seal theraround that extends away from the inner wall of the cartridge **901**. This ring can help prevent any spilled liquid from splashing into the inlets **962***a,b*. This ring may be lip or ridge projecting into the overflow leak chamber, as shown in FIG. **16**.

Referring still to FIG. **16**, in some embodiments, the contacts **935** of the reusable portion **911** of the device **900** can be pin contacts while the contacts **1035** of the cartridge **901** can be annular contacts or pin receptacles configured to mate with the pins. Further, in some embodiments, pin receptacles **1035** can include spring-loaded wiping mechanisms on the inner diameter thereof. The spring-loaded wiping mechanisms can be configured to wipe the pins as they pass therethrough. As a result, any vapor residue on the pins can be removed to maintain the proper electrical connection there between.

Power and Temperature Control

In any of the apparatuses described herein, the vaporizer apparatus may be controlled so that the temperature used to vaporize the vaporizable material is maintained within a preset range (e.g., one or more preset temperatures as discussed above, within +/− a few degrees (e.g., +/−3° C., 2° C., 1° C., 0.5° C., etc.). In general, the microcontroller may control the temperature of the resistive heater (e.g., resistive coil, etc.) based on a change in resistance due to temperature (e.g., TCR). For example, a heater may be any appropriate resistive heater, such as a resistive coil. The heater is typically coupled to the heater controller via two or more connectors (electrically conductive wires or lines) so that the heater controller applies power (e.g., from the power source) to the heater. The heater controller may include regulatory control logic to regulate the temperature of the heater by adjusting the applied power. The heater controller may include a dedicated or general-purpose processor, circuitry, or the like and is generally connected to the power source and may receive input from the power source to regulate the applied power to the heater.

For example, any of the apparatuses described herein may include logic for determining the temperature of the heater based on the TCR of the heating element (resistive coil), based on sensed resistance of the coil. The resistance of the heater (e.g., a resistive heater) may be measured (R_{heater}) and the controller may use the known properties of the heater (e.g., the temperature coefficient of resistance) for the heater to determine the temperature of the heater. For example, the resistance of the heater may be detected by a detection circuit connected at the electrical contacts that connect to the cartridge, and this resistance compared to a target resistance, which is typically the resistance of the resistive heater at the target temperature. In some cases this resistance may be estimated from the resistance of the resistive hearing element at ambient temperature (baseline).

In some variations, a reference resistor ($R_{reference}$) may be used to set the target resistance. The ratio of the heater resistance to the reference resistance ($R_{heater}/R_{reference}$) is

linearly related to the temperature (above room temp) of the heater, and may be directly converted to a calibrated temperature. For example, a change in temperature of the heater relative to room temperature may be calculated using an expression such as $(R_{heater}/R_{reference}-1)*(1/TCR)$, where TCR is the temperature coefficient of resistivity for the heater. In one example, TCR for a particular device heater is 0.00014/° C. In determining the partial doses and doses described herein, the temperature value used (e.g., the temperature of the vaporizable material during a dose interval, T_i, described in more detail below) may refer to the unit less resistive ratio (e.g., $R_{heater}/R_{reference}$) or it may refer to the normalized/corrected temperature (e.g., in ° C.).

When controlling a vaporization device by comparing a measure resistance of a resistive heater to a target resistance, the target resistance may be initially calculated and may be factory preset and/or calibrated by a user-initiated event. For example, the target resistance of the resistive heater during operation of the apparatus may be set by the percent change in baseline resistance plus the baseline resistance of the resistive heater, as will be described in more detail below. As mentioned, the resistance of the heating element at ambient is the baseline resistance. For example, the target resistance may be based on the resistance of the resistive heater at an ambient temperature and a target change in temperature of the resistive heater.

As mentioned above, the target resistance of the resistive heater may be based on a target heating element temperature. Any of the apparatuses and methods for using them herein may include determining the target resistance of the resistive heater based on a resistance of the resistive heater at ambient temperature and a percent change in a resistance of the resistive heater at an ambient temperature.

In any of the methods and apparatuses described herein, the resistance of the resistive heater may be measured (using a resistive measurement circuit) and compared to a target resistance by using a voltage divider. Alternatively or additionally any of the methods and apparatuses described herein may compare a measured resistance of the resistive heater to a target resistance using a Wheatstone bridge and thereby adjust the power to increase/decrease the applied power based on this comparison.

In any of the variations described herein, adjusting the applied power to the resistive heater may comprise comparing the resistance (actual resistance) of the resistive heater to a target resistance using a voltage divider, Wheatstone bridge, amplified Wheatstone bridge, or RC charge time circuit.

When using resistance and/or power applied to determine the temperature of the apparatus and/or to control temperature for vaporization, the inventors have determined that there may be a surprising disparity between the actual temperature and that predetected or determined using resistance of the heater alone. This problem because particularly acute when the distance between the heating element (e.g. resistive coil) and the electrical input into the cartridge (the power contacts from the vaporizer base) is longer, or there is a change in the conductive material between the heater and the contacts, as shown in FIG. **15**A. Where there is a change in the conductive material between the contacts, the electrical wiring and the resistive coil, thermoelectric effects arising due to this change in electrical characteristics (resistance) may give rise to inaccuracies when determining the power applied.

In the exemplary cartridges described above, the heating coil is connected to the electrical contacts by extension wires **1054**, **1054'** (see, e.g., FIG. **10**B). Because the extension wires are different materials, a voltage (EMF) may be generated at the junction between the different electrical conductors when there is a temperature gradient. This thermoelectric effect may be referred to as the Seebeck effect, and may generate a voltage that is based on the material properties of the different conductors. In the variations described above, although the heating coil, extensions and wick are nearly symmetric, during normal usage there may be uneven temperatures across the three, developing a temperature gradient. This may result in an uneven voltage being generated; this disparity may then lead to inaccuracies in controlling the heater (applied power) and/or estimation of the temperature.

Although at any particular time, the effect may be relatively minor (and therefore overlooked), the cumulative effect may lead to dramatic reductions in accuracy and temperature control; other systems may attempt to avoid this problem by modifying the resistance of the material used for the resistive heater, requiring a larger power; although this may reduce the overall contribution of the offset EMF voltage due to the thermoelectric property mismatch, it also requires a larger wattage and therefore battery (and resulting power) be applied.

Instead, any of the apparatuses described herein may include a precision resistance measurement circuit to track resistance of the heating element (e.g., a coil made from resistive heating alloy wire) when not heating and heating to control the temperature of the coil based on changes in coil resistance from room temperature to vaporization temperatures, as discussed above. For example, in some variations, the measurement circuit is an amplified Wheatstone bridge where the heating element (when connected) is one half of one of the two voltage dividers in the Wheatstone bridge and the two divider voltages are inputs to a differential op amp circuit. This control circuit may be modified as described herein to account for the mismatch in thermoelectric properties leading to the offset voltage.

Currently known resistance measurement systems typically use a two-terminal sensing or four-terminal sensing circuit, and are prone to measurement error when the load to be measured is also a voltage source or has an additional unknown voltage applied to it. As just mentioned above, in vaporizers that use resistive heating elements (often coils), extension leads are often used to route power to the heating element with minimal Joule heating and losses in the path between the heating element (where Joule heating is desired) and the voltage source (often a battery or power supply). For manufacturability, these extension leads are often the only connection between the device (or contacts that connect to the device) and the heating element, so measurement of the resistance of the heating element invariably includes the resistance of the extension leads and measurement error arising from the mismatched thermoelectric properties (Seebeck error). The heating element and extension leads (three conductors if considered individually) each have some temperature gradient along their lengths, and this temperature gradient generates an electromotive force (EMF, which is also a measureable voltage when the conductor is open circuit) in each conductor, which is $E_{emf}=-S\nabla T$, where S is the Seebeck coefficient of the conductor which depends heavily on the conductor material (but also on temperature of the conductor) and ∇T is the temperature gradient across the material. Because ideal materials for the heating element and extension leads often have different Seebeck coefficients, and since the temperatures at the two connection points between each extension lead and the heating element are likely to differ while heating (due to acceptable asym-

metries in both heating element assembly and heat transferred from the heating element and extension leads that are expected in a mass-produced product), there will be a net EMF across the extensions and heating element (seen as one load in any vaporization system where one set of extension leads electrically connects the heating element to the device) which will skew the resistance measurement, making temperature control of the heating element using measured resistance impossible without correction for this effect. More generally, measured resistance of the heating element will be skewed by the mismatched thermoelectric properties (e.g., the Seebeck effect) whenever there is a temperature difference between and material transition at the two heating element terminals where contacts or extensions are connected.

A simplified model of a heating element with two extension leads of the same material is shown in FIG. **17**. In this example, the heating element and extension lead combination connects to the device at the open ends of the extension leads shown above, so the resistance measurement of the heating element is taken through the extension leads connecting to it. S**1** and S**3** are constant coefficients that depend on the material properties (Seebeck coefficients) of each of the two extension lead materials, and S**2** is the Seebeck coefficient of the heating element. T**1** and T**4** are temperatures at the ends of the extensions that electrically connect to the vaporization device. T**2** and T**3** are temperatures of the connections between the extension leads and heating element (which may be welds, crimps, solder joints, or other electrical connections). The EMF, E_{net} is expected to skew the resistance measurement if E_{net} is non-zero. E_{net} from the Seebeck effect is expected to be:

$$E_{net}=-S1(T2-T1)-S2(T3-T2)-S3(T4-T3).$$

To illustrate how temperature differences between T**2** and T**3** can create a non-zero Enet, consider a further simplified model where temperatures at the two open (as shown) ends of the conductive path are assumed to be the same and close to the device temperature (T**1**=T**4**), which is an acceptable simplification in systems like ours where extensions connect to electrical contacts with large thermal mass at T**1** and T**4**. Seebeck coefficients for the two extensions are assumed to be the same since the two extension leads are of the same material (S**1**=S**3**). This reduces the above expression to:

$$E_{net}=(S2-S1)(T2-T3)$$

From the above expression, if S**2** and S**1** are not equal (heating element and extension leads have different Seebeck coefficients) and T**2** and T**3** are not equal (non-zero net temp gradient across the two points where heating element meets extensions), Enet will not be zero, and it will skew the resistance measurement taken by the device. For comparison, if there are no extension leads, EMF for the heating element alone can be considered:

$$E_{net}=S2(T2-T3)$$

When the heating element is connected directly to electrical contacts that are large thermal masses, it is expected (and can be measured) that T**2** and T**3** are very close and Seebeck effect introduces negligible error in resistance measurement. In other systems where extension leads are used, the Seebeck effect will skew measured resistance, making temperature control impossible when Seebeck effect is not corrected for.

Additionally, some systems without extension leads may still see a temperature difference between T**2** and T**3** depending on the device and heating element assembly. If this temperature difference is significant, this effect will have to be corrected for if accurate resistance measurements is desired.

The simple model above with extension leads and heating element is provided to illustrate the source of heating element EMF. In most systems there will be additional material transitions and temperature gradients in each material in the resistance measurement path. As described below, a complete understanding or modeling of all material transitions and junction temperatures is not needed to correct for this effect. The heating element EMF (caused by the Seebeck effect) can simply be measured and used to correct for the error it introduces in resistance measurements.

In a vaporization devices that uses measured heating element resistance for temperature control of the heating element as described above, heating element EMF may also measure and used to control the power applied and/or estimates of temperature. The Seebeck effect may be observed to be the main contributor to heating element EMF and is the only known contributor to heating element EMF when no current (or constant current) has been flowing through the element for some time. Measured heating element EMF can be used to correct for resistance measurement error caused by heating element EMF. The resistance measurement (skewed by Seebeck EMF) and the Seebeck EMF measurement together can be used to calculate accurate heating element resistances, which can be used to control average temperature of the heating element.

The effect of heating element EMF on the resistance measurement depends on the measurement circuit used. Heating element EMF will produce measurement error in all known resistance measurement circuits, so heating element EMF may be separately measured to correct for the error it causes in the resistance measurement. Sensitivity of the resistance measurement to heating element EMF may be understood so that measured heating element EMF can be used correctly to calculate heating element resistance from the two measurements taken. For example, the same differential op-amp used for the resistance measurement may also be used for the heating element EMF measurement. In the resistance measurement, the heating element may be powered through a voltage divider so that there is a measureable voltage across the heater which is compared against a reference voltage or summed with other reference voltages and amplified by the differential op amp circuit. For heating element EMF measurement, no voltage is applied to the heating element, which allows for direct measurement of the EMF, which is compared against another close reference voltage and amplified by the same differential op amp circuit used for the resistance measurement.

Because the same amplification circuit may be used, the sensitivities of both the resistance measurement and the heating element EMF measurement to heating element EMF will be the same. The two measurements may then be used to calculate accurate heating element resistances, the raw reading difference between measured heating element EMFs when the device is heating and when device has not been heating for some time (note that Seebeck EMF is 0 when heating element reaches thermal equilibrium in device) and may be subtracted from the raw resistance measurement reading before other calculations are performed to yield heating element resistance from corrected resistance measurement reading.

FIG. **18** illustrates one example of a measurement circuit that may be used as part of a vaporization apparatus. Operation of this circuit to control heating element resistance while heating may be as follows (with signal and

component names below referencing signals and components from schematic of FIG. **18**); except for H+ **1821**, all output boxes (**1801**, **1803**, **1805**, **1807**, **1809**, **1811**, **1813**) are connected to the microcontroller, which is not shown; timing noted below is for one exemplary software implementation and may be different or modified for different implementations). Heating element is connected between H+ **1821** and GND.

In FIG. **18**, when device is heating, HEATER **1807** is driven with PWM to connect VBAT to H+ **1821** through Q5 (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element. When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement), HEATER **1807** is held off and HM_PWR **1805** is held on (powering differential op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 us of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1809**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1809** between AREF_HM_OUT **1801** and GND during the last 68 μs of the measurement window. For the heating element resistance measurement, HM_NEG_REF_EN **1803** is on to bias the heating element so that the voltage divider formed by R**19** and the heating element can compared by the differential op amp circuit (comprised of U**5**, R**21**, R**22**, R**23**, and R**33**) against a fixed voltage divider formed by R**20** and R**32**, and some combination of R**28**, R**29**, and R**30**, which are used to keep HM_OUT **1809** in a usable voltage range between AREF_HM_OUT **1801** and GND for the range of heating element resistances that the device might see. HM_SCALE_**0-2** **1813** are either allowed to float (high impedance) or connected to GND within the microcontroller to use R**28-30** to set the resistance measurement range of the circuit.

For the heating element EMF measurement, HM_NEG_REF_EN **1803** is off to allow H+ to float to a voltage that is the heating element EMF (relative GND) and SEEBECK_REF_EN **1815** is on to make the fixed reference used by the differential op amp circuit close enough to heating element EMF that HM_OUT **1809** will be usable (will be between AREF_HM_OUT **1801** and GND) over the range of heating element EMFs expected when heating element is heated. Heating element EMF may be as high as +/−3 mV. The heating element EMF measurement circuit can measure between +/−5 mV. The measurement circuit yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations. Resistance calculations are as follows:

> Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset

Resistance measurement sensitivities and offsets may depend on the active resistance measurement scale (selected using HM_SCALE_**0-2** **1813**) and may be solved for using circuit component values and then included in the device (e.g., in the firmware, hardware or software of the apparatus).

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs. temperature curve.

The resistance measurement circuit may be a two-terminal sensing circuit, as just discussed. In other variations, a four-terminal sensing may be used to mitigate effects of variable contact resistance and trace or lead resistance in series with the heating element resistance measurement. Changing contact resistance and trace/lead resistance have a negligible impact on resistance measurement and temperature control, but these effects may be more pronounced in variations which have a lower resistance heating element and different heating element and device assembly. In this case, a four-terminal (also known as four-point) resistance and EMF measurement circuit, such as the one shown in FIG. **19**, may be used.

Operation of the circuit shown in FIG. **19** to control heating element resistance while heating may be done as follows (with signal and component names below referencing signals and components from schematic above; signals **1903**, **1905**, **1907**, **1909**, **1911**, **1913**, **1915**, **1917**) are connected to the microcontroller, which is not shown; timing noted below is exemplary only, and may be different). In FIG. **19**, HI+ **1822** and HV+ **1826** connect directly to one terminal of the heating element, while HV− **1828** and HI− **1824** connect directly to the other terminal of the heating element.

When device is heating, HEATER **1907** is driven with PWM to connect VBAT to H+ **1822** through Q2 (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element.

When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement), HEATER **197** is held off and HM_PWR **1905** is held on (powering the differential summing op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 μs of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1915**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1915** between AREF_HM_OUT **1913** and GND during the last 68 μs of the measurement window.

For the heating element resistance measurement, HM_WS_ISRC_EN **1903** is on to bias the heating element through R**20** and HI+/− terminals so that the voltage across HV+/− can measured by the differential summing op amp circuit (comprised of U**2**, R**19**, R**23-25**, and optionally R**10-14**, R**17**, and R**21**). HM_WS_POS_REF_EN **1903** is on to sum GND through R**19** with HV+ through R**25**. Some combination of HM_SCALE_**0-5** are on to sum HV− through R**24** with VBAT through some respective combination of R**10-14** to keep HM_OUT **1915** in a usable voltage range between AREF_HM_OUT **1913** and GND for the range of heating element resistances that the device might see.

For the heating element EMF measurement, HM_WS_ISRC_EN **1903** is off to allow HV+ to float to a voltage that is the heating element EMF (relative HV−), HM_WS_POS_REF_EN **1909** is off to sum the R**17**, R**21**, R**19** voltage divider through R**19** with HV+ through R**25**, and HM_SCALE**0-4** **1911** are all off to provide no summing and only negative feedback at the negative input of the op-amp. This differential summing configuration keeps HM_OUT **1915** in a usable range (will be between AREF_HM_OUT **1913** and GND) over the range of heating element EMFs

expected when heating element is heated. With the values shown above, the heating element EMF measurement circuit can measure between +/−3.5 mV. The measurement circuit yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations.

Resistance calculations are as follows:

Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset Resistance measurement sensitivities and offsets depend on the active resistance measurement scale (selected using HM_SCALE_**0-4 1911**) and may be solved for using circuit component values and then included in the device.

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs. temperature curve.

As described above, the mismatch in thermoelectric properties and the resulting EM (e.g., the Seebeck EMF) has been found by the inventors to be a potential source of resistance measurement error after data taken from controlled tests of vaporizer prototypes (e.g., using heating elements with extension leads). A single heating element run with temp control of the heating element (using measured heating element resistance without correction for this EMF) may consistently run with much higher power when connected in one polarity vs. the other polarity. It was discovered that asymmetries in the heating element (in this case the wick and coil) assembly could consistently produce hotter temperatures at one of the two heating element/extension lead junctions, resulting in consistent offset voltage at operating temperatures that skewed the resistance measurement in one direction with the heating element connected in one polarity and in the other direction with heating element connected in the other polarity. Although measured resistance was controlled during these tests, these devices were not accurately controlling heating element temperatures because measurements were skewed by this offset EMF resulting from the mismatch in thermoelectric properties of the components. With the correction described above, used to correct for the error in resistance measurement, it is observed that heating element polarity does not have an effect on the power required to hold the heating element at operating temperatures during controlled testing, which suggests that this correction yields accurate calculated heating element resistances that remove the effect of the offset EMF, providing much more accurate temperature control of the heating element than when not corrected.

Thus, in any of the variations described herein, the apparatus may include an offset correction circuit (also referred to as a Seebeck correction circuit) to correct for the offset voltage resulting from the mismatch in thermoelectric properties between the resistive heating coil and the conductive connectors linking the resistive heating coil to the power input (e.g., from the vaporizer base, including the vaporizer power controller) in the cartridge. The offset correction circuit may be located in the vaporizer base and connected between the coupling connectors **595**, **595'** to couple with the cartridge connectors and determine the offset voltage due to the mismatch in thermoelectric properties of the heating (resistive) coil and the wires linking the coil to the connector on the cartridge. Also described herein are methods of correcting for the mismatch (Seebeck effect) in thermoelectric properties between the coil and the wires (electrical extensions) connecting to the electrical connectors.

Dose Monitoring

As mentioned above, any of the apparatuses described herein may also or alternatively detect and display the dose of material applied. U.S. patent application Ser. No. 14/960,259 (filed on Dec. 4, 2015, and published as US-2016-0157524-A1), herein incorporated by reference in its entirety, describes examples of methods for determining dose (and apparatuses including dose determination). Generally these methods may be used to accurately calculate dose based on the power applied to the heater and the temperature of the heater (or a material in contact with the heater) during an immediately before a small increment of time; total dose may be determined by summing these small increments up over a desired time range. These methods may be incorporated herein, and may be made even more accurate by correcting the power applied as described above (e.g., accounting for the offset EMF due to the Seebeck effect).

Alternatively or additionally, described herein are methods and apparatuses that may provide a rough approximation of dose based on the power applied over time to vaporize the material within the cartridge. This may be referred to herein as the consumption (of the vaporizable material in the cartridge, an indication of consumption) of the cartridge or vaporizable material, or the like. In general, the apparatus may aggregate the power during operation of the apparatus (e.g., the power applied over time during a puff/inhalation and/or the power applied over this time multiplied times the duration of the inhalation).

The apparatus may further provide an output of the amount of consumption. This output may be, in particular, a qualitative approximation. For example, the output may be incrementally increasing the number, intensity and/or color of one or more LEDs on the surface of the apparatus. For example, in this case, the consumption amount (dose) is not an absolute amount, but is an indicator or readout of the power applied to vaporize the material (power applied to the coils) over time. In FIG. **9**C, for example, when the user first installs a cartridge and the apparatus is set up to display consumption/dose, the four LEDS **897** may initially be unlit or lit to the neutral color (e.g., white). As the user draws on the device and vaporizes the material within the cartridge, the number of LEDS illuminated may be increased and the intensity and/or color of illumination may be increased to indicate increasing dosage or consumption; for example the calculation of power applied over time may determine based on a number or predetermined increments, whether to increase the number of illuminated LEDS of a particular color and/or intensity, to change color and/or intensity, etc.

The accumulated dose may be reset manually (e.g., using an app, shaking the device, etc.) or by removing the cartridge. Alternatively or additionally to the qualitative output described above, a quantitative estimate based on the power may be displayed or output to a remote processor (e.g. smartphone, etc.).

Thermocouple as Heater

In any of the apparatuses described herein, the heater may be configured as a thermocouple junction. See, e.g., FIGS. **20**A and **20**B. Thus, a thermocouple junction (comprising materials having dissimilar thermoelectric properties) may be used to measure temperature at a point along the heater coil. As discussed above, this may allow an apparatus to resistively determine temperature along the heater coil using the thermoelectric properties described above. Thus, similar

to what is described above, the heating element performs both as a heater and a temperature sensor. For example, a resistive heater may comprised of two dissimilar conductors (e.g., stainless steel and titanium) welded together, as shown in FIG. **20**A. When the heater (heating coil) heats up, the dissimilar material will be heated differentially, resulting in a temperature gradient and a resulting offset voltage (EMF), due to the Seebeck effect discussed above, at the junction of the two dissimilar materials. This effect may be used to determine the temperature at that junction (whereas typically, we determine the average temperature of the entire heater by using TCR, temperature coefficient of resistance, as also discussed above.

The Seebeck effect also occurs at the junction between the heater end poles and passive electrical conduits. Although the correction circuits discussed above are aimed at correcting for the effect, it may also be possible to take advantage of the effect for a more localized temperature measurement. Compare, FIG. **20**B to FIG. **20**A, for example. In FIG. **20**A, the junction is located in the middle of the heating element, and determining the offset voltage in this case, which is based on the temperature, may allow accurate temperature determination. This embodiment may be particularly relevant for a convection vaporizer, where you likely have a (relatively) large heater and you care about the temperature at just the air outlet end.

In vaporization systems where the heating element is connected to the device through extension leads, if Seebeck coefficients are known for both materials, the measured Seebeck EMF can be used to determine the net temperature gradient across the heating element. With some modeling, this measurement could be used to approximately control maximum heating element temperature instead of or in addition to average heating element temperature. This measurement can also be used to perform quality control where the heating element assembly is manufactured. In vaporization systems where the heating element is connected to the device through extension leads and the heating element is used to primarily heat air, if Seebeck coefficients are known for both materials, Seebeck EMF can be used to determine the net temperature gradient across the heating element, which with a known air flow path and thermal modeling of the system can be used to predict average air temperature at some point down-stream of the heating element. As mentioned above, this may be particularly advantageous in convection (hot-air) vaporization systems as two measurements (resistance and Seebeck EMF) taken from the actuator can allow for accurate temperature control of air flowing from the outlet of the heating element without additional sensors in the air path or connected to the heating element.

As shown in FIG. **20**A, the Seebeck effect alone or the Seebeck effect in conjunction with resistance measurement can be used for temperature control of a heating element that has a material transition (junction) at the position where temperature is to be controlled. This is essentially creating a thermocouple out of resistive heating alloys so that the Seebeck EMF can be measured in order to control temperature at the hot junction of the thermocouple resistive heater. The junction could be positioned where the heating element is expected to be hottest to control maximum temperature of the heating element. The control algorithm could use a target average temperature of the heating element (calculated using resistance and EMF measurements) as well as a maximum acceptable max temperature of the heating element (calculated using just the EMF measurement). A device that knows both the average temperature of the heating element and the maximum temperature of the heating element could know more about the temperature gradient along the heating element and be better at predicting mass of material vaporized while heating than a device that only knows either maximum or average heating element temperature (device knowing precise mass of material vaporized is critical for dose-control in vaporizers). If extensions are used in such a system, they could be the same material as the intended heating element but much larger gauge for reduced losses in the extensions. Alternatively, extensions with Seebeck coefficients that are very similar to the Seebeck coefficients of the two heating element sections could be used so that Seebeck EMF is still usable for temp control of the hot junction (small contribution of heating element/extension junctions to net Seebeck EMF).

Vaporizers without Cartridges

Any of the features described herein may be incorporated into a vaporizer apparatus that does not require the uses of a separate (e.g., removable cartridge), including vaporizer apparatuses such as loose-leaf vaporizer apparatuses.

Such apparatuses are described, for example, in each of the following applications, herein incorporated by reference in their entirety: U.S. patent application Ser. No. 13/837,438, filed on Mar. 15, 2013, Publication No. US 2013-0312742 A1; U.S. patent application Ser. No. 15/166,001, filed on May 26, 2016, Publication No. US 2016-0262459 A1; U.S. patent application Ser. No. 14/581,666, filed on Dec. 23, 2014, Publication No. US 2015-0208729 A1; U.S. patent application Ser. No. 15/053,927, filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1; U.S. patent application Ser. No. 15/257,748, filed on Sep. 6, 2016; U.S. patent application Ser. No. 15/257,760, filed on Sep. 6, 2016, Publication No. US 2016-0374399 A1; and U.S. patent application Ser. No. 15/257,768, filed on Sep. 6, 2016, Publication No. US 2016-0366947 A1.

For example such a device may include preset and allow the user to enter temp set mode by holding down on a button (on or under the mouthpiece) for >0.6 seconds. Pressing the button again cycles through the 4+1 presets. To exit temp set, again hold the button for >0.6 sec. The presets may be, e.g.,: 180C, 193C, 204C, 216C.

Any of the apparatuses described herein may include haptic feedback that may include distinct profiles for different events: For example:

/‾\—trapezoid—power on, and Bluetooth connect

‖—quick click—manual power off, and Bluetooth disconnect

|‾|‖‾|—2 long clicks—temp reached

|‾|—1 long click—entered low temp standby, and auto shutoff

Also the user may change the intensity of these envelopes via the app.

Although the disclosure, including the figures, described herein may described and/or exemplify these different variations separately, it should be understood that all or some, or components of them, may be combined.

Although various illustrative embodiments are described above, any of a number of changes may be made to various embodiments without departing from the scope of the invention as described by the claims. For example, the order in which various described method steps are performed may often be changed in alternative embodiments, and in other alternative embodiments one or more method steps may be skipped altogether. Optional features of various device and system embodiments may be included in some embodiments and not in others. Therefore, the foregoing description is

provided primarily for exemplary purposes and should not be interpreted to limit the scope of the invention as it is set forth in the claims.

When a feature or element is herein referred to as being "on" another feature or element, it can be directly on the other feature or element or intervening features and/or elements may also be present. In contrast, when a feature or element is referred to as being "directly on" another feature or element, there are no intervening features or elements present. It will also be understood that, when a feature or element is referred to as being "connected", "attached" or "coupled" to another feature or element, it can be directly connected, attached or coupled to the other feature or element or intervening features or elements may be present. In contrast, when a feature or element is referred to as being "directly connected", "directly attached" or "directly coupled" to another feature or element, there are no intervening features or elements present. Although described or shown with respect to one embodiment, the features and elements so described or shown can apply to other embodiments. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

Terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. For example, as used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items and may be abbreviated as "/".

Spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if a device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms "upwardly", "downwardly", "vertical", "horizontal" and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

Although the terms "first" and "second" may be used herein to describe various features/elements (including steps), these features/elements should not be limited by these terms, unless the context indicates otherwise. These terms may be used to distinguish one feature/element from another feature/element. Thus, a first feature/element discussed below could be termed a second feature/element, and similarly, a second feature/element discussed below could be termed a first feature/element without departing from the teachings of the present invention.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising" means various components can be co-jointly employed in the methods and articles (e.g., compositions and apparatuses including device and methods). For example, the term "comprising" will be understood to imply the inclusion of any stated elements or steps but not the exclusion of any other elements or steps.

As used herein in the specification and claims, including as used in the examples and unless otherwise expressly specified, all numbers may be read as if prefaced by the word "about" or "approximately," even if the term does not expressly appear. The phrase "about" or "approximately" may be used when describing magnitude and/or position to indicate that the value and/or position described is within a reasonable expected range of values and/or positions. For example, a numeric value may have a value that is +/−0.1% of the stated value (or range of values), +/−1% of the stated value (or range of values), +/−2% of the stated value (or range of values), +/−5% of the stated value (or range of values), +/−10% of the stated value (or range of values), etc. Any numerical values given herein should also be understood to include about or approximately that value, unless the context indicates otherwise.

The examples and illustrations included herein show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. As mentioned, other embodiments may be utilized and derived there from, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is, in fact, disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

What is claimed is:

1. A vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;

a reservoir comprising an internal volume at least partially defined by the cartridge body, the internal volume configured to hold a vaporizable material;

a first reservoir seal;

a second reservoir seal, wherein the first reservoir seal and the second reservoir seal are each configured to cover a corresponding reservoir opening exposing the internal volume of the reservoir;

a first pad positioned within an interior of the mouthpiece;

a second pad positioned within the interior of the mouthpiece;

a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening;

a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;

a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and

a heater chamber comprising:

an atomizer configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the atomizer, the housing piece comprising a housing opening into which at least a portion of the atomizer passes into the housing piece; and

an air tube extending from the housing piece, the air tube configured to deliver the aerosol from the atomizer to the mouthpiece;

wherein the first pad and the second pad do not intersect with a central axis of the air tube.

2. The vaporizer cartridge of claim **1**, wherein the atomizer comprises ceramic.

3. The vaporizer cartridge of claim **1**, wherein at least a portion of the housing piece is cylindrical.

4. The vaporizer cartridge of claim **1**, further comprising: a magnetic material configured to couple and secure the vaporizer cartridge within a cartridge receiver of the vaporizer body.

5. A vaporizer device, comprising:

the vaporizer cartridge of claim **1**; and

the vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, the cartridge receiver comprising:

the first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;

the second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end.

6. The vaporizer device of claim **5**, further comprising:

a pressure sensor configured to detect a draw on the mouthpiece to activate the vaporizer device; and

a channel extending from the base of the cartridge receiver to the pressure sensor.

7. The vaporizer device of claim **5**, further comprising one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the atomizer of the vaporizer cartridge.

8. The vaporizer cartridge of claim **1**, wherein the bottom cover comprises only two air openings, the air openings comprising the first air opening and the second air opening.

9. The vaporizer cartridge of claim **1**, further comprising only two cartridge electrical contacts, the electrical contacts comprising the first cartridge electrical contact and the second cartridge electrical contact.

10. The vaporizer cartridge of claim **1**, wherein the bottom portion of the bottom cover comprises:

a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; and

a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.

11. A vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;

a reservoir comprising an internal volume at least partially defined by the cartridge body, the internal volume configured to hold a vaporizable material;

a first reservoir seal;

a second reservoir seal, wherein the first reservoir seal and the second reservoir seal are each configured to cover a corresponding reservoir opening exposing the internal volume of the reservoir;

a first pad positioned within an interior of the mouthpiece;

a second pad positioned within the interior of the mouthpiece;

a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening;

a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;

a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and

a heater chamber comprising:

an atomizer configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the atomizer, the housing piece comprising a housing opening into which at least a portion of the atomizer passes into the housing piece; and

an air tube extending from the housing piece, the air tube configured to deliver the aerosol from the atomizer to the mouthpiece;

wherein the first pad and the second pad do not intersect with a central axis of the air tube.

12. The vaporizer device of claim **11**, wherein the atomizer comprises ceramic.

13. The vaporizer device of claim **11**, wherein at least a portion of the housing piece is cylindrical.

14. The vaporizer device of claim **11**, wherein the vaporizer cartridge further comprises: a magnetic material configured to couple and secure the vaporizer cartridge within the cartridge receiver of the vaporizer body.

15. The vaporizer device of claim **11**, wherein the bottom cover comprises only two air openings, the air openings comprising the first air opening and the second air opening.

16. The vaporizer device of claim **11**, wherein the vaporizer cartridge comprises only two cartridge electrical contacts, the cartridge electrical contacts comprising the first cartridge electrical contact and the second cartridge electrical contact.

17. The vaporizer device of claim **11**, wherein the bottom portion of the bottom cover further comprises:

a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; and

a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 11,369,756 B2
APPLICATION NO. : 17/204148
DATED : June 28, 2022
INVENTOR(S) : Nicholas J. Hatton et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

At Column 36, Claim 11, Line number 1, delete the word "cartridge" and insert --device--.

Signed and Sealed this
Twenty-first Day of March, 2023

Katherine Kelly Vidal

Katherine Kelly Vidal
Director of the United States Patent and Trademark Office

US011369757B2

(12) **United States Patent**
Hatton et al.

(10) **Patent No.: US 11,369,757 B2**
(45) **Date of Patent: *Jun. 28, 2022**

(54) **LEAK-RESISTANT VAPORIZER DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

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A61M 15/06	(2006.01)
A24F 40/10	(2020.01)
A61M 15/00	(2006.01)

(52) **U.S. Cl.**

CPC ***A61M 11/00*** (2013.01); ***A24F 40/40*** (2020.01); ***A61M 11/042*** (2014.02); ***A61M 15/06*** (2013.01); *A24F 40/10* (2020.01); *A61M 15/0021* (2014.02); *A61M 2205/8206* (2013.01)

(58) **Field of Classification Search**

None

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,671,185 A 5/1928 Flynn
1,950,542 A 3/1934 Daniel
(Continued)

FOREIGN PATENT DOCUMENTS

AT 507187 A4 3/2010
CA 2920973 C 9/2018
(Continued)

OTHER PUBLICATIONS

U.S. Appl. No. 15/396,584, filed Dec. 31, 2016, US 2018-0077967 A1.

(Continued)

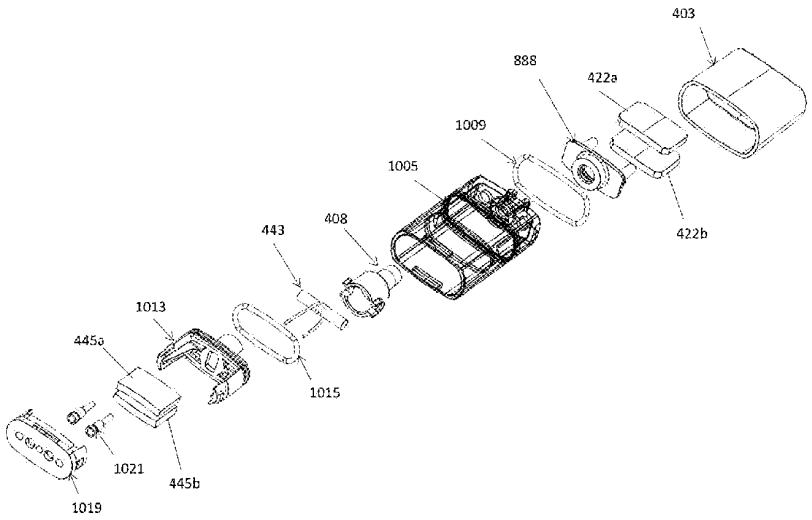
Primary Examiner — Phu H Nguyen

(74) *Attorney, Agent, or Firm* — Mintz, Levin, Cohn, Ferris, Glovsky and Popeo, P.C.

(57) **ABSTRACT**

Vaporizer cartridges and vaporizer apparatuses, and methods for making, using and delivering vapor to a user, that are leak-resistant for use with cannabinoids. In particular, described herein are leak-resistant vaporizer cartridges and apparatuses adapted for use with oil-based vaporizable materials including *cannabis* oils.

20 Claims, 26 Drawing Sheets



Related U.S. Application Data

(60) Provisional application No. 62/398,494, filed on Sep. 22, 2016.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,900,989	A	8/1959	Glenn
4,945,931	A	8/1990	Gori
6,516,796	B1	2/2003	Cox et al.
6,637,430	B1	10/2003	Voges et al.
7,284,553	B2	10/2007	Hochrainer
7,802,569	B2	9/2010	Yeates et al.
8,528,569	B1	9/2013	Newton
8,714,161	B2	5/2014	Liu et al.
8,752,545	B2	6/2014	Buchberger
8,833,364	B2	9/2014	Buchberger
8,899,240	B2	12/2014	Mass
8,948,578	B2	2/2015	Buchberger
9,010,335	B1	4/2015	Scatterday
9,078,474	B2	7/2015	Thompson
9,089,166	B1	7/2015	Scatterday
9,155,336	B2	10/2015	Liu
9,247,773	B2	2/2016	Memari et al.
9,289,014	B2	3/2016	Tucker et al.
9,351,522	B2	5/2016	Safari
9,364,025	B2	6/2016	Liu
9,427,022	B2	8/2016	Levin et al.
9,497,998	B2	11/2016	Chen
9,510,623	B2	12/2016	Tucker et al.
9,526,272	B2	12/2016	Liu
9,648,908	B1	5/2017	Rinehart et al.
9,668,520	B2	6/2017	Boldrini et al.
9,668,522	B2	6/2017	Memari et al.
9,681,688	B1	6/2017	Rinehart et al.
9,763,475	B2	9/2017	Liu
9,763,478	B2	9/2017	Cameron et al.
9,770,055	B2	9/2017	Cameron et al.
9,795,168	B2	10/2017	Zhu
9,833,021	B2	12/2017	Perez et al.
9,844,234	B2	12/2017	Thorens et al.
9,861,135	B2	1/2018	Chen
9,877,519	B2	1/2018	Xiang
9,918,496	B2	3/2018	Kane et al.
9,955,726	B2	5/2018	Brinkley et al.
9,986,762	B2	6/2018	Alarcon et al.
10,058,128	B2	8/2018	Cameron et al.
10,070,668	B2	9/2018	Li et al.
10,080,387	B2	9/2018	Phillips et al.
10,085,481	B2	10/2018	Verleur et al.
10,085,486	B2	10/2018	Cameron
10,130,123	B2	11/2018	Hatton et al.
10,131,532	B2	11/2018	Murison et al.
10,159,282	B2	12/2018	Monsees et al.
10,206,429	B2	2/2019	Davis et al.
10,279,934	B2	5/2019	Christensen et al.
10,299,513	B2	5/2019	Perez et al.
10,383,368	B2	8/2019	Larson
10,426,199	B2	10/2019	Turner et al.
10,492,542	B1	12/2019	Worm et al.
2003/0154991	A1	8/2003	Fournier et al.
2007/0215168	A1	9/2007	Banerjee et al.
2009/0255534	A1	10/2009	Paterno
2010/0186757	A1	7/2010	Crooks et al.
2010/0200008	A1	8/2010	Taieb
2012/0018529	A1	1/2012	Gammon et al.
2012/0318882	A1	12/2012	Abehasera
2013/0192615	A1	8/2013	Tucker et al.
2013/0199528	A1	8/2013	Goodman et al.
2013/0312742	A1	11/2013	Monsees et al.
2014/0041655	A1	2/2014	Barron et al.
2014/0041658	A1	2/2014	Goodman et al.
2014/0150810	A1	6/2014	Hon
2014/0158129	A1	6/2014	Pratt et al.
2014/0182612	A1	7/2014	Chen
2014/0202454	A1	7/2014	Buchberger
2014/0238421	A1	8/2014	Shapiro
2014/0261399	A1	9/2014	Murphy
2014/0290677	A1	10/2014	Liu
2014/0345635	A1	11/2014	Rabinowitz et al.
2014/0355969	A1	12/2014	Stern
2015/0007836	A1	1/2015	Xu et al.
2015/0040929	A1	2/2015	Hon
2015/0136158	A1	5/2015	Stevens et al.
2015/0144147	A1	5/2015	Li et al.
2015/0150305	A1	6/2015	Shenkal
2015/0157054	A1	6/2015	Liu
2015/0164147	A1	6/2015	Verleur et al.
2015/0181941	A1	7/2015	Liu
2015/0184846	A1	7/2015	Liu
2015/0189919	A1	7/2015	Liu
2015/0201674	A1	7/2015	Dooly et al.
2015/0208729	A1	7/2015	Monsees et al.
2015/0216236	A1	8/2015	Bless et al.
2015/0223521	A1	8/2015	Menting et al.
2015/0223522	A1	8/2015	Ampolini et al.
2015/0245654	A1	9/2015	Memari et al.
2015/0245655	A1	9/2015	Memari et al.
2015/0245657	A1	9/2015	Memari et al.
2015/0245665	A1	9/2015	Memari et al.
2015/0245666	A1	9/2015	Memari et al.
2015/0245667	A1	9/2015	Memari et al.
2015/0245668	A1	9/2015	Memari et al.
2015/0257451	A1	9/2015	Brannon et al.
2015/0272217	A1	10/2015	Chen
2015/0282530	A1	10/2015	Johnson et al.
2015/0289565	A1	10/2015	Cadieux et al.
2015/0305406	A1	10/2015	Li et al.
2015/0313287	A1	11/2015	Verleur et al.
2015/0320116	A1	11/2015	Bleloch et al.
2015/0327595	A1	11/2015	Scatterday
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2015/0342258	A1	12/2015	Chen
2015/0366267	A1	12/2015	Liu
2016/0000147	A1	1/2016	Li et al.
2016/0000149	A1	1/2016	Scatterday
2016/0007655	A1	1/2016	Li et al.
2016/0044965	A1	2/2016	Liu
2016/0073692	A1	3/2016	Alarcon et al.
2016/0081394	A1	3/2016	Alarcon et al.
2016/0095357	A1	4/2016	Burton
2016/0100632	A1	4/2016	Debono et al.
2016/0120226	A1	5/2016	Rado et al.
2016/0120227	A1	5/2016	Levitz et al.
2016/0128384	A1	5/2016	Luciani
2016/0129205	A1	5/2016	Shahaf et al.
2016/0135504	A1	5/2016	Li et al.
2016/0150823	A1	6/2016	Liu
2016/0150824	A1	6/2016	Memari et al.
2016/0157524	A1	6/2016	Bowen et al.
2016/0174611	A1	6/2016	Monsees et al.
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2016/0219937	A1	8/2016	Rado
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2016/0235125	A1	8/2016	Safari
2016/0249684	A1	9/2016	Liu
2016/0262452	A1	9/2016	Zhu
2016/0262459	A1	9/2016	Monsees et al.
2016/0278163	A1	9/2016	Chen
2016/0286860	A1	10/2016	Flayler
2016/0286863	A1	10/2016	Lin
2016/0286865	A1	10/2016	King et al.
2016/0302487	A1	10/2016	Chen
2016/0309785	A1	10/2016	Holtz
2016/0324217	A1	11/2016	Cameron
2016/0325055	A1	11/2016	Cameron
2016/0331022	A1	11/2016	Cameron
2016/0331023	A1	11/2016	Cameron
2016/0331024	A1	11/2016	Cameron
2016/0331025	A1	11/2016	Cameron
2016/0331026	A1	11/2016	Cameron

(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0331034	A1	11/2016	Cameron
2016/0331037	A1	11/2016	Cameron
2016/0332754	A1	11/2016	Brown et al.
2016/0334847	A1	11/2016	Cameron
2016/0337141	A1	11/2016	Cameron
2016/0337444	A1	11/2016	Cameron
2016/0338413	A1	11/2016	Li et al.
2016/0345621	A1	12/2016	Li et al.
2016/0356751	A1	12/2016	Blackley
2016/0360789	A1	12/2016	Hawes et al.
2016/0363570	A1	12/2016	Blackley
2016/0363917	A1	12/2016	Blackley
2016/0366936	A1	12/2016	Liu
2016/0366943	A1	12/2016	Li et al.
2016/0366945	A1	12/2016	Rado
2016/0366947	A1	12/2016	Monsees et al.
2016/0367925	A1	12/2016	Blackley
2016/0370335	A1	12/2016	Blackley
2016/0374399	A1	12/2016	Monsees et al.
2017/0006922	A1	1/2017	Wang et al.
2017/0013885	A1	1/2017	Qiu
2017/0018000	A1	1/2017	Cameron
2017/0020188	A1	1/2017	Cameron
2017/0020195	A1	1/2017	Cameron
2017/0020196	A1	1/2017	Cameron
2017/0020197	A1	1/2017	Cameron
2017/0035110	A1	2/2017	Keen
2017/0042229	A1	2/2017	Liu
2017/0042246	A1	2/2017	Lau et al.
2017/0049153	A1	2/2017	Guo et al.
2017/0055586	A1	3/2017	Liu
2017/0055588	A1	3/2017	Cameron
2017/0071249	A1	3/2017	Ampolini et al.
2017/0108210	A1	4/2017	Meinhart et al.
2017/0112193	A1	4/2017	Chen
2017/0119057	A1	5/2017	Liu
2017/0119060	A1	5/2017	Li et al.
2017/0196265	A1	7/2017	Liu
2017/0196272	A1	7/2017	Li et al.
2017/0208857	A1	7/2017	Branton et al.
2017/0224013	A1	8/2017	Huang
2017/0231282	A1	8/2017	Bowen et al.
2017/0231286	A1	8/2017	Borkovec et al.
2017/0245546	A1	8/2017	Huang et al.
2017/0259170	A1	9/2017	Bowen et al.
2017/0347706	A1	12/2017	Aoun et al.
2017/0360093	A1	12/2017	Fernando
2018/0016040	A1	1/2018	Ewing et al.
2018/0022516	A1	1/2018	Liu
2018/0064169	A1	3/2018	Biel et al.
2018/0160733	A1	6/2018	Leadley et al.
2018/0161525	A1	6/2018	Liu et al.
2018/0168227	A1	6/2018	Fraser et al.

FOREIGN PATENT DOCUMENTS

CN	101263935	A	9/2008
CN	100589726	C	2/2010
CN	201430916	Y	3/2010
CN	204180941	U	3/2015
CN	204217907	U	3/2015
CN	204426692	U	7/2015
CN	105249536	A	1/2016
CN	105962419	A	9/2016
DE	202015009688	U1	3/2019
EP	0535695	A2	4/1993
EP	1093936	A1	4/2001
EP	2789248	A1	10/2014
EP	3031339	A1	6/2016
EP	3143884	A2	4/2017
EP	3158883	A2	4/2017
EP	3195738	A2	7/2017
EP	3024344	B1	9/2018
EP	3313215	B1	6/2019
EP	3409597	B1	6/2019
KR	20110006928	U	7/2011
KR	200461404	Y1	7/2012
KR	200462610	Y1	9/2012
KR	20120006582	U	9/2012
KR	200473510	Y1	8/2014
KR	101541750	B1	8/2015
KR	101634882	B1	6/2016
KR	200481405	Y1	10/2016
KR	101774283	B1	9/2017
KR	101995956	B1	7/2019
WO	WO-2006021153	A1	3/2006
WO	WO-2009135729	A1	11/2009
WO	WO-2010045671	A1	4/2010
WO	WO-2010118644	A1	10/2010
WO	WO-2012040512	A2	3/2012
WO	WO-2012134117	A2	10/2012
WO	WO-2012173322	A1	12/2012
WO	WO-2012174677	A1	12/2012
WO	WO-2013089358	A1	6/2013
WO	WO-2013089551	A1	6/2013
WO	WO-2014020953	A1	2/2014
WO	WO-2014071747	A1	5/2014
WO	WO-2014101734	A1	7/2014
WO	WO-2014185937	A1	11/2014
WO	WO-2015070398	A1	5/2015
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WO	WO-2015106440	A1	7/2015
WO	WO-2015128665	A1	9/2015
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WO	WO-2015149311	A1	10/2015
WO	WO-2015149403	A1	10/2015
WO	WO-2015154309	A1	10/2015
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WO	WO-2015165081	A1	11/2015
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WO	WO-2015165105	A1	11/2015
WO	WO-2015172331	A1	11/2015
WO	WO-2015172368	A1	11/2015
WO	WO-2015176230	A1	11/2015
WO	WO-2015176580	A1	11/2015
WO	WO-2015180061	A1	12/2015
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WO	WO-2015184747	A1	12/2015
WO	WO-2015188295	A1	12/2015
WO	WO-2015192377	A1	12/2015
WO	WO-2015196463	A1	12/2015
WO	WO-2016000206	A1	1/2016
WO	WO-2016000214	A1	1/2016
WO	WO-2016019353	A1	2/2016
WO	WO-2016023212	A1	2/2016
WO	WO-2016023824	A1	2/2016
WO	WO-2016026104	A1	2/2016
WO	WO-2016029344	A1	3/2016
WO	WO-2016061730	A1	4/2016
WO	WO-2016061859	A1	4/2016
WO	WO-2016074229	A1	5/2016
WO	WO-2016090303	A1	6/2016
WO	WO-2016090602	A1	6/2016
WO	WO-2016095220	A1	6/2016
WO	WO-2016103202	A1	6/2016
WO	WO-2016106476	A1	7/2016
WO	WO-2016106500	A1	7/2016
WO	WO-2016108694	A1	7/2016
WO	WO-2016109931	A1	7/2016
WO	WO-2016115701	A1	7/2016
WO	WO-2016119098	A1	8/2016
WO	WO-2016119101	A1	8/2016
WO	WO-2016119167	A1	8/2016
WO	WO-2016119225	A1	8/2016
WO	WO-2016122417	A1	8/2016
WO	WO-2016123764	A1	8/2016
WO	WO-2016123780	A1	8/2016
WO	WO-2016123781	A1	8/2016
WO	WO-2016127360	A1	8/2016
WO	WO-2016127406	A1	8/2016
WO	WO-2016141508	A1	9/2016

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	WO-2016145611	A1	9/2016
WO	WO-2016149932	A1	9/2016
WO	WO-2016154798	A1	10/2016
WO	WO-2016172898	A1	11/2016
WO	WO-2016179828	A1	11/2016
WO	WO-2016184247	A1	11/2016
WO	WO-2016201602	A1	12/2016
WO	WO-2016202304	A1	12/2016
WO	WO-2017001818	A1	1/2017
WO	WO-2017001819	A1	1/2017
WO	WO-2017021536	A2	2/2017
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WO	WO-2017035720	A1	3/2017
WO	WO-2017055799	A1	4/2017
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WO	WO-2017066955	A1	4/2017
WO	WO-2017070871	A1	5/2017
WO	WO-2017082728	A1	5/2017
WO	WO-2017093452	A1	6/2017
WO	WO-2017093535	A1	6/2017
WO	WO-2017107546	A1	6/2017
WO	WO-2017109448	A2	6/2017
WO	WO-2017113106	A1	7/2017
WO	WO-2017124662	A1	7/2017
WO	WO-2017137554	A1	8/2017
WO	WO-2017153270	A1	9/2017
WO	WO-2017156696	A1	9/2017
WO	WO-2017163046	A1	9/2017
WO	WO-2017163050	A1	9/2017
WO	WO-2017163051	A1	9/2017
WO	WO-2017163052	A1	9/2017
WO	WO-2017166263	A1	10/2017

OTHER PUBLICATIONS

U.S. Appl. No. 17/199,370, filed Mar. 11, 2021, US 2021-0268206 A1.

U.S. Appl. No. 17/204,148, filed Mar. 17, 2021, US 2021-0268208 A1.

U.S. Appl. No. 17/199,377, filed Mar. 11, 2021, US 2021-0268207 A1.

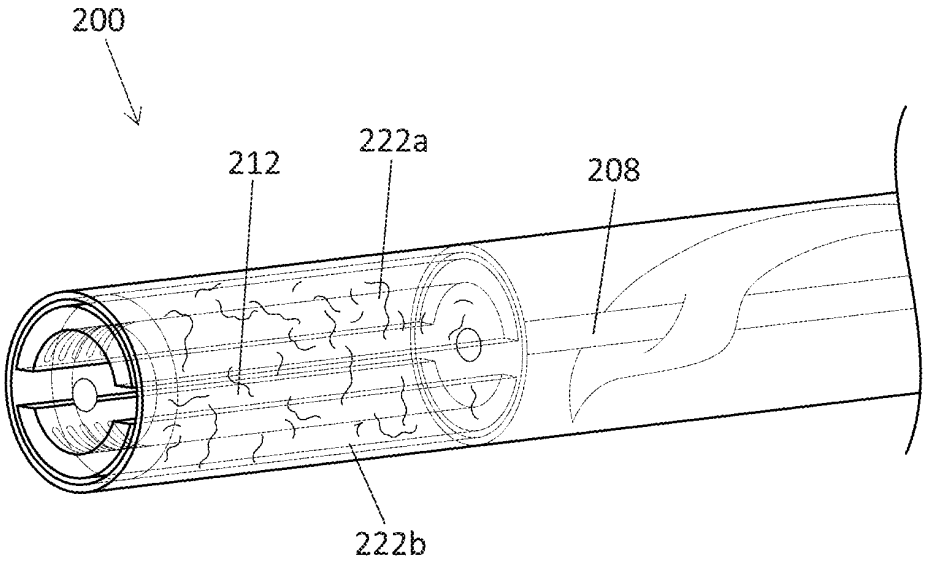


FIG. 1

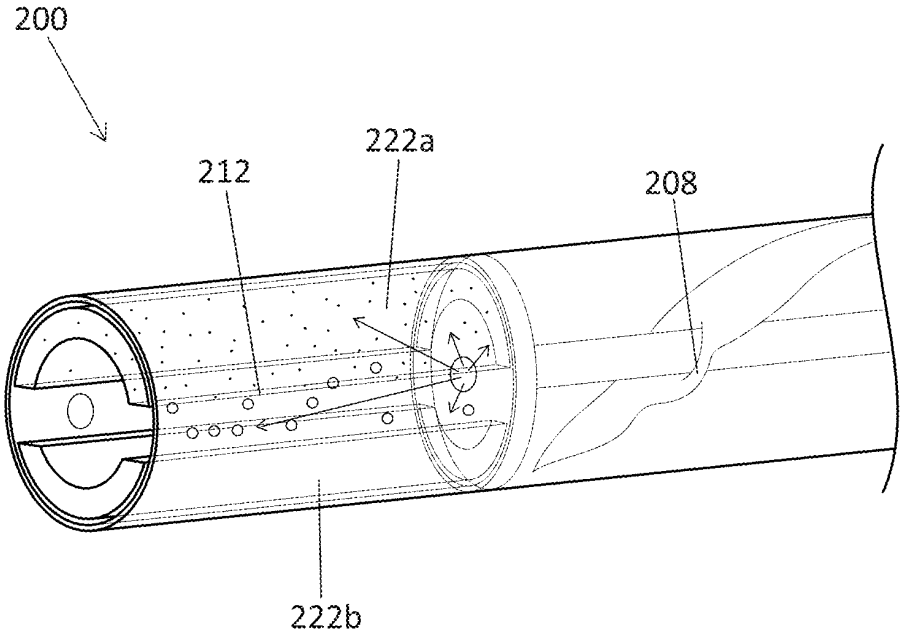


FIG. 2

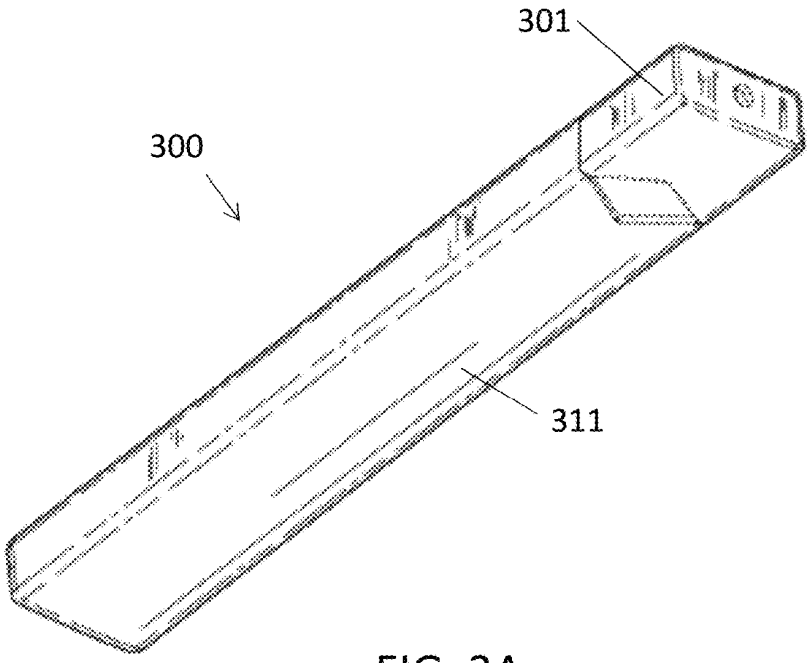

301
300
311

FIG. 3A

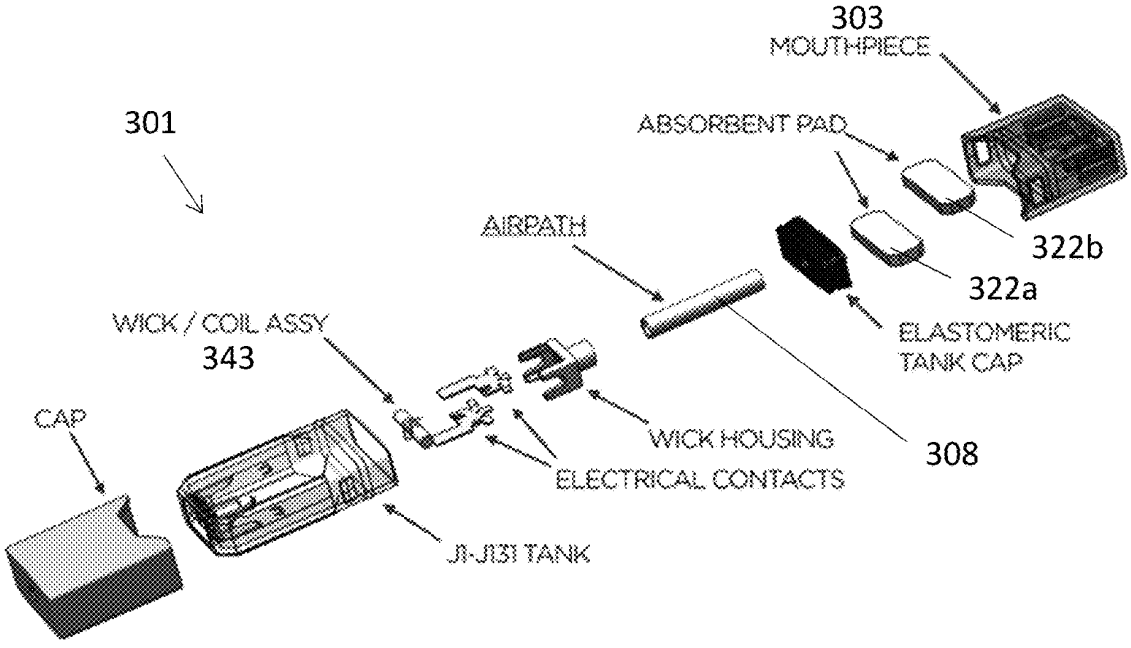

303
MOUTHPIECE
301
ABSORBENT PAD
AIRPATH
322b
322a
ELASTOMERIC
TANK CAP
WICK / COIL ASSY
343
CAP
WICK HOUSING
308
ELECTRICAL CONTACTS
JI-JI3I TANK

FIG. 3B

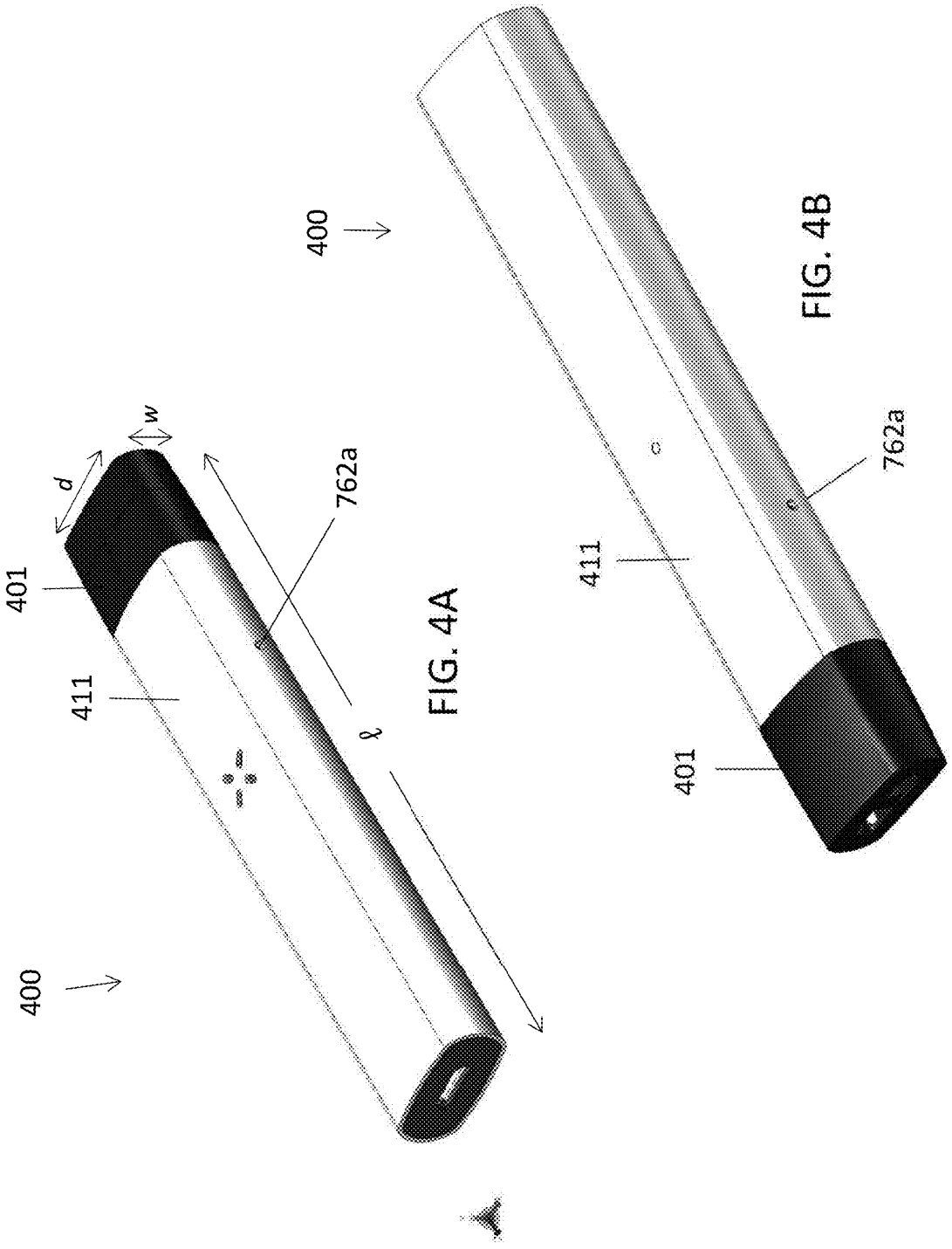


FIG. 4A

FIG. 4B

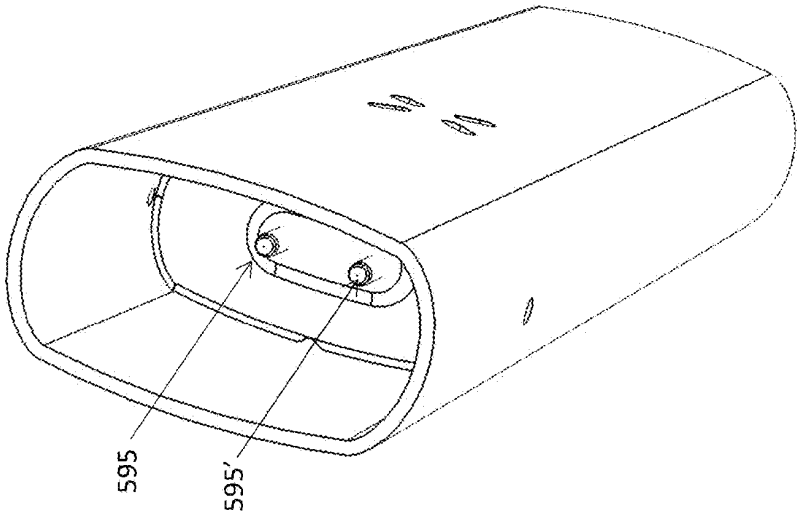


FIG. 5C

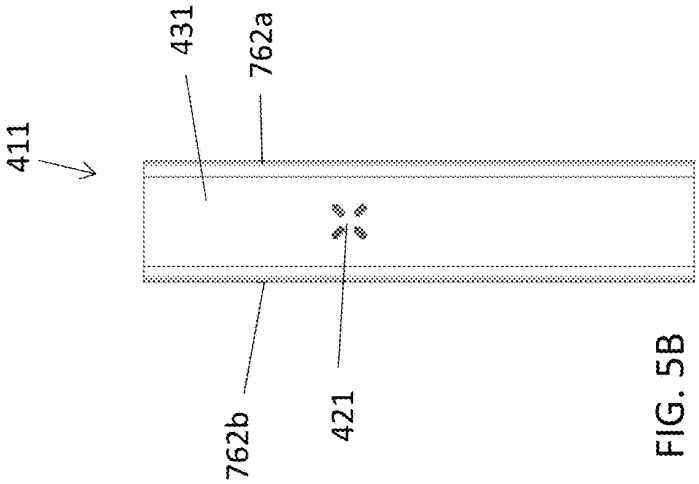


FIG. 5B

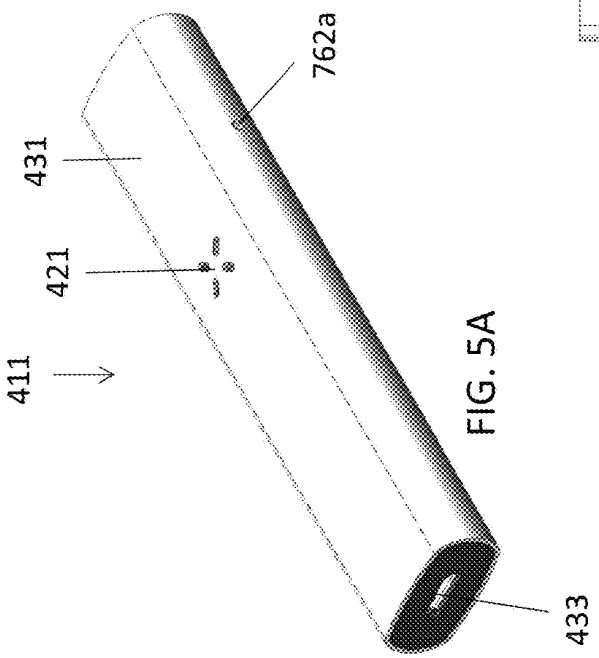


FIG. 5A

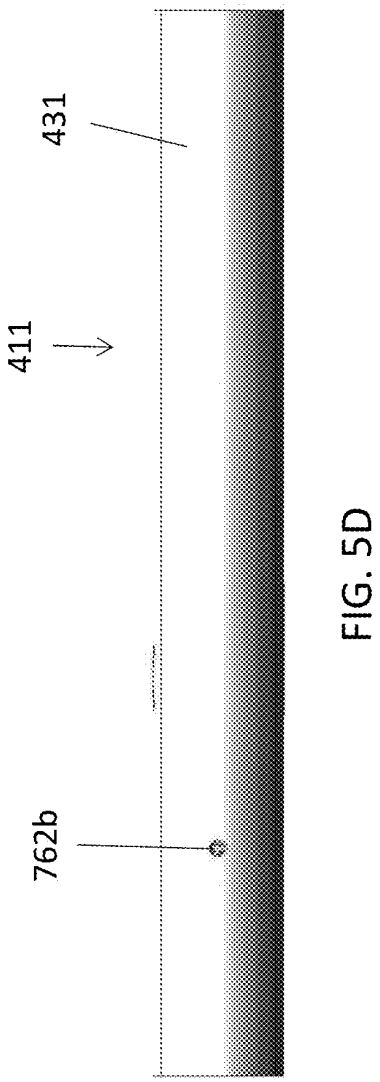


FIG. 5D

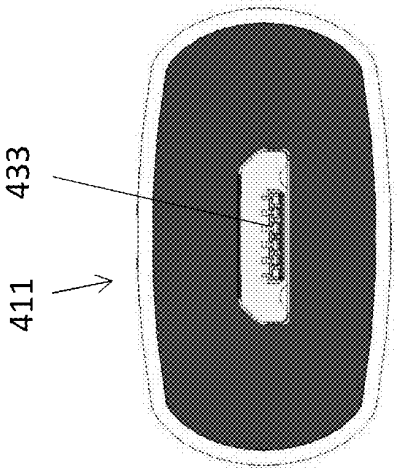


FIG. 5F

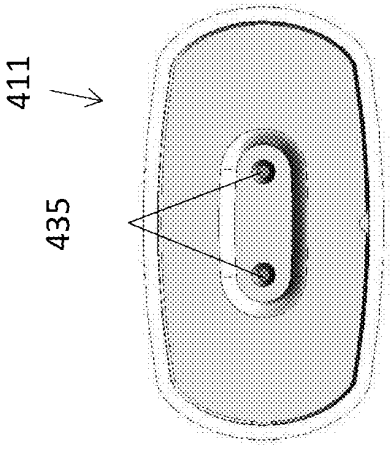


FIG. 5E

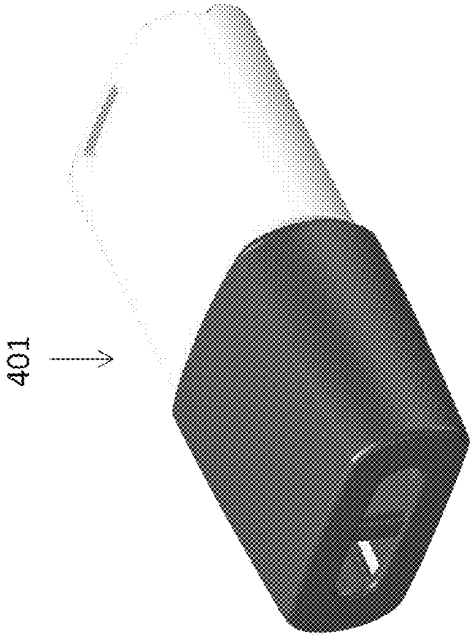


FIG. 6C

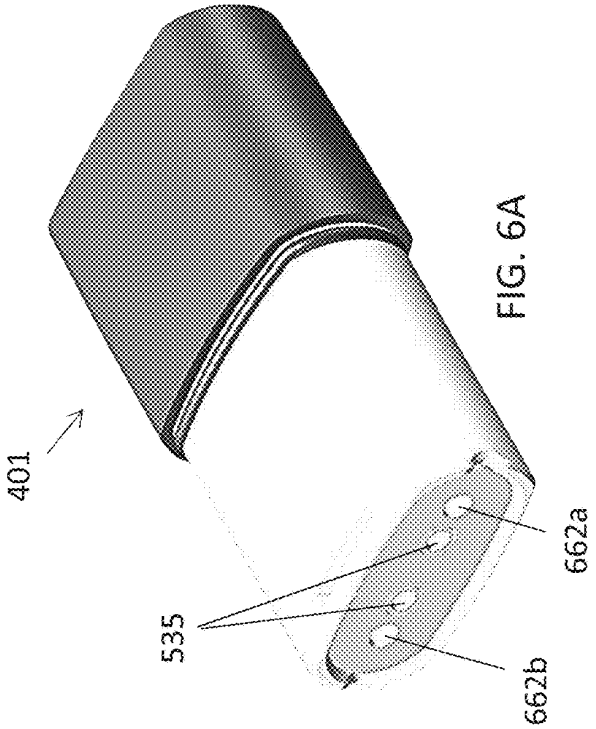


FIG. 6A

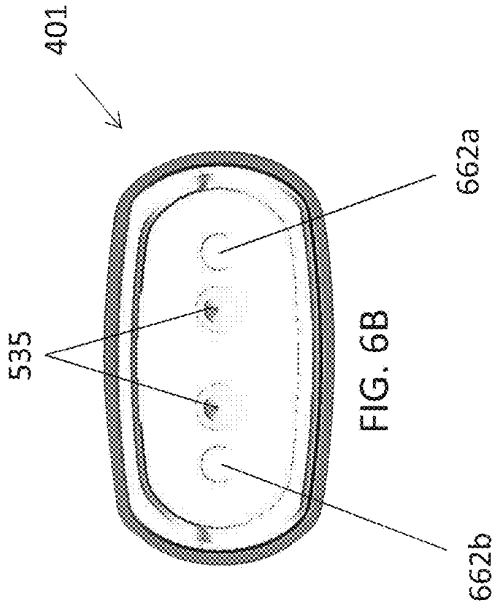


FIG. 6B

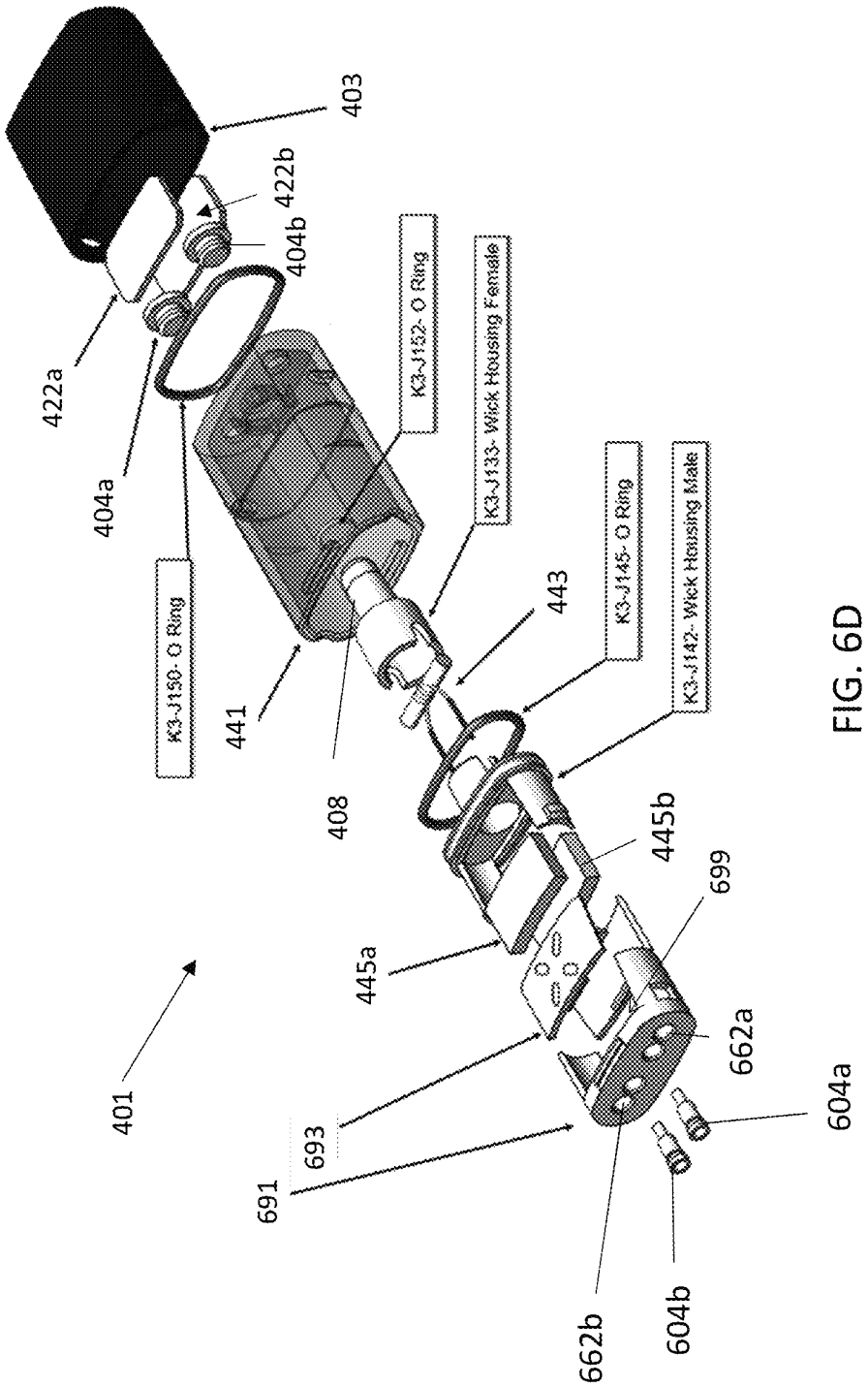

403
422b
404b
422a
404a
K3-J152- O Ring
K3-J133- Wick Housing Female
K3-J150- O Ring
443
K3-J145- O Ring
K3-J142- Wick Housing Male
441
408
445b
699
445a
662a
604a
401
693
691
662b
604b

FIG. 6D

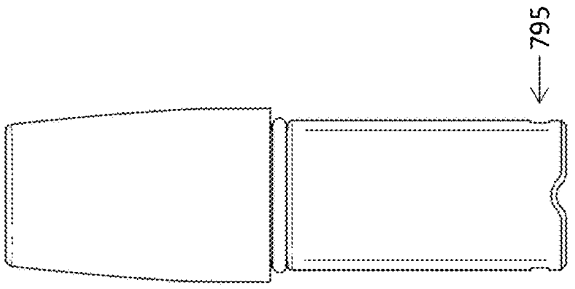


FIG. 7D

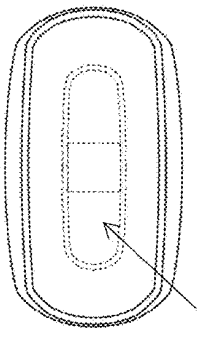


FIG.7F

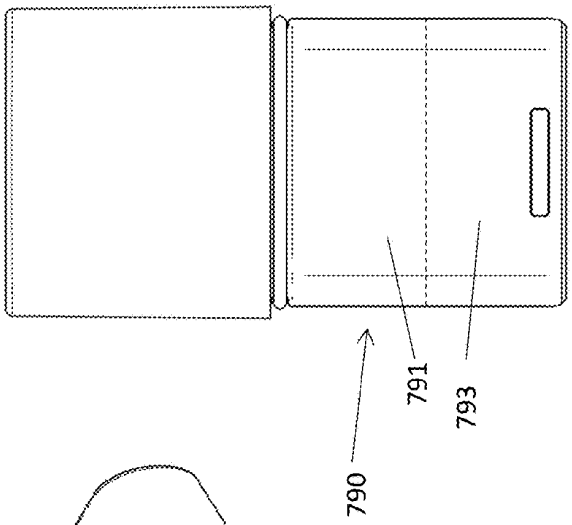


FIG. 7C

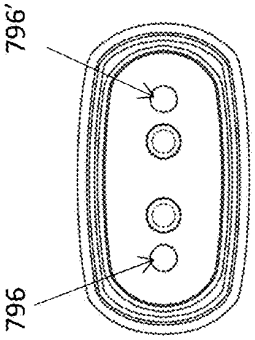


FIG. 7E

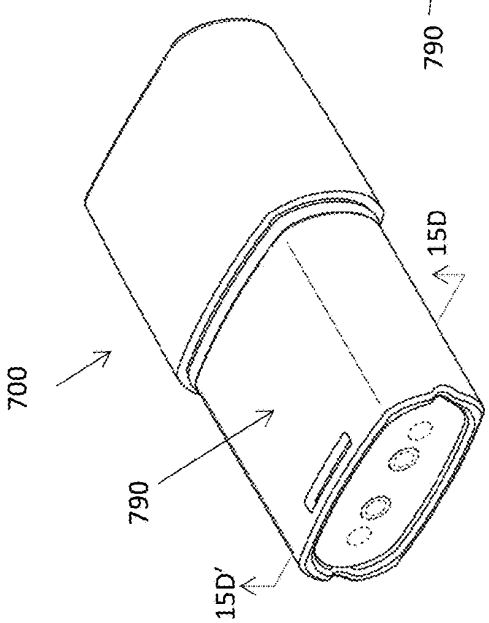


FIG. 7A

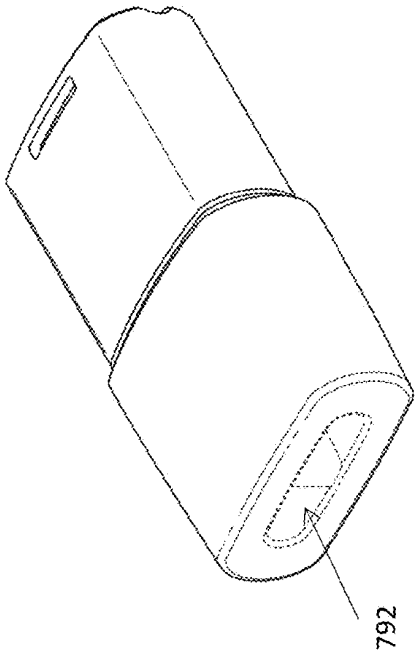


FIG. 7B

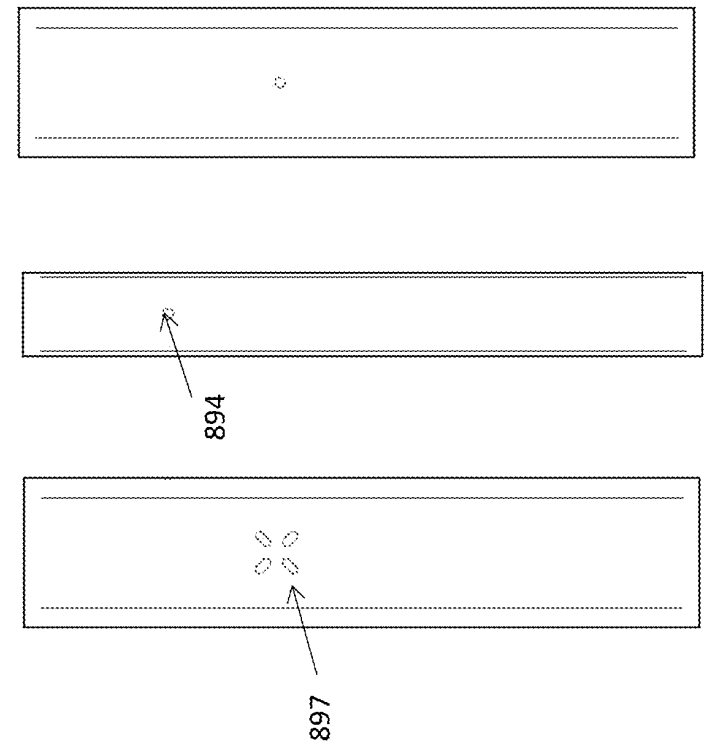


FIG. 8E

FIG. 8D

FIG. 8C

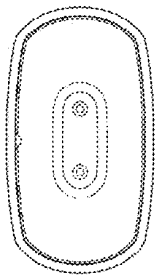


FIG. 8G

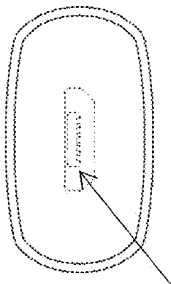


FIG. 8F

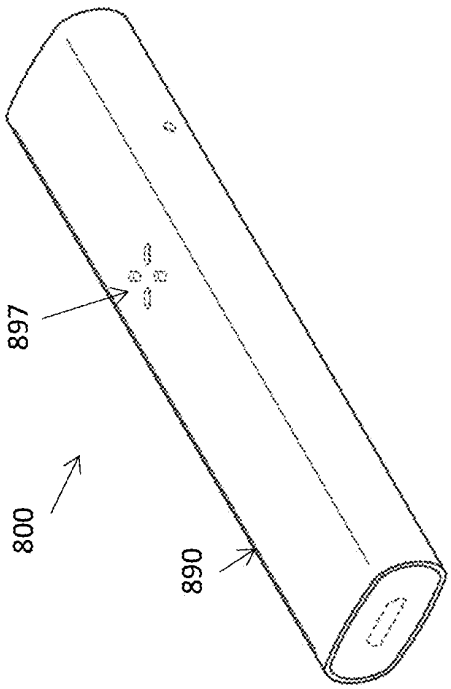


FIG. 8A

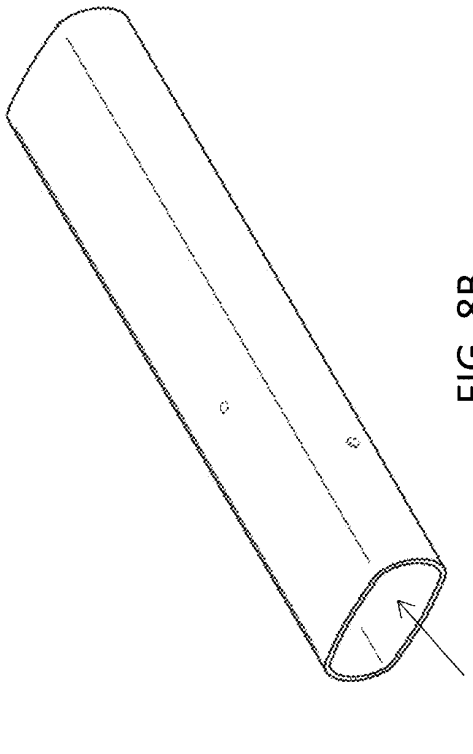


FIG. 8B

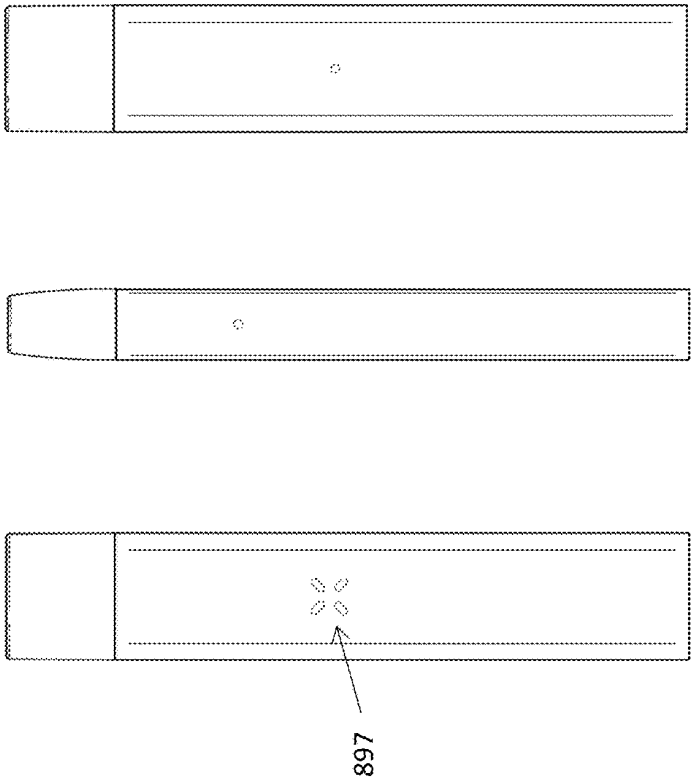


FIG. 9C

FIG. 9D

FIG. 9E

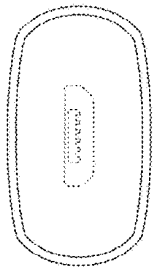


FIG. 9F

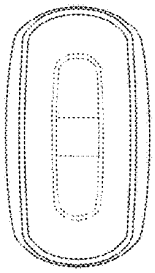


FIG. 9G

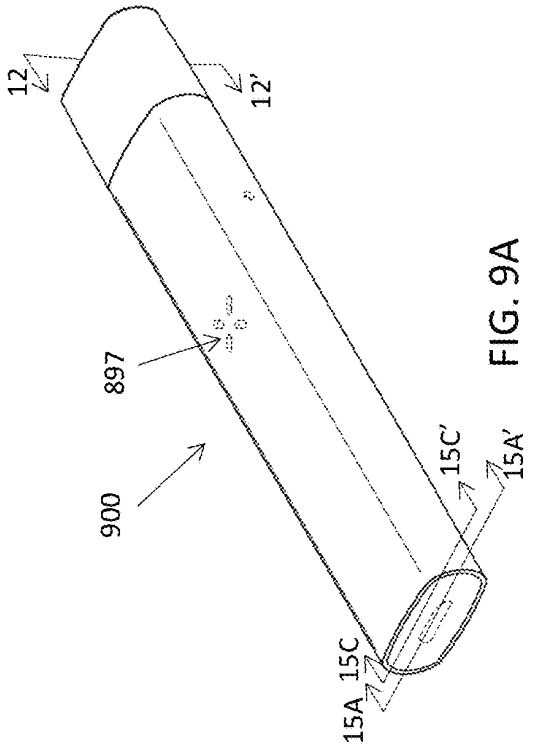


FIG. 9A

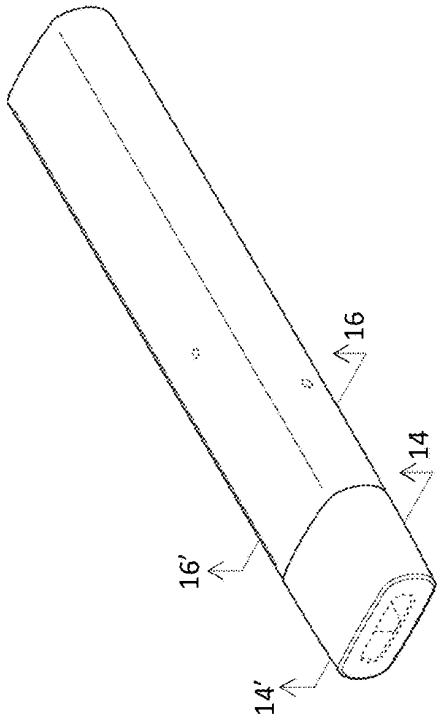


FIG. 9B

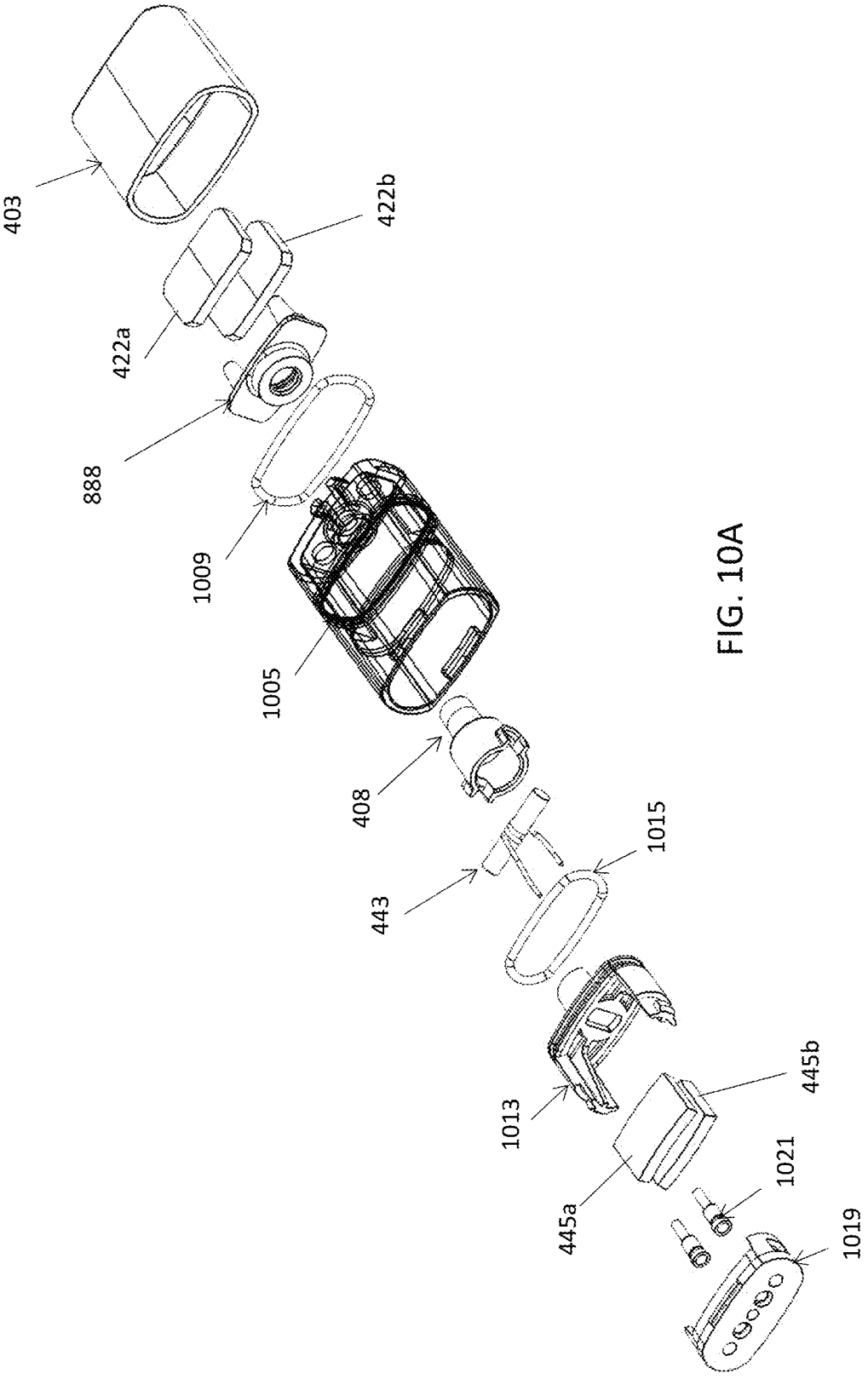

403
422b
422a
888
1009
1005
408
443
1015
1013
445b
445a
1021
1019

FIG. 10A

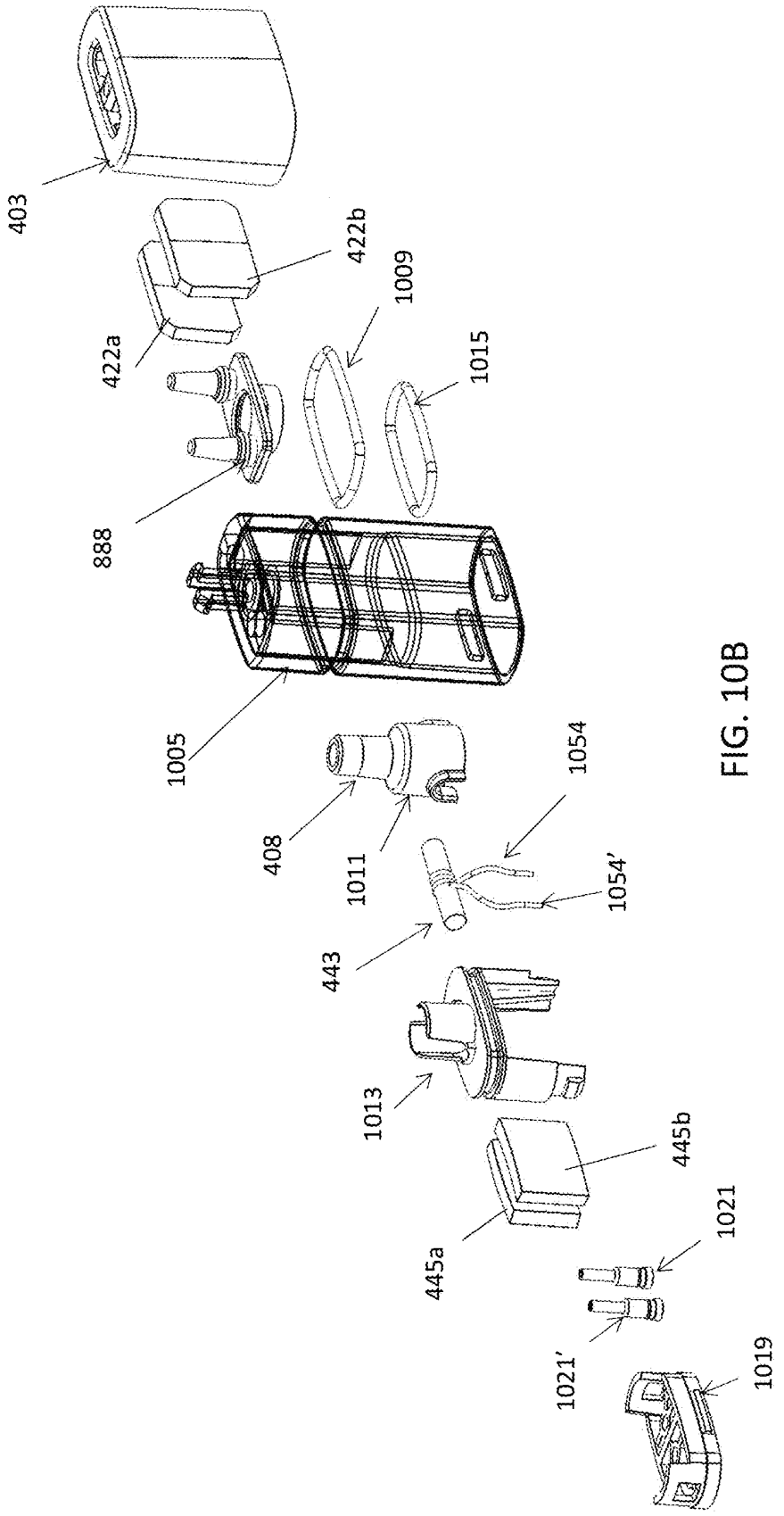

403
422b
1009
422a
1015
888
1005
1054
408
1011
1054'
443
1013
445b
445a
1021
1021'
1019

FIG. 10B

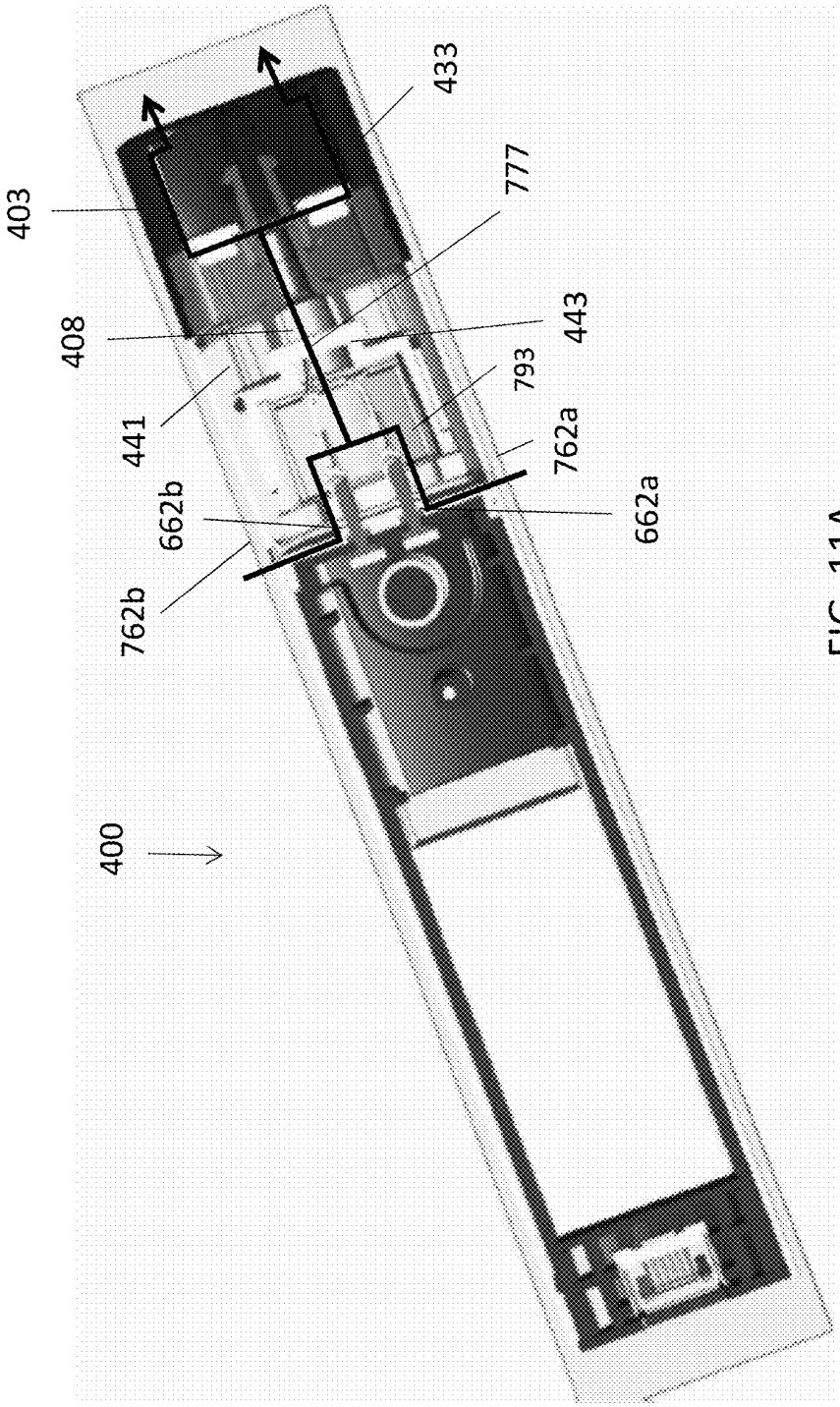


FIG. 11A

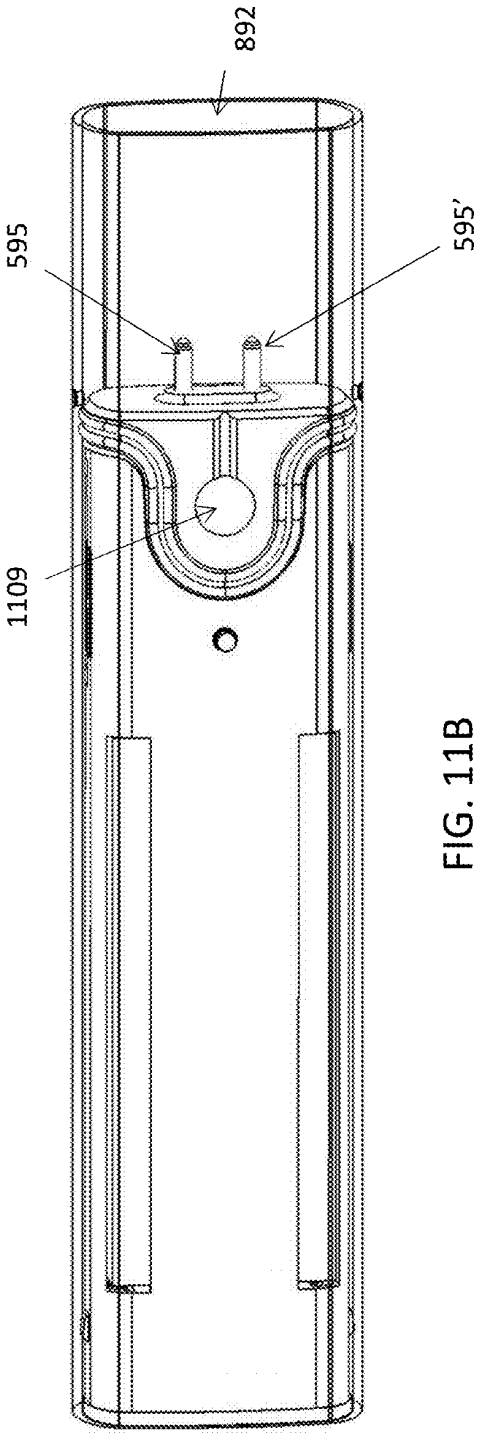


FIG. 11B

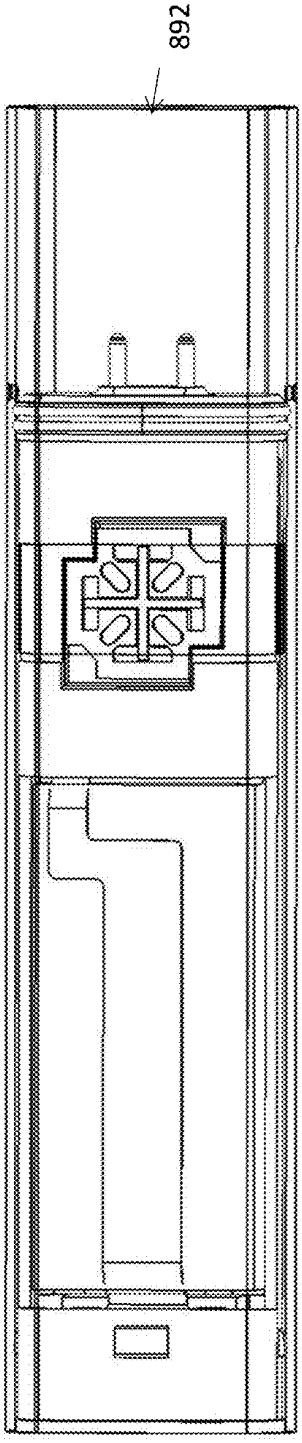


FIG. 11C

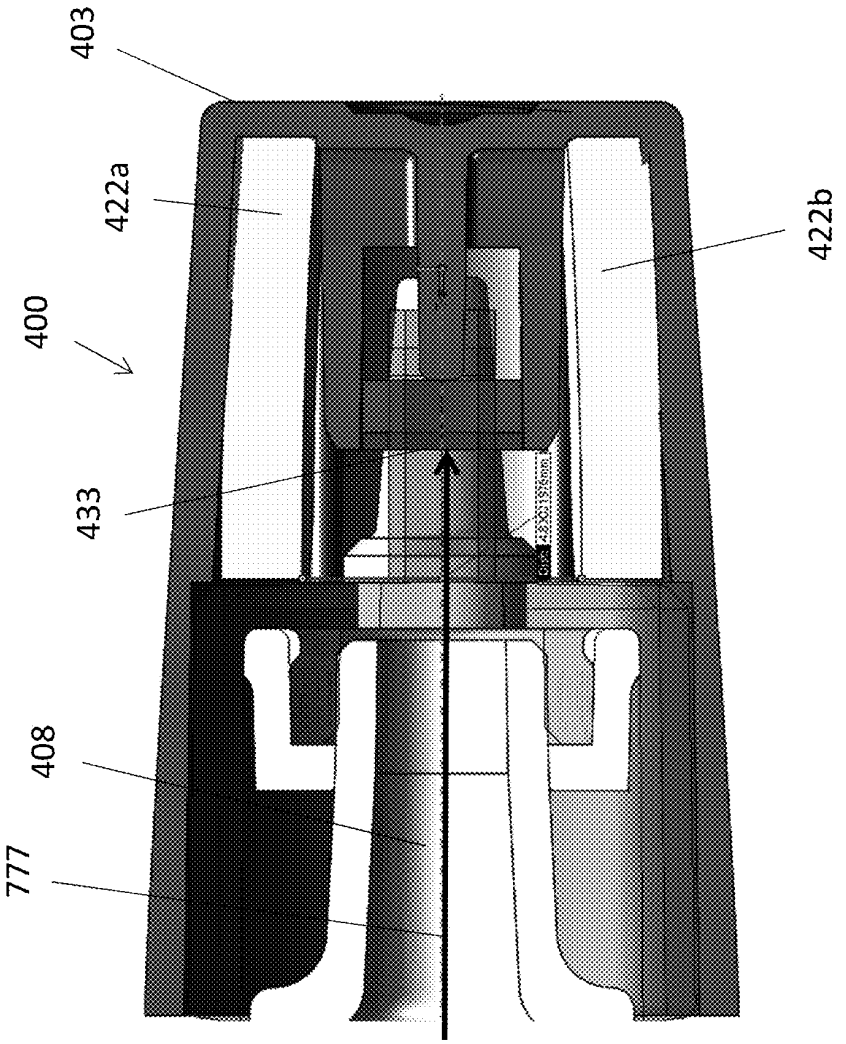


FIG. 12

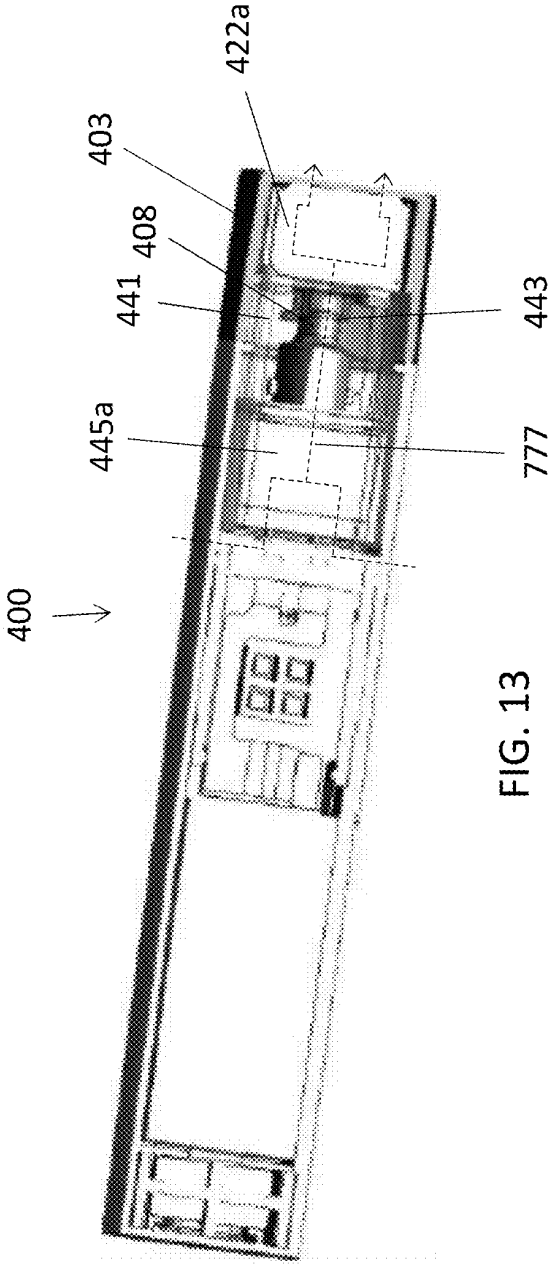


FIG. 13

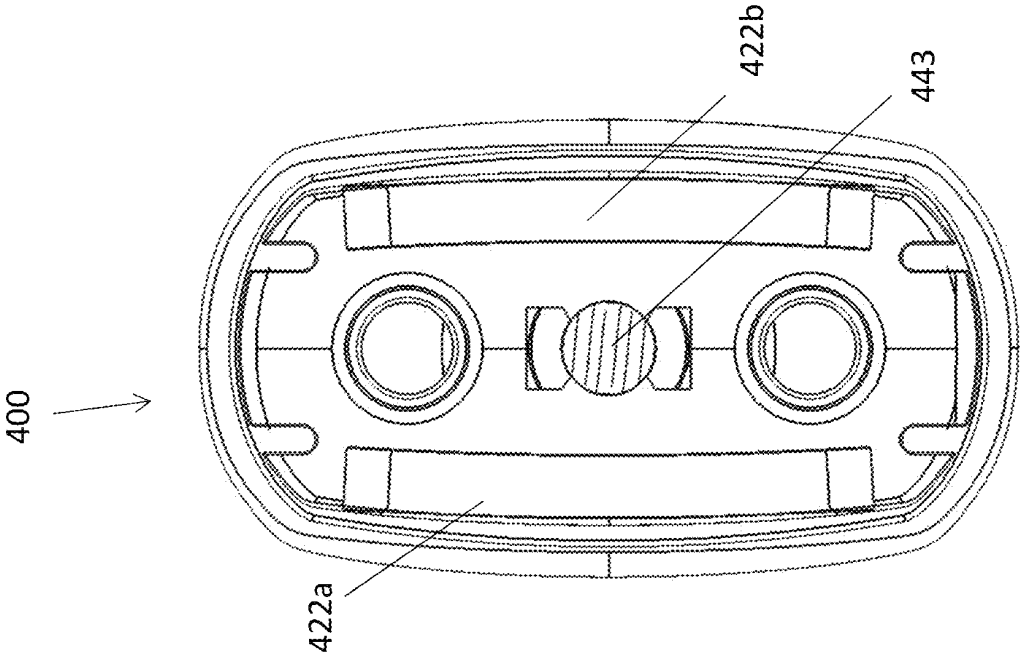


FIG. 14

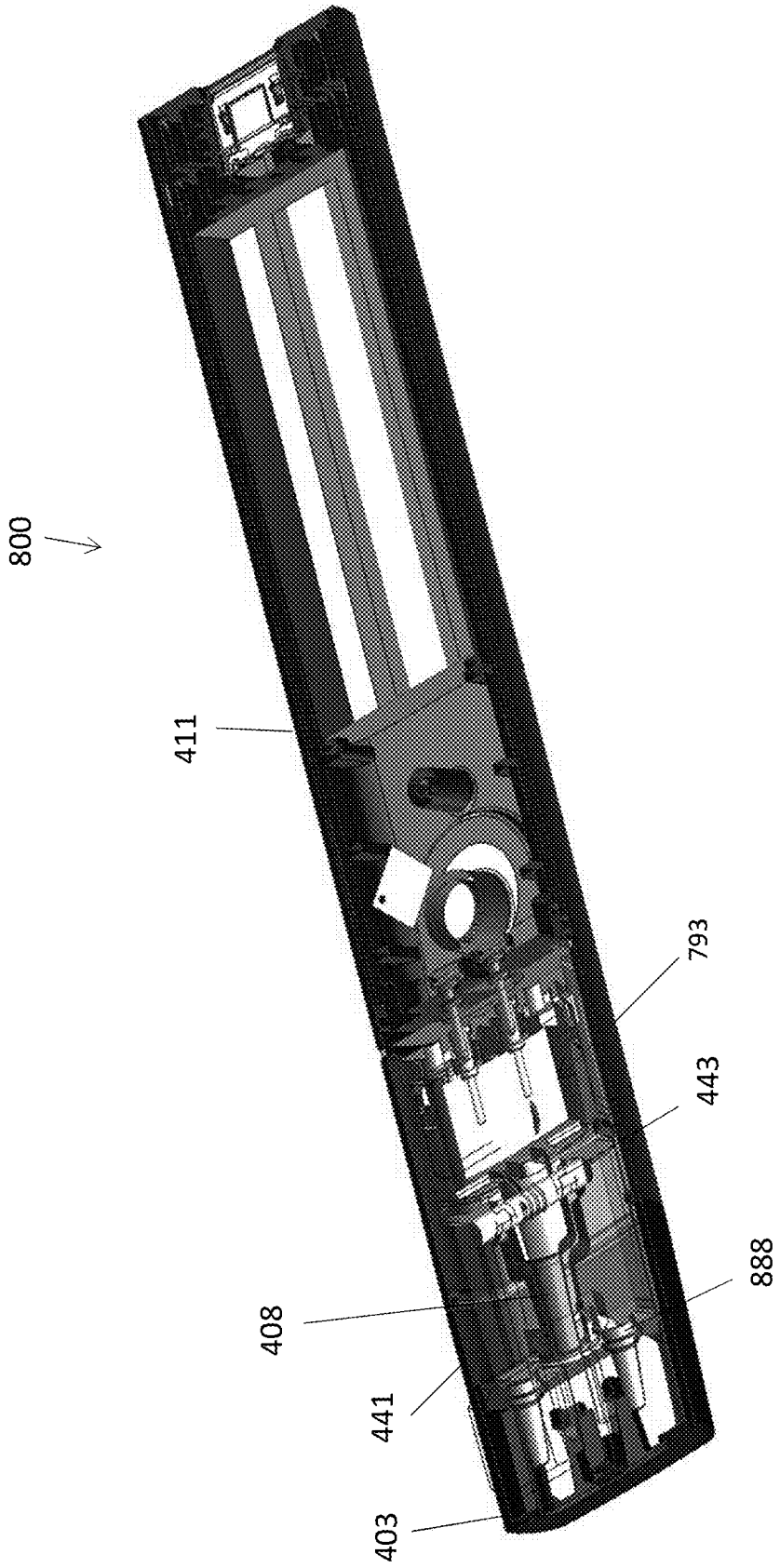


FIG. 15A

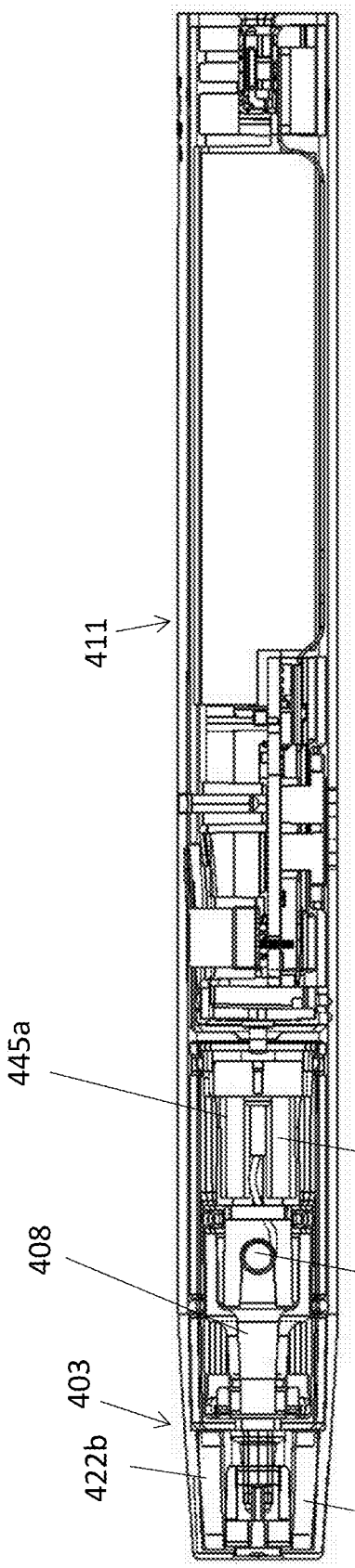


FIG. 15B

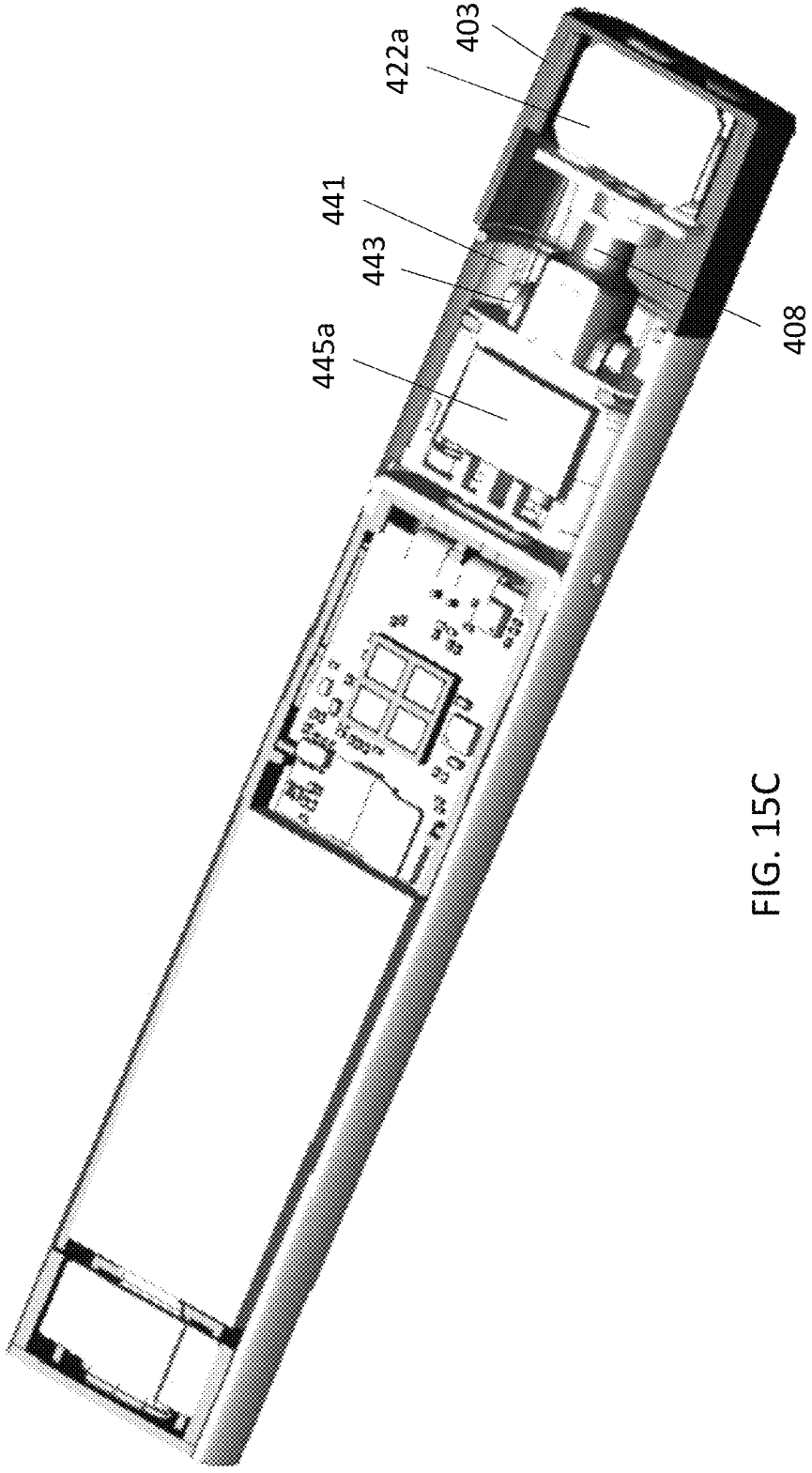


FIG. 15C

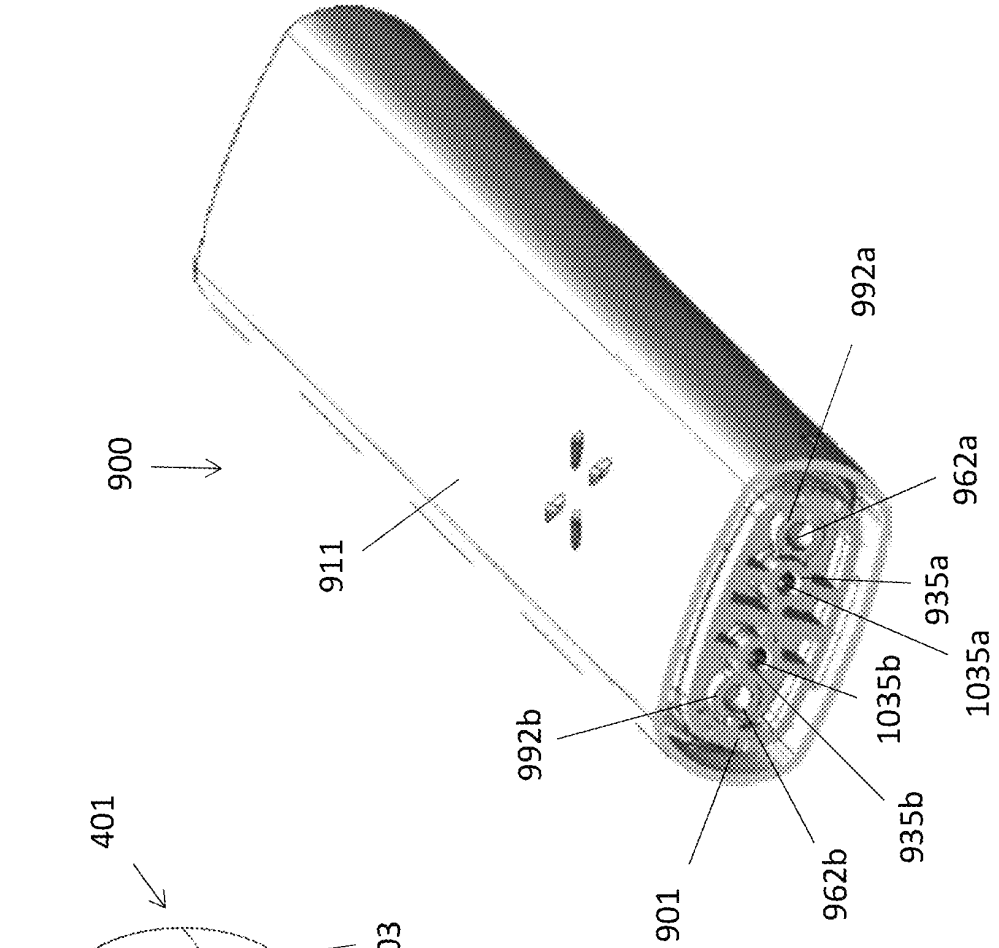


FIG. 16

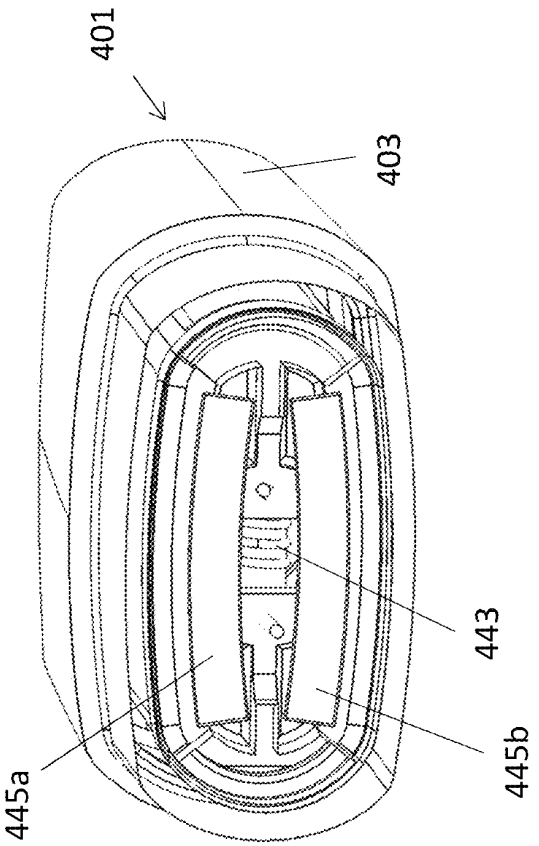


FIG. 15D

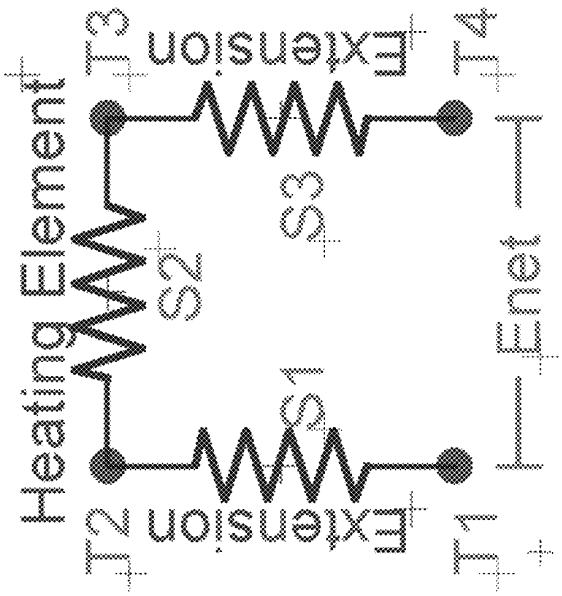

Heating Element
T3
Extension
T4
S3
S2
Enet
S1
T2
Extension
T1

FIG. 17

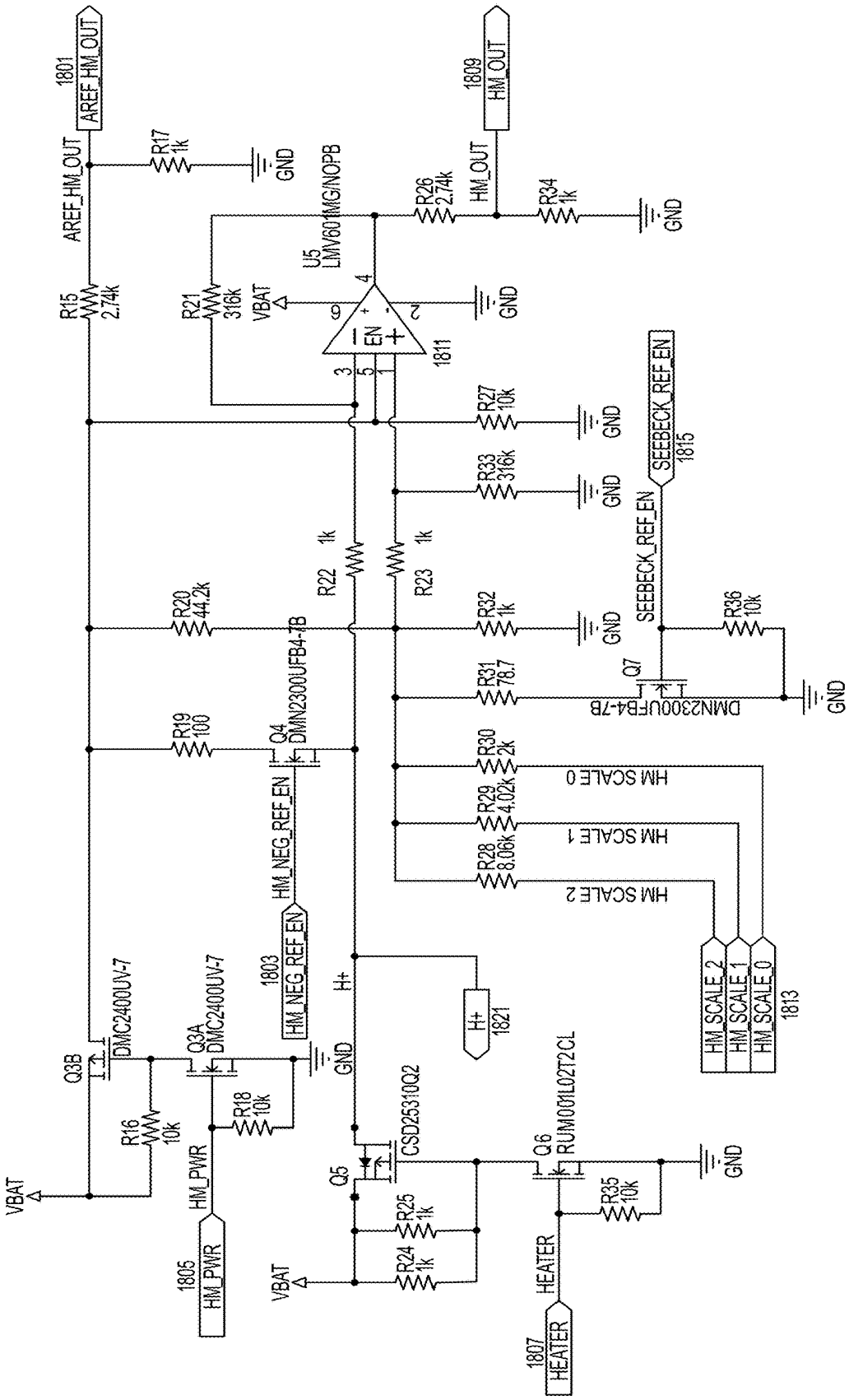

1801
AREF_HM_OUT
R17
1k
GND
1809
HM_OUT
R26
2.74k
R34
1k
U5
LMV601MG/NOPB
R15
2.74k
R21
316k
VBAT
1811
EN
R27
10k
R33
316k
SEEBECK_REF_EN
1815
R22
1k
R23
1k
R20
44.2k
R32
1k
R36
10k
Q7
DMN2300UFB4-7B
R31
78.7
R19
100
Q4
DMN2300UFB4-7B
R30
2k
R29
4.02k
R28
8.06k
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM_NEG_REF_EN
1803
H+
1821
HM_SCALE_2
HM_SCALE_1
HM_SCALE_0
1813
Q3B
DMC2400UV-7
Q3A
DMC2400UV-7
R16
10k
R18
10k
HM_PWR
CSD25310Q2
Q5
Q6
RUM001L02T2CL
R35
10k
R25
1k
R24
1k
HEATER
1805
HM_PWR
1807
HEATER

FIG. 18

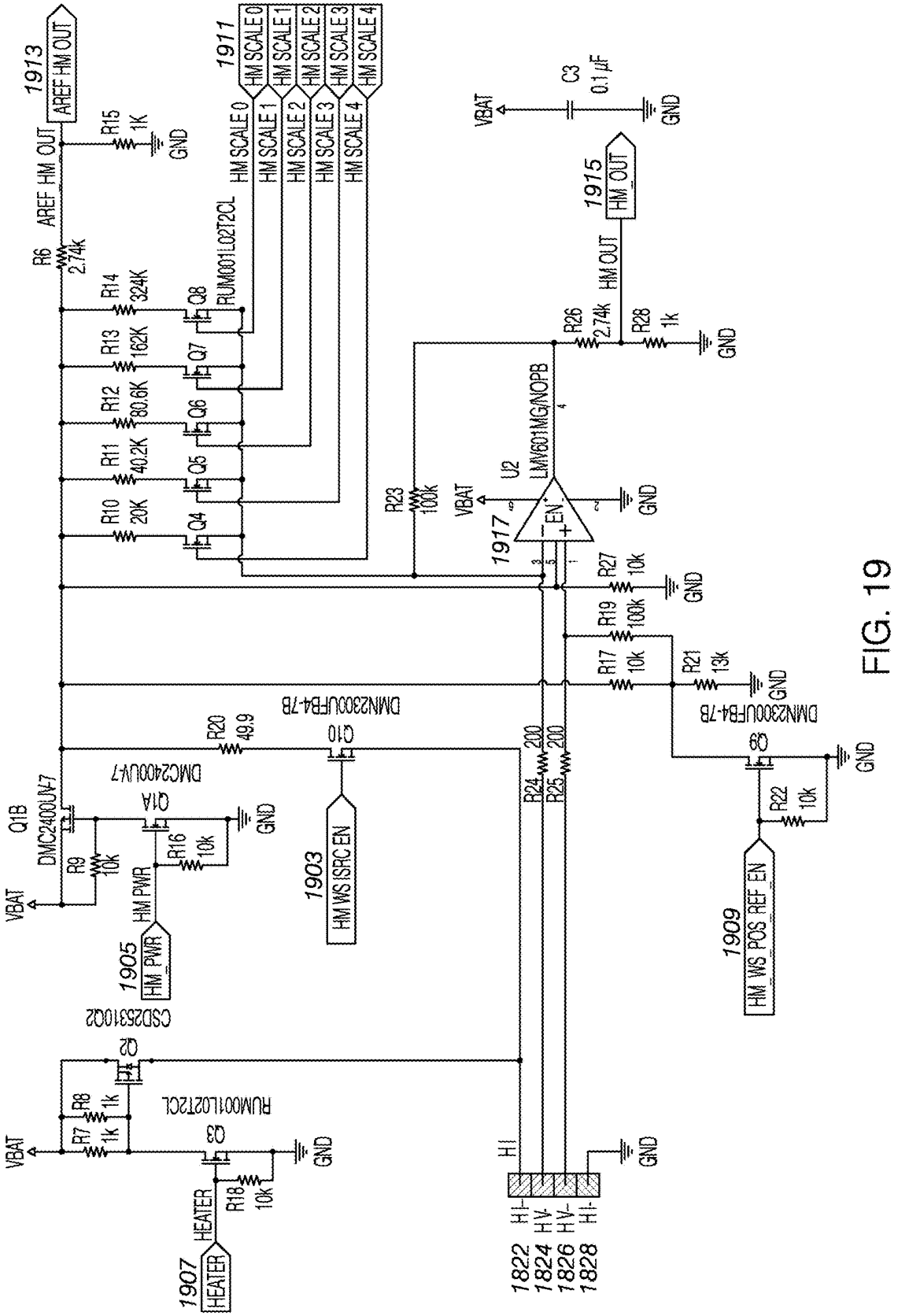

1913
AREF HM OUT
R15
1K
GND
R6
2.74k
R14
324K
R13
162K
R12
80.6K
R11
40.2K
R10
20K
1911
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM SCALE 3
HM SCALE 4
Q8
Q7
Q6
Q5
Q4
RUM001L02T2CL
C3
0.1 µF
VBAT
1915
HM_OUT
HM OUT
R26
2.74k
R28
1k
U2
LMV601MG/NOPB
R23
100k
1917
EN
R27
10k
R19
100k
R17
10k
R21
13k
DMN2300UFB4-7B
R20
49.9
C10
R24
200
R25
200
Q9
R22
10k
1909
HM_WS_POS_REF_EN
Q1B
DMC2400UV-7
Q1A
R9
10k
R16
10k
HM PWR
1905
HM_PWR
1903
HM WS ISRC EN
CSD25310Q2
Q2
R8
1k
R7
1k
RUM001L02T2CL
Q3
R18
10k
HEATER
1907
HEATER
H1
H1-
HV-
HV-
H1-
1822
1824
1826
1828

FIG. 19

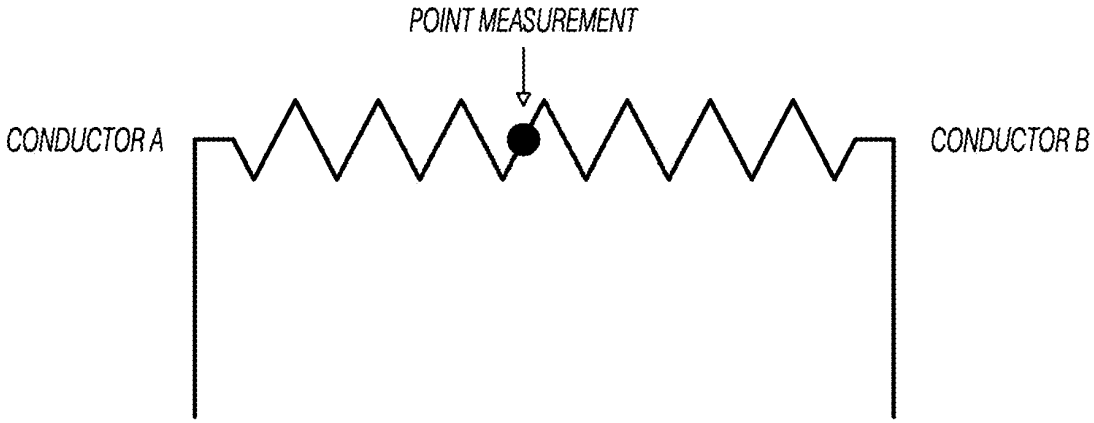


FIG. 20A

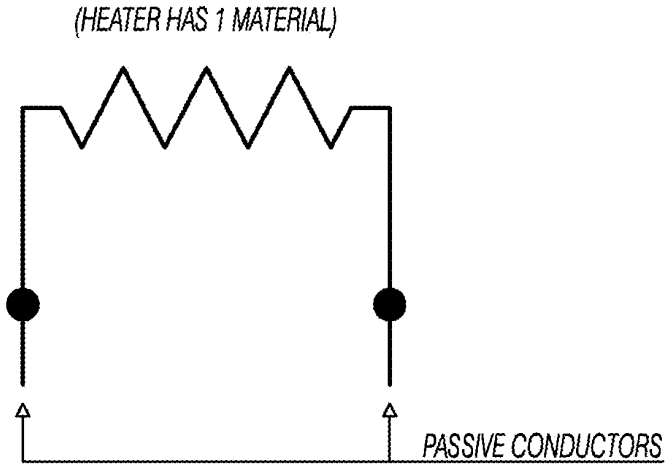


FIG. 20B

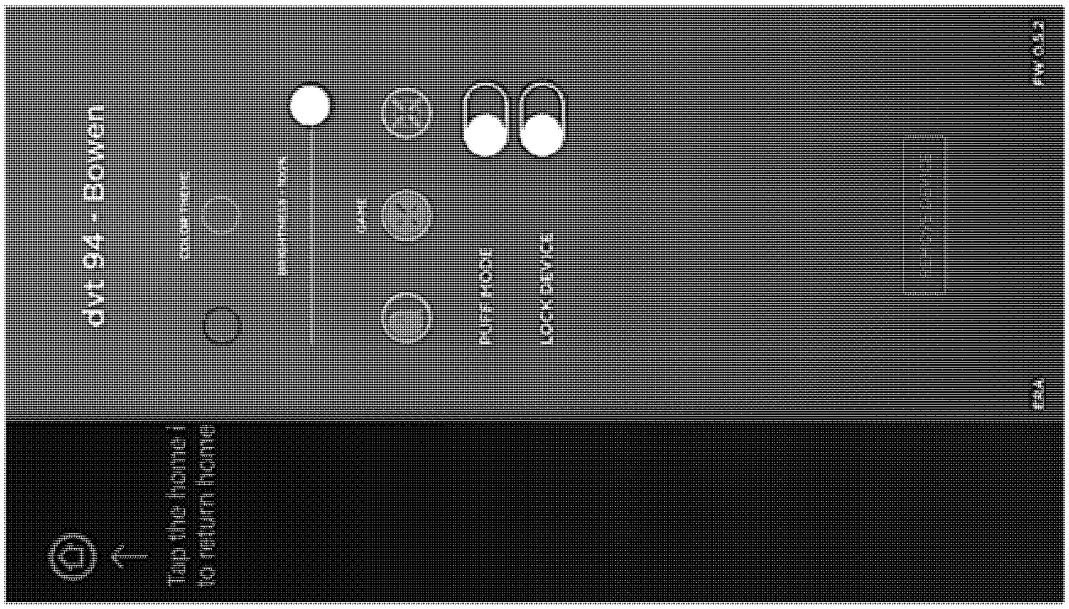

dvt 94 - Bowen
Tap the home i
to return home
PUFF MODE
LOCK DEVICE

FIG. 22

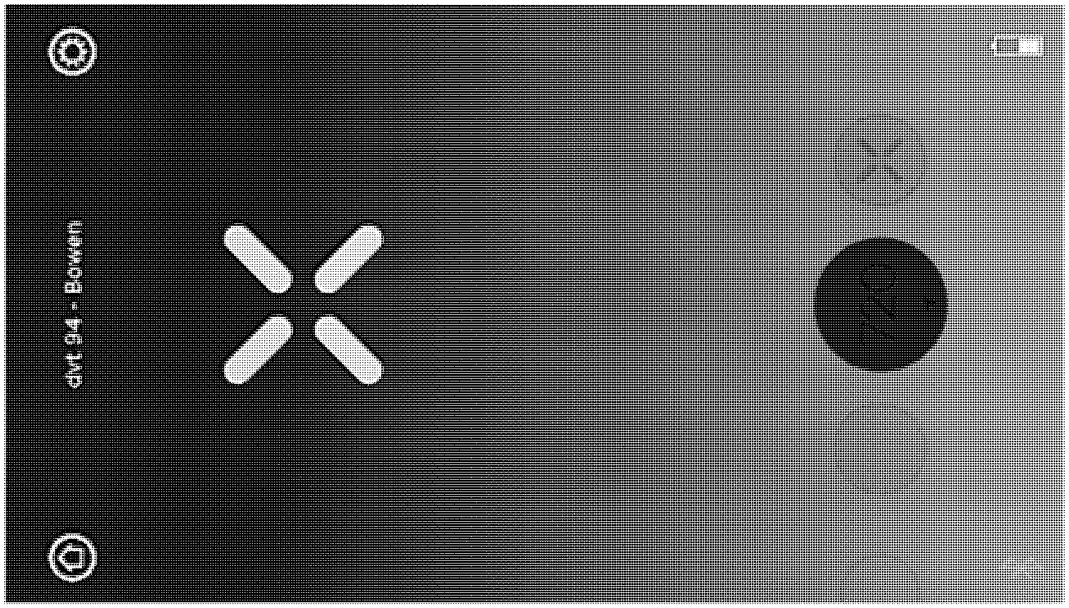

dvt 94 - Bowen

FIG. 21

LEAK-RESISTANT VAPORIZER DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation of U.S. patent application Ser. No. 15/396,584, titled "LEAK-RESISTANT VAPORIZER DEVICE," filed on Dec. 31, 2016, which claims priority to U.S. Provisional Patent Application No. 62/398,494, filed on Sep. 22, 2016 and entitled "VAPORIZER APPARATUSES FOR USE WITH CANNABINOIDS", the disclosure of each of which is incorporated herein by reference in its entirety.

INCORPORATION BY REFERENCE

All publications and patent applications mentioned in this specification are herein incorporated by reference in their entirety to the same extent as if each individual publication or patent application was specifically and individually indicated to be incorporated by reference.

FIELD

Described herein are vaporizer apparatuses, including vaporizer or vaporization devices and vaporizer systems, and methods for making, using and delivering vapor to a user. In particular, vaporizer apparatuses adapted for use with oil-based vaporizable materials including *cannabis* oils.

BACKGROUND

Electronic devices that produce an inhalable aerosol (e.g., inhalable aerosol devices or alternatively referred to as vaporizers, vaporizer devices, vaporization devices, electronic vaping devices, etc.) typically utilize a vaporizable material that is heated to create an aerosol vapor capable of delivering an active ingredient to a user. Vaporizers have been described for vaporizing solids (herbs, tobacco, *cannabis*, etc.), liquids (extracts, waxes, etc.) and combinations of both solids and liquids.

Current market inhalable aerosol devices often consist of a tank or cartridge, vaporizable liquid in the tank or cartridge, an air tube, and a wick/coil subassembly that generates the vapor. Air commonly enters the cartridge through the distal end of the product and is forced through the heated zone where the immediate air becomes fully saturated. As the vapor continues its way through the air tube, it comes in contact with cooler surfaces, causing moisture to collect throughout its use. Depending on the complexity of the air path, particle deposition can add to the existing condensation. As a result, some of the liquid can work its way from the tank or cartridge holding the liquid to other areas of the vaporizer, including the mouthpiece and/or the electronics, causing user dissatisfaction and/or problems with the electronic circuitry.

Conventional vaporizers for aqueous (e.g., water, glycerol, etc.) based vaporizable materials do not manage condensation and leakage of the liquid vaporizable material particularly well, and this problem is particularly acute for oils such as *cannabis* extract oils, in which the liquid material may be particularly oily and/or viscous, and for which evaporation of the liquid material may result in a sticky residue that may impair the operation of the vaporizer.

Further, vaporization of *cannabis* extract liquids may be more technically difficult than vaporization of other liquids (such as nicotine solutions).

For example, conventional e-cigarettes may address moisture build-up by integrating a filter pad in line with air flow. However, having a filter pad in line with the air flow can impede or restrict the air flow as the user draws on the mouthpiece. Moreover, this restriction to draw incrementally climbs as the filter becomes more saturated throughout, often requiring the user to change his or her draw accordingly and increasing the possibility of drawing liquid of the product and into the user's mouth.

In addition, the control of the temperature when vaporizing *cannabis* extracts may require a high degree of precision. Virtually all vaporizers currently available today would benefit from a higher degree of precision in power management and control of the heater (atomizer). In particular, vaporizers well suited for vaporizing *cannabis* (e.g., liquid *cannabis* extract solutions) may benefit from precise and accurate control of the heater forming the vapor.

It would also be beneficial to provide cartridges that do not roll and may rest in a small number of secure positions (e.g., cartridges having non-circular cross-sections) and to provide an immediate approximate (visual) estimate of the amount of material consumed.

Finally, it would be particularly beneficial to provide pre-loaded and tightly controllable cartridges for use in consuming *cannabis* extract liquids that prevent or reduce leakage of particularly viscous vaporizable materials such as *cannabis* oils/extracts.

Accordingly, described herein are vaporizers (including vaporizer cartridges) and methods of operating and using them addresses the issues raised above.

SUMMARY OF THE DISCLOSURE

In general, described herein are apparatuses such as devices and systems for vaporizing a material (including, in particular, but not limited to, *cannabis* extract liquids) and method of using them. For example, described herein are vaporizers, cartridges for use with such vaporizers, and vaporizer control systems.

Described herein are vaporizer cartridges that are pre-loaded (filled) with a *cannabis* vaporizer material. The vaporizable *cannabis* material is typically a liquid material, and may be a *cannabis* extract liquid (*cannabis* "oil"). Also described herein are vaporizers with or without cartridges that are adapted for use with *cannabis* liquid extracts. Either or both the vaporizer base (which mates with the vaporizer cartridge to form the vaporizer device) and vaporizer cartridge may be adapted specifically for use with *cannabis* liquid extracts, although any of the apparatuses and methods described herein may be operated with other vaporizable materials, including nicotine solutions and/or solutions having no active ingredient at all (e.g., just including a carrier such as polyether compounds like polyethylene glycol and/or glycerol, or the like, and flavorants).

For example, a cartridge as described herein may include a vaporizable material such as *cannabis* oil. *Cannabis* oils present particular challenges when vaporized using a cartridge and/or a handheld vaporizer device. For example, *cannabis* oil is relatively "sticky" and may be viscous, particularly once it dries out. Thus, leakage may be a more serious consideration and challenge compared to other aqueous vaporizable materials. In particular, leakage of *cannabis* oil may result in clogging of the device and disturbing the electrical components, particularly the electrical contacts,

which may be otherwise "gummed up" by leaked oil. The dried oil is not only sticky, but may also be electrically insulative, and may disrupt the electrical control of the vaporizer. Described herein are apparatuses and methods to prevent or control leakage and to avoid disruption of electrical contacts between cartridges containing the *cannabis* extract and the rest of the vaporizer.

For example, the apparatuses described herein may include one or more electrical contacts (e.g., between the cartridge and the vaporizer base) referred to herein as wiping or scraping contacts. These electrical connections may be configured so that as a connection/contact is made between two electrically conductive surfaces, the contact (e.g., on the cartridge and/or the vaporizer base) scrapes the mating surface of the other contact to remove any vaporizable material, including vaporizable material that has dried on the contact. For example, a contact may include a canister with one or more extensions (e.g., wipers, knives, fingers, or scrapers) that are driven against and across the mating surface of the opposite electrical contact to scrape away any leaked vaporizable material (including dried-on material). The complimentary electrical contact may be a pin (including a pogo-pin) electrically conductive connector that is scraped as it enters into the canister by the wiper/scraper(s) therein. Thus, in general, the electrical contact in the vaporizer base may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer cartridge and/or the electrical contact in the vaporizer cartridge may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer base to remove contaminating material. Thus either contact may include a scraping projection (e.g., edge, blade, wire, etc.) that is driven across the opposite surface. Typically two or more contacts are included in the vaporizer cartridge, and each of them may be configured as a scraping or wiping contact. In some variations, it may be desirable to have the scrapers on the connectors of the cartridge, although the scrapers may be present on the vaporizer base instead or in addition.

Any of the cartridges described herein may include a tank or storage region within the cartridge and/or forming a portion of the body of the cartridge. In particular, all or a portion of the cartridge (including the tank) may be clear, transparent and/or translucent so that the level of vaporizable material within the tank can be seen by a user. The tank may be prefilled or fillable. The tank may be sealed closed at the top (near the mouthpiece, which may cover the top of the cartridge). The mouthpiece may be plastic and may be secured over the tank by a snap fit, a friction fit, and adhesive, or the like. For example, the distal end of the elongate and flattened tubular body is configured to be secured by a friction fit within a vaporizer body. As described in greater detail herein, one or more absorbent members, (e.g., sponges, pads, felts, etc.) may be included in the mouthpiece between the tank and the mouthpiece, to prevent leakage of vaporizable material from contacting the portion of the mouthpiece where the user applies her or his lips. The tank may be sealed, e.g., by a tank seal that covers the one or more openings for filling the tank. In some variations, rather than one or more small plugs (which may be difficult to install) the tank may be sealed by a multi-seal component (e.g., a single piece) that seals between the mouthpiece and the top of the tank as and closes off two or more openings into the tank.

During inhalation through the apparatus, the user may draw on the mouthpiece (by inhaling/sucking on the mouthpiece) to draw air through the mouthpiece. The device may be turned on by one or more of: a control on the device (e.g., on an outer surface of the device), but installing the cartridge into the vaporizer base, detecting inhalation, detecting lip contact with the mouthpiece. In some variations, the device is turned on, and the heater rises to an initial set temperature, when the device is in a ready to turn on state and when the user draws on the mouthpiece. The vaporizer may be placed in a ready to turn on state by connecting (or detecting connection of) a cartridge and/or by a switch or control on the outside of the apparatus and/or by the battery level being sufficient to operate the device.

Once the device is turned on, it may be operated by drawing on the mouthpiece to cause the temperature to cause the vaporizer heater (the atomizer) to heat to the desired temperature setting (which may be preset, selected from a plurality of pre-set temperatures or may be user selectable, including using a computer or other device having a processor and user interface that communicates with the device, either wirelessly or via a wired connection, such as a smartphone wirelessly communicating with the device).

Drawing on the mouthpiece typically causes airflow to enter the cartridge receiver region of the vaporizer base through one or more (e.g., two) air openings that are positioned through the wall of the cartridge receiver near a base of the cartridge receiver. Air may pass into the cartridge receiver and up through the cartridge via one or more openings in the base (bottom) of the cartridge. The air may then pass into a heater connector region that also includes one or more (e.g., two, parallel) absorbent pads or sponges for absorbing any leakage of vaporizable material that may enter into this air-filled heater connector region, which is also open to the vaporizing chamber across which a wick and heating coil is extended to form vapor. The two absorbent pads positioned in this air region positioned on the long axis of the cartridge, against the major faces of the cartridge body so that they don't block the air path into the vaporization chamber from the opening(s) at the base. These absorbent pads (e.g., sponges) may prevent dripping or leakage of the fluid from the vaporization chamber (e.g., off of the wick) even when the heater is not being heated. In order to prevent leakage should the absorbent pads not be sufficient, the opening into the base of the air chamber may include a rim or boss on the inner surface (within the heater connector region at the base of the cartridge) that prevents small amounts of fluid (e.g., vaporization fluid such as *cannabis* oil) to drip out of the opening(s) into the cartridge (e.g., the air chamber of the cartridge).

The air path from the vaporization chamber to the mouthpiece may have a minimum diameter that is slightly larger than previously described. For example, the minimum diameter of the air path between the vaporization chamber and the mouthpiece may be about 1.5 mm or greater, about 1.6 mm or greater, than about 1.7 mm or greater, than about 1.8 mm or greater, than about 1.9 mm or greater, than about 2 mm or greater, than about 2.1 mm or greater, than about 2.2 mm or greater, than about 2.3 mm or greater, than about 2.4 mm or greater, than about 2.5 mm or greater, etc. For example the minimum diameter may be 2.0 mm or greater.

In any of the variations described herein, the apparatus may include a wick as part of the atomizer (heater). In variations for use with *cannabis* oil the wick may be larger than typical cartridge wicks and may have a slightly larger pore size, because of the higher viscosity of the *cannabis* oil as compared to other (including nicotine) aqueous vaporization solutions. For example, the wick may be larger than 1.5 mm in diameter (e.g., about 1.9 mm or larger, about 2.0 mm or larger, about 2.1 mm or larger, about 2.2 mm or

larger, about 2.3 mm or larger, about 2.4 mm or larger, about 2.5 mm or larger, etc., including between about 1.8 mm and about 5 mm, between about 1.9 mm and about 4 mm, between about 2 mm and about 4 mm, etc.). The wick may generally extend across the vaporization chamber, e.g., along or perpendicular to the long axis of the cartridge, and between either the major or minor sides (in oval or flattened cartridges). The wick material may be any appropriate material, particularly those that are biocompatible, have a sufficient pore size, compatible with *cannabis* oils and may be resistant to heat up to the maximum heating temperature of the apparatus (e.g., will not degrade or combust significantly at temperatures up to about 450° C., 500° C., 550° C., 600° C., 650° C., etc.). For example, the wick may be made of a silica material (e.g., fiberglass).

In any of the heaters described herein, the heater (atomizer) may include a heating coil that may be wrapped around the wick for conductive heating. In any of the variations described herein convective heating of the liquid material (e.g., *cannabis* oil) wicked by the wick. The heating coil may be any appropriate material, but in particular, electrically resistive materials such as nichrome or other resistive materials, particularly those which change their resistance with heat (e.g., having a resistance that increases linearly and predictably with temperature over the desired range of temperatures, e.g., between 30° C. and 600° C., etc., including stainless steel, titanium, nickel, alloys of nickel, etc.).

The cartridge may have any desired shape or configuration. In some variations it may be beneficial in particular to have a shape that is cylindrical, and particularly a flattened cylinder, such as an approximately oval shape, with curved sides. Two of the sides (though curved) may be major sides, having a larger diameter, and two may be minor sides (though curved), having a smaller diameter. The flattened shape may prevent rolling when the device is placed on its side. In some variations the mouthpiece may extend in a slightly tapered shape. The tank may form a central region of the cartridge, bounded by the mouthpiece at one end (at the top) and the air chamber (at the bottom). A central cannula may form the air path between the vaporization chamber and the mouthpiece. The vaporization chamber and cannula may be surrounded by the tank, and may be visible through the walls of the tank (e.g., the vaporization chamber and cannula may be opaque, transparent or translucent). One or more seals, including o-rings, may be used to seal and secure the mouthpiece from the tank and the air chamber (base of the cartridge) from the tank. For example an inner seal may be between the mouthpiece and the outer wall of the tank (which may include a channel or track for the seal/o-ring) and a second seal (o-ring) may be positioned in an inner wall of the tank between the tank and the walls forming the air chamber and/or vaporization chamber at the base of the cartridge.

In any of the variations described herein it may be useful to provide an indication of the amount of the cartridge vaporized, which may be approximately correlated to the dose of the vaporizable material delivered. In any of the apparatuses described herein, the apparatus may include an output (e.g., LED, LCD or other display, etc.) on the apparatus or on a device in communication (e.g., wireless communication) with the apparatus such as a smartphone, laptop, desktop, pad, or the like. The output may indicate a qualitative and/or quantitative amount of the dose of vapor delivered from a particular cartridge. Dose may be determined using the processor of the apparatus to indicate approximately how much of the material, e.g., *cannabis* oil, has been consumed based on the power applied to the heater and the duration of heating. A qualitative output may be provided by sequentially illuminating (and/or changing the intensity and/or color of illumination) of a plurality of LEDs. In another example a 'status bar' showing consumption or dose delivered from a cartridge may be displayed on the apparatus body (e.g., the vaporizer body) or another device (e.g., smartphone) in communication therewith. For example, a plurality of LEDs (RGB) may be illuminated to provide qualitative feedback to a user on the operation of the vaporizer. Upon inserting a cartridge, the vaporizer apparatus may display using the LEDs an illumination corresponding to the intensity of the inhalation and/or the progression of consumption of vaporizable material from the cartridge. The processor in the vaporizer apparatus may estimate a dose based on the power applied to the vaporizer and the duration of heating and/or the duration of draw (inhalation). For example, the power applied * duration of draw may be accumulated by the processor, and the value output. In some variations the output may be provided for display on the body of the apparatus (e.g., by illuminating a sequence of LEDs. This may provide immediate visual feedback to the user.

The apparatuses, and particularly the cartridges, described herein may be adapted specifically for use with oils such as *cannabis* oils. As discussed above, existing cartridges are poorly suited for use with *cannabis* oils, as they may leak. Leaking of *cannabis* oils is both messy and detrimental to the operation of the vaporizer, as the leaked *cannabis* oils may disrupt the electrical connections driving vaporization and may clog or jam the operation of the apparatus. The cartridges described herein may include a number of specific modifications that address these issues; individually, these modifications may be helpful, but as will be described below, in combination these features have proven surprisingly effective at providing a robustly leak-resistant and reliable cartridge when using an oil such as a *cannabis* oil.

For example a cartridge device for holding a vaporizable cannabinoid material without leaking (e.g., that is substantially leak-resistant) may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having a width and a diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

In particular the combination of the flattened elongate body shape (which may be oval or rectangular) along with the enlarged and enclosed overflow leak chamber (typically having an open volume of greater 0.5× or greater the tank volume) at the distal end, and one or more (e.g., two, three, four, etc.) openings into the overflow leak chamber, which may preferably include a lip region around the openings inside the overflow leak chamber. The use of absorbents pads positioned within the overflow leak chamber (e.g., positioned off-axis, along a major wall of the overflow leak chamber, such as the wall extending in the diameter) provides an effective leakage barrier even when changing altitudes or when the user misuses the cartridge, e.g., user-

induced failure modes such as biting or squeezing the mouthpiece, and/or blowing into the mouthpiece. Surprisingly, other combinations of such features are less effective, particularly in user-induced failure modes. For example, otherwise similar cylindrical devices, e.g., having a width and diameter that are equivalent or nearly equivalent (e.g., a diameter less than 1.2×, or greater than 0.8×, the width) may show greater leakage compared to more flattened devices; the addition of one or more absorbent pads, particularly along the long wall of an overflow leak chamber) show an even greater reduction in leakage.

The one or more openings into the overflow leak chamber may be present on any surface of the cartridge, including through the distal end of the overflow leak chamber. Although placement of the opening at the distal end may otherwise result in an increase in leakage of the highly viscous oil from the cartridge, including the leak chamber and the absorbent pad(s) prevents or reduces leakage. In addition, the one or more openings may be surrounded by a lip within the leak chamber. The lip may have a height above the inner wall of the chamber that is 0.3 mm or greater (e.g., 0.5 mm or greater, 0.7 mm or greater, 0.8 mm or greater, 0.9 mm or greater, 1 mm or greater, 1.2 mm or greater, 1.3 mm or greater, 1.4 mm or greater, 1.5 mm or greater, 2 mm or greater, etc.).

The one or more absorbent pads may be positioned within the overflow leak chamber along the diameter, off-axis relative to an air flow path through overflow leak chamber from the opening to the air path.

In general, the overflow leak chamber may be relatively large, e.g., the volume of the overflow leak chamber (including the absorbent pad(s)) may be between 0.4 and 1.5× the volume of the tank (reservoir). In particular, the volume of the overflow leak chamber may be between 0.4 and 1× the volume of the tank (e.g., 0.4× or greater, 0.5× or greater, 0.6× or greater, 0.7× or greater, etc. than the volume of the tank). Alternatively, this may be described as the length of the overflow leak chamber along the distal to proximal axis relative to the length of the tank, and may be between 0.4× and 2× the length of the tank along the distal to proximal axis (e.g., between 0.4× and 1×, between 0.5× and 2×, between 0.5× and 1.5×, etc.), typically 0.4× or greater. In general, the overflow leak chamber may be enclosed within the distal end of the elongate and flattened tubular body.

In general, the cartridges described herein may be configured for insertion (e.g., by friction fitting) into a vaporizer body. Thus, the cartridge, and particularly the distal end of the cartridge, may be adapted to be inserted securely into the re-usable vaporizer device. The cartridge may therefore have straight (e.g., flat) or inwardly tapered sides and may include one or more friction-engagement regions that couple within the vaporizer. In some variations the distal end region of the cartridge may include a channel, rim, lip, ridge, protrusion, etc. that may engage with a complimentary region in the vaporizer (e.g., in a cartridge receiver in the vaporizer body). Thus, the cartridge may be configured to 'snap' fit into the vaporizer body. For example, the distal end of the elongate and flattened tubular body may include a lip or rim configured to snap into a vaporizer body.

The cartridge may also include one or more (e.g., a pair) of electrical contacts on the distal end of the cartridge (e.g., on the distal end of the overflow leak chamber) in electrical communication with the heater. These electrical contacts may also be configured and adapted to prevent or ameliorate the effects of leakage of oil from the cartridge. For example, the electrical contacts may comprise scraping contacts (also referred to as wiping or wiper contacts), which may include an edge or edge to scrape against the contact (e.g., pogo pin) from the vaporizer before (and/or separately from) making electrical contact. For example, the pair of electrical contacts may comprise pin receptacles. These pin receptacles may include an outer scraping edge with an inner conductive surface.

In any of the variations described herein, the tank may include a cannabinoid solution (e.g., a *cannabis* oil solution). Thus, the cartridge may be pre-filled with a *cannabis* oil. The tank volume may be configured to hold between about 0.2 mL and about 2 mL or more of oil. For example, the tank may be configured to hold between about 0.4 mL and about 1.2 mL (e.g., between about 0.4 mL and 0.8 mL, etc.)

The mouthpiece may be configured to fit over the proximal end of the elongate and flattened tubular body, and may be in fluid communication with the air path through the tank. The mouthpiece may include an internal volume; one or more absorbent pads may be positioned within this internal volume. The one or more mouthpiece absorbent pads within the mouthpiece may generally be off-axis relative to the air path (leaving a central air path that is not occluded by the absorbent pads). For example, the mouthpiece absorbent pads may be off-axis relative to an air flow path from the air path and out of the mouthpiece. The mouthpiece absorbent pads may be positioned on the sides of the mouthpiece (e.g., the major sides, corresponding to the diameter of the mouthpiece). The absorbent pad(s) may be between a proximal end of the mouthpiece and the elongate and flattened tubular body.

In any of the devices described herein the air path may extend through the cartridge, from the distal end (e.g., the opening(s) into the overflow leak chamber), past the heater, through and/or around the tank, and out of the mouthpiece. In some variations, the air path comprises a cannula extending through the tank. In general, the elongate body may be transparent or translucent, and any material in the tank may be visible; when the device includes a cannula running through the tank this may also be visible.

The absorbent pads in the overflow leak chamber may be the same material and/or dimensions as those (if present) in the mouthpiece, or they may be different materials and/or dimensions. The one or more absorbent pads may be made of a sponge or felt material. The one or more absorbent pads may comprise a pair of flat absorbent pads arranged in parallel. For example, the one or more absorbent pads may comprise a cotton material. The one or more absorbent pads may be rectangular.

As mentioned, the one or more absorbent pads in the overflow leak chamber may be a pair of absorbent pads positioned within the overflow leak chamber off-axis relative to an air flow path through the overflow leak chamber from the opening to the air path.

The heater (e.g., wick and coil) may be positioned within the air path so that it is parallel, transverse or oblique to the air path. For example, the heater may extend across the air path in a transverse direction.

The elongate and flattened tubular body may have an oval cross-section or a rectangular cross-section transverse to the distal to proximal axis, and may be any appropriate size. For example, the elongate tubular housing may be between about 1 cm and 10 cm long (e.g., between about 2 cm and 7 cm long, etc.). It may be particularly beneficial to have the elongate tubular housing be somewhat short and compact (e.g., less than 8 cm, less than 7 cm, less than 6 cm, less than 5.5 cm, less than 5 cm, etc.)

The sizes of the openings into the air path (through the overflow leak chamber, e.g., at the distal end of the cartridge) may be configured to allow relatively easy draw through the cartridge, while preventing leakage out of the overflow leak path. Leaking may occur from the heater (e.g., the exposed wick) which is inserted through the wall of the tank; the air path within the cartridge is open and continuous, which would otherwise allow the material to leak. Thus, for example, the size of the one or more openings may be specified within a range identified as allowing sufficient air flow without permitting excessive leaking. For example, in some variations, the diameter of the opening(s) into the overflow leak chamber is/are between 0.1 mm and 5 mm (e.g., between 0.1 mm and 3 mm, between about 0.1 mm and 2 mm, etc.).

The tank portion of the device may be filled by an opening beneath the mouthpiece, which may be sealed or plugged. For example, the cartridge may include a plug between the mouthpiece and the elongate and flattened tubular body, wherein the plug closes off the tank of the elongate and flattened tubular body.

Any of the cartridge devices for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece on the proximal end of the elongate and flattened tubular body; an enclosed overflow leak chamber at a distal end of the elongate and flattened tubular body, The device of claim **1**, wherein a length of the overflow leak chamber along the distal to proximal axis is 0.5 times or greater than a length of the tank along the distal to proximal axis; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path proximal to the overflow leak chamber; an opening through the distal end of the overflow leak chamber, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

For example, a cartridge device for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body, wherein a length of the overflow leak chamber along the distal to proximal axis is between 0.5 and 2 times a length of the tank along the distal to proximal axis; an air path extending proximally from the overflow leak chamber through the tank to the mouthpiece, wherein the air path comprises a cannula extending through the middle of the tank; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** show moisture and vapor deposition on a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **3**A and **3**B show a vaporization device with a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **4**A and **4**B show an exemplary vaporization device. This exemplary device includes two pairs of absorbent filter pads, as described herein. FIGS. **4**A and **4**B show a cartridge placed within the reusable component of the device.

FIGS. **5**A-**5**F illustrate the vaporizer body (e.g., a reusable component of the vaporizer device of FIGS. **4**A and **4**B). FIG. **5**A is a bottom perspective view; FIG. **5**B is a front view, FIG. **5**C is a top perspective view (looking into the cartridge receiver region including electrical contacts), FIG. **5**D is a side view, FIG. **5**E is a top view, and FIG. **5**F is a bottom view, showing the electrical connection to a charger or other wired electrical connection.

FIGS. **6**A-**6**D illustrate the cartridge of the device of FIGS. **4**A and **4**B. FIG. **6**A is a bottom perspective view, FIG. **6**B is a bottom view, FIG. **6**C is a top perspective view (showing the opening into the mouthpiece) and FIG. **6**D is an exploded view of the cartridge of FIG. **6**A.

FIGS. **7**A-**7**F illustrate an alternative view of a cartridge as described herein. FIG. **7**A shows a bottom perspective view; FIG. **7**B is a top perspective view; FIG. **7**C is a front view; FIG. **7**D is a side view; FIG. **7**E is a bottom view; and FIG. **7**F is a top view.

FIGS. **8**A-**8**G show a variation of a vaporizer base of a vaporizer apparatus into which a cartridge such as the one shown in FIGS. **7**A-**7**F may be inserted. FIG. **8**A is a bottom perspective view; FIG. **8**B is a top perspective view showing the cartridge receiver portion of the vaporizer base; FIGS. **8**C, **8**D and **8**E show front, side and back views, respectively of the vaporizer base; and FIGS. **8**F and **8**G show bottom and top views, respectively of the vaporizer base.

FIGS. **9**A-**9**G show an assembled vaporizer apparatus including a vaporizer cartridge such as the one shown in FIGS. **7**A-**7**F that has been fully seated and retained in a vaporizer base such as the one shown in FIGS. **8**A-**8**G. FIGS. **9**A and **9**B show bottom perspective and top perspective views, respectively of the assembled vaporizer apparatus; FIGS. **9**C, **9**D and **9**E show front, side and back views, respectively of the assembled vaporizer apparatus; FIGS. **9**F and **9**G show bottom and top views, respectively, of the vaporizer apparatus.

FIG. **10**A is an exploded view of the cartridge of FIGS. **7**A-**7**F with the components arranged in line.

FIG. **10**B is an alternative exploded view of the cartridge of FIGS. **7**A-**7**F, showing the component parts positioned adjacent to each other at the approximate vertical position for assembly.

FIG. **11**A is a semi-transparent view (in which the outer casing of the vaporizer base, mouthpiece, and cartridge housing have been a made transparent) showing the air path through the assembled vaporizer apparatus such as the one shown in FIGS. **7**A-**9**G.

FIGS. **11**B and **11**C show front and back views, respectively, of an example of a vaporizer base with the outer housing (case or shell) made transparent, showing the cartridge receiving end including connectors and air entry port therein.

FIG. **12** is an enlarged view of a section through a midline of the proximal (top) region of a cartridge (as shown by

dashed line **12-12'** in FIG. **9**A), showing the air path from the vaporization chamber to the mouthpiece openings.

FIG. **13** is a section through the midline of a vaporizer apparatus (including a vaporizer base into which a vaporizer cartridge has been coupled), showing the air path during inhalation (puffing, drawing, etc.).

FIG. **14** show a section through a cartridge, just beneath the mouthpiece (as shown by dashed line **14'-14'** in FIG. **9**B) showing the arrangement of the distal pair of absorbent pads offset from the airflow path.

FIG. **15**A is a section through the midline of an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **15**A-**15**A').

FIG. **15**B is another section through an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **12-12'**).

FIG. **15**C shows another section through the assembled vaporizer apparatus (through line **15**C-**15**C' in FIG. **9**B).

FIG. **15**D is a section through a cartridge (through line **15**D-**15**D' of a cartridge such as the one shown in FIG. **7**A) showing a pair of overflow filter pads that are off-axis relative to the airflow path of the device.

FIG. **16** is a section through another of another exemplary vaporization device (at line **16-16'** in FIG. **9**B), near the base of the cartridge and inserted into the cartridge receiver of the vaporizer base.

FIG. **17** is an electrical schematic of a heating element and connectors showing the Seebeck coefficients for a simplified model of the components of the heating circuit.

FIG. **18** is a Seebeck measurement circuit for a vaporizer apparatus correcting for the Seebeck effect, configured as a two-terminal sensing circuit.

FIG. **19** is another example of a Seebeck measurement circuit for a vaporizer apparatus, configured as a four-terminal (four-point) circuit.

FIGS. **20**A and **20**B illustrate two examples of heating coils comprising different component conductors coupled to result in resistive heater from which a temperature measurement may be determined using a Seebeck sensing circuit as described herein.

FIG. **21** is one example of a user interface (UI) for interacting with the apparatuses described herein using an external controller (e.g., smartphone, pad, etc.)

FIG. **22** is another example of a US for interacting with an apparatus as described herein.

DETAILED DESCRIPTION

The apparatuses and methods described herein generally include forming a vapor from a material (including in particular, liquid and oil-type plant materials) using a vaporization device. The vapor may be delivered for inhalation by a user. These apparatuses may be particularly adapted for use with an oil-based vaporizable material, including *cannabis* oils.

The vaporizer apparatuses, including cartridges (vaporizer cartridges) and reusable vaporizers bases described herein may be used with any appropriate vaporizable material, including aqueous vaporizable materials. These apparatuses may be particularly well adapted for use with viscous, oil-based vaporizable materials, including *cannabis* oils. For example, any of the cartridges described herein may be used (e.g., filled) with a vaporizable material comprising viscous liquid such as a *cannabis* oil. In some variations the *cannabis* oil comprises between 40-100% *cannabis* oil extract. The viscous oil may include a carrier for improving vapor formation, such as propylene glycol, glycerol, etc., at between 0.01% and 25% (e.g., between 0.1% and 22%, between 1% and 20%, between 1% and 15%, etc.). In some variations the vapor-forming carrier is 1,3-Propanediol. A *cannabis* oil may include a cannabinoid or cannabinoids (natural and/or synthetic), and/or a terpene or terpenes. For example, any of the vaporizable materials described herein may include one or more (e.g., a mixture of) cannabinoid including one or more of: CBG (Cannabigerol), CBC (Cannabichromene), CBL (Cannabicyclol), CBV (Cannabivarin), THCV (Tetrahydrocannabivarin), CBDV (Cannabidivarin), CBCV (Cannabichromevarin), CBGV (Cannabigerovarin), CBGM (Cannabigerol Monomethyl Ether), Tetrahydrocannabinol, Cannabidiol (CBD), Cannabinol (CBN), one or more Endocannabinoids (e.g., anandamide, 2-Arachidonoylglycerol, 2-Arachidonyl glyceryl ether, N-Arachidonoyl dopamine, Virodhamine, Lysophosphatidylinositol), and/or a synthetic cannabinoids such as one or more of: JWH-018, JWH-073, CP-55940, Dimethylheptylpyran, HU-210, HU-331, SR144528, WIN 55,212-2, JWH-133, Levonantradol (Nantrodolum), and AM-2201. The oil vaporization material may include one or more terpene, such as Hemiterpenes, Monoterpenes (e.g., geraniol, terpineol, limonene, myrcene, linalool, pinene, Iridoids), Sesquiterpenes (e.g., humulene, farnesenes, farnesol), Diterpenes (e.g., cafestol, kahweol, cembrene and taxadiene), Sesterterpenes, (e.g., geranylfarnesol), Triterpenes (e.g., squalene), Sesquarterpenes (e.g., ferrugicadiol and tetraprenylcurcumene), Tetraterpenes (lycopene, gamma-carotene, alpha- and beta-carotenes), Polyterpenes, and Norisoprenoids. For example, an oil vaporization material as described herein may include between 20-80% cannabinoids (e.g., 30-90%, 40-80%, 50-75%, 60-80%, etc.), 0-40% terpenes (e.g., 1-30%, 10-30%, 10-20%, etc.), and 0-25% carrier (e.g., polyethylene glycol).

In any of the oil vaporization materials described herein (including in particular, the cannabinoid-based vaporization materials, the viscosity may be within a predetermined range. The range may be between about 30 cP (centipoise) and 115 KcP (kilocentipoise). For example, the viscosity may be between 40 cP and 113 KcP. Outside of this range, the vaporizable material may fail to wick appropriately to form a vapor as described herein. In particular, the oil may be made sufficiently thin to both permits wicking at a rate that is useful with the apparatuses described herein, while also limiting leaking (e.g., viscosities below that of ~40 cP might result in problems with leaking).

For example, FIGS. **7**A-**7**F illustrate one example of a cartridge that is adapted for use with a viscous oil-based vaporizable material (having a viscosity at room temperature of between 40 cP and 113 KcP), such as a *cannabis* oil. In this example, the cartridge **700** includes a flattened body that is approximately oval in cross-sectional area (see, e.g., FIGS. **7**E and **7**F showing top and bottom views) and includes a mouthpiece that is attached over a clear body forming a reservoir region holding the vaporizable material. The body **790** may be transparent, translucent or opaque. The mouthpiece may include one or more openings **792** at the proximal end (top) out of which vapor may be inhaled, by drawing breath through the device. The bottom may also include a locking feature (e.g., tab, indent, magnetic lock, etc.) for coupling and securing the cartridge within a cartridge receiver of a vaporizer base, such as the reusable vaporizer base **800** shown in FIGS. **8**A-**8**G. In this example, the body may be elongate and may include an outer shell or cover **890**; the proximal end of the vaporizer base may include an opening forming a cartridge receiver **892**. The cartridge receiver may include one or more opening there-

through (e.g., lateral openings) to allow airflow therein, as described in more detail below. Any of these cartridges may also or alternatively include a rim, ridge, channel, protrusion, lip, etc. along the distal end region for engaging a complimentary portion of the vaporizer device. For example, in FIG. **7**D, the cartridge include a channel or lip **795** at the distal end which may engage with a deflectable or deformable tab or protrusion in the cartridge receiving portion of the vaporizer; this may provide a snap fit. In general, the cartridge may fit within the cartridge receiver of the vaporizer by a friction fit. The snap-fit may provide audible and/or tactile confirmation that the cartridge is held in position. This fit may also lock or hold the cartridge within the receiver, but still allow it to be easily withdrawn to remove the cartridge.

As shown in FIG. **7**C, the elongate and flattened body **790** may contain within it the tank region **791** (e.g., holding the vaporizable oil material) and a distal overflow leak chamber **793**. These structures may be formed by the internal components within the elongate and tubular body, as shown below.

FIGS. **10**A and **10**B show exploded view of a cartridge as described herein. In this example, the apparatus includes a cartridge body **1005** that may be clear (transparent), opaque and/or translucent. The cartridge body may form a reservoir for the liquid vaporizable material, and particularly for a viscous liquid vaporizable material such as the cannabinoid oils described herein. The cartridge may include an outer seal (e.g., o-ring **1009**) that seals the mouthpiece **403** over the body **1005**. The reservoir (tank) may be sealed on the top (at the proximal end) under the mouthpiece by a single-piece plug **888** that covers multiple openings which may be used for filling the tank. The vaporization chamber may be formed at the bottom (distal end) of the cartridge; in exemplary cartridges described herein the vaporization chamber is formed from a cannula and housing piece **1011** that includes opening into which the wick (wick portion of wick and coil **443**) passes into the chamber; the walls forming the vaporization chamber separate it from the tank and mate with a back piece **1013** that forms the bottom (distal end) of the tank within the cartridge body. This piece is also sealed (e.g., by an o-ring **1015**) to the cartridge body from within the cartridge body, as shown. An air chamber is then formed between the bottom of the cartridge **1019** and the back piece **1013** of the tank. One or more (e.g., two) air openings **796**, **796'** through this bottom **1019** allow air to pass (after entering the cartridge receiver through one or more openings **894** in the side) into the distal end of the cartridge, into the air chamber region and then up through an opening into the vaporization chamber. The piece forming the bottom of the cartridge **1019** may also accommodate or include one or more (e.g., two) electrical connectors that are configured to mate with the connectors on the vaporizer base. As mentioned, these contacts may be wiper or scraping contacts. In FIGS. **10**A and **10**B, they are shown as cans **1021**, **1021'** having openings into which the pins project to form an electrical contact.

The vaporizer body typically includes a battery and one or more control circuits housed within the cover **890**. The control circuitry may control the heater, which in this example, is present in the cartridge. The heater may generally include a heating coil (resistive heater) in thermal contact with the wick; additional connectors formed of a different material (e.g., conductive material) may connect the heater coil to the electrical contacts on the base of the cartridge; although this may lead to inaccuracies in detecting and controlling temperature electrically, as described below, the control circuitry may include one or more additional circuits, such as Seebeck measurement circuits, that correct for offsets and other inaccuracies in the determination of temperature and therefore the power applied to the apparatus. The control circuitry may also include and may control and/or communicate with a batter regulator (which may regulate the battery output, regulate charging/discharging of the battery, and may provide alerts to indicate when the battery charge is low, etc.). The co control circuitry may also include and may control and/or communicate with an output, such as a display, one or more LEDs, one or more LCDS, a haptic output, or any combination of these. In the example shown in FIGS. **7**A-**9**G, the apparatus includes only four (RGB) LEDs **897**, arranged in a pattern (e.g., a circular, spiral or floral pattern; other patterns may include linear patterns). Any of the apparatuses described herein may also include a wireless communication circuitry that is part of, connected and/or controlled by the control circuitry. The apparatus may be configured to wireless communicate with a remote processor (e.g., smartphone, pad, wearable electronics, etc.); thus the apparatus may receive control information (e.g., for setting temperature, resetting a dose counter, etc.) and/or output information (dose information, operational information, error information, temperature setting information, charge/battery information, etc.).

The apparatus may also include one or more inputs, such as an accelerometer, a lip sensing input, a contact input, or the like. In particular, described herein are vaporizer apparatuses in which the device does not include any visible buttons, switches or external user input on an outer surface of the cartridge or vaporizer base. Instead, the input may be an accelerometer (coupled to, part of, and/or controlled by the control circuitry). The accelerometer and any accelerometer control circuitry may be configured to detect tapping on the apparatus (e.g., the case) and/or rolling of the apparatus (e.g., around the long axis or the short axis of the device). In some variations the apparatus may also include circuitry for sensing/detecting when a cartridge is connected and/or removed from the vaporizer base. For example, cartridge-detection circuitry may determine when a cartridge is connected to the device based on an electrical state of the electrical contacts within the cartridge reliever in the vaporizer base. For example, FIG. **5**C illustrates the two electrical contacts **595**, **595'**. Without a cartridge inserted into the apparatus the circuit is open (e.g., between **595** and **595'**) with the cartridge inserted, the electrical contacts (shown as pins **595**, **595'** in FIGS. **5**D and **11**B) engage with the contacts (such as wiping contracts, described above, which scrape to remove leaked and/or dried vaporizable material on the electrode contact surfaces). The controller (via a separate or integrated cartridge-detection circuit) may determine that a cartridge has been inserted when the resistance between these contacts changes to within a recognizable range (from the open circuit). Other cartridge detectors may be used alternatively or additionally, including a trip switch (which is activated when the cartridge is present), or the like. Any of the apparatuses described herein may also include one or more breath detectors, including a pressure sensor **1109** (e.g., microphone coil) having a connection to the inside of the cartridge receiver, as shown in FIG. **11**B.

The vaporizer body may also include a connector **899** at the distal end for coupling the device to a charger and/or data connection. The internal battery may be charged when coupling the device to a connector; alternatively other electrical connectors and/or inductive charging may be used.

FIGS. **9**A-**9**G illustrate an example of an apparatus (vaporizer apparatus) in which the cartridge **700** has been inserted completely into the vaporizer body **800**. The resulting device is small, lightweight, hand-held and may be safely stored in a pocket, purse, or the like.

In operation, the user may (once charged sufficiently), may activate the vaporizer by being drawing (inhaling) through the mouthpiece. The device may detect a draw (e.g., using a pressure sensor, flow sensors, or the like, including a sensor configured to detect a change in temperature or power applied to a heater element, e.g., anemometer detection) and may increase the power to a predetermined temperature preset. The power may be regulated by the controller by detecting the change in resistance of the heating coil and using the temperature coefficient of resistivity to determine the temperature. As described in greater detail below, the temperature determination and/or power applied may be optionally corrected in cases where there are different electrically conductive materials connecting the resistive heater to the power supply/power, in which the Seebeck effect may be an issue, using a sensing circuit to estimate and compensate for this potential source of inaccuracy.

In any of the apparatuses described herein, the temperature may be adjusted or selected by the user. As mentioned, in some variations the apparatus does not include an exterior control or user input, but still allows the user to select the temperature from among a plurality (e.g., two or more, three or more, etc.) of pre-set heating/vaporizing temperatures above 100° C. This may be achieved by allowing the user to coordinate (in time, e.g., within 60 seconds, within 50 seconds, within 40 seconds, within 45 seconds, within 40 seconds, within 30 seconds, within 20 seconds, within 10 seconds, between 1 second and 60 seconds, between 2 seconds and 60 seconds, between 3 seconds and 60 seconds, etc.) a pair of distinct inputs that are based detection of inputs that are internal to the apparatus (e.g., not from controls on the surface of the apparatus), such detection an accelerometer input (e.g., tapping, such as one or more, e.g. 3 or more, taps, rotations of the device in the long axis, etc.) within a predefined time after removing the cartridge and/or inserting the cartridge. For example, the apparatus may enter into a temperature selection mode to allow a user to select the temperature by removing the cartridge after shaking the apparatus (e.g., for 1 or more seconds, e.g., 2 or more seconds, etc.). Once in a temperature selection mode, the user may select from among a number (e.g., 4) or pre-set temperatures by tapping the housing of the device to cycle through the pre-set temperatures, which may be displayed on an output (e.g., LED, monitor, LCD, etc.) on the apparatus.

Any other input on the device that is not (or not connected to) a button, and particularly an external button, may be used in a predetermined activation sequence (e.g., pattern of taps detected by the accelerometer, insertion/removal of cartridge, etc.) or in a set of sequential independent actuations. For example, the apparatus may enter into a temperature selection mode after removing and inserting a cartridge three times in quick successions (e.g., within 5 seconds of each step). In any of the variations described herein, merely shaking the apparatus may display information about the status of the device (e.g., the charge) using the output; the additional non-button input (e.g., removing the cartridge and/or inserting the cartridge) within the predetermined time may then allow the operating temperature to be selected.

In some variations, the apparatus includes multiple (e.g., 4) presets, and an optional additional preset (e.g., 5th preset or more) that may be user-settable. Alternatively or additionally, an external controller (smartphone, pad, computer, etc.) in may communicate with the apparatus to allow setting and/or selecting the operating temperature.

In on example, the apparatus may be operated to allow the user to select the operating temp (set mode) by shaking the device with a cartridge inserted. In some variations this may then change the display (e.g., multi-colored LEDs on the surface of the device), for example, displaying battery life using the multiple LEDs arranged (e.g., in an X pattern **897**, see, e.g., FIG. **8**C). While in this state, removing cartridge enters temp set mode. The device automatically cycles through the 4 (+1 or more, when user defined) presets. The user may then choose one by reinserting the pod at appropriate time. In some variations, the preset temperatures are: 270° C., 320° C., 370° C., 420° C. In some variations the user may modify or include an additional preset within a temp range around each preset, e.g.: within an operational range of between 270-420° C.

As mentioned above, any of the apparatuses described herein may be operated with an external processor to receive input and/or output to control operation of the device. For example, the vaporizer apparatus may be operated with an application software ("app") that allows control of the temperature or other functional setting and/or allows storage, display and/or transmission of operational and/or use information, including dose information. As described herein, an approximate estimate for dose may be determined based on the power applied to the heater (resistive coil) during inhalation (over time), e.g., power applied to coil multiplied by time of draw. This approximate 'dose' estimate may be accumulated over the use of a particular cartridge (e.g., once a cartridge is inserted, it may be accumulated and/or displayed until the cartridge is removed, roughly amounting to a "session" with that cartridge).

For example, FIGS. **21** and **22** illustrate exemplary user interfaces for an application software that allows the user to set and or adjust the pre-set temperatures of the apparatus. In FIG. **21**, the user may select the per-set temperature. FIG. **22** illustrates the use of the app to control the appearance and activity of the apparatus. For example, the user may lock/unlock the apparatus, and track usage (e.g., by does estimation).

In any of the apparatuses described herein the apparatus may allow the user to play one or more interactive "games" with the device. For example, any of these apparatuses may include an entertainment mode that may be entered by manipulating the device (e.g., by tapping, shaking, rotating, puffing in a predetermined pattern, etc.). In general, the entertainment mode may include one or more presentations (e.g., LED light displays, tones/music, patterns of vibrations, or combinations of these) and/or games. The device may be configured to allow selection of the presentation states or game states (games) to be played, or it may randomly select one. In general the games may be interactive, allowing the user to provide input, e.g., via the one or more inputs, such as movement of the device, via motions sensing, touching the device, via a button and/or capacitive sensor (e.g., lip sensing, etc.), puff/airflow sensing, inserting and/or removing the cartridge, etc.

For example, the entertainment mode may include a game such as a pattern-following game, wherein the device presents an output (e.g., one or more LEDS illuminated in a pattern and/or color), and the device (e.g. controller) may determine if a response entered by the user on the input correlates with a predetermined response. In general, the same controller used to control the heater may be used to control the entertainment mode including the games. Alter-

natively a separate controller may be used, and may communicate with the controller controlling the heater.

The one or more games may include a memory game. For example, in a memory game the device may presents an output sequence and determines if a sequence of responses entered by the user on the input correlates with a predetermined sequence of responses. The one or more games may include a triggered output game wherein the device presents an output in response to a predetermined user input. For example, the device may illuminate a series differently positioned and/or colored LEDs based on the angle or movement that the user holds the device.

The one or more games may include a chance type game, wherein the device is configured to display a random pattern of one or more of colors, tones or vibrations, in response to a predetermined user input. The entertainment mode may include a display game wherein the output comprises a plurality of LEDs and wherein the device is configured to cycle the LEDs through a predetermined sequence of colors in response to a predetermined user input. The entertainment mode may include a tone game wherein the output comprises a plurality of tones and wherein the device is configured to play a predetermined sequence of tones in response to a predetermined user input.

As mentioned, the device may be configured to be toggled between the normal mode and the entertainment mode by applying one or more predetermined user manipulations to the input. For example, the device may be rotated. In some variations, the device input comprises an accelerometer, and the device may be configured to be toggled between the normal mode and the entertainment mode by rolling or rotating the device (e.g., three or more times) in one or more directions.

In addition to or alternative to the games, the entertainment mode may include an entertainment output (display) that is triggered upon entering into the entertainment mode. For example, as mentioned, the entertainment output may include one or more of: a display of a plurality of colors and/or patterns on the output, a tone or series of tones, a vibration or series of vibrations.

Leak Prevention

Any of the apparatuses described herein may be configured to prevent or reduce leakage of the vaporizable material. As mentioned, leaking an oil-based (and particularly cannabinoid oils) is particularly troublesome in a vaporizer because the vaporizable material may dry as a sticky, tarry substance that is both messy and may disrupt operation of the apparatus, particular the reusable (e.g., vaporizer base) portion.

For example, any of the apparatuses described herein may include one or more absorbent pads or members that are oriented to prevent leakage without disrupting the airflow or formation of vapor. In general, moisture and particles from the vapor can be deposited on a filter pad that is off-axis relative to the vapor path. The vaporization device may be a handheld vaporization device.

As described above, any of the vaporization apparatuses (device and systems) may comprise a heating element, including a resistive heating element. The heating element may heat the material such that the temperature of the material increases. Vapor may be generated as a result of heating the material.

In some cases, a vaporization device may have an "atomizer" or "cartomizer" configured to heat an aerosol forming solution (e.g., vaporizable material). The vaporizable material may be heated to a sufficient temperature such that it may vaporize (e.g., between 200° C. and 500° C., e.g., between 250-450° C., between 270-420° C., etc.). The apparatus or method may include one or more pre-set vaporization temperatures and the apparatus or method may control (via controller including feedback logic) the temperature to a predetermined and/or selected temperature.

An atomizer may comprise a small heating element configured to heat and/or vaporize at least a portion of the vaporizable material and a wicking material that may draw a liquid vaporizable material into the atomizer (e.g., heater). When the apparatus includes a wicking material, the wicking material may comprise silica fibers, cotton, ceramic, hemp, stainless steel mesh, and/or rope cables. The wicking material may be configured to draw the liquid vaporizable material in to the atomizer without a pump or other mechanical moving part. A resistance wire may be wrapped around the wicking material and then connected to a positive and negative pole of a current source (e.g., energy source). The resistance wire may be a coil. When the resistance wire is activated, the resistance wire (or coil) may have a temperature increase as a result of the current flowing through the resistive wire to generate heat. The heat may be transferred to at least a portion of the vaporizable material through conductive, convective, and/or radiative heat transfer such that at least a portion of the vaporizable material vaporizes.

Alternatively or in addition to the atomizer, the vaporization device may be configured as a "cartomizer" to generate an aerosol from the vaporizable material for inhalation by the user. The cartomizer may comprise a cartridge and an atomizer. The cartomizer may comprise a heating element surrounded by a liquid-soaked poly-foam that acts as holder for the vaporizable material (e.g., the liquid). The cartomizer may be reusable, rebuildable, refillable, and/or disposable. The cartomizer may be used with a tank for extra storage of a vaporizable material.

Air may be drawn into the vaporization device to carry the vaporized aerosol away from the heating element, where it then cools and condenses to form liquid particles suspended in air, which may then be drawn out of the mouthpiece by the user. For example, any of the apparatuses described herein may include a draw channel or passage. The draw channel may be in fluid communication with the heater so that vapor formed by the heater passes into the draw channel, which is also in fluid communication with the mouthpiece, which may be integrated with the device (including a cartridge).

One or more aspects of the vaporization device may be designed and/or controlled in order to deliver a vapor with one or more specified properties to the user. For example, aspects of the vaporization device that may be designed and/or controlled to deliver the vapor with specified properties may comprise the heating temperature, heating mechanism, device air inlets, internal volume of the device, and/or composition of the material.

Energy may be required to operate the heating element. The energy may be derived from a battery in electrical communication with the heating element. Alternatively, a chemical reaction (e.g., combustion or other exothermic reaction) may provide energy to the heating element.

The term "aerosol" may generally refer to a colloid of fine solid particles or liquid droplets in air or another gas. In general, the aerosols described herein are liquid aerosols of primarily (e.g., >80%, >85%, >90%, >95%) liquid particles in air. The liquid or solid particles in an aerosol may have varying diameters of average mass that may range from monodisperse aerosols, producible in the laboratory, and containing particles of uniform size, to polydisperse colloidal systems, exhibiting a range of particle sizes. As the sizes

of these particles become larger, they have a greater settling speed which causes them to settle out of the aerosol faster, making the appearance of the aerosol less dense and to shorten the time in which the aerosol will linger in air. Interestingly, an aerosol with smaller particles will appear thicker or denser because it has more particles. Particle number has a much bigger impact on light scattering than particle size (at least for the considered ranges of particle size), thus allowing for a vapor cloud with many more smaller particles to appear denser than a cloud having fewer, but larger particle sizes.

A vapor may generally refer to a substance in the gas phase at a temperature lower than its critical point. As used herein, a vapor may include a liquid aerosol. For convenience the term vapor and aerosol, which may generally refer to liquid aerosols, may be used interchangeably herein, as is common in the art of electronic vaporization devices.

The methods and apparatuses described herein have a wide range of applications for inhalation of an active substance, such as botanicals, pharmaceuticals, nutraceuticals, or any other substance for inhalation to provide a benefit or sensation to an end user. In some embodiments, the devices described herein include a tank having a liquid containing an active ingredient, such as nicotine, *cannabis*, or a cannabinoid.

The term "*cannabis*" refers to plants of the genus *Cannabis* and loose-leaf products or extracts thereof. As mentioned above, the term "cannabinoid" refers to plant based or synthetic chemical compounds capable of acting on cannabinoid receptors and inducing a biological effect. Cannabinoids include acids, salts, and bioactive stereo isomers. Exemplary cannabinoids include tetrahydrocannabinol (THC), cannabigerolic acid (CBGA), cannabigerol (CBG), tetrahydrocannabinolic acid (THCA), cannabichromene (CBC), cannabicyclol (CBL), cannabivarin (CBV), cannabichromevarin (CBCV), cannabigerovarin (CBGV), cannabigerol Monomethyl Ether (CBGM), delta-8-tetrahydrocannabinol (D8THC), delta-9-tetrahydrocannabinol (D9THC), tetrahydrocannabivarin (THCV), cannabinolic acid (CBNA), Cannabinol (CBN), cannabidiolic acid (CBDA), Cannabidivaric acid (CBDVA), cannabidiol (CBD), cannabichromenic acid (CBCA), Cannabichromene (CBC), or cannabicyclolic acid (CBLA) and/or any salt or stereo isomer of the above.

The devices described herein for generating an inhalable aerosol may include a body having a battery, a cartridge or tank including or configured to include the vaporizable material, at least input (e.g., in some variations without any input on an outer surface of the apparatus, e.g., "button less"), and circuitry for controlling the device.

An exemplary vaporization device **200** is shown in FIGS. **1** and **2**. The vaporization device **200** includes two filter pads **222***a,b*. The filter pads **222***a,b* are positioned off of the central axis of the air path **212**. As the vapor travels down the air tube **208** and begins to return to liquid state, both condensation and particle aggregation will occur. As the vapor exits the air tube **208** into the air path **212**, the moisture (see FIG. **1**) and larger particles (see FIG. **2**) can filter onto the pads **222***a,b* (i.e., via gravity) without interfering with the user's draw on the device.

The one or more pads for use with any of the embodiments described herein (including pads **222***a,b*) can be made of an absorbent material. The absorbent material can both wick moisture quickly and allow it to disperse quickly therethrough. Thus, the absorbent material can be hydrophilic. Exemplary materials include cotton, e.g., a non-woven cotton lintner paper, felt, cellulose, or hydrophilic polymers. Further, the one or more pads can be curved, as shown in FIGS. **1** and **2** or can be substantially flat panels. In some embodiments, the one or more pads can each be made of two or more thin sheets of layered material.

The one or more pads can be positioned within or proximate to the mouthpiece so as to capture moisture just prior to inhalation by the user. Further, in some embodiments, as shown in FIGS. **1** and **2**, the one or more pads can be pushed up against the interior surface of the vaporizer so as to minimize interference with other components of the vaporizer. In other embodiments, the one or more pads can be pulled away from the interior walls so as to maximize the surface area available for moisture absorption. The pads can be rectangular, circular, ovoid, triangular, square, or other shape. The shape and size of the pads can be chosen so as to minimize interference with the air path while maximizing moisture and particle collection.

Another exemplary vaporizer **300** utilizing moisture deposition pads **322***a,b* is shown in FIGS. **3**A and **3**B. The vaporizer **300** includes a cartridge **301** that is attachable to a reusable component **300** (which can include the electronics to power the device, etc.). As shown in FIGS. **3**A and **3**B, the cartridge **301** can include a tank **302**, a heater assembly **343**, an air tube **308**, and a mouthpiece **303**. The pads **322***a,b* can be rectangular, flat, and positioned in parallel within the mouthpiece **303** on either side of the air tube **308** (i.e., off-axis with the air tube **308**). The vaporizer **300** can further include any of the features described in U.S. application Ser. No. 15/053,927, titled "VAPORIZATION DEVICE SYSTEMS AND METHODS," filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1, the entirety of which is incorporated by reference herein.

Another exemplary vaporizer **400** that can utilize one or more pads is shown in FIGS. **4**A-**6**B. As shown in FIGS. **4**A and **4**B, the vaporizer **400** includes a reusable component **411** and a cartridge **401**. The diameter of device **400** is greater than the width (e.g., greater than 1.2×, 1.3×, 1.4×, 1.5×, 1.6×, 1.7×, 1.8×1.9×, etc.), making the device have a substantially long and flat appearance and feel.

Referring to FIGS. **5**A and **5**B, the reusable component **411** includes a shell **431**, which can include the electronics for operating the vaporizer. Further, the reusable component **411** can include a visual indicator **421**, such as an LED, for signaling the operating status of the vaporizer **400**. The distal end of the reusable component **411** (shown in FIG. **5**F) includes a charging element **433** configured for charging the device. Further, the proximal end of the device (FIG. **5**E) includes contacts **435** for maintaining an electrical connection with the cartridge **401**.

The cartridge **401** is shown in FIGS. **6**A-**6**D. As best shown in the exploded view of FIG. **6**D the cartridge **401** includes a tank **441** configured to hold a liquid vaporizable material therein, a heater (e.g. a wick and coil assembly) **443** configured to heat the vaporizable material in the tank **441**, and an air tube **408** extending from the tank to a mouthpiece **403**. Contacts **535** are configured to connect with contacts **435** on the reusable component **411** to provide power to activate the wick and coil assembly **443**. At the distal end of the cartridge the walls of the elongate and flattened tubular body **441** and a bottom cover piece **691** form an overflow leak chamber **699**, which is shown with a pair of absorbent pads **495***a,b* are positioned along the long walls (along the diameter) of the overflow leak chamber. An option felt cover **693** may be included (also acting as an absorbent member).

As shown in FIGS. **4**A-**5**D, the device **400** further includes openings, configured as air inlets **762***a,b*, on the side of the shell **431**. The air inlets are proximate to openings

(air inlets) **662***a,b* on the distal end of the cartridge **401** (see FIGS. **6**A and **6**B) opening into the overflow leak chamber (not visible). Referring to FIG. **11**A (which is a cross-section of the device **400** at the center), the air flow path **777** from inlets **762***a,b* to inlets **662***a,b*, extends through the tube **408** until it reaches the stop **433** (see FIG. **12**) and then divides into two separate paths that extend along the inner surface of the mouthpiece **402** (between the pads **422***a,b*) and out through the outlets of the mouthpiece **403**.

As shown in FIGS. **6**D and **12-14**, parallel absorbent pads **422***a,b* can be positioned within the mouthpiece **403**. The absorbent pads **422***a,b* are rectangular and parallel with one another. The absorbent pads **422***a,b* are positioned substantially parallel to the flat side of the device **400** (parallel with the plane of the length **1** and width w in FIG. **4**A) and parallel with one another. In some embodiments, the pads **422***a,b* can be biased fully against the inside walls of the mouthpiece **403** so as to easily capture liquid that rolls along the walls. A distance between the two pads **422***a,b* can be, for example, between 3 and 6 mm, such as between 4 and 5 mm, e.g., approximately 4.8 mm. The gap between the absorbent pads **422***a,b* advantageously prevents the pads from interfering with the air flow path when a user draws on the mouthpiece **403**.

Further, as shown in FIGS. **6**D, **12** and **13** in some embodiments, over-flow pads **445***a,b* are positioned proximate to the tank **441**, i.e., within an overflow leak chamber below the tank, to absorb liquid that may leak out of the tank **441** during use. The over-flow pads **445***a,b* can be similarly placed parallel to one another and/or against the sides of the shell **431** as described above with respect to pads **422***a,b*.

FIG. **13** (which is a cross-section of the device **400** through the pads **422***a,b* and **445***a,b*) shows the air flow path **777** in dotted lines relative to the placement of the pads **442***a,b* and **445***a,b*. The air path **777** extends alongside all of the pads **422***a,b* without extending therethrough. That is, the pads **422***a,b* and **445***a,b* extend off-axis relative to the air path **777** and do not interfere with user draw. However, the pads **422***a,b* and **445***a,b* are positioned so that the air path **777** travels along, besides, and/or in contact with the pads **422***a,b* and **445***a,b* for an extended period of time so as to allow maximum absorption of liquid.

In use (i.e., when the user draws on the device), the device **400** can be held horizontally with the width, w, in the vertical direction and the diameter, d, in the horizontal direction. As such, at least one of the pads **422***a,b* and/or **445***a,b* will be substantially horizontal while the user draws on the device, ensuring that gravity will pull any moisture or particles down onto the lower pad **422***a,b* and/or **445***a,b*. Further, having two pads **422***a,b* and/or **445***a,b* advantageously ensures that moisture will be caught whether the user holds the device with pad **422***a* or **445***a* on top or **422***b* or **445***b* on top. This can both prevent interference with the electronics of the device and prevent the user from getting any liquid from the tank in his or her mouth when drawing on the device.

Referring to FIGS. **15**A-**15**D, exemplary device **800** is similar to device **400** (similar reference numbers are therefore used) except that it includes a single plug **888** in the proximal section of the cartridge **801** (i.e., as opposed to the two tank seals **604***a,b* shown in FIG. **6**D). The plug **888** is configured to simultaneously seal both outlets of the mouthpiece **403** while also sealing around the tube **408**.

Although sets of absorbent pads are shown and described with respect to the embodiments herein, only a single off-axis (i.e. "off air path") pad can be used in each location. Likewise, more than two (e.g., 3, 4, 5, or more) off-axis pads, such as strips of absorbent material, may be used. Similarly, only a single set of pads can be used.

In some embodiments, the absorbent pads can be located only in the cartridge area (i.e., in the disposable portion). In other embodiments, additional absorbent pads can also be used in the reusable portion of the device.

The wick for use with any of the embodiments herein can be large to handle higher viscosity liquids (e.g., liquids with cannabinoids). For example, the wick can be greater than 1.5 mm in diameter, such as approximately 2 mm in diameter.

Referring to FIG. **16**, in some embodiments, the openings (also referred to as air inlets) **962***a,b* to the cartridge **901** can include a protective annular ring **992***a,b* or seal therearound that extends away from the inner wall of the cartridge **901**. This ring can help prevent any spilled liquid from splashing into the inlets **962***a,b*. This ring may be lip or ridge projecting into the overflow leak chamber, as shown in FIG. **16**.

Referring still to FIG. **16**, in some embodiments, the contacts **935** of the reusable portion **911** of the device **900** can be pin contacts while the contacts **1035** of the cartridge **901** can be annular contacts or pin receptacles configured to mate with the pins. Further, in some embodiments, pin receptacles **1035** can include spring-loaded wiping mechanisms on the inner diameter thereof. The spring-loaded wiping mechanisms can be configured to wipe the pins as they pass therethrough. As a result, any vapor residue on the pins can be removed to maintain the proper electrical connection there between.

Power and Temperature Control

In any of the apparatuses described herein, the vaporizer apparatus may be controlled so that the temperature used to vaporize the vaporizable material is maintained within a preset range (e.g., one or more preset temperatures as discussed above, within +/−a few degrees (e.g., +/−3° C., 2° C., 1° C., 0.5° C., etc.). In general, the microcontroller may control the temperature of the resistive heater (e.g., resistive coil, etc.) based on a change in resistance due to temperature (e.g., TCR). For example, a heater may be any appropriate resistive heater, such as a resistive coil. The heater is typically coupled to the heater controller via two or more connectors (electrically conductive wires or lines) so that the heater controller applies power (e.g., from the power source) to the heater. The heater controller may include regulatory control logic to regulate the temperature of the heater by adjusting the applied power. The heater controller may include a dedicated or general-purpose processor, circuitry, or the like and is generally connected to the power source and may receive input from the power source to regulate the applied power to the heater.

For example, any of the apparatuses described herein may include logic for determining the temperature of the heater based on the TCR of the heating element (resistive coil), based on sensed resistance of the coil. The resistance of the heater (e.g., a resistive heater) may be measured (R_{heater}) and the controller may use the known properties of the heater (e.g., the temperature coefficient of resistance) for the heater to determine the temperature of the heater. For example, the resistance of the heater may be detected by a detection circuit connected at the electrical contacts that connect to the cartridge, and this resistance compared to a target resistance, which is typically the resistance of the resistive heater at the target temperature. In some cases this resistance may be estimated from the resistance of the resistive hearing element at ambient temperature (baseline).

In some variations, a reference resistor ($R_{reference}$) may be used to set the target resistance. The ratio of the heater resistance to the reference resistance ($R_{heater}/R_{reference}$) is

linearly related to the temperature (above room temp) of the heater, and may be directly converted to a calibrated temperature. For example, a change in temperature of the heater relative to room temperature may be calculated using an expression such as $(R_{heater}/R_{reference}-1)*(1/TCR)$, where TCR is the temperature coefficient of resistivity for the heater. In one example, TCR for a particular device heater is 0.00014/° C. In determining the partial doses and doses described herein, the temperature value used (e.g., the temperature of the vaporizable material during a dose interval, T_1, described in more detail below) may refer to the unit less resistive ratio (e.g., $R_{heater}/R_{reference}$) or it may refer to the normalized/corrected temperature (e.g., in ° C.).

When controlling a vaporization device by comparing a measure resistance of a resistive heater to a target resistance, the target resistance may be initially calculated and may be factory preset and/or calibrated by a user-initiated event. For example, the target resistance of the resistive heater during operation of the apparatus may be set by the percent change in baseline resistance plus the baseline resistance of the resistive heater, as will be described in more detail below. As mentioned, the resistance of the heating element at ambient is the baseline resistance. For example, the target resistance may be based on the resistance of the resistive heater at an ambient temperature and a target change in temperature of the resistive heater.

As mentioned above, the target resistance of the resistive heater may be based on a target heating element temperature. Any of the apparatuses and methods for using them herein may include determining the target resistance of the resistive heater based on a resistance of the resistive heater at ambient temperature and a percent change in a resistance of the resistive heater at an ambient temperature.

In any of the methods and apparatuses described herein, the resistance of the resistive heater may be measured (using a resistive measurement circuit) and compared to a target resistance by using a voltage divider. Alternatively or additionally any of the methods and apparatuses described herein may compare a measured resistance of the resistive heater to a target resistance using a Wheatstone bridge and thereby adjust the power to increase/decrease the applied power based on this comparison.

In any of the variations described herein, adjusting the applied power to the resistive heater may comprise comparing the resistance (actual resistance) of the resistive heater to a target resistance using a voltage divider, Wheatstone bridge, amplified Wheatstone bridge, or RC charge time circuit.

When using resistance and/or power applied to determine the temperature of the apparatus and/or to control temperature for vaporization, the inventors have determined that there may be a surprising disparity between the actual temperature and that predetected or determined using resistance of the heater alone. This problem because particularly acute when the distance between the heating element (e.g. resistive coil) and the electrical input into the cartridge (the power contacts from the vaporizer base) is longer, or there is a change in the conductive material between the heater and the contacts, as shown in FIG. **15**A. Where there is a change in the conductive material between the contacts, the electrical wiring and the resistive coil, thermoelectric effects arising due to this change in electrical characteristics (resistance) may give rise to inaccuracies when determining the power applied.

In the exemplary cartridges described above, the heating coil is connected to the electrical contacts by extension wires **1054**, **1054'** (see, e.g., FIG. **10**B). Because the extension wires are different materials, a voltage (EMF) may be generated at the junction between the different electrical conductors when there is a temperature gradient. This thermoelectric effect may be referred to as the Seebeck effect, and may generate a voltage that is based on the material properties of the different conductors. In the variations described above, although the heating coil, extensions and wick are nearly symmetric, during normal usage there may be uneven temperatures across the three, developing a temperature gradient. This may result in an uneven voltage being generated; this disparity may then lead to inaccuracies in controlling the heater (applied power) and/or estimation of the temperature.

Although at any particular time, the effect may be relatively minor (and therefore overlooked), the cumulative effect may lead to dramatic reductions in accuracy and temperature control; other systems may attempt to avoid this problem by modifying the resistance of the material used for the resistive heater, requiring a larger power; although this may reduce the overall contribution of the offset EMF voltage due to the thermoelectric property mismatch, it also requires a larger wattage and therefore battery (and resulting power) be applied.

Instead, any of the apparatuses described herein may include a precision resistance measurement circuit to track resistance of the heating element (e.g., a coil made from resistive heating alloy wire) when not heating and heating to control the temperature of the coil based on changes in coil resistance from room temperature to vaporization temperatures, as discussed above. For example, in some variations, the measurement circuit is an amplified Wheatstone bridge where the heating element (when connected) is one half of one of the two voltage dividers in the Wheatstone bridge and the two divider voltages are inputs to a differential op amp circuit. This control circuit may be modified as described herein to account for the mismatch in thermoelectric properties leading to the offset voltage.

Currently known resistance measurement systems typically use a two-terminal sensing or four-terminal sensing circuit, and are prone to measurement error when the load to be measured is also a voltage source or has an additional unknown voltage applied to it. As just mentioned above, in vaporizers that use resistive heating elements (often coils), extension leads are often used to route power to the heating element with minimal Joule heating and losses in the path between the heating element (where Joule heating is desired) and the voltage source (often a battery or power supply). For manufacturability, these extension leads are often the only connection between the device (or contacts that connect to the device) and the heating element, so measurement of the resistance of the heating element invariably includes the resistance of the extension leads and measurement error arising from the mismatched thermoelectric properties (Seebeck error). The heating element and extension leads (three conductors if considered individually) each have some temperature gradient along their lengths, and this temperature gradient generates an electromotive force (EMF, which is also a measureable voltage when the conductor is open circuit) in each conductor, which is $E_{emf}=-S\nabla T$, where S is the Seebeck coefficient of the conductor which depends heavily on the conductor material (but also on temperature of the conductor) and ∇T is the temperature gradient across the material. Because ideal materials for the heating element and extension leads often have different Seebeck coefficients, and since the temperatures at the two connection points between each extension lead and the heating element are likely to differ while heating (due to acceptable asym-

metries in both heating element assembly and heat transferred from the heating element and extension leads that are expected in a mass-produced product), there will be a net EMF across the extensions and heating element (seen as one load in any vaporization system where one set of extension leads electrically connects the heating element to the device) which will skew the resistance measurement, making temperature control of the heating element using measured resistance impossible without correction for this effect. More generally, measured resistance of the heating element will be skewed by the mismatched thermoelectric properties (e.g., the Seebeck effect) whenever there is a temperature difference between and material transition at the two heating element terminals where contacts or extensions are connected.

A simplified model of a heating element with two extension leads of the same material is shown in FIG. **17**. In this example, the heating element and extension lead combination connects to the device at the open ends of the extension leads shown above, so the resistance measurement of the heating element is taken through the extension leads connecting to it. S**1** and S**3** are constant coefficients that depend on the material properties (Seebeck coefficients) of each of the two extension lead materials, and S**2** is the Seebeck coefficient of the heating element. T**1** and T**4** are temperatures at the ends of the extensions that electrically connect to the vaporization device. T**2** and T**3** are temperatures of the connections between the extension leads and heating element (which may be welds, crimps, solder joints, or other electrical connections). The EMF, E_{net} is expected to skew the resistance measurement if E_{net} is non-zero. E_{net} from the Seebeck effect is expected to be:

$$E_{net}=-S1(T2-T1)-S2(T3-T2)-S3(T4-T3).$$

To illustrate how temperature differences between T**2** and T**3** can create a non-zero Enet, consider a further simplified model where temperatures at the two open (as shown) ends of the conductive path are assumed to be the same and close to the device temperature (T**1**=T**4**), which is an acceptable simplification in systems like ours where extensions connect to electrical contacts with large thermal mass at T**1** and T**4**. Seebeck coefficients for the two extensions are assumed to be the same since the two extension leads are of the same material (S**1**=S**3**). This reduces the above expression to:

$$E_{net}=(S2-S1)(T2-T3)$$

From the above expression, if S**2** and S**1** are not equal (heating element and extension leads have different Seebeck coefficients) and T**2** and T**3** are not equal (non-zero net temp gradient across the two points where heating element meets extensions), Enet will not be zero, and it will skew the resistance measurement taken by the device. For comparison, if there are no extension leads, EMF for the heating element alone can be considered:

$$E_{net}=S2(T2-T3)$$

When the heating element is connected directly to electrical contacts that are large thermal masses, it is expected (and can be measured) that T**2** and T**3** are very close and Seebeck effect introduces negligible error in resistance measurement. In other systems where extension leads are used, the Seebeck effect will skew measured resistance, making temperature control impossible when Seebeck effect is not corrected for.

Additionally, some systems without extension leads may still see a temperature difference between T**2** and T**3** depending on the device and heating element assembly. If this temperature difference is significant, this effect will have to be corrected for if accurate resistance measurements is desired.

The simple model above with extension leads and heating element is provided to illustrate the source of heating element EMF. In most systems there will be additional material transitions and temperature gradients in each material in the resistance measurement path. As described below, a complete understanding or modeling of all material transitions and junction temperatures is not needed to correct for this effect. The heating element EMF (caused by the Seebeck effect) can simply be measured and used to correct for the error it introduces in resistance measurements.

In a vaporization devices that uses measured heating element resistance for temperature control of the heating element as described above, heating element EMF may also measure and used to control the power applied and/or estimates of temperature. The Seebeck effect may be observed to be the main contributor to heating element EMF and is the only known contributor to heating element EMF when no current (or constant current) has been flowing through the element for some time. Measured heating element EMF can be used to correct for resistance measurement error caused by heating element EMF. The resistance measurement (skewed by Seebeck EMF) and the Seebeck EMF measurement together can be used to calculate accurate heating element resistances, which can be used to control average temperature of the heating element.

The effect of heating element EMF on the resistance measurement depends on the measurement circuit used. Heating element EMF will produce measurement error in all known resistance measurement circuits, so heating element EMF may be separately measured to correct for the error it causes in the resistance measurement. Sensitivity of the resistance measurement to heating element EMF may be understood so that measured heating element EMF can be used correctly to calculate heating element resistance from the two measurements taken. For example, the same differential op-amp used for the resistance measurement may also be used for the heating element EMF measurement. In the resistance measurement, the heating element may be powered through a voltage divider so that there is a measureable voltage across the heater which is compared against a reference voltage or summed with other reference voltages and amplified by the differential op amp circuit. For heating element EMF measurement, no voltage is applied to the heating element, which allows for direct measurement of the EMF, which is compared against another close reference voltage and amplified by the same differential op amp circuit used for the resistance measurement.

Because the same amplification circuit may be used, the sensitivities of both the resistance measurement and the heating element EMF measurement to heating element EMF will be the same. The two measurements may then be used to calculate accurate heating element resistances, the raw reading difference between measured heating element EMFs when the device is heating and when device has not been heating for some time (note that Seebeck EMF is 0 when heating element reaches thermal equilibrium in device) and may be subtracted from the raw resistance measurement reading before other calculations are performed to yield heating element resistance from corrected resistance measurement reading.

FIG. **18** illustrates one example of a measurement circuit that may be used as part of a vaporization apparatus. Operation of this circuit to control heating element resistance while heating may be as follows (with signal and

component names below referencing signals and components from schematic of FIG. **18**); except for H+ **1821**, all output boxes (**1801**, **1803**, **1805**, **1807**, **1809**, **1811**, **1813**) are connected to the microcontroller, which is not shown; timing noted below is for one exemplary software implementation and may be different or modified for different implementations). Heating element is connected between H+ **1821** and GND.

In FIG. **18**, when device is heating, HEATER **1807** is driven with PWM to connect VBAT to H+ **1821** through Q**5** (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element. When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement), HEATER **1807** is held off and HM_PWR **1805** is held on (powering differential op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 us of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1809**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1809** between AREF_HM_OUT **1801** and GND during the last 68 μs of the measurement window. For the heating element resistance measurement, HM_NEG_REF_EN **1803** is on to bias the heating element so that the voltage divider formed by R**19** and the heating element can compared by the differential op amp circuit (comprised of U**5**, R**21**, R**22**, R**23**, and R**33**) against a fixed voltage divider formed by R**20** and R**32**, and some combination of R**28**, R**29**, and R**30**, which are used to keep HM_OUT **1809** in a usable voltage range between AREF_HM_OUT **1801** and GND for the range of heating element resistances that the device might see. HM_SCALE_**0-2 1813** are either allowed to float (high impedance) or connected to GND within the microcontroller to use R**28-30** to set the resistance measurement range of the circuit.

For the heating element EMF measurement, HM_NEG_REF_EN **1803** is off to allow H+ to float to a voltage that is the heating element EMF (relative GND) and SEEBECK_REF_EN **1815** is on to make the fixed reference used by the differential op amp circuit close enough to heating element EMF that HM_OUT **1809** will be usable (will be between AREF_HM_OUT **1801** and GND) over the range of heating element EMFs expected when heating element is heated. Heating element EMF may be as high as +/−3 mV. The heating element EMF measurement circuit can measure between +/−5 mV. The measurement circuit yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations. Resistance calculations are as follows:

> Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset

Resistance measurement sensitivities and offsets may depend on the active resistance measurement scale (selected using HM_SCALE_**0-2 1813**) and may be solved for using circuit component values and then included in the device (e.g., in the firmware, hardware or software of the apparatus).

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs. temperature curve.

The resistance measurement circuit may be a two-terminal sensing circuit, as just discussed. In other variations, a four-terminal sensing may be used to mitigate effects of variable contact resistance and trace or lead resistance in series with the heating element resistance measurement. Changing contact resistance and trace/lead resistance have a negligible impact on resistance measurement and temperature control, but these effects may be more pronounced in variations which have a lower resistance heating element and different heating element and device assembly. In this case, a four-terminal (also known as four-point) resistance and EMF measurement circuit, such as the one shown in FIG. **19**, may be used.

Operation of the circuit shown in FIG. **19** to control heating element resistance while heating may be done as follows (with signal and component names below referencing signals and components from schematic above; signals **1903**, **1905**, **1907**, **1909**, **1911**, **1913**, **1915**, **1917**) are connected to the microcontroller, which is not shown; timing noted below is exemplary only, and may be different). In FIG. **19**, HI+ **1822** and HV+ **1826** connect directly to one terminal of the heating element, while HV− **1828** and HI− **1824** connect directly to the other terminal of the heating element.

When device is heating, HEATER **1907** is driven with PWM to connect VBAT to H+ **1822** through Q**2** (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element.

When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement), HEATER **197** is held off and HM_PWR **1905** is held on (powering the differential summing op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 μs of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1915**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1915** between AREF_HM_OUT **1913** and GND during the last 68 μs of the measurement window.

For the heating element resistance measurement, HM_WS_ISRC_EN**0** negative feedback at the negative input of the op-amp. This differential summing configuration keeps HM_OUT **1915** in a usable range (will be between AREF_HM_OUT **1913** and GND) over the range of heating element EMFs expected when heating element is heated. With the values shown above, the heating element EMF measurement circuit can measure between +/−3.5 mV. The measurement circuit yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations.

Resistance calculations are as follows:

Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset Resistance measurement sensitivities and offsets depend on the active resistance measurement scale (selected using HM_SCALE_**0-4 1911**) and may be solved for using circuit component values and then included in the device.

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs. temperature curve.

As described above, the mismatch in thermoelectric properties and the resulting EM (e.g., the Seebeck EMF) has been found by the inventors to be a potential source of resistance measurement error after data taken from controlled tests of vaporizer prototypes (e.g., using heating elements with extension leads). A single heating element run with temp control of the heating element (using measured heating element resistance without correction for this EMF) may consistently run with much higher power when connected in one polarity vs. the other polarity. It was discovered that asymmetries in the heating element (in this case the wick and coil) assembly could consistently produce hotter temperatures at one of the two heating element/extension lead junctions, resulting in consistent offset voltage at operating temperatures that skewed the resistance measurement in one direction with the heating element connected in one polarity and in the other direction with heating element connected in the other polarity. Although measured resistance was controlled during these tests, these devices were not accurately controlling heating element temperatures because measurements were skewed by this offset EMF resulting from the mismatch in thermoelectric properties of the components. With the correction described above, used to correct for the error in resistance measurement, it is observed that heating element polarity does not have an effect on the power required to hold the heating element at operating temperatures during controlled testing, which suggests that this correction yields accurate calculated heating element resistances that remove the effect of the offset EMF, providing much more accurate temperature control of the heating element than when not corrected.

Thus, in any of the variations described herein, the apparatus may include an offset correction circuit (also referred to as a Seebeck correction circuit) to correct for the offset voltage resulting from the mismatch in thermoelectric properties between the resistive heating coil and the conductive connectors linking the resistive heating coil to the power input (e.g., from the vaporizer base, including the vaporizer power controller) in the cartridge. The offset correction circuit may be located in the vaporizer base and connected between the coupling connectors **595**, **595'** to couple with the cartridge connectors and determine the offset voltage due to the mismatch in thermoelectric properties of the heating (resistive) coil and the wires linking the coil to the connector on the cartridge. Also described herein are methods of correcting for the mismatch (Seebeck effect) in thermoelectric properties between the coil and the wires (electrical extensions) connecting to the electrical connectors.

Dose Monitoring

As mentioned above, any of the apparatuses described herein may also or alternatively detect and display the dose of material applied. U.S. patent application Ser. No. 14/960,259 (filed on Dec. 4, 2015, and published as US-2016-0157524-A1), herein incorporated by reference in its entirety, describes examples of methods for determining dose (and apparatuses including dose determination). Generally these methods may be used to accurately calculate dose based on the power applied to the heater and the temperature of the heater (or a material in contact with the heater) during an immediately before a small increment of time; total dose may be determined by summing these small increments up over a desired time range. These methods may be incorporated herein, and may be made even more accurate by correcting the power applied as described above (e.g., accounting for the offset EMF due to the Seebeck effect).

Alternatively or additionally, described herein are methods and apparatuses that may provide a rough approximation of dose based on the power applied over time to vaporize the material within the cartridge. This may be referred to herein as the consumption (of the vaporizable material in the cartridge, an indication of consumption) of the cartridge or vaporizable material, or the like. In general, the apparatus may aggregate the power during operation of the apparatus (e.g., the power applied over time during a puff/inhalation and/or the power applied over this time multiplied times the duration of the inhalation).

The apparatus may further provide an output of the amount of consumption. This output may be, in particular, a qualitative approximation. For example, the output may be incrementally increasing the number, intensity and/or color of one or more LEDs on the surface of the apparatus. For example, in this case, the consumption amount (dose) is not an absolute amount, but is an indicator or readout of the power applied to vaporize the material (power applied to the coils) over time. In FIG. **9**C, for example, when the user first installs a cartridge and the apparatus is set up to display consumption/dose, the four LEDS **897** may initially be unlit or lit to the neutral color (e.g., white). As the user draws on the device and vaporizes the material within the cartridge, the number of LEDS illuminated may be increased and the intensity and/or color of illumination may be increased to indicate increasing dosage or consumption; for example the calculation of power applied over time may determine based on a number or predetermined increments, whether to increase the number of illuminated LEDS of a particular color and/or intensity, to change color and/or intensity, etc.

The accumulated dose may be reset manually (e.g., using an app, shaking the device, etc.) or by removing the cartridge. Alternatively or additionally to the qualitative output described above, a quantitative estimate based on the power may be displayed or output to a remote processor (e.g. smartphone, etc.).

Thermocouple as Heater

In any of the apparatuses described herein, the heater may be configured as a thermocouple junction. See, e.g., FIGS. **20**A and **20**B. Thus, a thermocouple junction (comprising materials having dissimilar thermoelectric properties) may be used to measure temperature at a point along the heater coil. As discussed above, this may allow an apparatus to resistively determine temperature along the heater coil using the thermoelectric properties described above. Thus, similar to what is described above, the heating element performs both as a heater and a temperature sensor. For example, a resistive heater may comprised of two dissimilar conductors (e.g., stainless steel and titanium) welded together, as shown in FIG. **20**A. When the heater (heating coil) heats up, the dissimilar material will be heated differentially, resulting in a temperature gradient and a resulting offset voltage (EMF), due to the Seebeck effect discussed above, at the junction of the two dissimilar materials. This effect may be used to determine the temperature at that junction (whereas typically, we determine the average temperature of the entire heater by using TCR, temperature coefficient of resistance, as also discussed above.

The Seebeck effect also occurs at the junction between the heater end poles and passive electrical conduits. Although the correction circuits discussed above are aimed at correct-

ing for the effect, it may also be possible to take advantage of the effect for a more localized temperature measurement. Compare, FIG. **20**B to FIG. **20**A, for example. In FIG. **20**A, the junction is located in the middle of the heating element, and determining the offset voltage in this case, which is based on the temperature, may allow accurate temperature determination. This embodiment may be particularly relevant for a convection vaporizer, where you likely have a (relatively) large heater and you care about the temperature at just the air outlet end.

In vaporization systems where the heating element is connected to the device through extension leads, if Seebeck coefficients are known for both materials, the measured Seebeck EMF can be used to determine the net temperature gradient across the heating element. With some modeling, this measurement could be used to approximately control maximum heating element temperature instead of or in addition to average heating element temperature. This measurement can also be used to perform quality control where the heating element assembly is manufactured. In vaporization systems where the heating element is connected to the device through extension leads and the heating element is used to primarily heat air, if Seebeck coefficients are known for both materials, Seebeck EMF can be used to determine the net temperature gradient across the heating element, which with a known air flow path and thermal modeling of the system can be used to predict average air temperature at some point down-stream of the heating element. As mentioned above, this may be particularly advantageous in convection (hot-air) vaporization systems as two measurements (resistance and Seebeck EMF) taken from the actuator can allow for accurate temperature control of air flowing from the outlet of the heating element without additional sensors in the air path or connected to the heating element.

As shown in FIG. **20**A, the Seebeck effect alone or the Seebeck effect in conjunction with resistance measurement can be used for temperature control of a heating element that has a material transition (junction) at the position where temperature is to be controlled. This is essentially creating a thermocouple out of resistive heating alloys so that the Seebeck EMF can be measured in order to control temperature at the hot junction of the thermocouple resistive heater. The junction could be positioned where the heating element is expected to be hottest to control maximum temperature of the heating element. The control algorithm could use a target average temperature of the heating element (calculated using resistance and EMF measurements) as well as a maximum acceptable max temperature of the heating element (calculated using just the EMF measurement). A device that knows both the average temperature of the heating element and the maximum temperature of the heating element could know more about the temperature gradient along the heating element and be better at predicting mass of material vaporized while heating than a device that only knows either maximum or average heating element temperature (device knowing precise mass of material vaporized is critical for dose-control in vaporizers). If extensions are used in such a system, they could be the same material as the intended heating element but much larger gauge for reduced losses in the extensions. Alternatively, extensions with Seebeck coefficients that are very similar to the Seebeck coefficients of the two heating element sections could be used so that Seebeck EMF is still usable for temp control of the hot junction (small contribution of heating element/extension junctions to net Seebeck EMF).

Vaporizers without Cartridges

Any of the features described herein may be incorporated into a vaporizer apparatus that does not require the uses of a separate (e.g., removable cartridge), including vaporizer apparatuses such as loose-leaf vaporizer apparatuses.

Such apparatuses are described, for example, in each of the following applications, herein incorporated by reference in their entirety: U.S. patent application Ser. No. 13/837,438, filed on Mar. 15, 2013, Publication No. US 2013-0312742 A1; U.S. patent application Ser. No. 15/166,001, filed on May 26, 2016, Publication No. US 2016-0262459 A1; U.S. patent application Ser. No. 14/581,666, filed on Dec. 23, 2014, Publication No. US 2015-0208729 A1; U.S. patent application Ser. No. 15/053,927, filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1; U.S. patent application Ser. No. 15/257,748, filed on Sep. 6, 2016; U.S. patent application Ser. No. 15/257,760, filed on Sep. 6, 2016, Publication No. US 2016-0374399 A1; and U.S. patent application Ser. No. 15/257,768, filed on Sep. 6, 2016, Publication No. US 2016-0366947 A1.

For example such a device may include preset and allow the user to enter temp set mode by holding down on a button (on or under the mouthpiece) for >0.6 seconds. Pressing the button again cycles through the 4+1 presets. To exit temp set, again hold the button for >0.6 sec. The presets may be, e.g.: 180C, 193C, 204C, 216C.

Any of the apparatuses described herein may include haptic feedback that may include distinct profiles for different events: For example:

/‾\—trapezoid—power on, and Bluetooth connect

‖—quick click—manual power off, and Bluetooth disconnect

|‾‖‾|—2 long clicks—temp reached

|‾|—1 long click—entered low temp standby, and auto shutoff

Also the user may change the intensity of these envelopes via the app.

Although the disclosure, including the figures, described herein may described and/or exemplify these different variations separately, it should be understood that all or some, or components of them, may be combined.

Although various illustrative embodiments are described above, any of a number of changes may be made to various embodiments without departing from the scope of the invention as described by the claims. For example, the order in which various described method steps are performed may often be changed in alternative embodiments, and in other alternative embodiments one or more method steps may be skipped altogether. Optional features of various device and system embodiments may be included in some embodiments and not in others. Therefore, the foregoing description is provided primarily for exemplary purposes and should not be interpreted to limit the scope of the invention as it is set forth in the claims.

When a feature or element is herein referred to as being "on" another feature or element, it can be directly on the other feature or element or intervening features and/or elements may also be present. In contrast, when a feature or element is referred to as being "directly on" another feature or element, there are no intervening features or elements present. It will also be understood that, when a feature or element is referred to as being "connected", "attached" or "coupled" to another feature or element, it can be directly connected, attached or coupled to the other feature or element or intervening features or elements may be present. In contrast, when a feature or element is referred to as being "directly connected", "directly attached" or "directly coupled" to another feature or element, there are no inter-

vening features or elements present. Although described or shown with respect to one embodiment, the features and elements so described or shown can apply to other embodiments. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

Terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. For example, as used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items and may be abbreviated as "/".

Spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if a device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms "upwardly", "downwardly", "vertical", "horizontal" and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

Although the terms "first" and "second" may be used herein to describe various features/elements (including steps), these features/elements should not be limited by these terms, unless the context indicates otherwise. These terms may be used to distinguish one feature/element from another feature/element. Thus, a first feature/element discussed below could be termed a second feature/element, and similarly, a second feature/element discussed below could be termed a first feature/element without departing from the teachings of the present invention.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising" means various components can be co-jointly employed in the methods and articles (e.g., compositions and apparatuses including device and methods). For example, the term "comprising" will be understood to imply the inclusion of any stated elements or steps but not the exclusion of any other elements or steps.

As used herein in the specification and claims, including as used in the examples and unless otherwise expressly specified, all numbers may be read as if prefaced by the word "about" or "approximately," even if the term does not expressly appear. The phrase "about" or "approximately" may be used when describing magnitude and/or position to indicate that the value and/or position described is within a reasonable expected range of values and/or positions. For example, a numeric value may have a value that is +/−0.1% of the stated value (or range of values), +/−1% of the stated value (or range of values), +/−2% of the stated value (or range of values), +/−5% of the stated value (or range of values), +/−10% of the stated value (or range of values), etc. Any numerical values given herein should also be understood to include about or approximately that value, unless the context indicates otherwise.

The examples and illustrations included herein show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. As mentioned, other embodiments may be utilized and derived there from, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is, in fact, disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

What is claimed is:

1. A vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;

a reservoir configured to hold a vaporizable material;

a first pad positioned within an interior of the mouthpiece;

a second pad positioned within the interior of the mouthpiece;

a heater chamber comprising:

a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the heater, the housing piece comprising a housing opening configured to receive at least a portion of the heater;

an air tube extending from the housing piece;

a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening; and

a distal member positioned at least partially within the cartridge body between the housing piece and the bottom cover, the distal member comprising:

a proximal side;

a distal side opposite the proximal side;

a lateral side extending between the proximal side and the distal side; and

at least one recessed surface positioned on the lateral side;

wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and

wherein the first air opening and the second air opening of the bottom portion allow air to pass into the air chamber.

2. The vaporizer cartridge of claim **1**, wherein at least a portion of the distal member comprises a perimeter that has

a first shape corresponding to a second shape of an inner surface of the cartridge body.

3. The vaporizer cartridge of claim **1**, wherein the distal member comprises:

an extension feature having a cylindrical shape, the extension feature extending from the proximal side of the distal member.

4. The vaporizer cartridge of claim **3**, wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member.

5. The vaporizer cartridge of claim **1**, further comprising:

a cartridge electrical contact configured to contact a corresponding body electrical contact on a vaporizer body.

6. The vaporizer cartridge of claim **5**, wherein at least a portion of the heater extends at least partially through the distal member to contact the cartridge electrical contact.

7. The vaporizer cartridge of claim **1**, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece; and wherein the first pad and the second pad do not intersect with a central axis of the air tube.

8. The vaporizer cartridge of claim **1**, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within a cartridge receiver of a vaporizer body.

9. A vaporizer device, comprising:

the vaporizer cartridge of claim **1**; and

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, the cartridge receiver comprising:

a first body electrical contact;

a second body electrical contact;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end.

10. The vaporizer device of claim **9**, further comprising:

a pressure sensor configured to detect a draw on the mouthpiece to activate the heater; and

a channel extending from the base of the cartridge receiver to the pressure sensor.

11. The vaporizer device of claim **9**, further comprising one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heater of the vaporizer cartridge.

12. The vaporizer cartridge of claim **1**, wherein the bottom cover comprises exactly two air openings, the air openings comprising the first air opening and the second air opening.

13. The vaporizer cartridge of claim **1**, wherein the bottom portion of the bottom cover comprises:

a first cartridge electrical contact opening through which a first cartridge electrical contact of the vaporizer cartridge is exposed; and

a second cartridge electrical contact opening through which a second cartridge electrical contact of the vaporizer cartridge is exposed.

14. The vaporizer cartridge of claim **13**, wherein the bottom cover comprises exactly two air openings, the air openings comprising the first air opening and the second air opening; wherein the bottom portion of the bottom cover comprises a region positioned between the first cartridge electrical contact opening and the second cartridge electrical contact opening; and wherein the first air opening and the second air opening are not positioned within the region.

15. A vaporizer device comprising:

a vaporizer cartridge, comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, the mouthpiece comprising an outlet;

a reservoir configured to hold a vaporizable material;

a first pad positioned within an interior of the mouthpiece;

a second pad positioned within the interior of the mouthpiece;

a heater chamber comprising:

a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the heater, the housing piece configured to receive at least a portion of the heater;

an air tube extending from the housing piece;

a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, the bottom portion comprising: a first air opening and a second air opening;

a distal member positioned at least partially within the cartridge body between the housing piece and the bottom cover, the distal member comprising:

a proximal side;

a distal side opposite the proximal side;

a lateral side extending between the proximal side and the distal side; and

at least one recessed surface positioned on the lateral side;

wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and

wherein the first air opening and the second air opening of the bottom portion allow air to pass into the air chamber;

a first cartridge electrical contact; and

a second cartridge electrical contact; and

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, the cartridge receiver comprising:

a first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;

a second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end; and

one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heater of the vaporizer cartridge.

16. The vaporizer device of claim **15**, wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body.

17. The vaporizer device of claim **15**, wherein the distal member comprises:

an extension feature having a cylindrical shape, the extension feature extending from the proximal side of the distal member.

18. The vaporizer device of claim **17**, wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member.

19. The vaporizer device of claim **15**, wherein at least a first portion of the heater extends at least partially through the distal member to contact the first cartridge electrical contact; and at least a second portion of the heater extends at least partially through the distal member to contact the second cartridge electrical contact.

20. The vaporizer device of claim **15**, wherein the bottom portion of the bottom cover comprises: a first cartridge electrical contact opening through which the first cartridge electrical contact of the vaporizer cartridge is exposed; a second cartridge electrical contact opening through which the second cartridge electrical contact of the vaporizer cartridge is exposed; and a region positioned between the first cartridge electrical contact opening and the second cartridge electrical contact opening;

wherein the bottom cover comprises exactly two air openings, the air openings comprising the first air opening and the second air opening; and

wherein the first air opening and the second air opening are not positioned within the region.

* * * * *



(12) **United States Patent**
Hatton et al.

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(54) **LEAK-RESISTANT VAPORIZER DEVICE**

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None
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(56) **References Cited**

U.S. PATENT DOCUMENTS

1,671,185 A 5/1928 Flynn
1,950,542 A 3/1934 Copell
(Continued)

FOREIGN PATENT DOCUMENTS

AT 507187 A4 3/2010
CA 2920973 C 9/2018
(Continued)

OTHER PUBLICATIONS

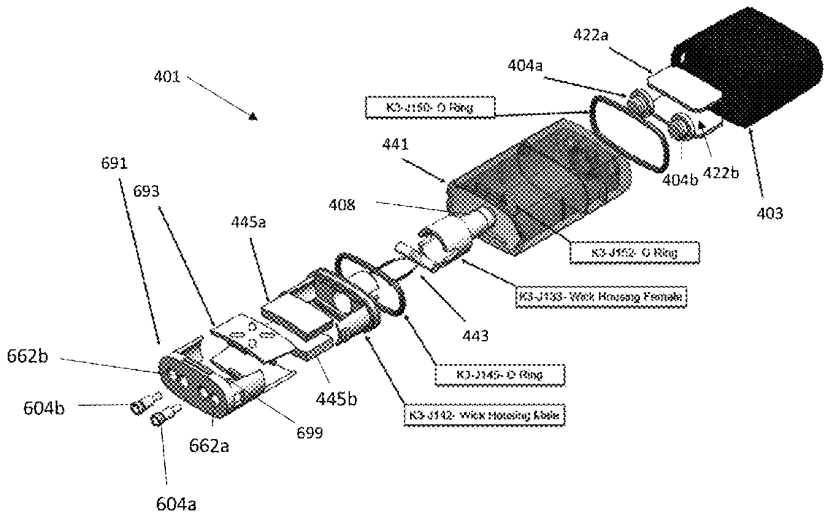
U.S. Appl. No. 15/396,584, filed Dec. 31, 2016, US 20180077967 A1.
(Continued)

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(57) **ABSTRACT**

Vaporizer cartridges and vaporizer apparatuses, and methods for making, using and delivering vapor to a user, that are leak-resistant for use with cannabinoids. In particular, described herein are leak-resistant vaporizer cartridges and apparatuses adapted for use with oil-based vaporizable materials including cannabis oils.

20 Claims, 26 Drawing Sheets



Related U.S. Application Data

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(56) **References Cited**

U.S. PATENT DOCUMENTS

2,900,989	A	8/1959	Davidson
4,945,931	A	8/1990	Gori
6,516,796	B1	2/2003	Cox et al.
6,637,430	B1	10/2003	Voges et al.
7,284,553	B2	10/2007	Hochrainer
7,802,569	B2	9/2010	Yeates et al.
8,528,569	B1	9/2013	Newton
8,714,161	B2	5/2014	Liu
8,752,545	B2	6/2014	Buchberger
8,833,364	B2	9/2014	Buchberger
8,899,240	B2	12/2014	Mass
8,948,578	B2	2/2015	Buchberger
9,010,335	B1	4/2015	Scatterday
9,078,474	B2	7/2015	Thompson
9,089,166	B1	7/2015	Scatterday
9,155,336	B2	10/2015	Liu
9,247,773	B2	2/2016	Memari et al.
9,289,014	B2	3/2016	Tucker et al.
9,351,522	B2	5/2016	Safari
9,364,025	B2	6/2016	Liu
9,427,022	B2	8/2016	Levin et al.
9,497,998	B2	11/2016	Chen
9,510,623	B2	12/2016	Tucker et al.
9,526,272	B2	12/2016	Liu
9,648,908	B1	5/2017	Rinehart et al.
9,668,520	B2	6/2017	Boldrini
9,668,522	B2	6/2017	Memari et al.
9,681,688	B1	6/2017	Rinehart et al.
9,763,475	B2	9/2017	Liu
9,763,478	B2	9/2017	Cameron et al.
9,770,055	B2	9/2017	Cameron et al.
9,795,168	B2	10/2017	Zhu
9,833,021	B2	12/2017	Perez et al.
9,844,234	B2	12/2017	Thorens et al.
9,861,135	B2	1/2018	Chen
9,877,519	B2	1/2018	Xiang
9,918,496	B2	3/2018	Kane et al.
9,955,726	B2	5/2018	Brinkley et al.
9,986,762	B2	6/2018	Alarcon et al.
10,058,128	B2	8/2018	Cameron et al.
10,070,668	B2	9/2018	Li et al.
10,080,387	B2	9/2018	Phillips et al.
10,085,481	B2	10/2018	Verleur et al.
10,085,486	B2	10/2018	Cameron
10,130,123	B2	11/2018	Hatton et al.
10,131,532	B2	11/2018	Murison et al.
10,159,282	B2	12/2018	Monsees et al.
10,206,429	B2	2/2019	Davis et al.
10,279,934	B2	5/2019	Christensen et al.
10,299,513	B2	5/2019	Perez et al.
10,383,368	B2	8/2019	Larson
10,426,199	B2	10/2019	Turner et al.
10,492,542	B1	12/2019	Worm et al.
2003/0154991	A1	8/2003	Fournier et al.
2007/0215168	A1	9/2007	Banerjee et al.
2009/0255534	A1	10/2009	Paterno
2010/0186757	A1	7/2010	Crooks et al.
2010/0200008	A1	8/2010	Taieb
2012/0018529	A1	1/2012	Gammon et al.
2012/0318882	A1	12/2012	Abehasera
2013/0192615	A1	8/2013	Tucker et al.
2013/0199528	A1	8/2013	Goodman et al.
2013/0312742	A1	11/2013	Monsees et al.
2014/0041655	A1	2/2014	Barron et al.
2014/0041658	A1	2/2014	Goodman et al.
2014/0150810	A1	6/2014	Hon
2014/0158129	A1	6/2014	Pratt, Jr.
2014/0182612	A1	7/2014	Chen
2014/0202454	A1	7/2014	Buchberger
2014/0238421	A1	8/2014	Shapiro
2014/0261399	A1	9/2014	Murphy
2014/0261408	A1	9/2014	John et al.
2014/0290677	A1	10/2014	Liu
2014/0345635	A1	11/2014	Rabinowitz et al.
2014/0355969	A1	12/2014	Stern
2015/0007836	A1	1/2015	Li et al.
2015/0040929	A1	2/2015	Hon
2015/0136158	A1	5/2015	Stevens et al.
2015/0144147	A1	5/2015	Li et al.
2015/0150305	A1	6/2015	Shenkal
2015/0157054	A1	6/2015	Liu
2015/0164147	A1	6/2015	Verleur et al.
2015/0181941	A1	7/2015	Liu
2015/0184846	A1	7/2015	Liu
2015/0189919	A1	7/2015	Liu
2015/0201674	A1	7/2015	Dooly et al.
2015/0208729	A1	7/2015	Monsees et al.
2015/0216236	A1	8/2015	Bless et al.
2015/0223521	A1	8/2015	Menting et al.
2015/0223522	A1	8/2015	Ampolini et al.
2015/0245654	A1	9/2015	Memari et al.
2015/0245655	A1	9/2015	Memari et al.
2015/0245657	A1	9/2015	Memari et al.
2015/0245665	A1	9/2015	Memari et al.
2015/0245666	A1	9/2015	Memari et al.
2015/0245667	A1	9/2015	Memari et al.
2015/0245668	A1	9/2015	Memari et al.
2015/0257451	A1	9/2015	Brannon et al.
2015/0272217	A1	10/2015	Chen
2015/0282530	A1	10/2015	Johnson et al.
2015/0289565	A1	10/2015	Cadieux et al.
2015/0305406	A1	10/2015	Li et al.
2015/0313287	A1	11/2015	Verleur et al.
2015/0320116	A1	11/2015	Bleloch et al.
2015/0327595	A1	11/2015	Scatterday
2015/0328415	A1	11/2015	Minskoff et al.
2015/0342258	A1	12/2015	Chen
2015/0366267	A1	12/2015	Liu
2016/0000147	A1	1/2016	Li et al.
2016/0000149	A1	1/2016	Scatterday
2016/0007655	A1	1/2016	Li et al.
2016/0044965	A1	2/2016	Liu
2016/0057811	A1	2/2016	Alarcon et al.
2016/0073692	A1	3/2016	Alarcon et al.
2016/0081394	A1	3/2016	Alarcon et al.
2016/0095357	A1	4/2016	Burton
2016/0100632	A1	4/2016	Debono et al.
2016/0120226	A1	5/2016	Rado
2016/0120227	A1	5/2016	Levitz et al.
2016/0128384	A1	5/2016	Luciani
2016/0129205	A1	5/2016	Shahaf et al.
2016/0135504	A1	5/2016	Li et al.
2016/0150823	A1	6/2016	Liu
2016/0150824	A1	6/2016	Memari et al.
2016/0157524	A1	6/2016	Bowen et al.
2016/0174611	A1	6/2016	Monsees et al.
2016/0193434	A1	7/2016	Gleixner et al.
2016/0198767	A1	7/2016	Verleur
2016/0198769	A1	7/2016	Liu
2016/0198770	A1	7/2016	Alarcon
2016/0213866	A1	7/2016	Tan
2016/0219934	A1	8/2016	Li et al.
2016/0219937	A1	8/2016	Rado
2016/0235120	A1	8/2016	Liu
2016/0235125	A1	8/2016	Safari
2016/0249684	A1	9/2016	Liu
2016/0262452	A1	9/2016	Zhu
2016/0262459	A1	9/2016	Monsees et al.
2016/0278163	A1	9/2016	Chen
2016/0286860	A1	10/2016	Flayler
2016/0286863	A1	10/2016	Lin
2016/0286865	A1	10/2016	King et al.
2016/0302487	A1	10/2016	Chen
2016/0309785	A1	10/2016	Holtz
2016/0324217	A1	11/2016	Cameron
2016/0325055	A1	11/2016	Cameron
2016/0331022	A1	11/2016	Cameron
2016/0331023	A1	11/2016	Cameron
2016/0331024	A1	11/2016	Cameron

(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0331025	A1	11/2016	Cameron
2016/0331026	A1	11/2016	Cameron
2016/0331034	A1	11/2016	Cameron
2016/0331037	A1	11/2016	Cameron
2016/0332754	A1	11/2016	Brown et al.
2016/0334847	A1	11/2016	Cameron
2016/0337141	A1	11/2016	Cameron
2016/0337444	A1	11/2016	Cameron
2016/0338413	A1	11/2016	Li et al.
2016/0345621	A1	12/2016	Li et al.
2016/0356751	A1	12/2016	Blackley
2016/0360789	A1	12/2016	Hawes et al.
2016/0363570	A1	12/2016	Blackley
2016/0363917	A1	12/2016	Blackley
2016/0366936	A1	12/2016	Liu
2016/0366943	A1	12/2016	Li et al.
2016/0366945	A1	12/2016	Rado
2016/0366947	A1	12/2016	Monsees et al.
2016/0367925	A1	12/2016	Blackley
2016/0370335	A1	12/2016	Blackley
2016/0374399	A1	12/2016	Monsees et al.
2017/0006922	A1	1/2017	Wang et al.
2017/0013885	A1	1/2017	Qiu
2017/0018000	A1	1/2017	Cameron
2017/0020188	A1	1/2017	Cameron
2017/0020195	A1	1/2017	Cameron
2017/0020196	A1	1/2017	Cameron
2017/0020197	A1	1/2017	Cameron
2017/0035110	A1	2/2017	Keen
2017/0042229	A1	2/2017	Liu
2017/0042246	A1	2/2017	Lau et al.
2017/0049153	A1	2/2017	Guo et al.
2017/0055586	A1	3/2017	Liu
2017/0055588	A1	3/2017	Cameron
2017/0071249	A1	3/2017	Ampolini et al.
2017/0108210	A1	4/2017	Meinhart et al.
2017/0112193	A1	4/2017	Chen
2017/0119057	A1	5/2017	Liu
2017/0119060	A1	5/2017	Li et al.
2017/0196265	A1	7/2017	Liu
2017/0196272	A1	7/2017	Li et al.
2017/0208857	A1	7/2017	Branton et al.
2017/0224013	A1	8/2017	Huang
2017/0231282	A1	8/2017	Bowen et al.
2017/0231286	A1	8/2017	Borkovec et al.
2017/0233114	A1	8/2017	Christensen et al.
2017/0245546	A1	8/2017	Huang
2017/0259170	A1	9/2017	Bowen et al.
2017/0347706	A1	12/2017	Aoun et al.
2017/0360093	A1	12/2017	Fernando
2018/0016040	A1	1/2018	Ewing et al.
2018/0022516	A1	1/2018	Liu
2018/0064169	A1	3/2018	Biel et al.
2018/0160733	A1	6/2018	Leadley et al.
2018/0161525	A1	6/2018	Liu et al.
2018/0168227	A1	6/2018	Fraser et al.

FOREIGN PATENT DOCUMENTS

CN	101263935	A	9/2008
CN	100589726	C	2/2010
CN	201430916	Y	3/2010
CN	204180941	U	3/2015
CN	204217907	U	3/2015
CN	204426692	U	7/2015
CN	105249536	A	1/2016
CN	205456063	U	8/2016
CN	105962419	A	9/2016
DE	202015009688	U1	3/2019
EP	0535695	A2	4/1993
EP	1093936	A1	4/2001
EP	2789248	A1	10/2014
EP	3031339	A1	6/2016
EP	3143884	A2	3/2017
EP	3158883	A2	4/2017
EP	3195738	A2	7/2017
EP	3024344	B1	9/2018
EP	3313215	B1	6/2019
EP	3409597	B1	6/2019
JP	2002231420	A	8/2002
JP	2016525345	A	8/2016
KR	20110006928	U	7/2011
KR	200461404	Y1	7/2012
KR	20-0462610	Y1	9/2012
KR	20120006582	U	9/2012
KR	200473510	Y1	8/2014
KR	101541750	B1	8/2015
KR	101634882	B1	6/2016
KR	200481405	Y1	10/2016
KR	101774283	B1	9/2017
KR	101995956	B1	7/2019
RU	2621596	C2	2/2016
WO	WO-2006021153	A1	3/2006
WO	WO-2009135729	A1	11/2009
WO	WO-2010045671	A1	4/2010
WO	WO-2010118644	A1	10/2010
WO	WO-2012040512	A2	3/2012
WO	WO-2012134117	A2	10/2012
WO	WO-2012173322	A1	12/2012
WO	WO-2012174677	A1	12/2012
WO	WO-2013089358	A1	6/2013
WO	WO-2013089551	A1	6/2013
WO	WO-2014020953	A1	2/2014
WO	WO-2014071747	A1	5/2014
WO	WO-2014101734	A1	7/2014
WO	WO-2014185937	A1	11/2014
WO	WO-2015070398	A1	5/2015
WO	WO-2015070405	A1	5/2015
WO	WO-2015100361	A1	7/2015
WO	WO-2015106440	A1	7/2015
WO	WO-2015107552	A1	7/2015
WO	WO-2015117703	A1	8/2015
WO	WO-2015120589	A1	8/2015
WO	WO-2015128665	A1	9/2015
WO	WO-2015144057	A1	10/2015
WO	WO-2015149311	A1	10/2015
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WO	WO-2015154309	A1	10/2015
WO	WO-2015157900	A1	10/2015
WO	WO-2015161407	A1	10/2015
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WO	WO-2015165081	A1	11/2015
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WO	WO-2015180061	A1	12/2015
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WO	WO-2015184747	A1	12/2015
WO	WO-2015188295	A1	12/2015
WO	WO-2015192377	A1	12/2015
WO	WO-2015196463	A1	12/2015
WO	WO-2016000206	A1	1/2016
WO	WO-2016000214	A1	1/2016
WO	WO-2016019353	A1	2/2016
WO	WO-2016023212	A1	2/2016
WO	WO-2016023824	A1	2/2016
WO	WO-2016026104	A1	2/2016
WO	WO-2016029344	A1	3/2016
WO	WO-2016061730	A1	4/2016
WO	WO-2016061859	A1	4/2016
WO	WO-2016074229	A1	5/2016
WO	WO-2016090303	A1	6/2016
WO	WO-2016090602	A1	6/2016
WO	WO-2016095220	A1	6/2016
WO	WO-2016103202	A1	6/2016
WO	WO-2016106476	A1	7/2016
WO	WO-2016106500	A1	7/2016
WO	WO-2016108694	A1	7/2016
WO	WO-2016109931	A1	7/2016
WO	WO-2016115701	A1	7/2016

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	WO-2016119098	A1	8/2016
WO	WO-2016119101	A1	8/2016
WO	WO-2016119167	A1	8/2016
WO	WO-2016119225	A1	8/2016
WO	WO-2016120177	A1	8/2016
WO	WO-2016122417	A1	8/2016
WO	WO-2016123764	A1	8/2016
WO	WO-2016123780	A1	8/2016
WO	WO-2016123781	A1	8/2016
WO	WO-2016127360	A1	8/2016
WO	WO-2016127406	A1	8/2016
WO	WO-2016141508	A1	9/2016
WO	WO-2016145611	A1	9/2016
WO	WO-2016149932	A1	9/2016
WO	WO-2016154798	A1	10/2016
WO	WO-2016172898	A1	11/2016
WO	WO-2016179828	A1	11/2016
WO	WO-2016184247	A1	11/2016
WO	WO-2016201602	A1	12/2016
WO	WO-2016202304	A1	12/2016
WO	WO-2017001818	A1	1/2017
WO	WO-2017001819	A1	1/2017
WO	WO-2017021536	A2	2/2017
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WO	WO-2017055802	A1	4/2017
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WO	WO-2017093452	A1	6/2017
WO	WO-2017093535	A1	6/2017
WO	WO-2017107546	A1	6/2017
WO	WO-2017109448	A2	6/2017
WO	WO-2017113106	A1	7/2017
WO	WO-2017124662	A1	7/2017
WO	WO-2017137554	A1	8/2017
WO	WO-2017153270	A1	9/2017
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WO	WO-2017163046	A1	9/2017
WO	WO-2017163050	A1	9/2017
WO	WO-2017163051	A1	9/2017
WO	WO-2017163052	A1	9/2017
WO	WO-2017166263	A1	10/2017
WO	WO-2019210402	A1	11/2019

OTHER PUBLICATIONS

U.S. Appl. No. 17/199,370, filed Mar. 11, 2021, US 20210268206 A1.

U.S. Appl. No. 17/199,377, filed Mar. 11, 2021, U.S. Pat. No. 11,369,755.

U.S. Appl. No. 17/204,148, filed Mar. 17, 2021, U.S. Pat. No. 11,369,756.

U.S. Appl. No. 17/364,436, filed Jun. 30, 2021, U.S. Pat. No. 11,369,757.

U.S. Appl. No. 18/173,712, filed Feb. 23, 2023.

U.S. Appl. No. 18/124,249, filed Mar. 21, 2023.

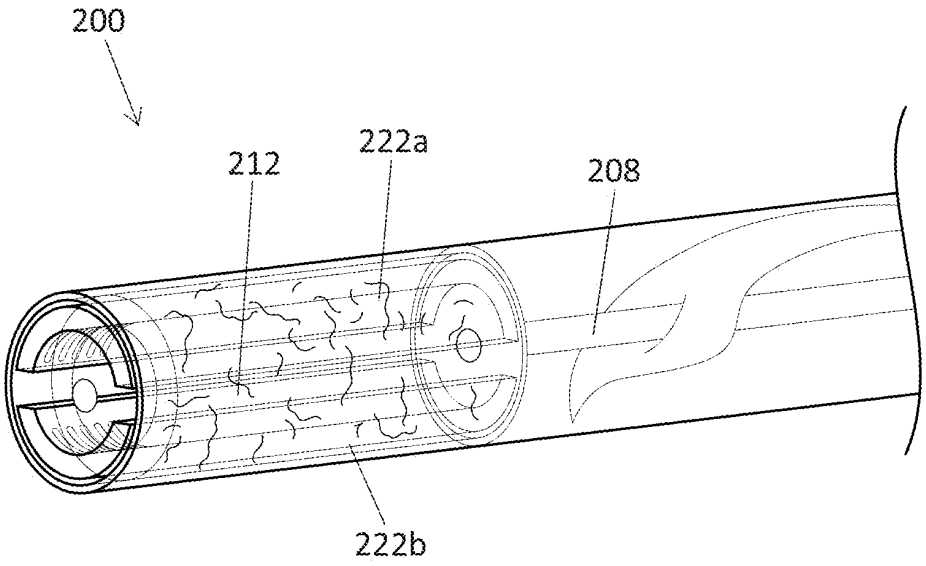


FIG. 1

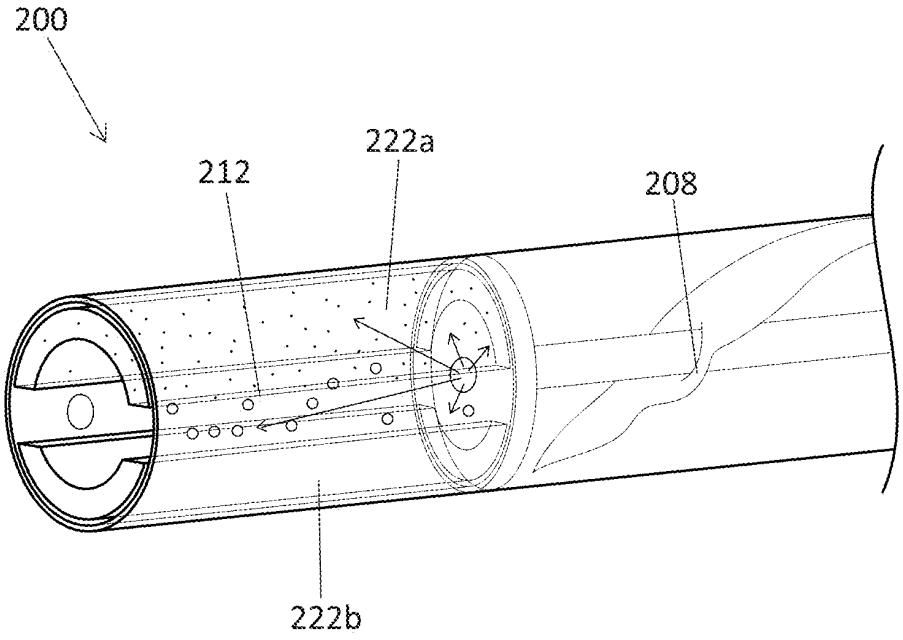


FIG. 2

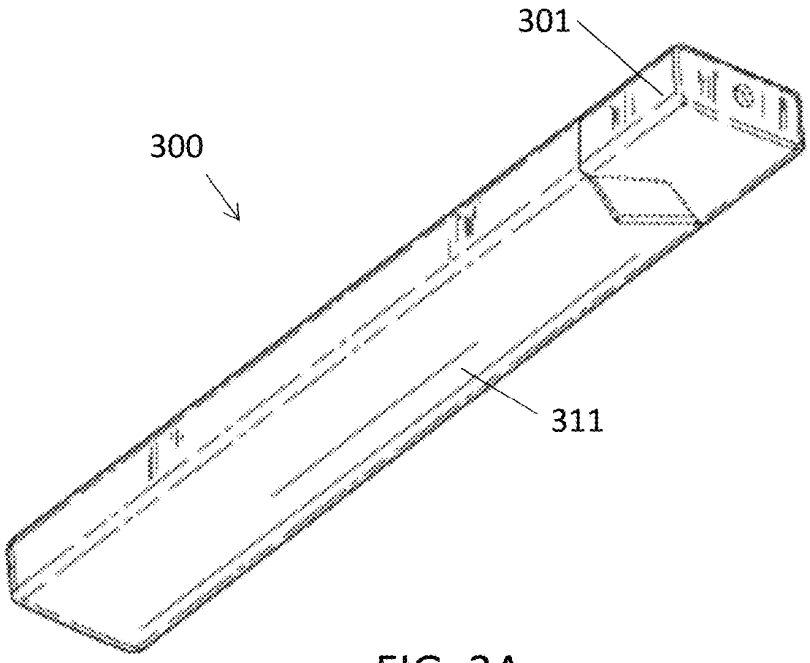

301
300
311

FIG. 3A

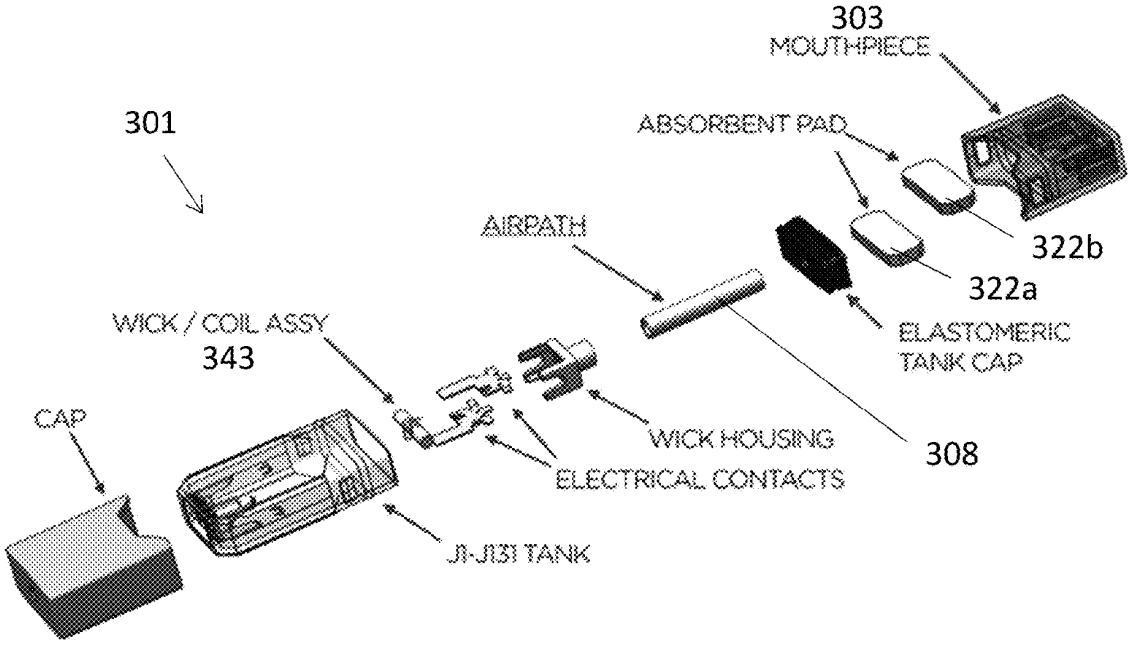

303
MOUTHPIECE
301
ABSORBENT PAD
AIRPATH
322b
322a
ELASTOMERIC
TANK CAP
WICK / COIL ASSY
343
CAP
WICK HOUSING
308
ELECTRICAL CONTACTS
JI-JI3I TANK

FIG. 3B

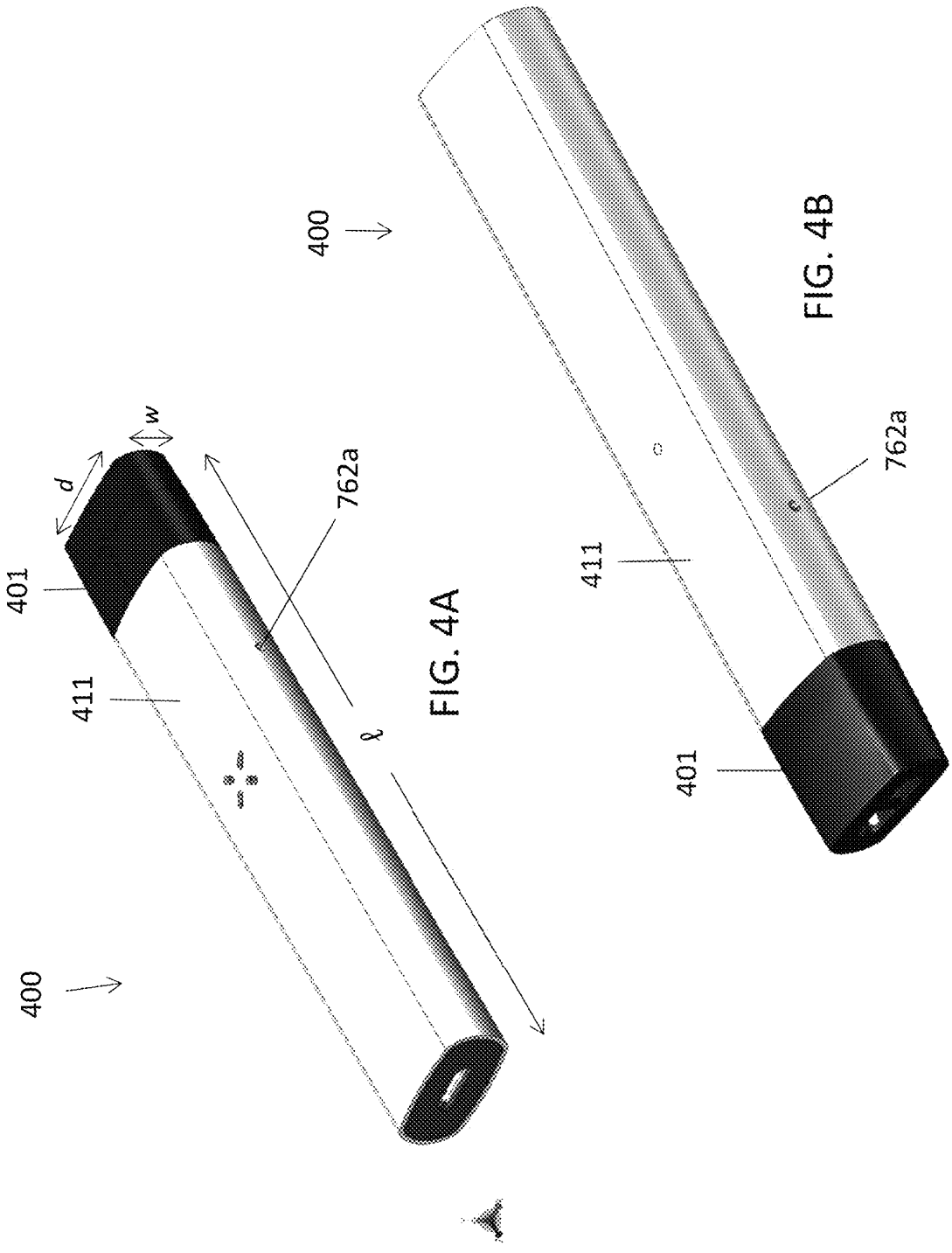


FIG. 4A

FIG. 4B

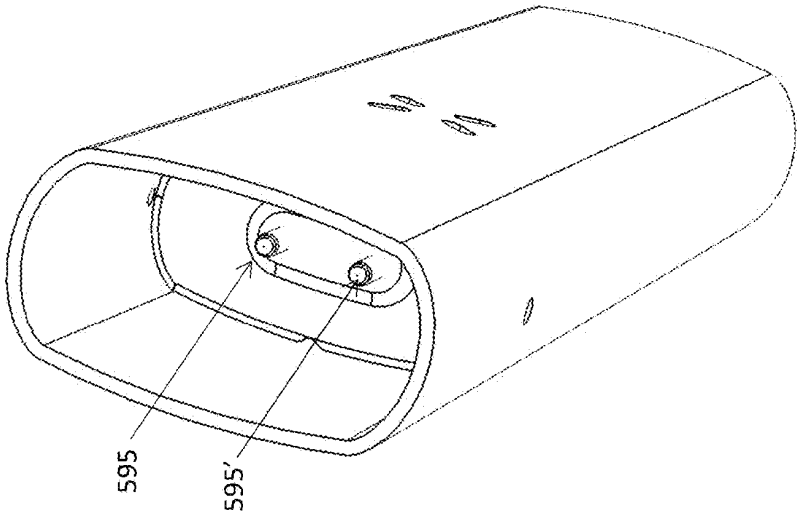


FIG. 5C

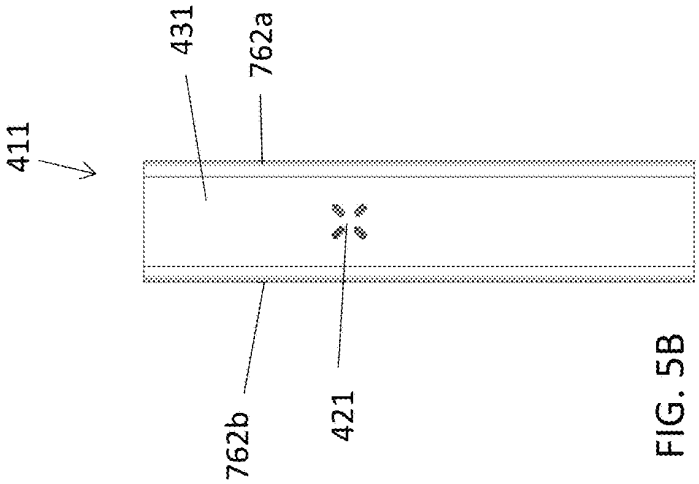


FIG. 5B

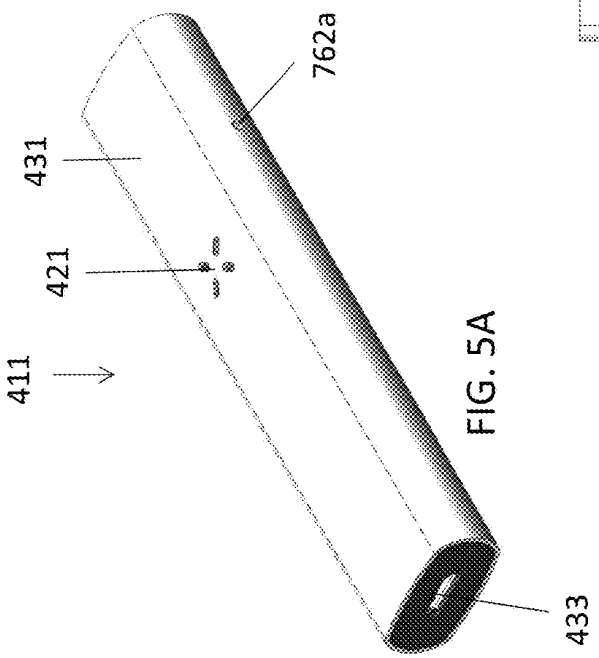


FIG. 5A

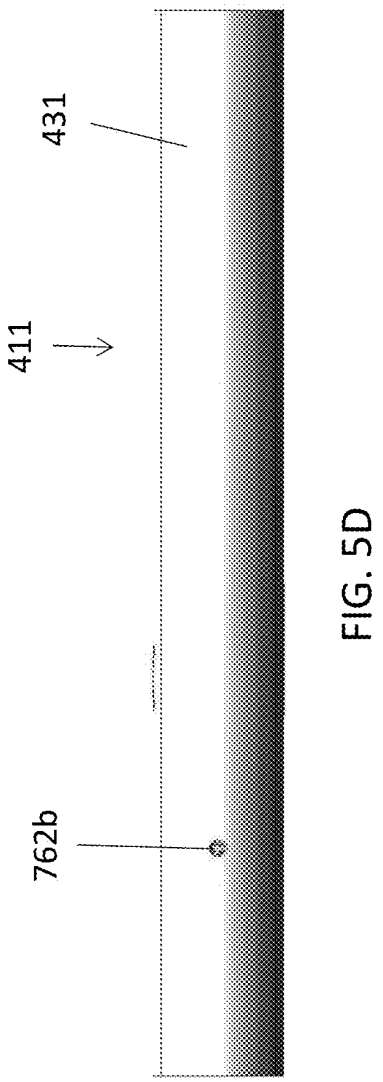


FIG. 5D

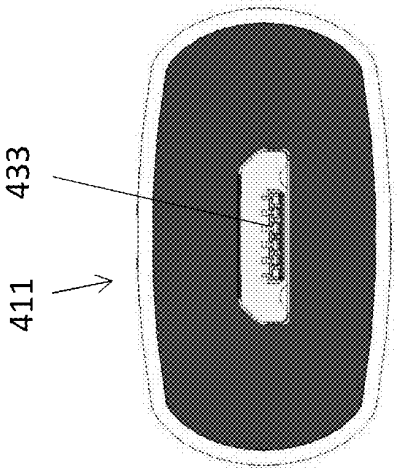


FIG. 5F

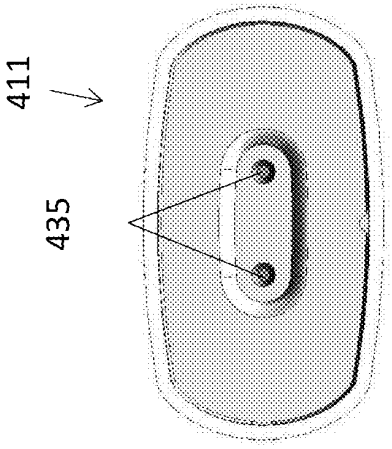


FIG. 5E

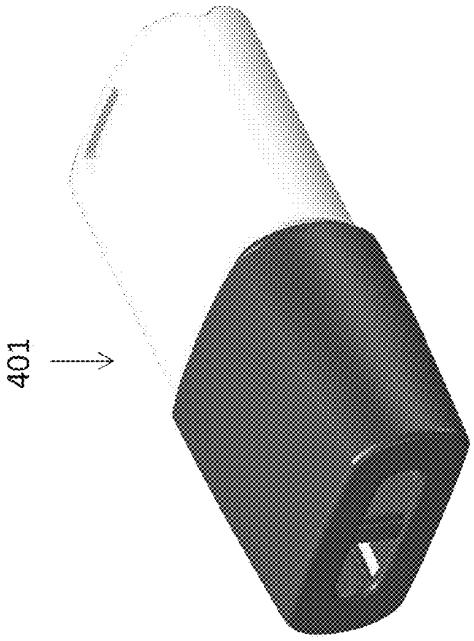


FIG. 6C

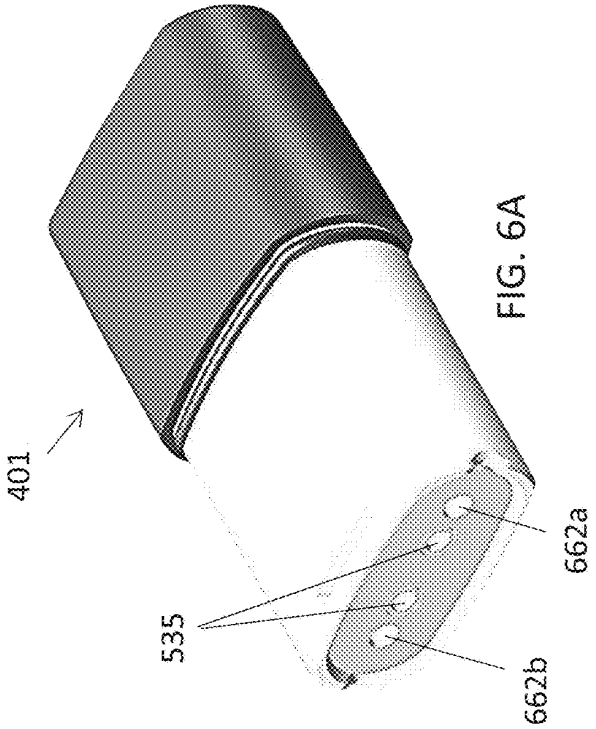


FIG. 6A

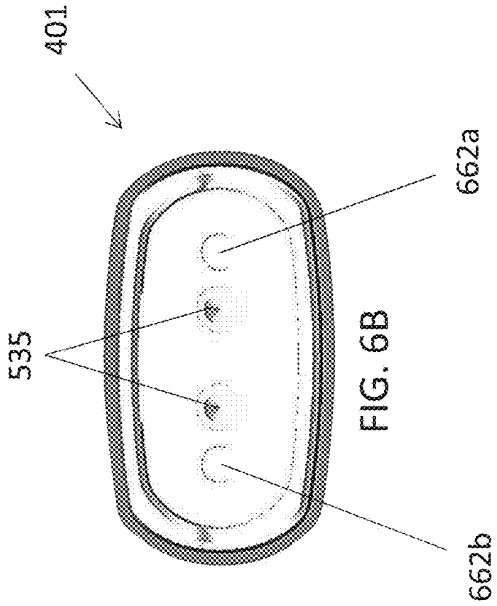


FIG. 6B

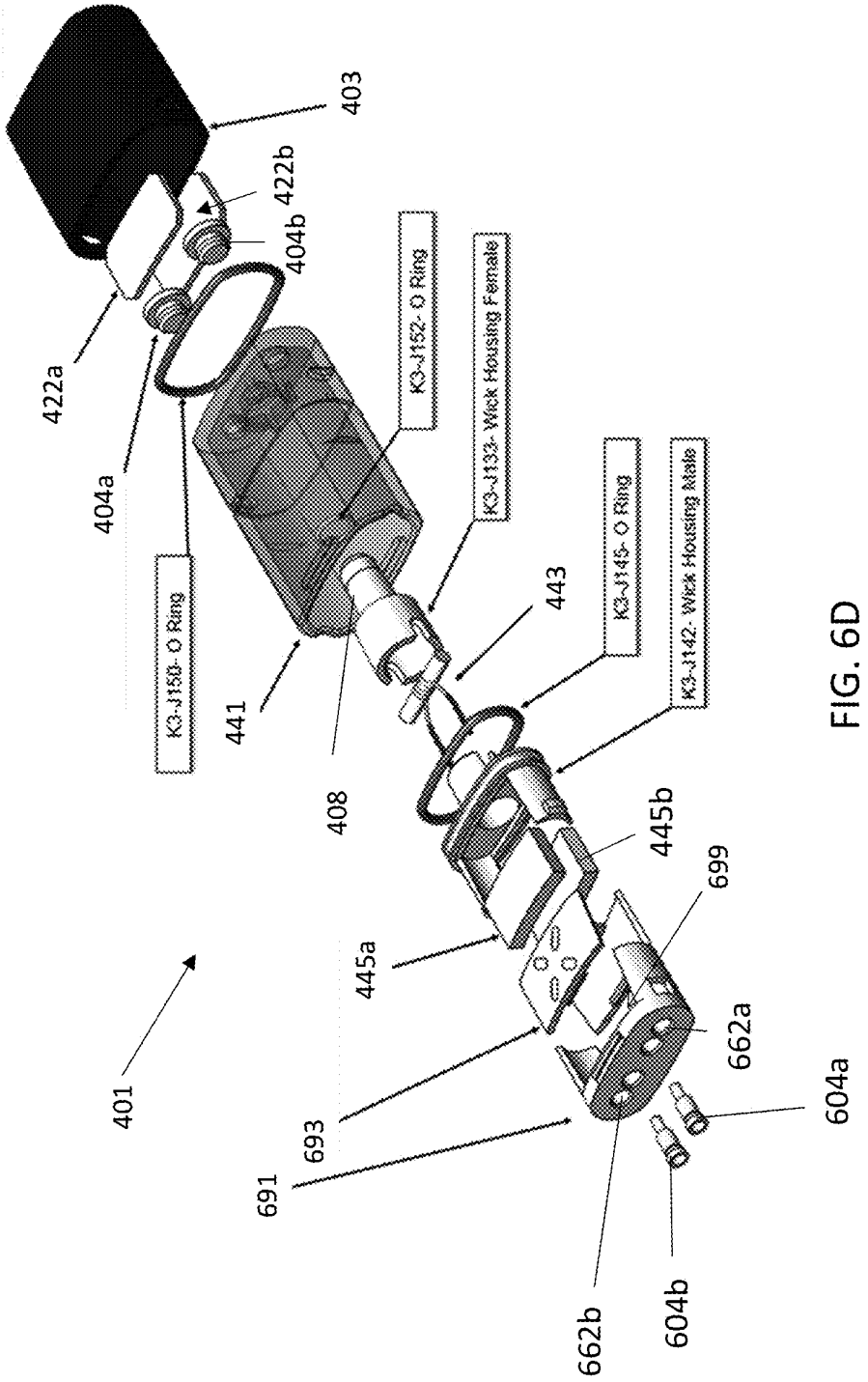

403
422b
404b
422a
404a
K3-J152- O Ring
K3-J133- Wet Housing Female
K3-J150- O Ring
K3-J145- O Ring
K3-J142- Wet Housing Male
443
441
408
445b
699
445a
662a
604a
401
693
691
662b
604b

FIG. 6D

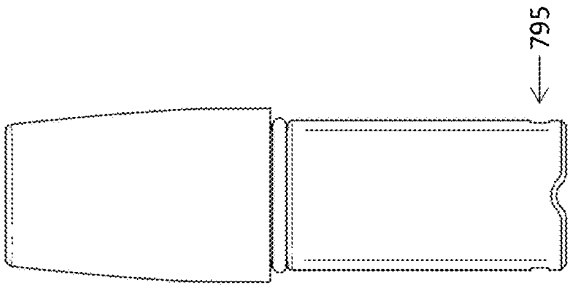


FIG. 7D

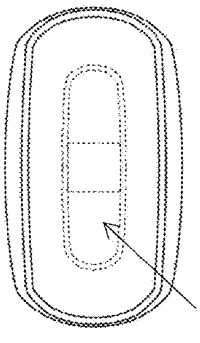


FIG.7F

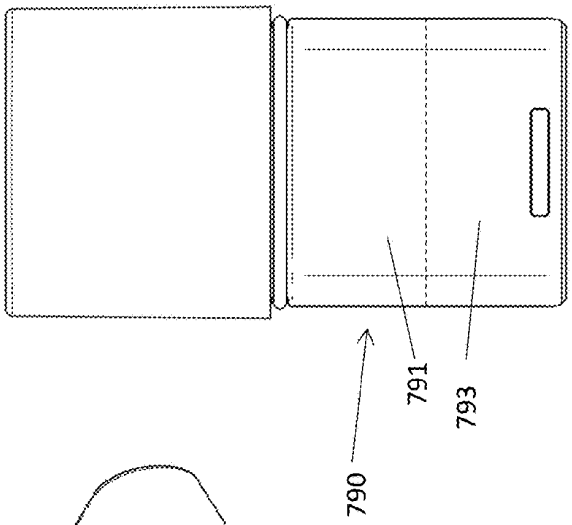


FIG. 7C

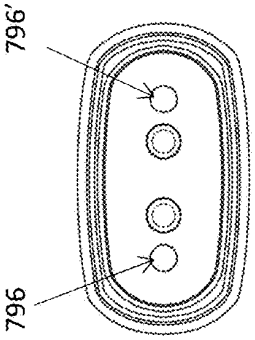


FIG. 7E

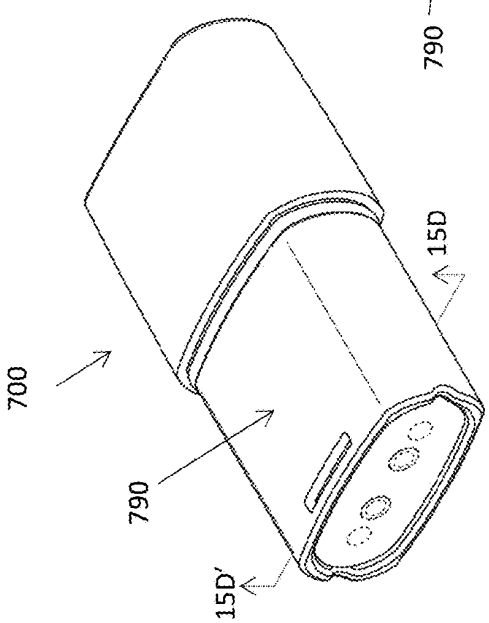


FIG. 7A

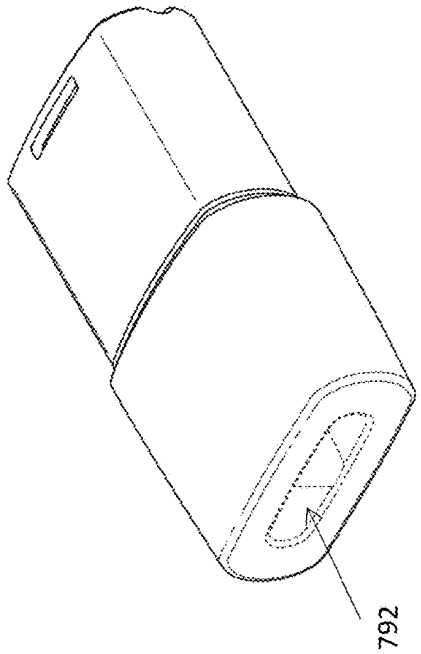


FIG. 7B

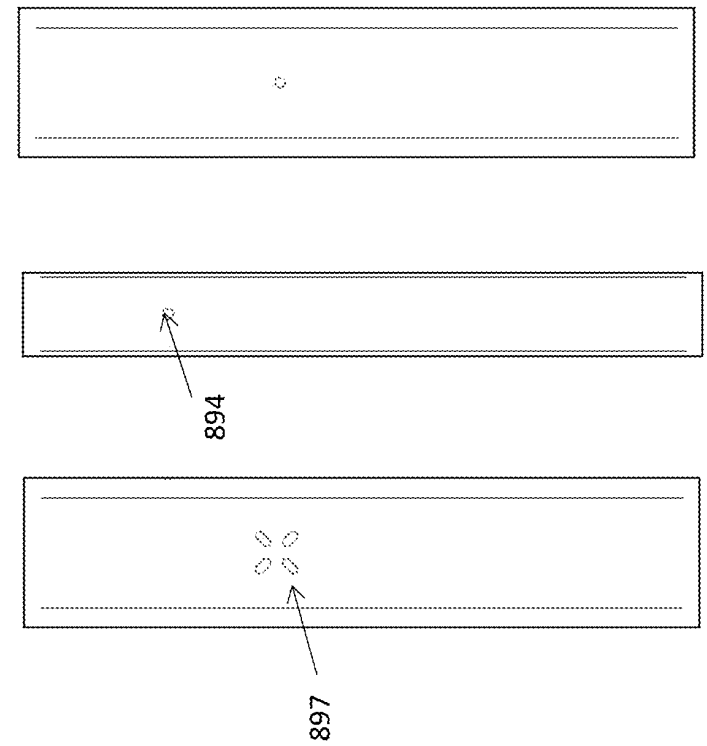


FIG. 8E

FIG. 8D

FIG. 8C

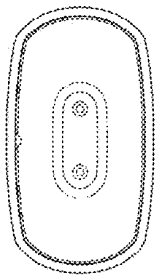


FIG. 8G

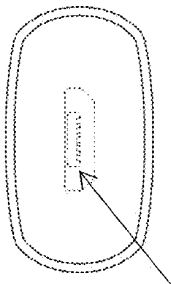


FIG. 8F

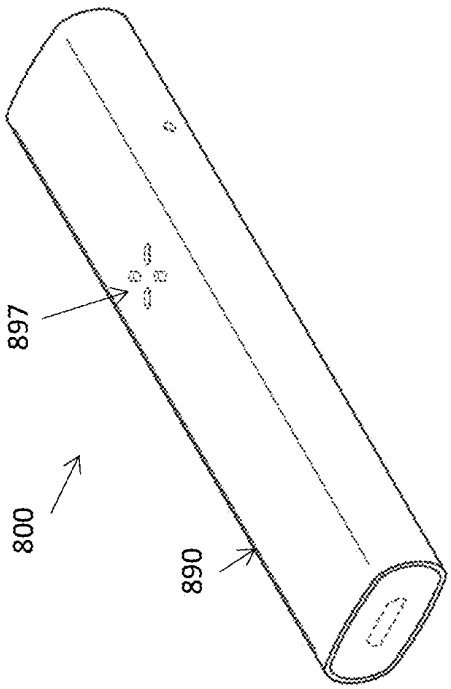


FIG. 8A

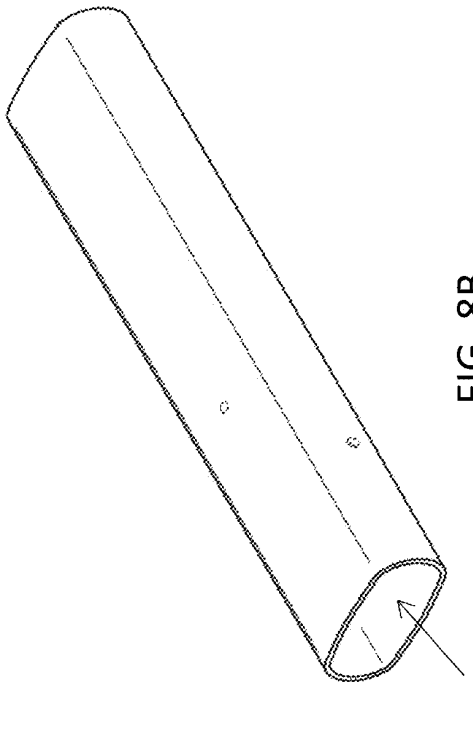


FIG. 8B

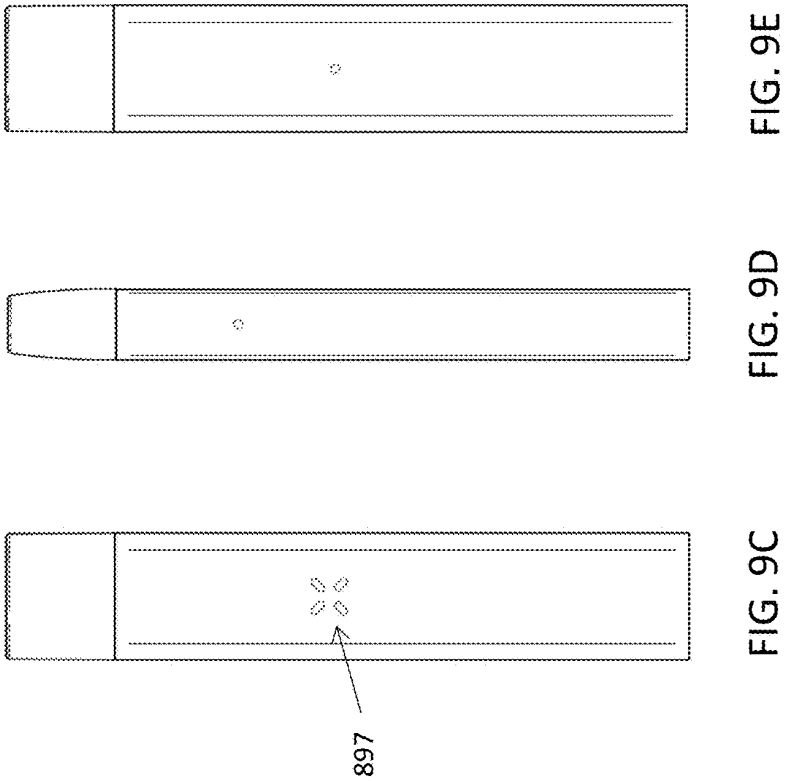


FIG. 9C

FIG. 9D

FIG. 9E

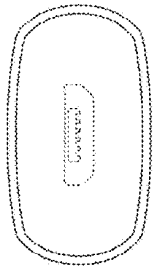


FIG. 9F

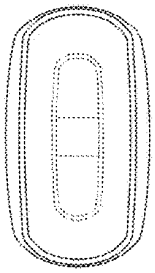


FIG. 9G

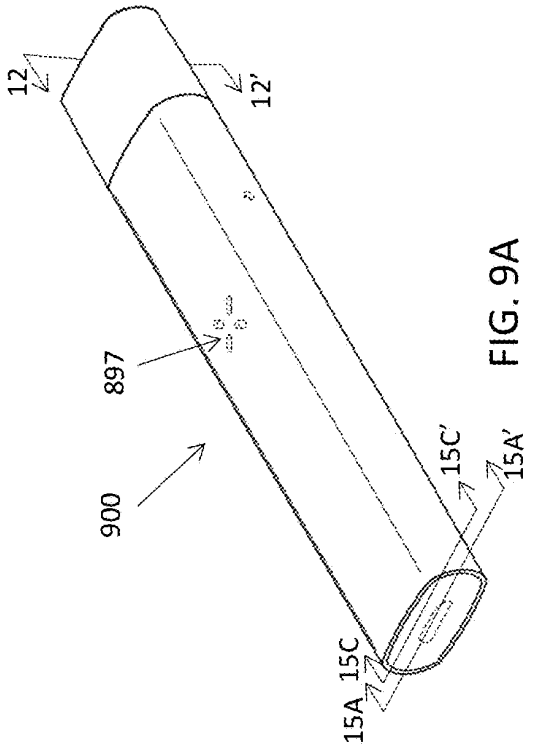


FIG. 9A

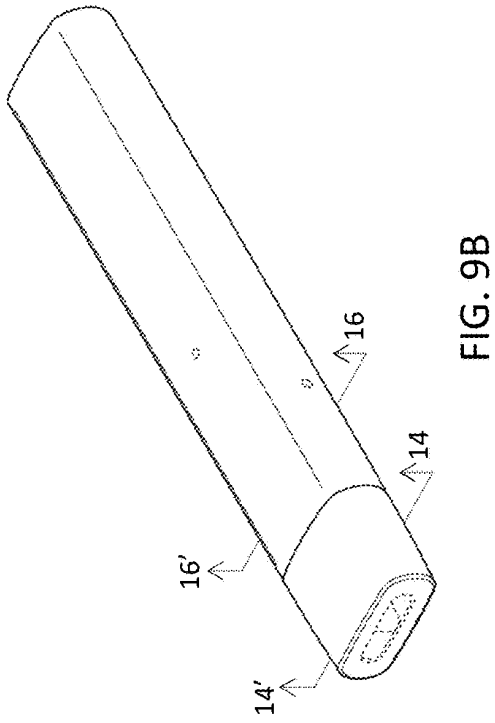


FIG. 9B

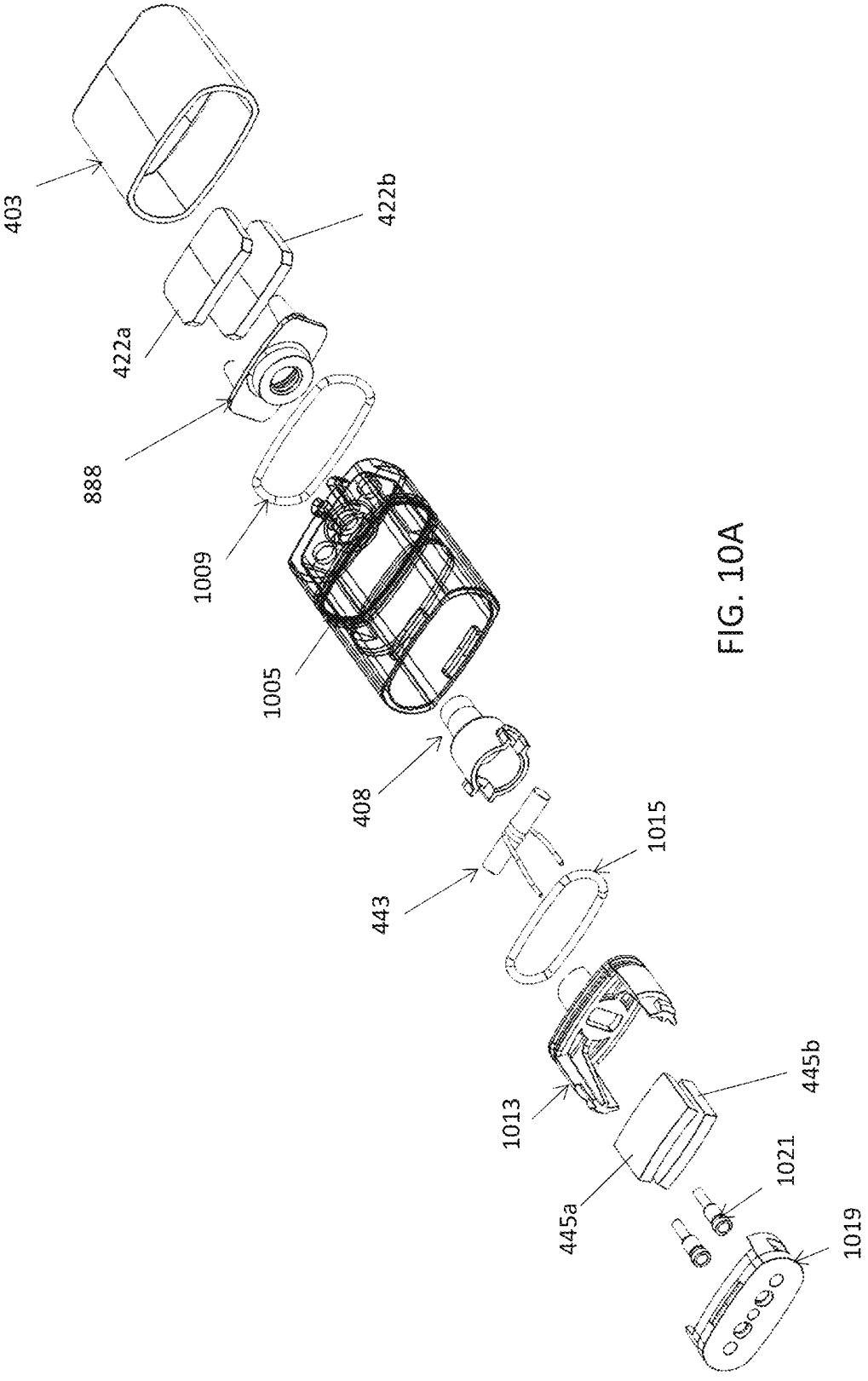

403
422b
422a
888
1009
1005
408
443
1015
1013
445b
445a
1021
1019

FIG. 10A

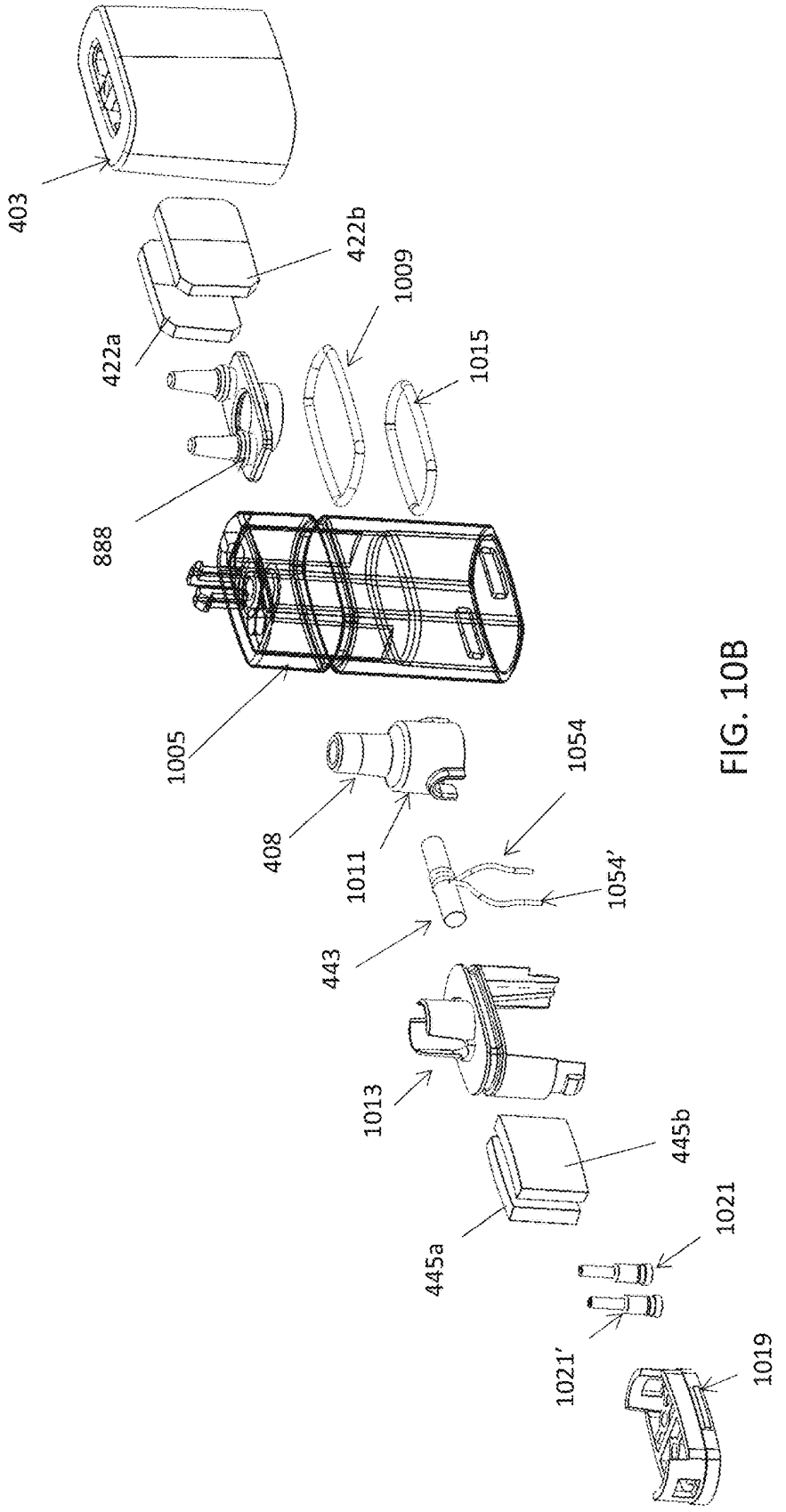

403
422b
1009
422a
1015
888
1005
408
1011
1054
1054'
443
1013
445b
445a
1021
1021'
1019

FIG. 10B

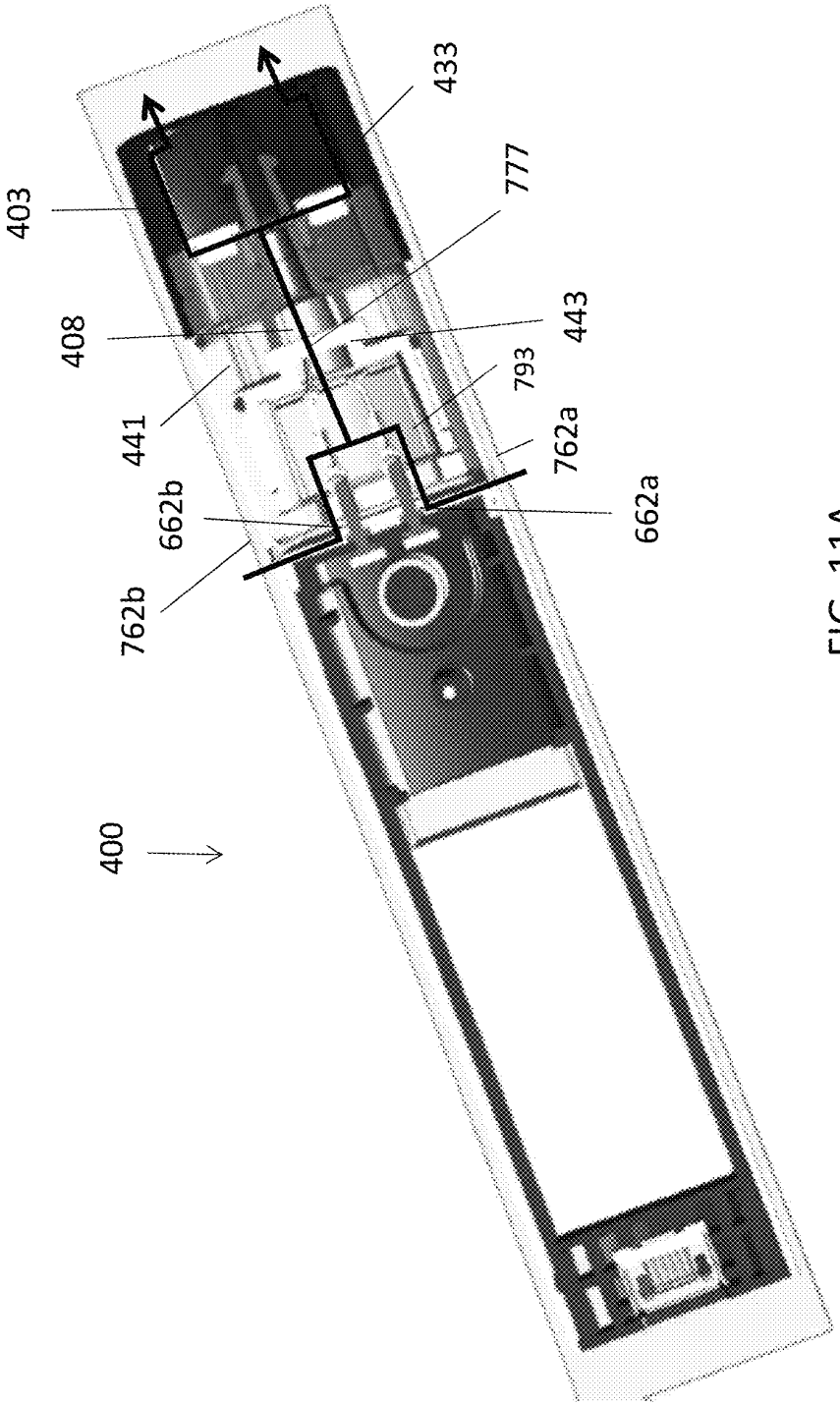


FIG. 11A

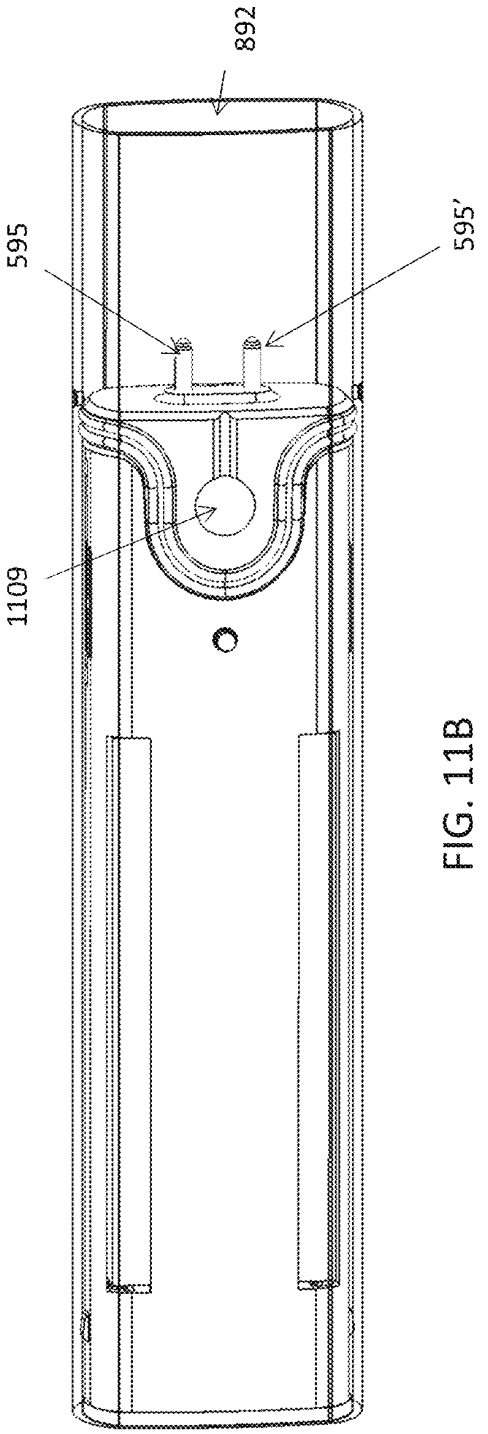


FIG. 11B

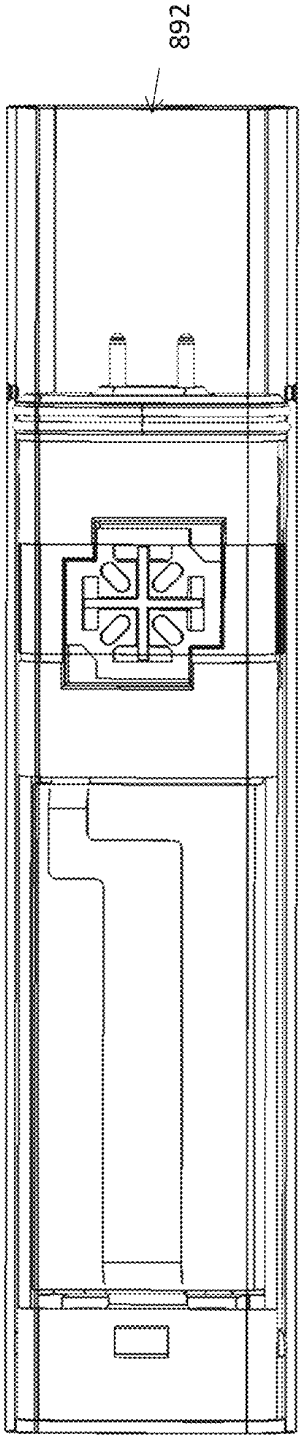


FIG. 11C

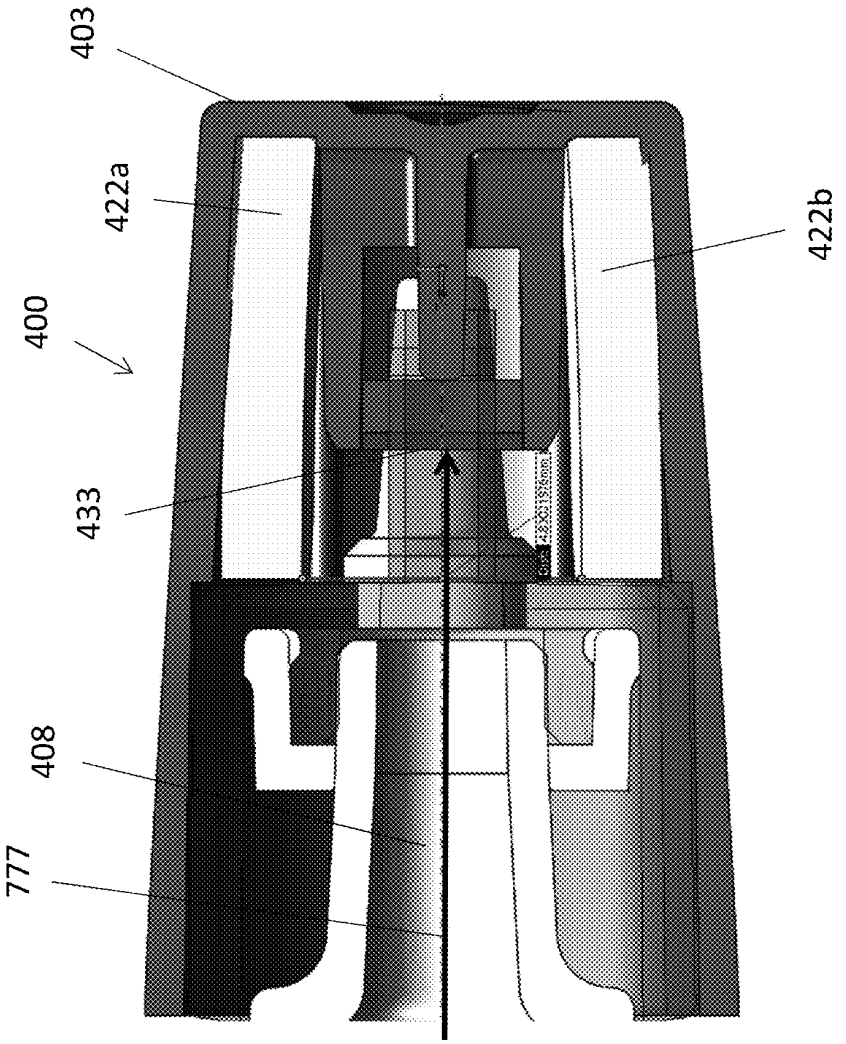


FIG. 12

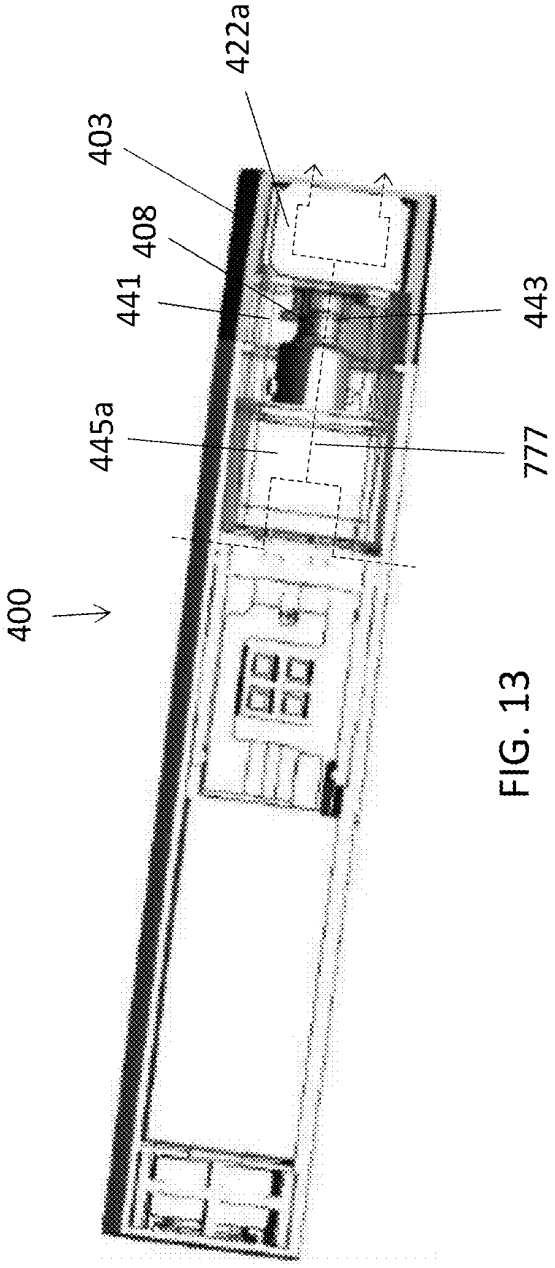


FIG. 13

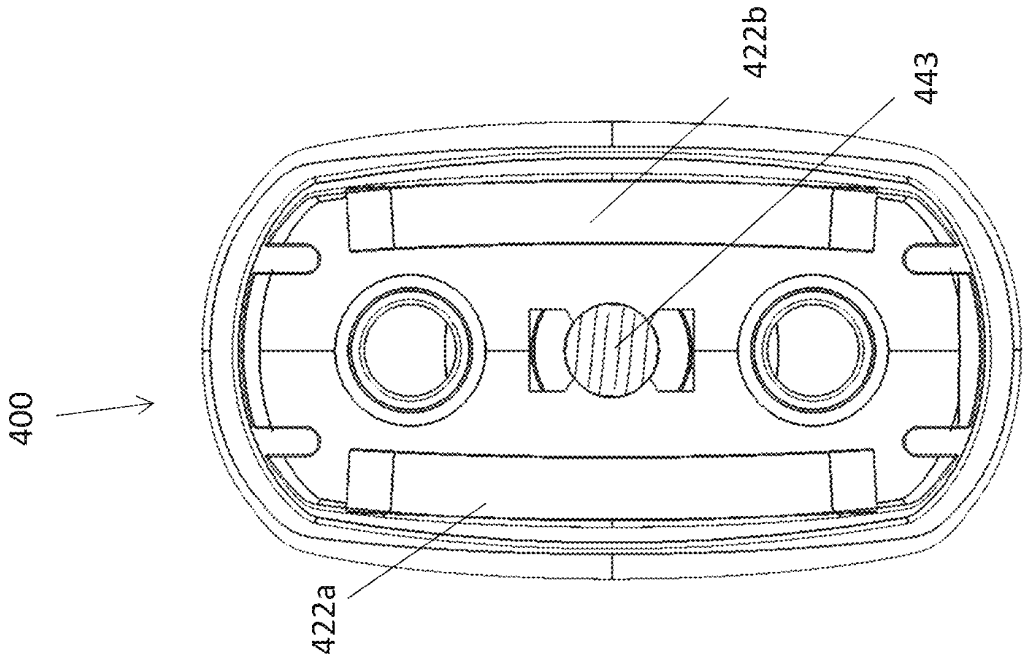


FIG. 14

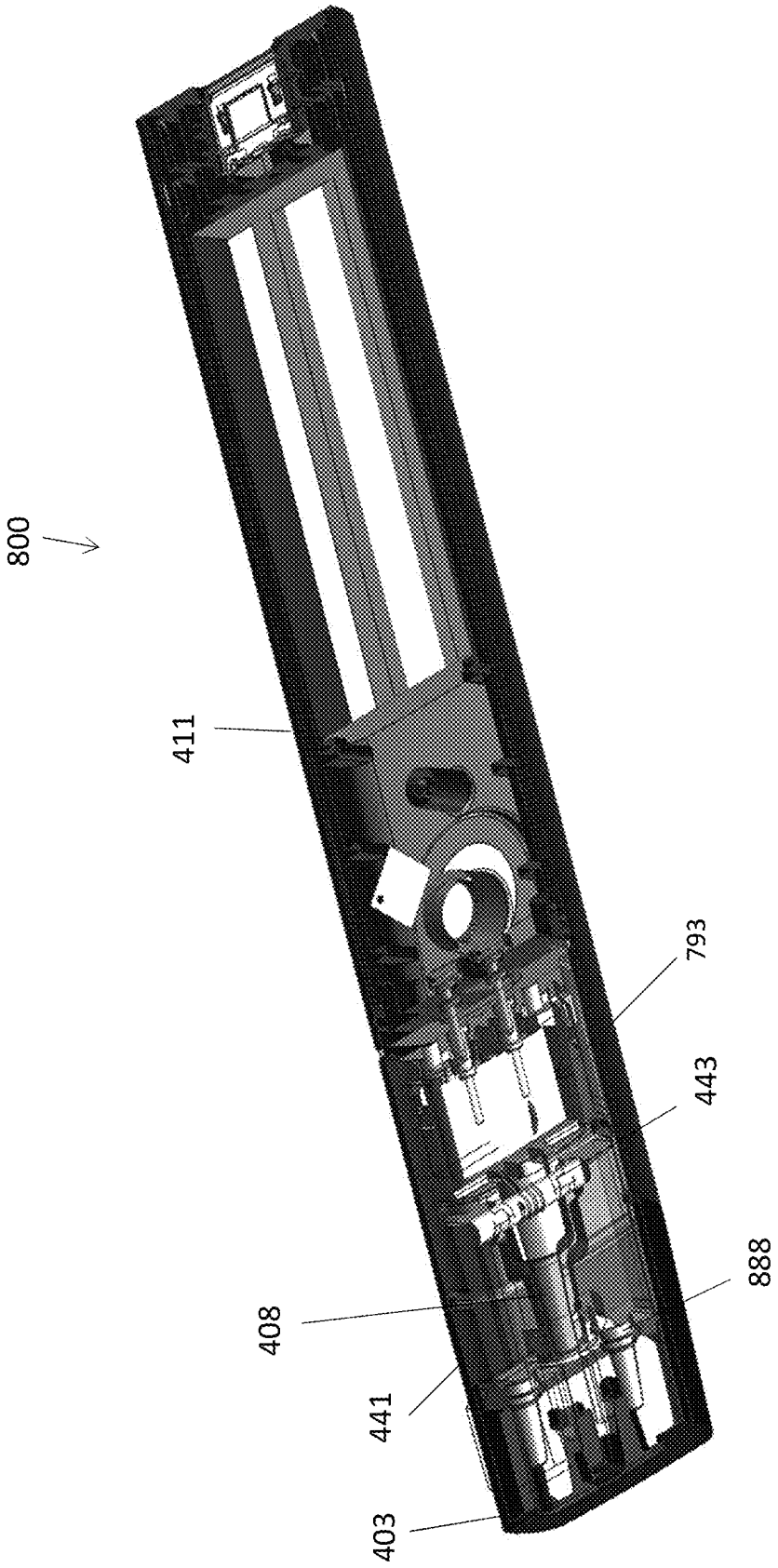


FIG. 15A

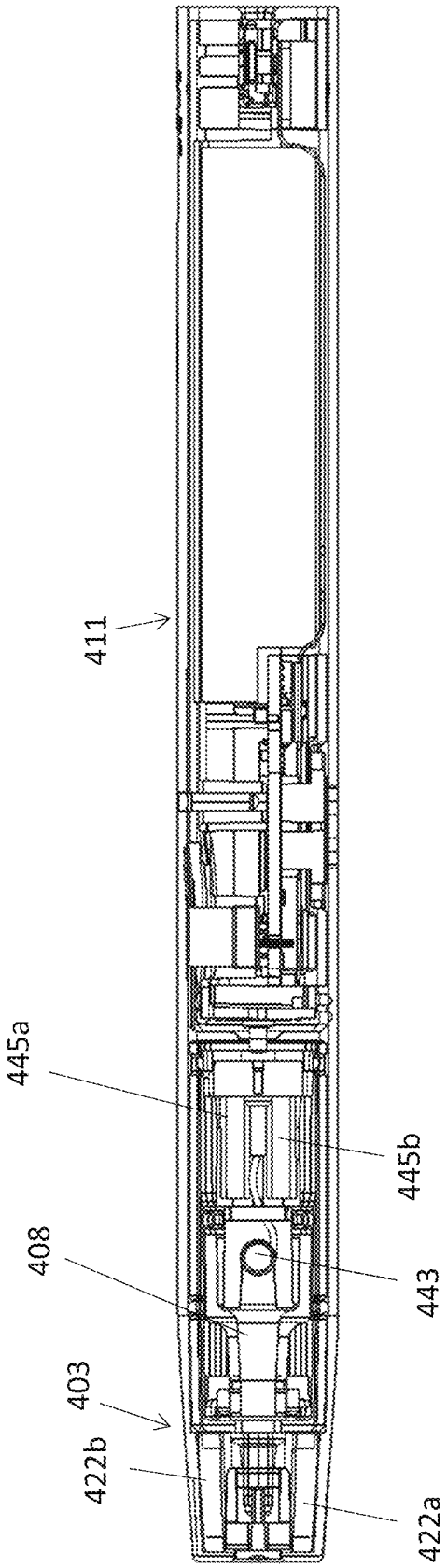


FIG. 15B

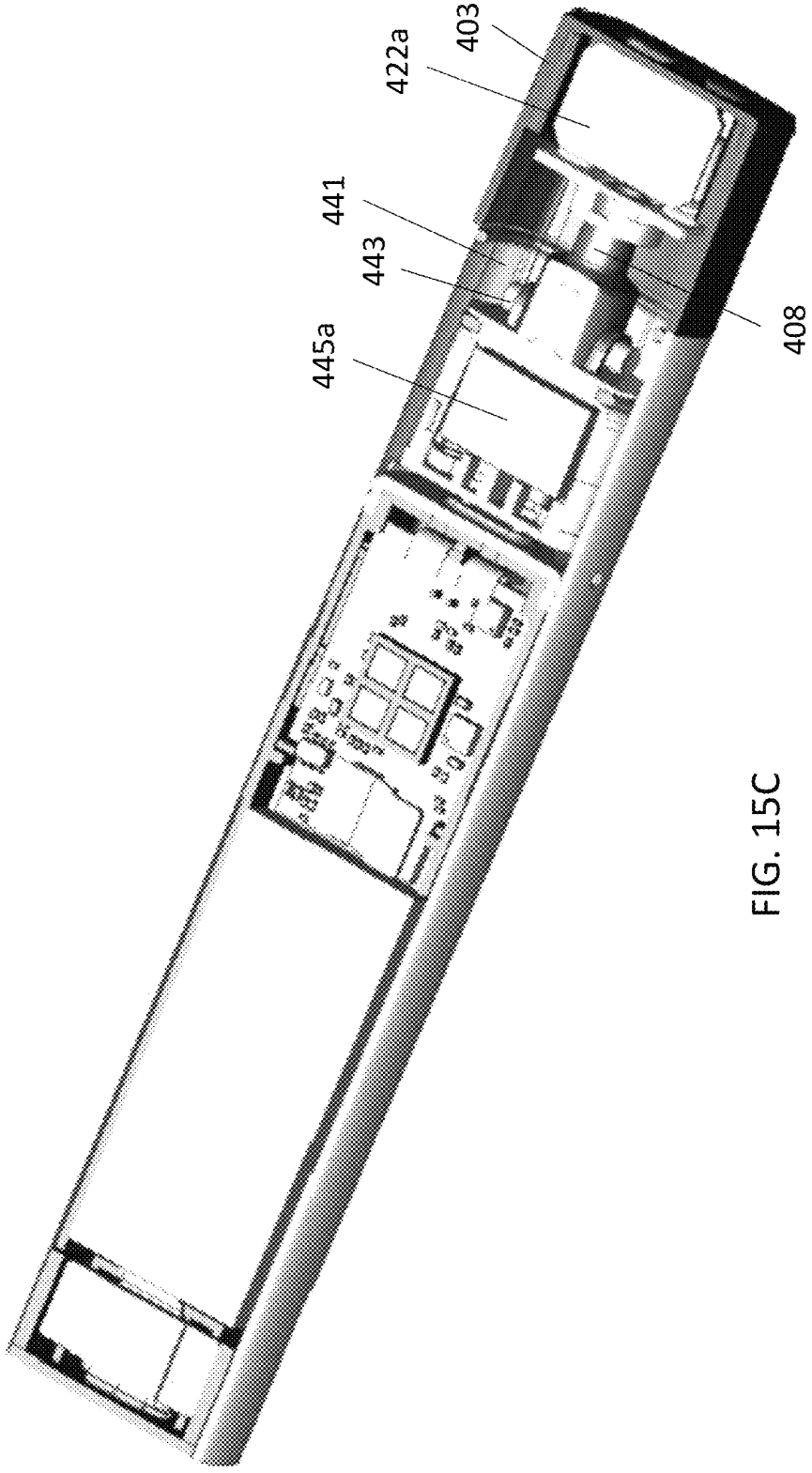


FIG. 15C

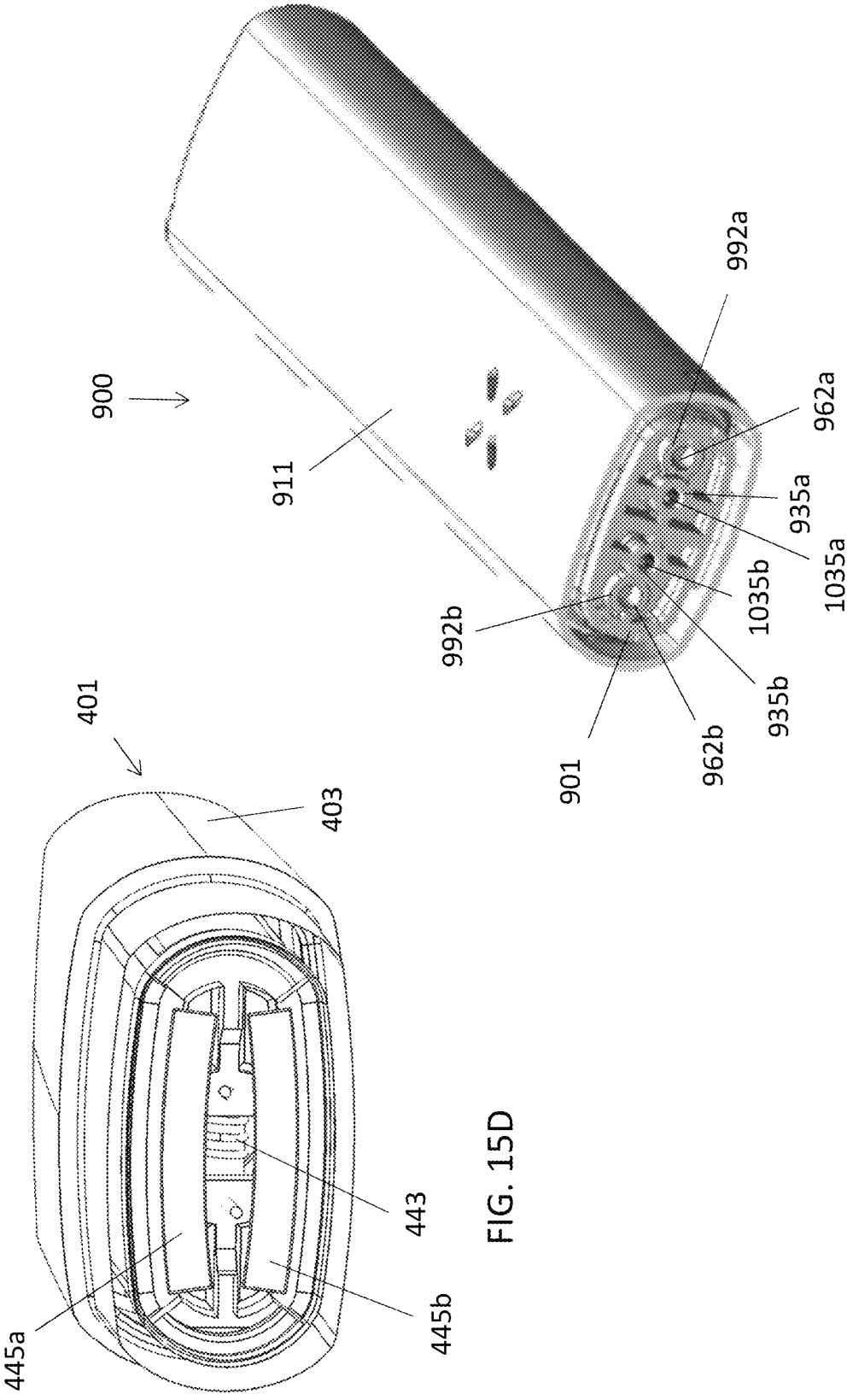


FIG. 15D

FIG. 16

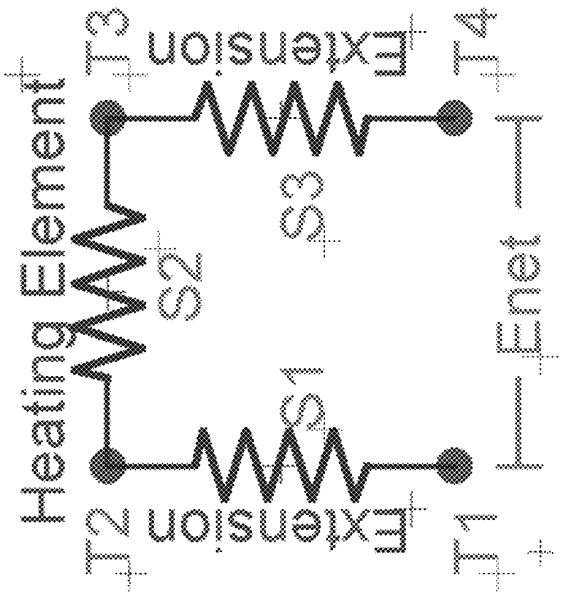

Heating Element
T3
Extension
T4
S3
S2
Enet
S1
T2
Extension
T1

FIG. 17

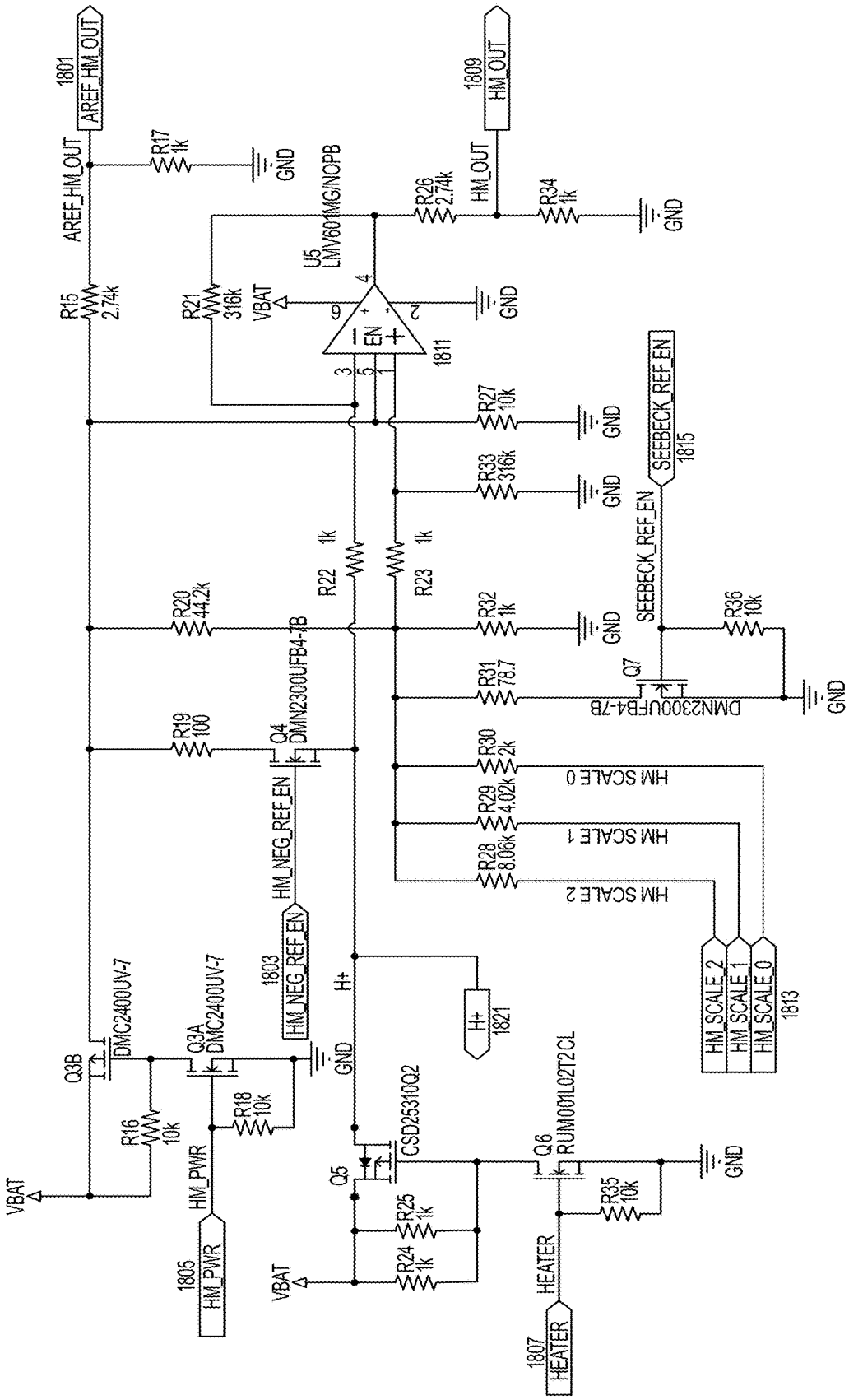

1801
AREF_HM_OUT
R17
1k
GND
1809
HM_OUT
R26
2.74k
R34
1k
U5
LMV601MG/NOPB
R15
2.74k
R21
316k
VBAT
1811
EN
R27
10k
R33
316k
SEEBECK_REF_EN
1815
R22
1k
R23
1k
R20
44.2k
R32
1k
R36
10k
Q7
DMN2300UFB4-7B
R31
78.7
R19
100
Q4
DMN2300UFB4-7B
R30
2k
R29
4.02k
R28
8.06k
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM_NEG_REF_EN
1803
H+
1821
HM_SCALE_2
HM_SCALE_1
HM_SCALE_0
1813
Q3B
DMC2400UV-7
Q3A
DMC2400UV-7
R16
10k
R18
10k
HM_PWR
1805
CSD25310Q2
Q5
Q6
RUM001L02T2CL
R25
1k
R24
1k
R35
10k
HEATER
1807

FIG. 18

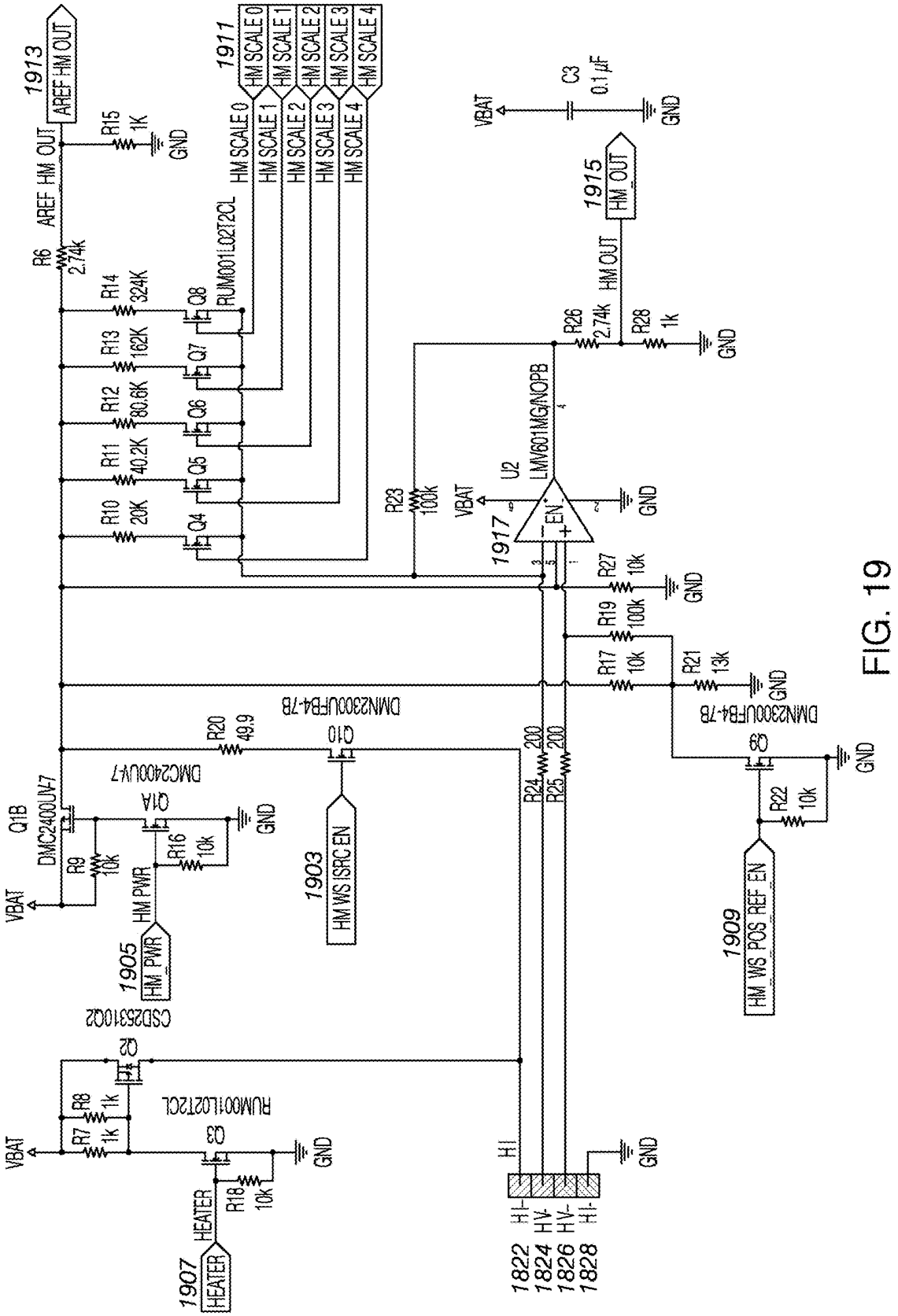

1913
AREF HM OUT
R15
1K
GND
1911
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM SCALE 3
HM SCALE 4
R6
2.74k
R14
324K
R13
162K
R12
80.6K
R11
40.2K
R10
20K
Q8
Q7
Q6
Q5
Q4
RUM001L02T2CL
C3
0.1 µF
VBAT
1915
HM_OUT
HM OUT
R26
2.74k
R28
1k
U2
LMV601MG/NOPB
R23
100k
1917
EN
R27
10k
R19
100k
R17
10k
R21
13k
DMN2300UFB4-7B
R20
49.9
Q10
R24
200
R25
200
Q9
R22
10k
1909
HM_WS_POS_REF_EN
Q1B
DMC2400UV-7
Q1A
R9
10k
R16
10k
1903
HM WS ISRC EN
1905
HM_PWR
HM PWR
CSD25310Q2
Q2
R8
1k
R7
1k
RUM001L02T2CL
Q3
R18
10k
1907
HEATER
HEATER
H1
1822
1824
1826
1828
H1-
HV-
HV-
H1-

FIG. 19

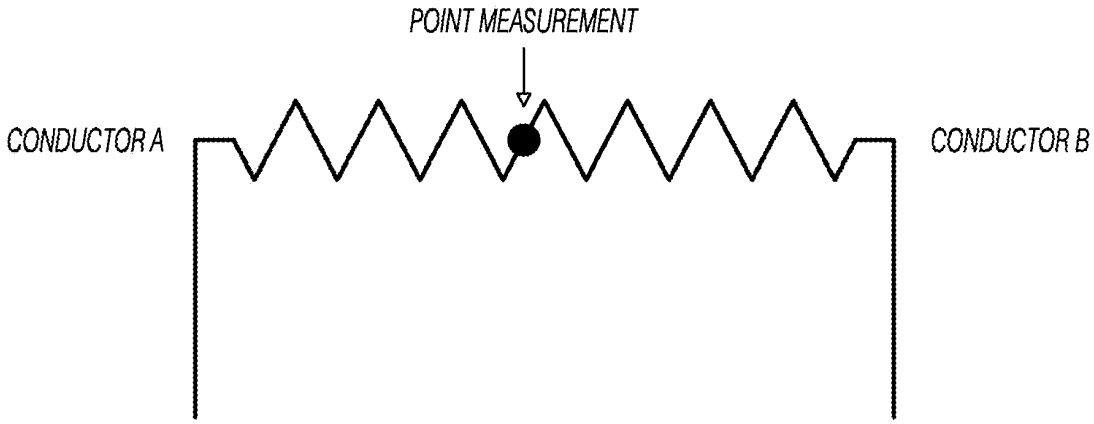


FIG. 20A

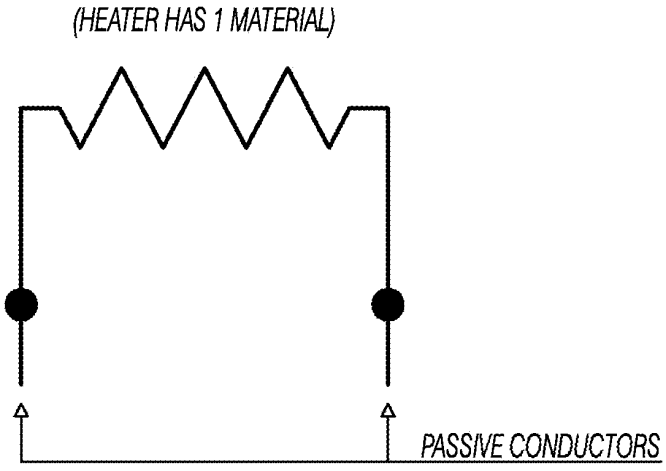


FIG. 20B

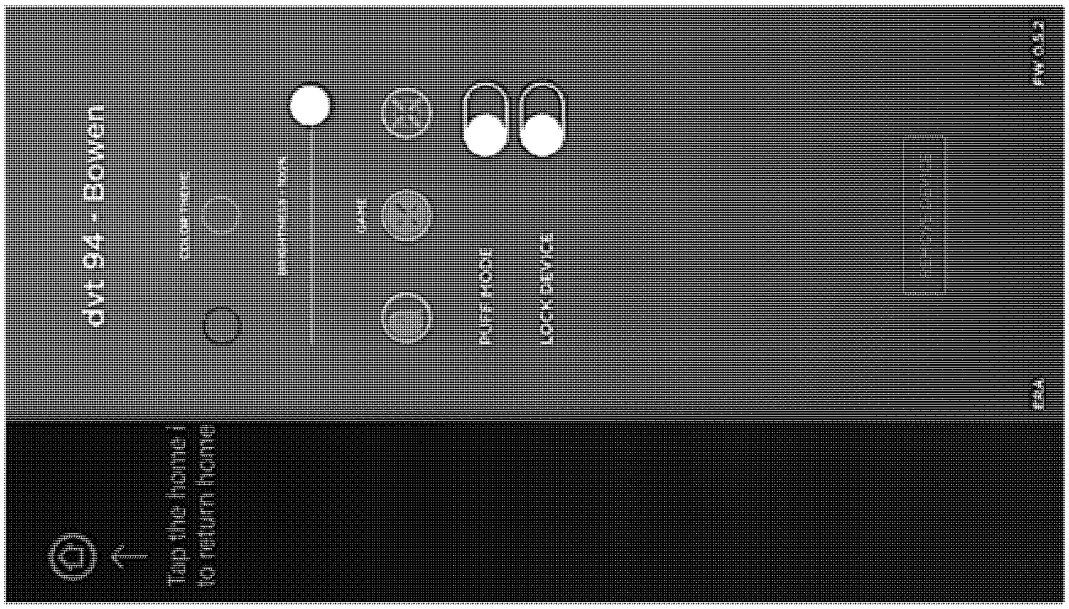

dvt 94 - Bowen
Tap the home i
to return home
PUFF MODE
LOCK DEVICE

FIG. 22

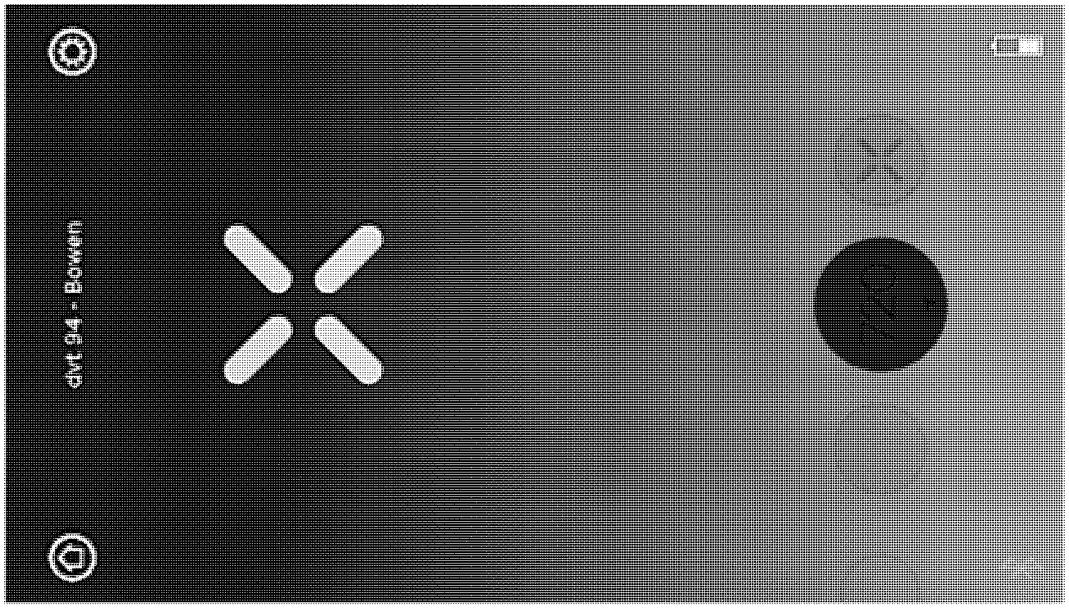

dvt 94 - Bowen

FIG. 21

LEAK-RESISTANT VAPORIZER DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation of U.S. patent application Ser. No. 15/396,584, titled "LEAK-RESISTANT VAPORIZER DEVICE." filed on Dec. 31, 2016, which claims priority to U.S. Provisional Patent Application No. 62/398,494, filed on Sep. 22, 2016 and entitled "VAPORIZER APPARATUSES FOR USE WITH CANNABINOIDS", the disclosure of each of which is incorporated herein by reference in its entirety.

INCORPORATION BY REFERENCE

All publications and patent applications mentioned in this specification are herein incorporated by reference in their entirely to the same extent as if each individual publication or patent application was specifically and individually indicated to be incorporated by reference.

FIELD

Described herein are vaporizer apparatuses, including vaporizer or vaporization devices and vaporizer systems, and methods for making, using and delivering vapor to a user. In particular, vaporizer apparatuses adapted for use with oil-based vaporizable materials including cannabis oils.

BACKGROUND

Electronic devices that produce an inhalable aerosol (e.g., inhalable aerosol devices or alternatively referred to as vaporizers, vaporizer devices, vaporization devices, electronic vaping devices, etc.) typically utilize a vaporizable material that is heated to create an aerosol vapor capable of delivering an active ingredient to a user. Vaporizers have been described for vaporizing solids (herbs, tobacco, cannabis, etc.), liquids (extracts, waxes, etc.) and combinations of both solids and liquids.

Current market inhalable aerosol devices often consist of a tank or cartridge, vaporizable liquid in the tank or cartridge, an air tube, and a wick/coil subassembly that generates the vapor. Air commonly enters the cartridge through the distal end of the product and is forced through the heated zone where the immediate air becomes fully saturated. As the vapor continues its way through the air tube, it comes in contact with cooler surfaces, causing moisture to collect throughout its use. Depending on the complexity of the air path, particle deposition can add to the existing condensation. As a result, some of the liquid can work its way from the tank or cartridge holding the liquid to other areas of the vaporizer, including the mouthpiece and/or the electronics, causing user dissatisfaction and/or problems with the electronic circuitry.

Conventional vaporizers for aqueous (e.g., water, glycerol, etc.) based vaporizable materials do not manage condensation and leakage of the liquid vaporizable material particularly well, and this problem is particularly acute for oils such as cannabis extract oils, in which the liquid material may be particularly oily and/or viscous, and for which evaporation of the liquid material may result in a sticky residue that may impair the operation of the vaporizer. Further, vaporization of cannabis extract liquids may be more technically difficult than vaporization of other liquids (such as nicotine solutions).

For example, conventional e-cigarettes may address moisture build-up by integrating a filter pad in line with air flow. However, having a filter pad in line with the air flow can impede or restrict the air flow as the user draws on the mouthpiece. Moreover, this restriction to draw incrementally climbs as the filter becomes more saturated throughout, often requiring the user to change his or her draw accordingly and increasing the possibility of drawing liquid of the product and into the user's mouth.

In addition, the control of the temperature when vaporizing cannabis extracts may require a high degree of precision. Virtually all vaporizers currently available today would benefit from a higher degree of precision in power management and control of the heater (atomizer). In particular, vaporizers well suited for vaporizing cannabis (e.g., liquid cannabis extract solutions) may benefit from precise and accurate control of the heater forming the vapor.

It would also be beneficial to provide cartridges that do not roll and may rest in a small number of secure positions (e.g., cartridges having non-circular cross-sections) and to provide an immediate approximate (visual) estimate of the amount of material consumed.

Finally, it would be particularly beneficial to provide pre-loaded and tightly controllable cartridges for use in consuming cannabis contract liquids that prevent or reduce leakage of particularly viscous vaporizable materials such as cannabis oils/extracts.

Accordingly, described herein are vaporizers (including vaporizer cartridges) and methods of operating and using them addresses the issues raised above.

SUMMARY OF THE DISCLOSURE

In general, described herein are apparatuses such as devices and systems for vaporizing a material (including, in particular, but not limited to, cannabis extract liquids) and method of using them. For example, described herein are vaporizers, cartridges for use with such vaporizers, and vaporizer control systems.

Described herein are vaporizer cartridges that are pre-loaded (filled) with a cannabis vaporizer material. The vaporizable cannabis material is typically a liquid material, and may be a cannabis extract liquid (cannabis "oil"). Also described herein are vaporizers with or without cartridges that are adapted for use with cannabis liquid extracts. Either or both the vaporizer base (which males with the vaporizer cartridge to form the vaporizer device) and vaporizer cartridge may be adapted specifically for use with cannabis liquid extracts, although any of the apparatuses and methods described herein may be operated with other vaporizable materials, including nicotine solutions and/or solutions having no active ingredient at all (e.g., just including a carrier such as polyether compounds like polyethylene glycol and/or glycerol, or the like, and flavorants).

For example, a cartridge as described herein may include a vaporizable material such as cannabis oil. Cannabis oils present particular challenges when vaporized using a cartridge and/or a handheld vaporizer device. For example, cannabis oil is relatively "sticky" and may be viscous, particularly once it dries out. Thus, leakage may be a more serious consideration and challenge compared to other aqueous vaporizable materials. In particular, leakage of cannabis oil may result in clogging of the device and disturbing the electrical components, particularly the electrical contacts, which may be otherwise "gummed up" by leaked oil. The dried oil is not only sticky, but may also be electrically insulative, and may disrupt the electrical control of the

vaporizer. Described herein are apparatuses and methods to prevent or control leakage and to avoid disruption of electrical contacts between cartridges containing the cannabis extract and the rest of the vaporizer.

For example, the apparatuses described herein may include one or more electrical contacts (e.g., between the cartridge and the vaporizer base) referred to herein as wiping or scraping contacts. These electrical connections may be configured so that as a connection/contact is made between two electrically conductive surfaces, the contact (e.g., on the cartridge and/or the vaporizer base) scrapes the mating surface of the other contact to remove any vaporizable material, including vaporizable material that has dried on the contact. For example, a contact may include a canister with one or more extensions (e.g., wipers, knives, fingers, or scrapers) that are driven against and across the mating surface of the opposite electrical contact to scrape away any leaked vaporizable material (including dried-on material). The complimentary electrical contact may be a pin (including a pogo-pin) electrically conductive connector that is scraped as it enters into the canister by the wiper/scraper(s) therein. Thus, in general, the electrical contact in the vaporizer base may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer cartridge and/or the electrical contact in the vaporizer cartridge may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer base to remove contaminating material. Thus either contact may include a scraping projection (e.g., edge, blade, wire, etc.) that is driven across the opposite surface. Typically two or more contacts are included in the vaporizer cartridge, and each of them may be configured as a scraping or wiping contact. In some variations, it may be desirable to have the scrapers on the connectors of the cartridge, although the scrapers may be present on the vaporizer base instead or in addition.

Any of the cartridges described herein may include a tank or storage region within the cartridge and/or forming a portion of the body of the cartridge. In particular, all or a portion of the cartridge (including the tank) may be clear, transparent and/or translucent so that the level of vaporizable material within the tank can be seen by a user. The tank may be prefilled or fillable. The tank may be sealed closed at the top (near the mouthpiece, which may cover the top of the cartridge). The mouthpiece may be plastic and may be secured over the tank by a snap fit, a friction fit, and adhesive, or the like. For example, the distal end of the elongate and flattened tubular body is configured to be secured by a friction fit within a vaporizer body. As described in greater detail herein, one or more absorbent members. (e.g., sponges, pads, felts, etc.) may be included in the mouthpiece between the tank and the mouthpiece, to prevent leakage of vaporizable material from contacting the portion of the mouthpiece where the user applies her or his lips. The tank may be sealed, e.g., by a tank seal that covers the one or more openings for filling the tank. In some variations, rather than one or more small plugs (which may be difficult to install) the tank may be sealed by a multi-seal component (e.g., a single piece) that seals between the mouthpiece and the top of the tank as and closes off two or more openings into the tank.

During inhalation through the apparatus, the user may draw on the mouthpiece (by inhaling/sucking on the mouthpiece) to draw air through the mouthpiece. The device may be turned on by one or more of: a control on the device (e.g., on an outer surface of the device), but installing the cartridge into the vaporizer base, detecting inhalation, detecting lip contact with the mouthpiece. In some variations, the device is turned on, and the heater rises to an initial set temperature, when the device is in a ready to turn on state and when the user draws on the mouthpiece. The vaporizer may be placed in a ready to turn on state by connecting (or detecting connection of) a cartridge and/or by a switch or control on the outside of the apparatus and/or by the battery level being sufficient to operate the device.

Once the device is turned on, it may be operated by drawing on the mouthpiece to cause the temperature to cause the vaporizer heater (the atomizer) to heat to the desired temperature setting (which may be preset, selected from a plurality of pre-set temperatures or may be user selectable, including using a computer or other device having a processor and user interface that communicates with the device, either wirelessly or via a wired connection, such as a smartphone wirelessly communicating with the device).

Drawing on the mouthpiece typically causes airflow to enter the cartridge receiver region of the vaporizer base through one or more (e.g., two) air openings that are positioned through the wall of the cartridge receiver near a base of the cartridge receiver. Air may pass into the cartridge receiver and up through the cartridge via one or more openings in the base (bottom) of the cartridge. The air may then pass into a heater connector region that also includes one or more (e.g., two, parallel) absorbent pads or sponges for absorbing any leakage of vaporizable material that may enter into this air-filled heater connector region, which is also open to the vaporizing chamber across which a wick and heating coil is extended to form vapor. The two absorbent pads positioned in this air region positioned on the long axis of the cartridge, against the major faces of the cartridge body so that they don't block the air path into the vaporization chamber from the opening(s) at the base. These absorbent pads (e.g., sponges) may prevent dripping or leakage of the fluid from the vaporization chamber (e.g., off of the wick) even when the heater is not being heated. In order to prevent leakage should the absorbent pads not be sufficient, the opening into the base of the air chamber may include a rim or boss on the inner surface (within the heater connector region at the base of the cartridge) that prevents small amounts of fluid (e.g., vaporization fluid such as cannabis oil) to drip out of the opening(s) into the cartridge (e.g., the air chamber of the cartridge).

The air path from the vaporization chamber to the mouthpiece may have a minimum diameter that is slightly larger than previously described. For example, the minimum diameter of the air path between the vaporization chamber and the mouthpiece may be about 1.5 mm or greater, about 1.6 mm or greater, than about 1.7 mm or greater, than about 1.8 mm or greater, than about 1.9 mm or greater, than about 2 mm or greater, than about 2.1 mm or greater, than about 2.2 mm or greater, than about 2.3 mm or greater, than about 2.4 mm or greater, than about 2.5 mm or greater, etc. For example the minimum diameter may be 2.0 mm or greater.

In any of the variations described herein, the apparatus may include a wick as part of the atomizer (heater). In variations for use with cannabis oil the wick may be larger than typical cartridge wicks and may have a slightly larger pore size, because of the higher viscosity of the cannabis oil as compared to other (including nicotine) aqueous vaporization solutions. For example, the wick may be larger than 1.5 mm in diameter (e.g., about 1.9 mm or larger, about 2.0 mm or larger, about 2.1 mm or larger, about 2.2 mm or larger, about 2.3 mm or larger, about 2.4 mm or larger, about 2.5 mm or larger, etc., including between about 1.8 mm and about 5 mm, between about 1.9 mm and about 4 mm,

between about 2 mm and about 4 mm, etc.). The wick may generally extend across the vaporization chamber, e.g., along or perpendicular to the long axis of the cartridge, and between either the major or minor sides (in oval or flattened cartridges). The wick material may be any appropriate material, particularly those that are biocompatible, have a sufficient pore size, compatible with cannabis oils and may be resistant to heat up to the maximum heating temperature of the apparatus (e.g., will not degrade or combust significantly at temperatures up to about 450° C., 500° C. 550° C., 600° C., 650° C., etc.). For example, the wick may be made of a silica material (e.g., fiberglass).

In any of the heaters described herein, the heater (atomizer) may include a heating coil that may be wrapped around the wick for conductive heating. In any of the variations described herein convective heating of the liquid material (e.g., cannabis oil) wicked by the wick. The heating coil may be any appropriate material, but in particular, electrically resistive materials such as nichrome or other resistive materials, particularly those which change their resistance with heat (e.g., having a resistance that increases linearly and predictably with temperature over the desired range of temperatures, e.g., between 30° C. and 600° C. etc., including stainless steel, titanium, nickel, alloys of nickel, etc.).

The cartridge may have any desired shape or configuration. In some variations it may be beneficial in particular to have a shape that is cylindrical, and particularly a flattened cylinder, such as an approximately oval shape, with curved sides. Two of the sides (though curved) may be major sides, having a larger diameter, and two may be minor sides (though curved), having a smaller diameter. The flattened shape may prevent rolling when the device is placed on its side. In some variations the mouthpiece may extend in a slightly tapered shape. The tank may form a central region of the cartridge, bounded by the mouthpiece at one end (at the top) and the air chamber (at the bottom). A central cannula may form the air path between the vaporization chamber and the mouthpiece. The vaporization chamber and cannula may be surrounded by the tank, and may be visible through the walls of the tank (e.g., the vaporization chamber and cannula may be opaque, transparent or translucent). One or more seals, including o-rings, may be used to seal and secure the mouthpiece from the tank and the air chamber (base of the cartridge) from the tank. For example an inner seal may be between the mouthpiece and the outer wall of the tank (which may include a channel or track for the seal/o-ring) and a second seal (o-ring) may be positioned in an inner wall of the tank between the tank and the walls forming the air chamber and/or vaporization chamber at the base of the cartridge.

In any of the variations described herein it may be useful to provide an indication of the amount of the cartridge vaporized, which may be approximately correlated to the dose of the vaporizable material delivered. In any of the apparatuses described herein, the apparatus may include an output (e.g., LED, LCD or other display, etc.) on the apparatus or on a device in communication (e.g., wireless communication) with the apparatus such as a smartphone, laptop, desktop, pad, or the like. The output may indicate a qualitative and/or quantitative amount of the dose of vapor delivered from a particular cartridge. Dose may be determined using the processor of the apparatus to indicate approximately how much of the material, e.g., cannabis oil, has been consumed based on the power applied to the heater and the duration of heating. A qualitative output may be provided by sequentially illuminating (and/or changing the intensity and/or color of illumination) of a plurality of LEDs. In another example a 'status bar' showing consumption or dose delivered from a cartridge may be displayed on the apparatus body (e.g., the vaporizer body) or another device (e.g., smartphone) in communication therewith. For example, a plurality of LEDs (RGB) may be illuminated to provide qualitative feedback to a user on the operation of the vaporizer. Upon inserting a cartridge, the vaporizer apparatus may display using the LEDs an illumination corresponding to the intensity of the inhalation and/or the progression of consumption of vaporizable material from the cartridge. The processor in the vaporizer apparatus may estimate a dose based on the power applied to the vaporizer and the duration of heating and/or the duration of draw (inhalation). For example, the power applied*duration of draw may be accumulated by the processor, and the value output. In some variations the output may be provided for display on the body of the apparatus (e.g., by illuminating a sequence of LEDs. This may provide immediate visual feedback to the user.

The apparatuses, and particularly the cartridges, described herein may be adapted specifically for use with oils such as cannabis oils. As discussed above, existing cartridges are poorly suited for use with cannabis oils, as they may leak. Leaking of cannabis oils is both messy and detrimental to the operation of the vaporizer, as the leaked cannabis oils may disrupt the electrical connections driving vaporization and may clog or jam the operation of the apparatus. The cartridges described herein may include a number of specific modifications that address these issues; individually, these modifications may be helpful, but as will be described below, in combination these features have proven surprisingly effective at providing a robustly leak-resistant and reliable cartridge when using an oil such as a cannabis oil.

For example a cartridge device for holding a vaporizable cannabinoid material without leaking (e.g., that is substantially leak-resistant) may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having a width and a diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path: an opening into the overflow leak chamber from an external surface of the device, wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

In particular the combination of the flattened elongate body shape (which may be oval or rectangular) along with the enlarged and enclosed overflow leak chamber (typically having an open volume of greater 0.5× or greater the tank volume) at the distal end, and one or more (e.g., two, three, four, etc.) openings into the overflow leak chamber, which may preferably include a lip region around the openings inside the overflow leak chamber. The use of absorbents pads positioned within the overflow leak chamber (e.g., positioned off-axis, along a major wall of the overflow leak chamber, such as the wall extending in the diameter) provides an effective leakage barrier even when changing altitudes or when the user misuses the cartridge, e.g., user-induced failure modes such as biting or squeezing the mouthpiece, and/or blowing into the mouthpiece. Surprisingly, other combinations of such features are less effective,

particularly in user-induced failure modes. For example, otherwise similar cylindrical devices, e.g., having a width and diameter that are equivalent or nearly equivalent (e.g., a diameter less than 1.2×, or greater than 0.8×, the width) may show greater leakage compared to more flattened devices; the addition of one or more absorbent pads, particularly along the long wall of an overflow leak chamber) show an even greater reduction in leakage.

The one or more openings into the overflow leak chamber may be present on any surface of the cartridge, including through the distal end of the overflow leak chamber. Although placement of the opening at the distal end may otherwise result in an increase in leakage of the highly viscous oil from the cartridge, including the leak chamber and the absorbent pad(s) prevents or reduces leakage. In addition, the one or more openings may be surrounded by a lip within the leak chamber. The lip may have a height above the inner wall of the chamber that is 0.3 mm or greater (e.g., 0.5 mm or greater, 0.7 mm or greater, 0.8 mm or greater, 0.9 mm or greater, 1 mm or greater, 1.2 mm or greater, 1.3 mm or greater, 1.4 mm or greater, 1.5 mm or greater, 2 mm or greater, etc.).

The one or more absorbent pads may be positioned within the overflow leak chamber along the diameter, off-axis relative to an air flow path through overflow leak chamber from the opening to the air path.

In general, the overflow leak chamber may be relatively large. e.g., the volume of the overflow leak chamber (including the absorbent pad(s)) may be between 0.4 and 1.5× the volume of the tank (reservoir). In particular, the volume of the overflow leak chamber may be between 0.4 and 1× the volume of the tank (e.g., 0.4× or greater, 0.5× or greater, 0.6× or greater, 0.7× or greater, etc. than the volume of the tank). Alternatively, this may be described as the length of the overflow leak chamber along the distal to proximal axis relative to the length of the tank, and may be between 0.4× and 2× the length of the tank along the distal to proximal axis (e.g., between 0.4× and 1×, between 0.5× and 2×, between 0.5× and 1.5×, etc.), typically 0.4× or greater. In general, the overflow leak chamber may be enclosed within the distal end of the elongate and flattened tubular body.

In general, the cartridges described herein may be configured for insertion (e.g., by friction fitting) into a vaporizer body. Thus, the cartridge, and particularly the distal end of the cartridge, may be adapted to be inserted securely into the re-usable vaporizer device. The cartridge may therefore have straight (e.g., flat) or inwardly tapered sides and may include one or more friction-engagement regions that couple within the vaporizer. In some variations the distal end region of the cartridge may include a channel, rim, lip, ridge, protrusion, etc. that may engage with a complimentary region in the vaporizer (e.g., in a cartridge receiver in the vaporizer body). Thus, the cartridge may be configured to 'snap' fit into the vaporizer body. For example, the distal end of the elongate and flattened tubular body may include a lip or rim configured to snap into a vaporizer body.

The cartridge may also include one or more (e.g., a pair) of electrical contacts on the distal end of the cartridge (e.g., on the distal end of the overflow leak chamber) in electrical communication with the heater. These electrical contacts may also be configured and adapted to prevent or ameliorate the effects of leakage of oil from the cartridge. For example, the electrical contacts may comprise scraping contacts (also referred to as wiping or wiper contacts), which may include an edge or edge to scrape against the contact (e.g., pogo pin) from the vaporizer before (and/or separately from) making electrical contact. For example, the pair of electrical contacts may comprise pin receptacles. These pin receptacles may include an outer scraping edge with an inner conductive surface.

In any of the variations described herein, the tank may include a cannabinoid solution (e.g., a cannabis oil solution). Thus, the cartridge may be pre-filled with a cannabis oil. The tank volume may be configured to hold between about 0.2 mL and about 2 mL or more of oil. For example, the tank may be configured to hold between about 0.4 mL and about 1.2 mL (e.g., between about 0.4 mL and 0.8 mL, etc.)

The mouthpiece may be configured to fit over the proximal end of the elongate and flattened tubular body, and may be in fluid communication with the air path through the tank. The mouthpiece may include an internal volume; one or more absorbent pads may be positioned within this internal volume. The one or more mouthpiece absorbent pads within the mouthpiece may generally be off-axis relative to the air path (leaving a central air path that is not occluded by the absorbent pads). For example, the mouthpiece absorbent pads may be off-axis relative to an air flow path from the air path and out of the mouthpiece. The mouthpiece absorbent pads may be positioned on the sides of the mouthpiece (e.g., the major sides, corresponding to the diameter of the mouthpiece). The absorbent pad(s) may be between a proximal end of the mouthpiece and the elongate and flattened tubular body.

In any of the devices described herein the air path may extend through the cartridge, from the distal end (e.g., the opening(s) into the overflow leak chamber), past the heater, through and/or around the tank, and out of the mouthpiece. In some variations, the air path comprises a cannula extending through the tank. In general, the elongate body may be transparent or translucent, and any material in the tank may be visible; when the device includes a cannula running through the tank this may also be visible.

The absorbent pads in the overflow leak chamber may be the same material and/or dimensions as those (if present) in the mouthpiece, or they may be different materials and/or dimensions. The one or more absorbent pads may be made of a sponge or felt material. The one or more absorbent pads may comprise a pair of flat absorbent pads arranged in parallel. For example, the one or more absorbent pads may comprise a cotton material. The one or more absorbent pads may be rectangular.

As mentioned, the one or more absorbent pads in the overflow leak chamber may be a pair of absorbent pads positioned within the overflow leak chamber off-axis relative to an air flow path through the overflow leak chamber from the opening to the air path.

The heater (e.g., wick and coil) may be positioned within the air path so that it is parallel, transverse or oblique to the air path. For example, the heater may extend across the air path in a transverse direction.

The elongate and flattened tubular body may have an oval cross-section or a rectangular cross-section transverse to the distal to proximal axis, and may be any appropriate size. For example, the elongate tubular housing may be between about 1 cm and 10 cm long (e.g., between about 2 cm and 7 cm long, etc.). It may be particularly beneficial to have the elongate tubular housing be somewhat short and compact (e.g., less than 8 cm, less than 7 cm, less than 6 cm, less than 5.5 cm, less than 5 cm, etc.)

The sizes of the openings into the air path (through the overflow leak chamber, e.g., at the distal end of the cartridge) may be configured to allow relatively easy draw through the cartridge, while preventing leakage out of the overflow leak path. Leaking may occur from the heater (e.g.,

the exposed wick) which is inserted through the wall of the tank; the air path within the cartridge is open and continuous, which would otherwise allow the material to leak. Thus, for example, the size of the one or more openings may be specified within a range identified as allowing sufficient air flow without permitting excessive leaking. For example, in some variations, the diameter of the opening(s) into the overflow leak chamber is/are between 0.1 mm and 5 mm (e.g., between 0.1 mm and 3 mm, between about 0.1 mm and 2 mm, etc.).

The tank portion of the device may be filled by an opening beneath the mouthpiece, which may be sealed or plugged. For example, the cartridge may include a plug between the mouthpiece and the elongate and flattened tubular body, wherein the plug closes off the tank of the elongate and flattened tubular body.

Any of the cartridge devices for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece on the proximal end of the elongate and flattened tubular body; an enclosed overflow leak chamber at a distal end of the elongate and flattened tubular body. The device of claim **1**, wherein a length of the overflow leak chamber along the distal to proximal axis is 0.5 times or greater than a length of the tank along the distal to proximal axis; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path proximal to the overflow leak chamber, an opening through the distal end of the overflow leak chamber, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

For example, a cartridge device for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body, wherein a length of the overflow leak chamber along the distal to proximal axis is between 0.5 and 2 times a length of the tank along the distal to proximal axis; an air path extending proximally from the overflow leak chamber through the tank to the mouthpiece, wherein the air path comprises a cannula extending through the middle of the tank; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** show moisture and vapor deposition on a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **3**A and **3**B show a vaporization device with a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **4**A and **4**B show an exemplary vaporization device. This exemplary device includes two pairs of absorbent filter pads, as described herein. FIGS. **4**A and **4**B show a cartridge placed within the reusable component of the device.

FIGS. **5**A-**5**F illustrate the vaporizer body (e.g., a reusable component of the vaporizer device of FIGS. **4**A and **4**B). FIG. **5**A is a bottom perspective view; FIG. **5**B is a front view, FIG. **5**C is a top perspective view (looking into the cartridge receiver region including electrical contacts), FIG. **5**D is a side view. FIG. **5**E is a top view, and FIG. **5**F is a bottom view, showing the electrical connection to a charger or other wired electrical connection.

FIGS. **6**A-**6**D illustrate the cartridge of the device of FIGS. **4**A and **4**B. FIG. **6**A is a bottom perspective view, FIG. **6**B is a bottom view, FIG. **6**C is a top perspective view (showing the opening into the mouthpiece) and FIG. **6**D is an exploded view of the cartridge of FIG. **6**A.

FIGS. **7**A-**7**F illustrate an alternative view of a cartridge as described herein. FIG. **7**A shows a bottom perspective view; FIG. **7**B is a top perspective view; FIG. **7**C is a front view;

FIG. **7**D is a side view; FIG. **7**E is a bottom view; and FIG. **7**F is a top view.

FIGS. **8**A-**8**G show a variation of a vaporizer base of a vaporizer apparatus into which a cartridge such as the one shown in FIGS. **7**A-**7**F may be inserted. FIG. **8**A is a bottom perspective view; FIG. **8**B is a top perspective view showing the cartridge receiver portion of the vaporizer base; FIGS. **8**C, **8**D and SE show front, side and back views, respectively of the vaporizer base; and FIGS. **8**F and **8**G show bottom and top views, respectively of the vaporizer base.

FIGS. **9**A-**9**G show an assembled vaporizer apparatus including a vaporizer cartridge such as the one shown in FIGS. **7**A-**7**F that has been fully seated and retained in a vaporizer base such as the one shown in FIGS. **8**A-**8**G. FIGS. **9**A and **9**B show bottom perspective and top perspective views, respectively of the assembled vaporizer apparatus; FIGS. **9**C, **9**D and **9**E show front, side and back views, respectively of the assembled vaporizer apparatus; FIGS. **9**F and **9**G show bottom and top views, respectively, of the vaporizer apparatus.

FIG. **10**A is an exploded view of the cartridge of FIGS. **7**A-**7**F with the components arranged in line.

FIG. **10**B is an alternative exploded view of the cartridge of FIGS. **7**A-**7**F, showing the component parts positioned adjacent to each other at the approximate vertical position for assembly.

FIG. **11**A is a semi-transparent view (in which the outer casing of the vaporizer base, mouthpiece, and cartridge housing have been a made transparent) showing the air path through the assembled vaporizer apparatus such as the one shown in FIGS. **7**A-**9**G.

FIGS. **11**B and **11**C show front and back views, respectively, of an example of a vaporizer base with the outer housing (case or shell) made transparent, showing the cartridge receiving end including connectors and air entry port therein.

FIG. **12** is an enlarged view of a section through a midline of the proximal (top) region of a cartridge (as shown by dashed line **12-12'** in FIG. **9**A), showing the air path from the vaporization chamber to the mouthpiece openings.

FIG. **13** is a section through the midline of a vaporizer apparatus (including a vaporizer base into which a vaporizer

cartridge has been coupled), showing the air path during inhalation (puffing, drawing, etc.).

FIG. **14** show a section through a cartridge, just beneath the mouthpiece (as shown by dashed line **14'-14'** in FIG. **9**B) showing the arrangement of the distal pair of absorbent pads offset from the airflow path.

FIG. **15**A is a section through the midline of an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **15**A-**15**A').

FIG. **15**B is another section through an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **12-12'**).

FIG. **15**C shows another section through the assembled vaporizer apparatus (through line **15**C-**15**C' in FIG. **9**B).

FIG. **15**D is a section through a cartridge (through line **15**D-**15**D' of a cartridge such as the one shown in FIG. **7**A) showing a pair of overflow filter pads that are off-axis relative to the airflow path of the device.

FIG. **16** is a section through another of another exemplary vaporization device (at line **16-16'** in FIG. **9**B), near the base of the cartridge and inserted into the cartridge receiver of the vaporizer base.

FIG. **17** is an electrical schematic of a heating element and connectors showing the Seebeck coefficients for a simplified model of the components of the heating circuit.

FIG. **18** is a Seebeck measurement circuit for a vaporizer apparatus correcting for the Seebeck effect, configured as a two-terminal sensing circuit.

FIG. **19** is another example of a Seebeck measurement circuit for a vaporizer apparatus, configured as a four-terminal (four-point) circuit.

FIGS. **20**A and **20**B illustrate two examples of heating coils comprising different component conductors coupled to result in resistive heater from which a temperature measurement may be determined using a Seebeck sensing circuit as described herein.

FIG. **21** is one example of a user interface (UI) for interacting with the apparatuses described herein using an external controller (e.g., smartphone, pad, etc.)

FIG. **22** is another example of a US for interacting with an apparatus as described herein.

DETAILED DESCRIPTION

The apparatuses and methods described herein generally include forming a vapor from a material (including in particular, liquid and oil-type plant materials) using a vaporization device. The vapor may be delivered for inhalation by a user. These apparatuses may be particularly adapted for use with an oil-based vaporizable material, including cannabis oils.

The vaporizer apparatuses, including cartridges (vaporizer cartridges) and reusable vaporizers bases described herein may be used with any appropriate vaporizable material, including aqueous vaporizable materials. These apparatuses may be particularly well adapted for use with viscous, oil-based vaporizable materials, including cannabis oils. For example, any of the cartridges described herein may be used (e.g., filled) with a vaporizable material comprising viscous liquid such as a cannabis oil. In some variations the cannabis oil comprises between 40-100% cannabis oil extract. The viscous oil may include a carrier for improving vapor formation, such as propylene glycol, glycerol, etc., at between 0.01% and 25% (e.g., between 0.1% and 22%, between 1% and 20%, between 1% and 15%, etc.). In some variations the vapor-forming carrier is 1,3-Propanediol. A cannabis oil may include a cannabinoid or cannabinoids (natural and/or synthetic), and/or a terpene or terpenes. For example, any of the vaporizable materials described herein may include one or more (e.g., a mixture of) cannabinoid including one or more of: CBG (Cannabigerol), CBC (Cannabichromene). CBL (Cannabicyclol), CBV (Cannabivarin), THCV (Tetrahydrocannabivarin), CBDV (Cannabidivarin). CBCV (Cannabichromevarin). CBGV (Cannabigerovarin). CBGM (Cannabigerol Monomethyl Ether), Tetrahydrocannabinol, Cannabidiol (CBD), Cannabinol (CBN), one or more Endocannabinoids (e.g., anandamide, 2-Arachidonoylglycerol, 2-Arachidonyl glyceryl ether. N-Arachidonoyl dopamine, Virodhamine. Lysophosphatidylinositol), and/or a synthetic cannabinoids such as one or more of: JWH-018, JWH-073, CP-55940, Dimethylheptylpyran, HU-210. HU-331, SR144528, WIN 55,212-2, JWH-133, Levonantradol (Nantrodolum), and AM-2201. The oil vaporization material may include one or more terpene, such as Hemiterpenes, Monoterpenes (e.g., geraniol, terpineol, limonene, myrcene, linalool, pinene. Iridoids), Sesquiterpenes (e.g., humulene, farnesenes, famesol). Diterpenes (e.g., cafestol, kahweol, cembrene and taxadiene), Sesterterpenes, (e.g., geranylfarnesol). Triterpenes (e.g., squalene), Sesquarterpenes (e.g., ferrugicadiol and tetraprenylcurcumene). Tetraterpenes (lycopene, gamma-carotene, alpha- and beta-carotenes), Polyterpenes, and Norisoprenoids. For example, an oil vaporization material as described herein may include between 20-80% cannabinoids (e.g., 30-90%, 40-80%, 50-75%, 60-80%, etc.), 0-40% terpenes (e.g., 1-30%, 10-30%, 10-20%, etc.), and 0-25% carrier (e.g., polyethylene glycol).

In any of the oil vaporization materials described herein (including in particular, the cannabinoid-based vaporization materials, the viscosity may be within a predetermined range. The range may be between about 30 cP (centipoise) and 115 KcP (kilocentipoise). For example, the viscosity may be between 40 cP and 113 KcP. Outside of this range, the vaporizable material may fail to wick appropriately to form a vapor as described herein. In particular, the oil may be made sufficiently thin to both permits wicking at a rate that is useful with the apparatuses described herein, while also limiting leaking (e.g., viscosities below that of ~40 cP might result in problems with leaking).

For example, FIGS. **7**A-**7**F illustrate one example of a cartridge that is adapted for use with a viscous oil-based vaporizable material (having a viscosity at room temperature of between 40 cP and 113 KcP), such as a cannabis oil. In this example, the cartridge **700** includes a flattened body that is approximately oval in cross-sectional area (see, e.g., FIGS. **7**E and **7**F showing top and bottom views) and includes a mouthpiece that is attached over a clear body forming a reservoir region holding the vaporizable material. The body **790** may be transparent, translucent or opaque. The mouthpiece may include one or more openings **792** at the proximal end (top) out of which vapor may be inhaled, by drawing breath through the device. The bottom may also include a locking feature (e.g., tab, indent, magnetic lock, etc.) for coupling and securing the cartridge within a cartridge receiver of a vaporizer base, such as the reusable vaporizer base **800** shown in FIGS. **8**A-**8**G. In this example, the body may be elongate and may include an outer shell or cover **890**; the proximal end of the vaporizer base may include an opening forming a cartridge receiver **892**. The cartridge receiver may include one or more opening therethrough (e.g., lateral openings) to allow airflow therein, as described in more detail below. Any of these cartridges may also or alternatively include a rim, ridge, channel, protrusion, lip, etc. along the distal end region for engaging a

complimentary portion of the vaporizer device. For example, in FIG. **7**D, the cartridge include a channel or lip **795** at the distal end which may engage with a deflectable or deformable tab or protrusion in the cartridge receiving portion of the vaporizer; this may provide a snap fit. In general, the cartridge may fit within the cartridge receiver of the vaporizer by a friction fit. The snap-fit may provide audible and/or tactile confirmation that the cartridge is held in position. This fit may also lock or hold the cartridge within the receiver, but still allow it to be easily withdrawn to remove the cartridge.

As shown in FIG. **7**C, the elongate and flattened body **790** may contain within it the tank region **791** (e.g., holding the vaporizable oil material) and a distal overflow leak chamber **793**. These structures may be formed by the internal components within the elongate and tubular body, as shown below.

FIGS. **10**A and **10**B show exploded view of a cartridge as described herein. In this example, the apparatus includes a cartridge body **1005** that may be clear (transparent), opaque and/or translucent. The cartridge body may form a reservoir for the liquid vaporizable material, and particularly for a viscous liquid vaporizable material such as the cannabinoid oils described herein. The cartridge may include an outer seal (e.g., o-ring **1009**) that seals the mouthpiece **403** over the body **1005**. The reservoir (tank) may be sealed on the top (at the proximal end) under the mouthpiece by a single-piece plug **888** that covers multiple openings which may be used for filling the tank. The vaporization chamber may be formed at the bottom (distal end) of the cartridge; in exemplary cartridges described herein the vaporization chamber is formed from a cannula and housing piece **1011** that includes opening into which the wick (wick portion of wick and coil **443**) passes into the chamber; the walls forming the vaporization chamber separate it from the tank and mate with a back piece **1013** that forms the bottom (distal end) of the tank within the cartridge body. This piece is also sealed (e.g., by an O-ring **1015**) to the cartridge body from within the cartridge body, as shown. An air chamber is then formed between the bottom of the cartridge **1019** and the back piece **1013** of the tank. One or more (e.g., two) air openings **796**, **796'** through this bottom **1019** allow air to pass (after entering the cartridge receiver through one or more openings **894** in the side) into the distal end of the cartridge, into the air chamber region and then up through an opening into the vaporization chamber. The piece forming the bottom of the cartridge **1019** may also accommodate or include one or more (e.g., two) electrical connectors that are configured to mate with the connectors on the vaporizer base. As mentioned, these contacts may be wiper or scraping contacts. In FIGS. **10**A and **10**B, they are shown as cans **1021**, **1021'** having openings into which the pins project to form an electrical contact.

The vaporizer body typically includes a battery and one or more control circuits housed within the cover **890**. The control circuitry may control the heater, which in this example, is present in the cartridge. The heater may generally include a heating coil (resistive heater) in thermal contact with the wick; additional connectors formed of a different material (e.g., conductive material) may connect the heater coil to the electrical contacts on the base of the cartridge; although this may lead to inaccuracies in detecting and controlling temperature electrically, as described below, the control circuitry may include one or more additional circuits, such as Seebeck measurement circuits, that correct for offsets and other inaccuracies in the determination of temperature and therefore the power applied to the apparatus. The control circuitry may also include and may control and/or communicate with a batter regulator (which may regulate the battery output, regulate charging/discharging of the battery, and may provide alerts to indicate when the battery charge is low, etc.). The co control circuitry may also include and may control and/or communicate with an output, such as a display, one or more LEDs, one or more LCDS, a haptic output, or any combination of these. In the example shown in FIGS. **7**A-**9**G, the apparatus includes only four (RGB) LEDs **897**, arranged in a pattern (e.g., a circular, spiral or floral pattern; other patterns may include linear patterns). Any of the apparatuses described herein may also include a wireless communication circuitry that is part of, connected and/or controlled by the control circuitry. The apparatus may be configured to wireless communicate with a remote processor (e.g., smartphone, pad, wearable electronics, etc.); thus the apparatus may receive control information (e.g., for setting temperature, resetting a dose counter, etc.) and/or output information (dose information, operational information, error information, temperature setting information, charge/battery information, etc.).

The apparatus may also include one or more inputs, such as an accelerometer, a lip sensing input, a contact input, or the like. In particular, described herein arm vaporizer apparatuses in which the device does not include any visible buttons, switches or external user input on an outer surface of the cartridge or vaporizer base. Instead, the input may be an accelerometer (coupled to, part of, and/or controlled by the control circuitry). The accelerometer and any accelerometer control circuitry may be configured to detect tapping on the apparatus (e.g., the case) and/or rolling of the apparatus (e.g., around the long axis or the short axis of the device). In some variations the apparatus may also include circuitry for sensing/detecting when a cartridge is connected and/or removed from the vaporizer base. For example, cartridge-detection circuitry may determine when a cartridge is connected to the device based on an electrical state of the electrical contacts within the cartridge reliever in the vaporizer base. For example, FIG. **5**C illustrates the two electrical contacts **595**, **595'**. Without a cartridge inserted into the apparatus the circuit is open (e.g., between **595** and **595'**) with the cartridge inserted, the electrical contacts (shown as pins **595**, **595'** in FIGS. **5**D and **11**B) engage with the contacts (such as wiping contracts, described above, which scrape to remove leaked and/or dried vaporizable material on the electrode contact surfaces). The controller (via a separate or integrated cartridge-detection circuit) may determine that a cartridge has been inserted when the resistance between these contacts changes to within a recognizable range (from the open circuit). Other cartridge detectors may be used alternatively or additionally, including a trip switch (which is activated when the cartridge is present), or the like. Any of the apparatuses described herein may also include one or more breath detectors, including a pressure sensor **1109** (e.g., microphone coil) having a connection to the inside of the cartridge receiver, as shown in FIG. **11**B.

The vaporizer body may also include a connector **899** at the distal end for coupling the device to a charger and/or data connection. The internal battery may be charged when coupling the device to a connector, alternatively other electrical connectors and/or inductive charging may be used.

FIGS. **9**A-**9**G illustrate an example of an apparatus (vaporizer apparatus) in which the cartridge **700** has been inserted completely into the vaporizer body **800**. The resulting device is small, lightweight, hand-held and may be safely stored in a pocket, purse, or the like.

In operation, the user may (once charged sufficiently), may activate the vaporizer by being drawing (inhaling) through the mouthpiece. The device may detect a draw (e.g., using a pressure sensor, flow sensors, or the like, including a sensor configured to detect a change in temperature or power applied to a heater element. e.g., anemometer detection) and may increase the power to a predetermined temperature preset. The power may be regulated by the controller by detecting the change in resistance of the heating coil and using the temperature coefficient of resistivity to determine the temperature. As described in greater detail below, the temperature determination and/or power applied may be optionally corrected in cases where there are different electrically conductive materials connecting the resistive heater to the power supply/power, in which the Seebeck effect may be an issue, using a sensing circuit to estimate and compensate for this potential source of inaccuracy.

In any of the apparatuses described herein, the temperature may be adjusted or selected by the user. As mentioned, in some variations the apparatus does not include an exterior control or user input, but still allows the user to select the temperature from among a plurality (e.g., two or more, three or more, etc.) of pre-set heating/vaporizing temperatures above 100° C. This may be achieved by allowing the user to coordinate (in time, e.g., within 60 seconds, within 50 seconds, within 40 seconds, within 45 seconds, within 40 seconds, within 30 seconds, within 20 seconds, within 10 seconds, between 1 second and 60 seconds, between 2 seconds and 60 seconds, between 3 seconds and 60 seconds, etc.) a pair of distinct inputs that are based detection of inputs that are internal to the apparatus (e.g., not from controls on the surface of the apparatus), such detection an accelerometer input (e.g., tapping, such as one or more, e.g. 3 or more, taps, rotations of the device in the long axis, etc.) within a predefined time after removing the cartridge and/or inserting the cartridge. For example, the apparatus may enter into a temperature selection mode to allow a user to select the temperature by removing the cartridge after shaking the apparatus (e.g., for 1 or more seconds, e.g., 2 or more seconds, etc.). Once in a temperature selection mode, the user may select from among a number (e.g., 4) or pre-set temperatures by tapping the housing of the device to cycle through the pre-set temperatures, which may be displayed on an output (e.g., LED, monitor, LCD, etc.) on the apparatus.

Any other input on the device that is not (or not connected to) a button, and particularly an external button, may be used in a predetermined activation sequence (e.g., pattern of taps detected by the accelerometer, insertion/removal of cartridge, etc.) or in a set of sequential independent actuations. For example, the apparatus may enter into a temperature selection mode after removing and inserting a cartridge three times in quick successions (e.g., within 5 seconds of each step). In any of the variations described herein, merely shaking the apparatus may display information about the status of the device (e.g., the charge) using the output; the additional non-button input (e.g., removing the cartridge and/or inserting the cartridge) within the predetermined time may then allow the operating temperature to be selected.

In some variations, the apparatus includes multiple (e.g., **4**) presets, and an optional additional preset (e.g., 5th preset or more) that may be user-settable. Alternatively or additionally, an external controller (smartphone, pad, computer, etc.) in may communicate with the apparatus to allow setting and/or selecting the operating temperature.

In on example, the apparatus may be operated to allow the user to select the operating temp (set mode) by shaking the device with a cartridge inserted. In some variations this may then change the display (e.g., multi-colored LEDs on the surface of the device), for example, displaying battery life using the multiple LEDs arranged (e.g., in an X pattern **897**, see, e.g., FIG. **8**C). While in this state, removing cartridge enters temp set mode. The device automatically cycles through the 4 (+1 or more, when user defined) presets. The user may then choose one by reinserting the pod at appropriate time. In some variations, the preset temperatures are: 270° C. 320° C., 370° C., 420° C. In some variations the user may modify or include an additional preset within a temp range around each preset. e.g.: within an operational range of between 270-420° C.

As mentioned above, any of the apparatuses described herein may be operated with an external processor to receive input and/or output to control operation of the device. For example, the vaporizer apparatus may be operated with an application software ("app") that allows control of the temperature or other functional setting and/or allows storage, display and/or transmission of operational and/or use information, including dose information. As described herein, an approximate estimate for dose may be determined based on the power applied to the heater (resistive coil) during inhalation (over time), e.g., power applied to coil multiplied by time of draw. This approximate 'dose' estimate may be accumulated over the use of a particular cartridge (e.g., once a cartridge is inserted, it may be accumulated and/or displayed until the cartridge is removed, roughly amounting to a "session" with that cartridge).

For example, FIGS. **21** and **22** illustrate exemplary user interfaces for an application software that allows the user to set and or adjust the pre-set temperatures of the apparatus. In FIG. **21**, the user may select the per-set temperature. FIG. **22** illustrates the use of the app to control the appearance and activity of the apparatus. For example, the user may lock/unlock the apparatus, and track usage (e.g., by does estimation).

In any of the apparatuses described herein the apparatus may allow the user to play one or more interactive "games" with the device. For example, any of these apparatuses may include an entertainment mode that may be entered by manipulating the device (e.g., by tapping, shaking, rotating, puffing in a predetermined pattern, etc.). In general, the entertainment mode may include one or more presentations (e.g., LED light displays, tones/music, patterns of vibrations, or combinations of these) and/or games. The device may be configured to allow selection of the presentation states or game states (games) to be played, or it may randomly select one. In general the games may be interactive, allowing the user to provide input, e.g., via the one or more inputs, such as movement of the device, via motions sensing, touching the device, via a button and/or capacitive sensor (e.g., lip sensing, etc.), puff/airflow sensing, inserting and/or removing the cartridge, etc.

For example, the entertainment mode may include a game such as a pattern-following game, wherein the device presents an output (e.g., one or more LEDS illuminated in a pattern and/or color), and the device (e.g. controller) may determine if a response entered by the user on the input correlates with a predetermined response. In general, the same controller used to control the heater may be used to control the entertainment mode including the games. Alternatively a separate controller may be used, and may communicate with the controller controlling the heater.

The one or more games may include a memory game. For example, in a memory game the device may presents an output sequence and determines if a sequence of responses

entered by the user on the input correlates with a predetermined sequence of responses. The one or more games may include a triggered output game wherein the device presents an output in response to a predetermined user input. For example, the device may illuminate a series differently positioned and/or colored LEDs based on the angle or movement that the user holds the device.

The one or more games may include a chance type game, wherein the device is configured to display a random pattern of one or more of colors, tones or vibrations, in response to a predetermined user input. The entertainment mode may include a display game wherein the output comprises a plurality of LEDs and wherein the device is configured to cycle the LEDs through a predetermined sequence of colors in response to a predetermined user input. The entertainment mode may include a tone game wherein the output comprises a plurality of tones and wherein the device is configured to play a predetermined sequence of tones in response to a predetermined user input.

As mentioned, the device may be configured to be toggled between the normal mode and the entertainment mode by applying one or more predetermined user manipulations to the input. For example, the device may be rotated. In some variations, the device input comprises an accelerometer, and the device may be configured to be toggled between the normal mode and the entertainment mode by rolling or rotating the device (e.g., three or more times) in one or more directions.

In addition to or alternative to the games, the entertainment mode may include an entertainment output (display) that is triggered upon entering into the entertainment mode. For example, as mentioned, the entertainment output may include one or more of: a display of a plurality of colors and/or patterns on the output, a tone or series of tones, a vibration or series of vibrations.

Leak Prevention

Any of the apparatuses described herein may be configured to prevent or reduce leakage of the vaporizable material. As mentioned, leaking an oil-based (and particularly cannabinoid oils) is particularly troublesome in a vaporizer because the vaporizable material may dry as a sticky, tarry substance that is both messy and may disrupt operation of the apparatus, particular the reusable (e.g., vaporizer base) portion.

For example, any of the apparatuses described herein may include one or more absorbent pads or members that are oriented to prevent leakage without disrupting the airflow or formation of vapor. In general, moisture and particles from the vapor can be deposited on a filter pad that is off-axis relative to the vapor path. The vaporization device may be a handheld vaporization device.

As described above, any of the vaporization apparatuses (device and systems) may comprise a heating element, including a resistive heating element. The heating element may heat the material such that the temperature of the material increases. Vapor may be generated as a result of heating the material.

In some cases, a vaporization device may have an "atomizer" or "cartomizer" configured to heat an aerosol forming solution (e.g., vaporizable material). The vaporizable material may be heated to a sufficient temperature such that it may vaporize (e.g., between 200° C. and 500° C., e.g., between 250-450° C., between 270-420° C., etc.). The apparatus or method may include one or more pre-set vaporization temperatures and the apparatus or method may control (via controller including feedback logic) the temperature to a predetermined and/or selected temperature.

An atomizer may comprise a small heating element configured to heat and/or vaporize at least a portion of the vaporizable material and a wicking material that may draw a liquid vaporizable material into the atomizer (e.g., heater). When the apparatus includes a wicking material, the wicking material may comprise silica fibers, cotton, ceramic, hemp, stainless steel mesh, and/or rope cables. The wicking material may be configured to draw the liquid vaporizable material in to the atomizer without a pump or other mechanical moving part. A resistance wire may be wrapped around the wicking material and then connected to a positive and negative pole of a current source (e.g., energy source). The resistance wire may be a coil. When the resistance wire is activated, the resistance wire (or coil) may have a temperature increase as a result of the current flowing through the resistive wire to generate heat. The heat may be transferred to at least a portion of the vaporizable material through conductive, convective, and/or radiative heat transfer such that at least a portion of the vaporizable material vaporizes.

Alternatively or in addition to the atomizer, the vaporization device may be configured as a "cartomizer" to generate an aerosol from the vaporizable material for inhalation by the user. The cartomizer may comprise a cartridge and an atomizer. The cartomizer may comprise a heating element surrounded by a liquid-soaked poly-foam that acts as holder for the vaporizable material (e.g., the liquid). The cartomizer may be reusable, rebuildable, refillable, and/or disposable. The cartomizer may be used with a tank for extra storage of a vaporizable material.

Air may be drawn into the vaporization device to carry the vaporized aerosol away from the heating element, where it then cools and condenses to form liquid particles suspended in air, which may then be drawn out of the mouthpiece by the user. For example, any of the apparatuses described herein may include a draw channel or passage. The draw channel may be in fluid communication with the heater so that vapor formed by the heater passes into the draw channel, which is also in fluid communication with the mouthpiece, which may be integrated with the device (including a cartridge).

One or more aspects of the vaporization device may be designed and/or controlled in order to deliver a vapor with one or more specified properties to the user. For example, aspects of the vaporization device that may be designed and/or controlled to deliver the vapor with specified properties may comprise the heating temperature, heating mechanism, device air inlets, internal volume of the device, and/or composition of the material.

Energy may be required to operate the heating element. The energy may be derived from a battery in electrical communication with the heating element. Alternatively, a chemical reaction (e.g., combustion or other exothermic reaction) may provide energy to the heating element.

The term "aerosol" may generally refer to a colloid of fine solid particles or liquid droplets in air or another gas. In general, the aerosols described herein are liquid aerosols of primarily (e.g., >80%, >85%, >90%, >95%) liquid particles in air. The liquid or solid particles in an aerosol may have varying diameters of average mass that may range from monodisperse aerosols, producible in the laboratory, and containing particles of uniform size, to polydisperse colloidal systems, exhibiting a range of particle sizes. As the sizes of these particles become larger, they have a greater settling speed which causes them to settle out of the aerosol faster, making the appearance of the aerosol less dense and to shorten the time in which the aerosol will linger in air. Interestingly, an aerosol with smaller particles will appear

thicker or denser because it has more particles. Particle number has a much bigger impact on light scattering than particle size (at least for the considered ranges of particle size), thus allowing for a vapor cloud with many more smaller particles to appear denser than a cloud having fewer, but larger particle sizes.

A vapor may generally refer to a substance in the gas phase at a temperature lower than its critical point. As used herein, a vapor may include a liquid aerosol. For convenience the term vapor and aerosol, which may generally refer to liquid aerosols, may be used interchangeably herein, as is common in the art of electronic vaporization devices.

The methods and apparatuses described herein have a wide range of applications for inhalation of an active substance, such as botanicals, pharmaceuticals, nutraceuticals, or any other substance for inhalation to provide a benefit or sensation to an end user. In some embodiments, the devices described herein include a tank having a liquid containing an active ingredient, such as nicotine, cannabis, or a cannabinoid.

The term "cannabis" refers to plants of the genus Cannabis and loose-leaf products or extracts thereof. As mentioned above, the term "cannabinoid" refers to plant based or synthetic chemical compounds capable of acting on cannabinoid receptors and inducing a biological effect. Cannabinoids include acids, salts, and bioactive stereo isomers. Exemplary cannabinoids include tetrahydrocannabinol (THC), cannabigerolic acid (CBGA), cannabigerol (CBG), tetrahydrocannabinolic acid (THCA), cannabichromene (CBC), cannabicyclol (CBL), cannabivarin (CBV), cannabichromevarin (CBCV), cannabigerovarin (CBGV), cannabigerol Monomethyl Ether (CBGM), delta-8-tetrahydrocannabinol (D8THC), delta-9-tetrahydrocannabinol (D9THC), tetrahydrocannabivarin (THCV), cannabinolic acid (CBNA), Cannabinol (CBN), cannabidiolic acid (CBDA). Cannabidivaric acid (CBDVA), cannabidiol (CBD), cannabichromenic acid (CBCA), Cannabichromene (CBC), or cannabicyclolic acid (CBLA) and/or any salt or stereo isomer of the above.

The devices described herein for generating an inhalable aerosol may include a body having a battery, a cartridge or tank including or configured to include the vaporizable material, at least input (e.g., in some variations without any input on an outer surface of the apparatus, e.g., "button less"), and circuitry for controlling the device.

An exemplary vaporization device **200** is shown in FIGS. **1** and **2**. The vaporization device **200** includes two filter pads **222***a,b*. The filter pads **222***a,b* are positioned off of the central axis of the air path **212**. As the vapor travels down the air tube **208** and begins to return to liquid state, both condensation and particle aggregation will occur. As the vapor exits the air tube **208** into the air path **212**, the moisture (see FIG. **1**) and larger particles (sec FIG. **2**) can filter onto the pads **222***a,b* (i.e., via gravity) without interfering with the user's draw on the device.

The one or more pads for use with any of the embodiments described herein (including pads **222***a,b*) can be made of an absorbent material. The absorbent material can both wick moisture quickly and allow it to disperse quickly therethrough. Thus, the absorbent material can be hydrophilic. Exemplary materials include cotton. e.g., a nonwoven cotton lintner paper, felt, cellulose, or hydrophilic polymers. Further, the one or more pads can be curved, as shown in FIGS. **1** and **2** or can be substantially flat panels. In some embodiments, the one or more pads can each be made of two or more thin sheets of layered material.

The one or more pads can be positioned within or proximate to the mouthpiece so as to capture moisture just prior to inhalation by the user. Further, in some embodiments, as shown in FIGS. **1** and **2**, the one or more pads can be pushed up against the interior surface of the vaporizer so as to minimize interference with other components of the vaporizer. In other embodiments, the one or more pads can be pulled away from the interior walls so as to maximize the surface area available for moisture absorption. The pads can be rectangular, circular, ovoid, triangular, square, or other shape. The shape and size of the pads can be chosen so as to minimize interference with the air path while maximizing moisture and particle collection.

Another exemplary vaporizer **300** utilizing moisture deposition pads **322***a,b* is shown in FIGS. **3**A and **3**B. The vaporizer **300** includes a cartridge **301** that is attachable to a reusable component **300** (which can include the electronics to power the device, etc.). As shown in FIGS. **3**A and **3**B, the cartridge **301** can include a tank **302**, a heater assembly **343**, an air tube **308**, and a mouthpiece **303**. The pads **322***a,b* can be rectangular, flat, and positioned in parallel within the mouthpiece **303** on either side of the air tube **308** (i.e., off-axis with the air tube **308**). The vaporizer **300** can further include any of the features described in U.S. application Ser. No. 15/053,927, titled "VAPORIZATION DEVICE SYSTEMS AND METHODS." filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1, the entirety of which is incorporated by reference herein.

Another exemplary vaporizer **400** that can utilize one or more pads is shown in FIGS. **4**A-**6**B. As shown in FIGS. **4**A and **4**B, the vaporizer **400** includes a reusable component **411** and a cartridge **401**. The diameter of device **400** is greater than the width (e.g., greater than 1.2×, 1.3×, 1.4×, 1.5×, 1.6×, 1.7×, 1.8× 1.9×, etc.), making the device have a substantially long and flat appearance and feel.

Referring to FIGS. **5**A and **5**B, the reusable component **411** includes a shell **431**, which can include the electronics for operating the vaporizer. Further, the reusable component **411** can include a visual indicator **421**, such as an LED, for signaling the operating status of the vaporizer **400**. The distal end of the reusable component **411** (shown in FIG. **5**F) includes a charging element **433** configured for charging the device. Further, the proximal end of the device (FIG. **5**E) includes contacts **435** for maintaining an electrical connection with the cartridge **401**.

The cartridge **401** is shown in FIGS. **6**A-**6**D. As best shown in the exploded view of FIG. **6**D the cartridge **401** includes a tank **441** configured to hold a liquid vaporizable material therein, a heater (e.g. a wick and coil assembly) **443** configured to heat the vaporizable material in the tank **441**, and an air tube **408** extending from the tank to a mouthpiece **403**. Contacts **535** are configured to connect with contacts **435** on the reusable component **411** to provide power to activate the wick and coil assembly **443**. At the distal end of the cartridge the walls of the elongate and flattened tubular body **441** and a bottom cover piece **691** form an overflow leak chamber **699**, which is shown with a pair of absorbent pads **495***a,b* are positioned along the long walls (along the diameter) of the overflow leak chamber. An option felt cover **693** may be included (also acting as an absorbent member).

As shown in FIGS. **4**A-**5**D, the device **400** further includes openings, configured as air inlets **762***a,b*, on the side of the shell **431**. The air inlets are proximate to openings (air inlets) **662***a,b* on the distal end of the cartridge **401** (see FIGS. **6**A and **6**B) opening into the overflow leak chamber (not visible). Referring to FIG. **11**A (which is a cross-section of the device **400** at the center), the air flow path **777** from

inlets **762***a,b* to inlets **662***a,b*, extends through the tube **408** until it reaches the stop **433** (see FIG. **12**) and then divides into two separate paths that extend along the inner surface of the mouthpiece **402** (between the pads **422***a,b*) and out through the outlets of the mouthpiece **403**.

As shown in FIGS. **6**D and **12-14**, parallel absorbent pads **422***a,b* can be positioned within the mouthpiece **403**. The absorbent pads **422***a,b* are rectangular and parallel with one another. The absorbent pads **422***a,b* are positioned substantially parallel to the flat side of the device **400** (parallel with the plane of the length l and width w in FIG. **4**A) and parallel with one another. In some embodiments, the pads **422***a,b* can be biased fully against the inside walls of the mouthpiece **403** so as to easily capture liquid that rolls along the walls. A distance between the two pads **422***a,b* can be, for example, between 3 and 6 mm, such as between 4 and 5 mm, e.g., approximately 4.8 mm. The gap between the absorbent pads **422***a,b* advantageously prevents the pads from interfering with the air flow path when a user draws on the mouthpiece **403**.

Further, as shown in FIGS. **6**D, **12** and **13** in some embodiments, over-flow pads **445***a,b* are positioned proximate to the tank **441**, i.e., within an overflow leak chamber below the tank, to absorb liquid that may leak out of the tank **441** during use. The over-flow pads **445***a,b* can be similarly placed parallel to one another and/or against the sides of the shell **431** as described above with respect to pads **422***a,b*.

FIG. **13** (which is a cross-section of the device **400** through the pads **422***a,b* and **445***a,b*) shows the air flow path **777** in dotted lines relative to the placement of the pads **442***a,b* and **445***a,b*. The air path **777** extends alongside all of the pads **422***a,b* without extending therethrough. That is, the pads **422***a,b* and **445***a,b* extend off-axis relative to the air path **777** and do not interfere with user draw. However, the pads **422***a,b* and **445***a,b* are positioned so that the air path **777** travels along, besides, and/or in contact with the pads **422***a,b* and **445***a,b* for an extended period of time so as to allow maximum absorption of liquid.

In use (i.e., when the user draws on the device), the device **400** can be held horizontally with the width, w, in the vertical direction and the diameter, d, in the horizontal direction. As such, at least one of the pads **422***a,b* and/or **445***a,b* will be substantially horizontal while the user draws on the device, ensuring that gravity will pull any moisture or particles down onto the lower pad **422***a,b* and/or **445***a,b*. Further, having two pads **422***a,b* and/or **445***a,b* advantageously ensures that moisture will be caught whether the user holds the device with pad **422***a* or **445***a* on top or **422***b* or **445***b* on top. This can both prevent interference with the electronics of the device and prevent the user from getting any liquid from the tank in his or her mouth when drawing on the device.

Referring to FIGS. **15**A-**15**D, exemplary device **800** is similar to device **400** (similar reference numbers are therefore used) except that it includes a single plug **888** in the proximal section of the cartridge **801** (i.e., as opposed to the two tank seals **604***a,b* shown in FIG. **6**D). The plug **888** is configured to simultaneously seal both outlets of the mouthpiece **403** while also sealing around the tube **408**.

Although sets of absorbent pads are shown and described with respect to the embodiments herein, only a single off-axis (i.e. "off air path") pad can be used in each location. Likewise, more than two (e.g., 3, 4, 5, or more) off-axis pads, such as strips of absorbent material, may be used. Similarly, only a single set of pads can be used.

In some embodiments, the absorbent pads can be located only in the cartridge area (i.e., in the disposable portion). In other embodiments, additional absorbent pads can also be used in the reusable portion of the device.

The wick for use with any of the embodiments herein can be large to handle higher viscosity liquids (e.g., liquids with cannabinoids). For example, the wick can be greater than 1.5 mm in diameter, such as approximately 2 mm in diameter.

Referring to FIG. **16**, in some embodiments, the openings (also referred to as air inlets) **962***a,b* to the cartridge **901** can include a protective annular ring **992***a,b* or seal therearound that extends away from the inner wall of the cartridge **901**. This ring can help prevent any spilled liquid from splashing into the inlets **962***a,b*. This ring may be lip or ridge projecting into the overflow leak chamber, as shown in FIG. **16**.

Referring still to FIG. **16**, in some embodiments, the contacts **935** of the reusable portion **911** of the device **900** can be pin contacts while the contacts **1035** of the cartridge **901** can be annular contacts or pin receptacles configured to mate with the pins. Further, in some embodiments, pin receptacles **1035** can include spring-loaded wiping mechanisms on the inner diameter thereof. The spring-loaded wiping mechanisms can be configured to wipe the pins as they pass therethrough. As a result, any vapor residue on the pins can be removed to maintain the proper electrical connection there between.

Power and Temperature Control

In any of the apparatuses described herein, the vaporizer apparatus may be controlled so that the temperature used to vaporize the vaporizable material is maintained within a preset range (e.g., one or more preset temperatures as discussed above, within +/− a few degrees (e.g., +/−3° C., 2° C., 1° C., 0.5° C., etc.). In general, the microcontroller may control the temperature of the resistive heater (e.g., resistive coil, etc.) based on a change in resistance due to temperature (e.g., TCR). For example, a heater may be any appropriate resistive heater, such as a resistive coil. The heater is typically coupled to the heater controller via two or more connectors (electrically conductive wires or lines) so that the heater controller applies power (e.g., from the power source) to the heater. The heater controller may include regulatory control logic to regulate the temperature of the heater by adjusting the applied power. The heater controller may include a dedicated or general-purpose processor, circuitry, or the like and is generally connected to the power source and may receive input from the power source to regulate the applied power to the heater.

For example, any of the apparatuses described herein may include logic for determining the temperature of the heater based on the TCR of the heating element (resistive coil), based on sensed resistance of the coil. The resistance of the heater (e.g., a resistive heater) may be measured (R_{heater}) and the controller may use the known properties of the heater (e.g., the temperature coefficient of resistance) for the heater to determine the temperature of the heater. For example, the resistance of the heater may be detected by a detection circuit connected at the electrical contacts that connect to the cartridge, and this resistance compared to a target resistance, which is typically the resistance of the resistive heater at the target temperature. In some cases this resistance may be estimated from the resistance of the resistive hearing element at ambient temperature (baseline).

In some variations, a reference resistor ($R_{reference}$) may be used to set the target resistance. The ratio of the heater resistance to the reference resistance ($R_{heater}/R_{reference}$) is linearly related to the temperature (above room temp) of the heater, and may be directly converted to a calibrated temperature. For example, a change in temperature of the heater relative to room temperature may be calculated using an

expression such as $(R_{heater}/R_{reference}-1)*(1/TCR)$, where TCR is the temperature coefficient of resistivity for the heater. In one example, TCR for a particular device heater is 0.00014/° C. In determining the partial doses and doses described herein, the temperature value used (e.g., the temperature of the vaporizable material during a dose interval, T_i, described in more detail below) may refer to the unit less resistive ratio (e.g., $R_{heater}/R_{reference}$) or it may refer to the normalized/corrected temperature (e.g., in ° C.).

When controlling a vaporization device by comparing a measure resistance of a resistive heater to a target resistance, the target resistance may be initially calculated and may be factory preset and/or calibrated by a user-initiated event. For example, the target resistance of the resistive heater during operation of the apparatus may be set by the percent change in baseline resistance plus the baseline resistance of the resistive heater, as will be described in more detail below. As mentioned, the resistance of the heating element at ambient is the baseline resistance. For example, the target resistance may be based on the resistance of the resistive heater at an ambient temperature and a target change in temperature of the resistive heater.

As mentioned above, the target resistance of the resistive heater may be based on a target heating element temperature. Any of the apparatuses and methods for using them herein may include determining the target resistance of the resistive heater based on a resistance of the resistive heater at ambient temperature and a percent change in a resistance of the resistive heater at an ambient temperature.

In any of the methods and apparatuses described herein, the resistance of the resistive heater may be measured (using a resistive measurement circuit) and compared to a target resistance by using a voltage divider. Alternatively or additionally any of the methods and apparatuses described herein may compare a measured resistance of the resistive heater to a target resistance using a Wheatstone bridge and thereby adjust the power to increase/decrease the applied power based on this comparison.

In any of the variations described herein, adjusting the applied power to the resistive heater may comprise comparing the resistance (actual resistance) of the resistive heater to a target resistance using a voltage divider, Wheatstone bridge, amplified Wheatstone bridge, or RC charge time circuit.

When using resistance and/or power applied to determine the temperature of the apparatus and/or to control temperature for vaporization, the inventors have determined that there may be a surprising disparity between the actual temperature and that predetected or determined using resistance of the heater alone. This problem because particularly acute when the distance between the heating element (e.g. resistive coil) and the electrical input into the cartridge (the power contacts from the vaporizer base) is longer, or there is a change in the conductive material between the heater and the contacts, as shown in FIG. **15**A. Where there is a change in the conductive material between the contacts, the electrical wiring and the resistive coil, thermoelectric effects arising due to this change in electrical characteristics (resistance) may give rise to inaccuracies when determining the power applied.

In the exemplary cartridges described above, the heating coil is connected to the electrical contacts by extension wires **1054**, **1054'** (see, e.g., FIG. **10**B). Because the extension wires are different materials, a voltage (EMF) may be generated at the junction between the different electrical conductors when there is a temperature gradient. This thermoelectric effect may be referred to as the Seebeck effect, and may generate a voltage that is based on the material properties of the different conductors. In the variations described above, although the heating coil, extensions and wick are nearly symmetric, during normal usage there may be uneven temperatures across the three, developing a temperature gradient. This may result in an uneven voltage being generated; this disparity may then lead to inaccuracies in controlling the heater (applied power) and/or estimation of the temperature.

Although at any particular time, the effect may be relatively minor (and therefore overlooked), the cumulative effect may lead to dramatic reductions in accuracy and temperature control; other systems may attempt to avoid this problem by modifying the resistance of the material used for the resistive heater, requiring a larger power; although this may reduce the overall contribution of the offset EMF voltage due to the thermoelectric property mismatch, it also requires a larger wattage and therefore battery (and resulting power) be applied.

Instead, any of the apparatuses described herein may include a precision resistance measurement circuit to track resistance of the heating element (e.g., a coil made from resistive heating alloy wire) when not heating and heating to control the temperature of the coil based on changes in coil resistance from room temperature to vaporization temperatures, as discussed above. For example, in some variations, the measurement circuit is an amplified Wheatstone bridge where the heating element (when connected) is one half of one of the two voltage dividers in the Wheatstone bridge and the two divider voltages are inputs to a differential op amp circuit. This control circuit may be modified as described herein to account for the mismatch in thermoelectric properties leading to the offset voltage.

Currently known resistance measurement systems typically use a two-terminal sensing or four-terminal sensing circuit, and are prone to measurement error when the load to be measured is also a voltage source or has an additional unknown voltage applied to it. As just mentioned above, in vaporizers that use resistive heating elements (often coils), extension leads are often used to mute power to the heating element with minimal Joule heating and losses in the path between the heating element (where Joule heating is desired) and the voltage source (often a battery or power supply). For manufacturability, these extension leads are often the only connection between the device (or contacts that connect to the device) and the heating element, so measurement of the resistance of the heating element invariably includes the resistance of the extension leads and measurement error arising from the mismatched thermoelectric properties (Seebeck error). The heating element and extension leads (three conductors if considered individually) each have some temperature gradient along their lengths, and this temperature gradient generates an electromotive force (EMF, which is also a measureable voltage when the conductor is open circuit) in each conductor, which is $E_{emf}=-S\nabla T$, where S is the Seebeck coefficient of the conductor which depends heavily on the conductor material (but also on temperature of the conductor) and ∇T is the temperature gradient across the material. Because ideal materials for the heating element and extension leads often have different Seebeck coefficients, and since the temperatures at the two connection points between each extension lead and the heating element are likely to differ while heating (due to acceptable asymmetries in both heating element assembly and heat transferred from the heating element and extension leads that are expected in a mass-produced product), there will be a net EMF across the extensions and heating element (seen as one

load in any vaporization system where one set of extension leads electrically connects the heating element to the device) which will skew the resistance measurement, making temperature control of the heating element using measured resistance impossible without correction for this effect. More generally, measured resistance of the heating element will be skewed by the mismatched thermoelectric properties (e.g., the Seebeck effect) whenever there is a temperature difference between and material transition at the two heating element terminals where contacts or extensions are connected.

A simplified model of a heating element with two extension leads of the same material is shown in FIG. **17**. In this example, the heating element and extension lead combination connects to the device at the open ends of the extension leads shown above, so the resistance measurement of the heating element is taken through the extension leads connecting to it. S1 and S3 are constant coefficients that depend on the material properties (Seebeck coefficients) of each of the two extension lead materials, and S2 is the Seebeck coefficient of the heating element. T1 and T4 are temperatures at the ends of the extensions that electrically connect to the vaporization device. T2 and T3 are temperatures of the connections between the extension leads and heating element (which may be welds, crimps, solder joints, or other electrical connections). The EMF, E_{net} is expected to skew the resistance measurement if E_{net} is non-zero. E_{net} from the Seebeck effect is expected to be:

$$E_{net}=-S1(T2-T1)-S2(T3-T2)-S3(T4-T3).$$

To illustrate how temperature differences between T2 and T3 can create a non-zero Enet, consider a further simplified model where temperatures at the two open (as shown) ends of the conductive path are assumed to be the same and close to the device temperature (T1=T4), which is an acceptable simplification in systems like ours where extensions connect to electrical contacts with large thermal mass at T1 and T4. Seebeck coefficients for the two extensions are assumed to be the same since the two extension leads are of the same material (S1=S3). This reduces the above expression to:

$$E_{net}=(S2-S1)(T2-T3)$$

From the above expression, if S2 and S1 are not equal (heating element and extension leads have different Seebeck coefficients) and T2 and T3 are not equal (non-zero net temp gradient across the two points where heating element meets extensions), Enet will not be zero, and it will skew the resistance measurement taken by the device. For comparison, if there are no extension leads, EMF for the heating element alone can be considered:

$$E_{net}=S2(T2-T3)$$

When the heating element is connected directly to electrical contacts that are large thermal masses, it is expected (and can be measured) that T2 and T3 are very close and Seebeck effect introduces negligible error in resistance measurement. In other systems where extension leads are used, the Seebeck effect will skew measured resistance, making temperature control impossible when Seebeck effect is not corrected for.

Additionally, some systems without extension leads may still see a temperature difference between T2 and T3 depending on the device and heating element assembly. If this temperature difference is significant, this effect will have to be corrected for if accurate resistance measurements is desired.

The simple model above with extension leads and heating element is provided to illustrate the source of heating element EMP. In most systems there will be additional material transitions and temperature gradients in each material in the resistance measurement path. As described below, a complete understanding or modeling of all material transitions and junction temperatures is not needed to correct for this effect. The heating element EMF (caused by the Seebeck effect) can simply be measured and used to correct for the error it introduces in resistance measurements.

In a vaporization devices that uses measured heating element resistance for temperature control of the heating element as described above, heating element EMF may also measure and used to control the power applied and/or estimates of temperature. The Seebeck effect may be observed to be the main contributor to heating element EMF and is the only known contributor to heating element EMF when no current (or constant current) has been flowing through the element for some time. Measured heating element EMF can be used to correct for resistance measurement error caused by heating element EMF. The resistance measurement (skewed by Seebeck EMF) and the Seebeck EMF measurement together can be used to calculate accurate heating element resistances, which can be used to control average temperature of the heating element.

The effect of heating element EMF on the resistance measurement depends on the measurement circuit used. Heating element EMF will produce measurement error in all known resistance measurement circuits, so heating element EMF may be separately measured to correct for the error it causes in the resistance measurement. Sensitivity of the resistance measurement to heating element EMF may be understood so that measured heating element EMF can be used correctly to calculate heating element resistance from the two measurements taken. For example, the same differential op-amp used for the resistance measurement may also be used for the heating element EMF measurement. In the resistance measurement, the heating element may be powered through a voltage divider so that there is a measurable voltage across the heater which is compared against a reference voltage or summed with other reference voltages and amplified by the differential op amp circuit. For heating element EMF measurement, no voltage is applied to the heating element, which allows for direct measurement of the EMF, which is compared against another close reference voltage and amplified by the same differential op amp circuit used for the resistance measurement.

Because the same amplification circuit may be used, the sensitivities of both the resistance measurement and the heating element EMF measurement to heating element EMF will be the same. The two measurements may then be used to calculate accurate heating element resistances, the raw reading difference between measured heating element EMFs when the device is heating and when device has not been heating for some time (note that Seebeck EMF is 0 when heating element reaches thermal equilibrium in device) and may be subtracted from the raw resistance measurement reading before other calculations are performed to yield heating element resistance from corrected resistance measurement reading.

FIG. **18** illustrates one example of a measurement circuit that may be used as part of a vaporization apparatus. Operation of this circuit to control heating element resistance while heating may be as follows (with signal and component names below referencing signals and components from schematic of FIG. **18**); except for H+ **1821**, all output boxes (**1801**, **1803**, **1805**, **1807**, **1809**, **1811**, **1813**)

are connected to the microcontroller, which is not shown; timing noted below is for one exemplary software implementation and may be different or modified for different implementations). Heating element is connected between H+**1821** and GND.

In FIG. **18**, when device is heating. HEATER **1807** is driven with PWM to connect VBAT to H+**1821** through Q**5** (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element. When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement). HEATER **1807** is held off and HM_PWR **1805** is held on (powering differential op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 us of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1809**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1809** between AREF_HM_OUT **1801** and GND during the last 68 μs of the measurement window. For the heating element resistance measurement, HM_NEG_REF_EN **1803** is on to bias the heating element so that the voltage divider formed by R**19** and the heating element can compared by the differential op amp circuit (comprised of U**5**, R**21**, R**22**, R**23**, and R**33**) against a fixed voltage divider formed by R**20** and R**32**, and some combination of R**28**, R**29**, and R**30**, which are used to keep HM_OUT **1809** in a usable voltage range between AREF_HM_OUT **1801** and GND for the range of heating element resistances that the device might see. HM_SCALE_**0-2** **1813** are either allowed to float (high impedance) or connected to GND within the microcontroller to use R**28-30** to set the resistance measurement range of the circuit.

For the heating element EMF measurement. HM_NEG_REF_EN **1803** is off to allow H+ to float to a voltage that is the heating element EMF (relative GND) and SEEBECK_REF_EN **1815** is on to make the fixed reference used by the differential op amp circuit close enough to heating element EMF that HM_OUT **1809** will be usable (will be between AREF_HM_OUT **1801** and GND) over the range of heating element EMFs expected when heating element is heated. Heating element EMF may be as high as +/−3 mV. The heating element EMF measurement circuit can measure between +/−5 mV. The measurement circuit yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations. Resistance calculations are as follows:

> Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset

Resistance measurement sensitivities and offsets may depend on the active resistance measurement scale (selected using HM_SCALE_**0-2** **1813**) and may be solved for using circuit component values and then included in the device (e.g., in the firmware, hardware or software of the apparatus).

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs. temperature curve.

The resistance measurement circuit may be a two-terminal sensing circuit, as just discussed. In other variations, a four-terminal sensing may be used to mitigate effects of variable contact resistance and trace or lead resistance in series with the heating element resistance measurement. Changing contact resistance and trace/lead resistance have a negligible impact on resistance measurement and temperature control, but these effects may be more pronounced in variations which have a lower resistance heating element and different heating element and device assembly. In this case, a four-terminal (also known as four-point) resistance and EMF measurement circuit, such as the one shown in FIG. **19**, may be used.

Operation of the circuit shown in FIG. **19** to control heating element resistance while heating may be done as follows (with signal and component names below referencing signals and components from schematic above; signals **1903**, **1905**, **1907**, **1909**, **1911**, **1913**, **1915**, **1917**) are connected to the microcontroller, which is not shown; timing noted below is exemplary only, and may be different). In FIG. **19**. HI+**1822** and HV+**1826** connect directly to one terminal of the heating element, while HV−**1828** and HI−**1824** connect directly to the other terminal of the heating element.

When device is heating, HEATER **1907** is driven with PWM to connect VBAT to H+**1822** through Q**2** (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element.

When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement), HEATER **197** is held off and HM_PWR **1905** is held on (powering the differential summing op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 μs of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1915**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1915** between AREF_HM_OUT **1913** and GND during the last 68 μs of the measurement window.

For the heating element resistance measurement. HM_WS_ISRC_EN **1903** is on to bias the heating element through R**20** and HI+/− terminals so that the voltage across HV+/− can measured by the differential summing op amp circuit (comprised of U**2**, R**19**, R**23-25**, and optionally R**10-14**. R**17**, and R**21**). HM_WS_POS_REF_EN **1903** is on to sum GND through R**19** with HV+ through R**25**. Some combination of HM_SCALE_**0-5** are on to sum HV− through R**24** with VBAT through some respective combination of R**10-14** to keep HM_OUT **1915** in a usable voltage range between AREF_HM_OUT **1913** and GND for the range of heating element resistances that the device might see.

For the heating element EMF measurement. HM_WS_ISRC_EN **1903** is off to allow HV+ to float to a voltage that is the heating element EMF (relative HV−), HM_WS_POS_REF_EN **1909** is off to sum the R**17**, R**21**, R**19** voltage divider through R**19** with HV+ through R**25**, and HM_SCALE**0-4** **1911** are all off to provide no summing and only negative feedback at the negative input of the op-amp. This differential summing configuration keeps HM_OUT **1915** in a usable range (will be between AREF_HM_OUT **1913** and GND) over the range of heating element EMFs expected when heating element is heated. With the values shown above, the heating element EMF measurement circuit can measure between +/−3.5 mV. The measurement circuit

yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations.

Resistance calculations are as follows:

> Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset Resistance measurement sensitivities and offsets depend on the active resistance measurement scale(selected using HM_SCALE_**0-4 1911**) and may be solved for using circuit component values and then included in the device.

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs. temperature curve.

As described above, the mismatch in thermoelectric properties and the resulting EM (e.g., the Seebeck EMF) has been found by the inventors to be a potential source of resistance measurement error after data taken from controlled tests of vaporizer prototypes (e.g., using heating elements with extension leads). A single heating element run with temp control of the heating element (using measured heating element resistance without correction for this EMF) may consistently run with much higher power when connected in one polarity vs. the other polarity. It was discovered that asymmetries in the heating element (in this case the wick and coil) assembly could consistently produce hotter temperatures at one of the two heating element/extension lead junctions, resulting in consistent offset voltage at operating temperatures that skewed the resistance measurement in one direction with the heating element connected in one polarity and in the other direction with heating element connected in the other polarity. Although measured resistance was controlled during these tests, these devices were not accurately controlling heating element temperatures because measurements were skewed by this offset EMF resulting from the mismatch in thermoelectric properties of the components. With the correction described above, used to correct for the error in resistance measurement, it is observed that heating element polarity does not have an effect on the power required to hold the heating element at operating temperatures during controlled testing, which suggests that this correction yields accurate calculated heating element resistances that remove the effect of the offset EMF, providing much more accurate temperature control of the heating element than when not corrected.

Thus, in any of the variations described herein, the apparatus may include an offset correction circuit (also referred to as a Seebeck correction circuit) to correct for the offset voltage resulting from the mismatch in thermoelectric properties between the resistive heating coil and the conductive connectors linking the resistive heating coil to the power input (e.g., from the vaporizer base, including the vaporizer power controller) in the cartridge. The offset correction circuit may be located in the vaporizer base and connected between the coupling connectors **595**, **595'** to couple with the cartridge connectors and determine the offset voltage due to the mismatch in thermoelectric properties of the heating (resistive) coil and the wires linking the coil to the connector on the cartridge. Also described herein are methods of correcting for the mismatch (Seebeck effect) in thermoelectric properties between the coil and the wires (electrical extensions) connecting to the electrical connectors.

Dose Monitoring

As mentioned above, any of the apparatuses described herein may also or alternatively detect and display the dose of material applied. U.S. patent application Ser. No. 14/960,259 (filed on Dec. 4, 2015, and published as US-2016-0157524-A1), herein incorporated by reference in its entirety, describes examples of methods for determining dose (and apparatuses including dose determination). Generally these methods may be used to accurately calculate dose based on the power applied to the heater and the temperature of the heater (or a material in contact with the heater) during an immediately before a small increment of time; total dose may be determined by summing these small increments up over a desired time range. These methods may be incorporated herein, and may be made even more accurate by correcting the power applied as described above (e.g., accounting for the offset EMF due to the Seebeck effect).

Alternatively or additionally, described herein are methods and apparatuses that may provide a rough approximation of dose based on the power applied over time to vaporize the material within the cartridge. This may be referred to herein as the consumption (of the vaporizable material in the cartridge, an indication of consumption) of the cartridge or vaporizable material, or the like. In general, the apparatus may aggregate the power during operation of the apparatus (e.g., the power applied over time during a puff/inhalation and/or the power applied over this time multiplied times the duration of the inhalation).

The apparatus may further provide an output of the amount of consumption. This output may be, in particular, a qualitative approximation. For example, the output may be incrementally increasing the number, intensity and/or color of one or more LEDs on the surface of the apparatus. For example, in this case, the consumption amount (dose) is not an absolute amount, but is an indicator or readout of the power applied to vaporize the material (power applied to the coils) over time. In FIG. **9**C, for example, when the user first installs a cartridge and the apparatus is set up to display consumption/dose, the four LEDS **897** may initially be unlit or lit to the neutral color (e.g., white). As the user draws on the device and vaporizes the material within the cartridge, the number of LEDS illuminated may be increased and the intensity and/or color of illumination may be increased to indicate increasing dosage or consumption; for example the calculation of power applied over time may determine based on a number or predetermined increments, whether to increase the number of illuminated LEDS of a particular color and/or intensity, to change color and/or intensity, etc.

The accumulated dose may be reset manually (e.g., using an app, shaking the device, etc.) or by removing the cartridge. Alternatively or additionally to the qualitative output described above, a quantitative estimate based on the power may be displayed or output to a remote processor (e.g. smartphone, etc.).

Thermocouple as Heater

In any of the apparatuses described herein, the heater may be configured as a thermocouple junction. See, e.g., FIGS. **20**A and **20**B. Thus, a thermocouple junction (comprising materials having dissimilar thermoelectric properties) may be used to measure temperature at a point along the heater coil. As discussed above, this may allow an apparatus to resistively determine temperature along the heater coil using the thermoelectric properties described above. Thus, similar to what is described above, the heating element performs both as a heater and a temperature sensor. For example, a resistive heater may comprised of two dissimilar conductors

(e.g., stainless steel and titanium) welded together, as shown in FIG. **20**A. When the heater (heating coil) heats up, the dissimilar material will be heated differentially, resulting in a temperature gradient and a resulting offset voltage (EMF), due to the Seebeck effect discussed above, at the junction of the two dissimilar materials. This effect may be used to determine the temperature at that junction (whereas typically, we determine the average temperature of the entire heater by using TCR, temperature coefficient of resistance, as also discussed above.

The Seebeck effect also occurs at the junction between the heater end poles and passive electrical conduits. Although the correction circuits discussed above are aimed at correcting for the effect, it may also be possible to take advantage of the effect for a more localized temperature measurement. Compare. FIG. **20**B to FIG. **20**A, for example. In FIG. **20**A, the junction is located in the middle of the heating element, and determining the offset voltage in this case, which is based on the temperature, may allow accurate temperature determination. This embodiment may be particularly relevant for a convection vaporizer, where you likely have a (relatively) large heater and you care about the temperature at just the air outlet end.

In vaporization systems where the heating element is connected to the device through extension leads, if Seebeck coefficients are known for both materials, the measured Seebeck EMF can be used to determine the net temperature gradient across the heating element. With some modeling, this measurement could be used to approximately control maximum heating element temperature instead of or in addition to average heating element temperature. This measurement can also be used to perform quality control where the heating element assembly is manufactured. In vaporization systems where the heating element is connected to the device through extension leads and the heating element is used to primarily heat air, if Seebeck coefficients are known for both materials. Seebeck EMF can be used to determine the net temperature gradient across the heating element, which with a known air flow path and thermal modeling of the system can be used to predict average air temperature at some point down-stream of the heating element. As mentioned above, this may be particularly advantageous in convection (hot-air) vaporization systems as two measurements (resistance and Seebeck EMF) taken from the actuator can allow for accurate temperature control of air lowing from the outlet of the heating element without additional sensors in the air path or connected to the heating element.

As shown in FIG. **20**A, the Seebeck effect alone or the Seebeck effect in conjunction with resistance measurement can be used for temperature control of a heating element that has a material transition (junction) at the position where temperature is to be controlled. This is essentially creating a thermocouple out of resistive heating alloys so that the Seebeck EMF can be measured in order to control temperature at the hot junction of the thermocouple resistive heater. The junction could be positioned where the heating element is expected to be hottest to control maximum temperature of the heating element. The control algorithm could use a target average temperature of the heating element (calculated using resistance and EMF measurements) as well as a maximum acceptable max temperature of the heating element (calculated using just the EMF measurement). A device that knows both the average temperature of the heating element and the maximum temperature of the heating element could know more about the temperature gradient along the heating element and be better at predicting mass of material vaporized while heating than a device that only knows either maximum or average heating element temperature (device knowing precise mass of material vaporized is critical for dose-control in vaporizers). If extensions are used in such a system, they could be the same material as the intended heating element but much larger gauge for reduced losses in the extensions. Alternatively, extensions with Seebeck coefficients that are very similar to the Seebeck coefficients of the two heating element sections could be used so that Seebeck EMF is still usable for temp control of the hot junction (small contribution of heating element/extension junctions to net Seebeck EMF).

Vaporizers without Cartridges

Any of the features described herein may be incorporated into a vaporizer apparatus that does not require the uses of a separate (e.g., removable cartridge), including vaporizer apparatuses such as loose-leaf vaporizer apparatuses.

Such apparatuses are described, for example, in each of the following applications, herein incorporated by reference in their entirety: U.S. patent application Ser. No. 13/837,438, filed on Mar. 15, 2013, Publication No. US 2013-0312742 A1; U.S. patent application Ser. No. 15/166,001, filed on May 26, 2016, Publication No. US 2016-0262459 A1; U.S. patent application Ser. No. 14/581,666, filed on Dec. 23, 2014, Publication No. US 2015-0208729 A1; U.S. patent application Ser. No. 15/053,927, filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1; U.S. patent application Ser. No. 15/257,748, filed on Sep. 6, 2016; U.S. patent application Ser. No. 15/257,760, filed on Sep. 6, 2016. Publication No. US 2016-0374399 A1; and U.S. patent application Ser. No. 15/257,768, filed on Sep. 6, 2016. Publication No. US 2016-0366947 A1.

For example such a device may include preset and allow the user to enter temp set mode by holding down on a button (on or under the mouthpiece) for >0.6 seconds. Pressing the button again cycles through the 4+1 presets. To exit temp set, again hold the button for >0.6 sec. The presets may be, e.g.: **180**C, **193**C. **204**C, **216**C.

Any of the apparatuses described herein may include haptic feedback that may include distinct profiles for different events: For example:

/‾\—trapezoid—power on, and Bluetooth connect

‖—quick click—manual power off, and Bluetooth disconnect

|‾|‾|—2 long clicks—temp reached

|‾|—1 long click—entered low temp standby, and auto shutoff

Also the user may change the intensity of these envelopes via the app.

Although the disclosure, including the figures, described herein may described and/or exemplify these different variations separately, it should be understood that all or some, or components of them, may be combined.

Although various illustrative embodiments are described above, any of a number of changes may be made to various embodiments without departing from the scope of the invention as described by the claims. For example, the order in which various described method steps are performed may often be changed in alternative embodiments, and in other alternative embodiments one or more method steps may be skipped altogether. Optional features of various device and system embodiments may be included in some embodiments and not in others. Therefore, the foregoing description is provided primarily for exemplary purposes and should not be interpreted to limit the scope of the invention as it is set forth in the claims.

When a feature or element is herein referred to as being "on" another feature or element, it can be directly on the other feature or element or intervening features and/or elements may also be present. In contrast, when a feature or element is referred to as being "directly on" another feature or element, there are no intervening features or elements present. It will also be understood that, when a feature or element is referred to as being "connected", "attached" or "coupled" to another feature or element, it can be directly connected, attached or coupled to the other feature or element or intervening features or elements may be present. In contrast, when a feature or element is referred to as being "directly connected", "directly attached" or "directly coupled" to another feature or element, there are no intervening features or elements present. Although described or shown with respect to one embodiment, the features and elements so described or shown can apply to other embodiments. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

Terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. For example, as used herein, the singular forms "a". "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items and may be abbreviated as "/".

Spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if a device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms "upwardly". "downwardly", "vertical", "horizontal" and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

Although the terms "first" and "second" may be used herein to describe various features/elements (including steps), these features/elements should not be limited by these terms, unless the context indicates otherwise. These terms may be used to distinguish one feature/element from another feature/element. Thus, a first feature/element discussed below could be termed a second feature/element, and similarly, a second feature/element discussed below could be termed a first feature/element without departing from the teachings of the present invention.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising" means various components can be co-jointly employed in the methods and articles (e.g., compositions and apparatuses including device and methods). For example, the term "comprising" will be understood to imply the inclusion of any stated elements or steps but not the exclusion of any other elements or steps.

As used herein in the specification and claims, including as used in the examples and unless otherwise expressly specified, all numbers may be read as if prefaced by the word "about" or "approximately," even if the term does not expressly appear. The phrase "about" or "approximately" may be used when describing magnitude and/or position to indicate that the value and/or position described is within a reasonable expected range of values and/or positions. For example, a numeric value may have a value that is +/−0.1% of the stated value (or range of values), +/−1% of the stated value (or range of values), +/−2% of the stated value (or range of values), +/−5% of the stated value (or range of values), +/−10% of the stated value (or range of values), etc. Any numerical values given herein should also be understood to include about or approximately that value, unless the context indicates otherwise.

The examples and illustrations included herein show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. As mentioned, other embodiments may be utilized and derived there from, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is, in fact, disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

What is claimed is:

1. A vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, where the mouthpiece comprises an outlet;

a reservoir configured to hold a vaporizable material;

a vaporization chamber comprising:

a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and

an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;

an extension wire extending from the heater;

a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening; and

a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:

a proximal side;

a distal side opposite the proximal side;

a lateral side extending between the proximal side and the distal side; and

an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member, and wherein the

extension feature comprises an opening extending therethrough that allows air to pass through the distal member;

wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and

wherein at least a portion of the extension wire extends at least partially through the distal member;

wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover.

2. The vaporizer cartridge of claim **1**, further comprising:

a cartridge electrical contact configured to contact a corresponding body electrical contact on a vaporizer body.

3. The vaporizer cartridge of claim **2**, wherein the distal member accommodates at least a portion of the cartridge electrical contact.

4. The vaporizer cartridge of claim **1**, wherein at least a second portion of the distal member is positioned within at least a portion of the bottom cover.

5. The vaporizer cartridge of claim **1**, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within a cartridge receiver of a vaporizer body.

6. A vaporizer device, comprising:

the vaporizer cartridge of claim **1**;

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge,

wherein the cartridge receiver comprises:

a body electrical contact;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end;

a sensor configured to detect a draw on the mouthpiece, causing activation of the heater;

a channel extending from the base of the cartridge receiver to the sensor; and

one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heater of the vaporizer cartridge.

7. The vaporizer cartridge of claim **1**, wherein the bottom portion of the bottom cover comprises: a first cartridge electrical contact opening through which a first cartridge electrical contact of the vaporizer cartridge is exposed; and a second cartridge electrical contact opening through which a second cartridge electrical contact of the vaporizer cartridge is exposed.

8. A vaporizer device comprising:

a vaporizer cartridge, comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;

a reservoir configured to hold a vaporizable material;

a vaporization chamber comprising:

a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and

an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;

an extension wire extending from the heater;

a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening;

at least one cartridge electrical contact; and

a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:

a proximal side;

a distal side opposite the proximal side;

a lateral side extending between the proximal side and the distal side; and

an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member, and wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member;

wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and

wherein at least a portion of the extension wire extends at least partially through the distal member;

wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:

at least one body electrical contact configured to electrically couple to the at least one cartridge electrical contact of the vaporizer cartridge;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end;

a sensor configured to detect a draw on the mouthpiece, causing activation of the heater; and

a channel extending from the base of the cartridge receiver to the sensor.

9. The vaporizer device of claim **8**, wherein at least the portion of the heater extending at least partially through the distal member contacts the at least one cartridge electrical contact.

10. The vaporizer device of claim **8**, wherein the bottom portion of the bottom cover comprises: a first cartridge electrical contact opening through which the first cartridge electrical contact of the vaporizer cartridge is exposed; a second cartridge electrical contact opening through which the second cartridge electrical contact of the vaporizer cartridge is exposed; and a region positioned between the first cartridge electrical contact opening and the second cartridge electrical contact opening, wherein the bottom cover comprises exactly two air openings, and wherein the air openings are not positioned within the region.

11. A vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;

at least one pad positioned within an interior of the mouthpiece;

a reservoir configured to hold a vaporizable material;

a vaporization chamber comprising:

a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and

an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;

an extension wire extending from the heater;

a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening; and

a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:

a proximal side;

a distal side opposite the proximal side;

a lateral side extending between the proximal side and the distal side; and

an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member, and wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member;

wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and

wherein at least a portion of the extension wire extends at least partially through the distal member;

wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover.

12. The vaporizer cartridge of claim **11**, further comprising: a cartridge electrical contact configured to contact a corresponding body electrical contact on a vaporizer body.

13. The vaporizer cartridge of claim **12**, wherein the distal member accommodates at least a portion of the cartridge electrical contact.

14. The vaporizer cartridge of claim **11**, wherein at least a second portion of the distal member is positioned within at least a portion of the bottom cover.

15. The vaporizer cartridge of claim **11**, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within a cartridge receiver of a vaporizer body.

16. A vaporizer device, comprising:

the vaporizer cartridge of claim **11**;

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:

a body electrical contact;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end;

a sensor configured to detect a draw on the mouthpiece, causing activation of the heater;

a channel extending from the base of the cartridge receiver to the sensor; and

one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heater of the vaporizer cartridge.

17. The vaporizer cartridge of claim **11**, wherein the bottom portion of the bottom cover comprises: a first cartridge electrical contact opening through which a first cartridge electrical contact of the vaporizer cartridge is exposed; and a second cartridge electrical contact opening through which a second cartridge electrical contact of the vaporizer cartridge is exposed.

18. A vaporizer device comprising:

a vaporizer cartridge, comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;

at least one pad positioned within the mouthpiece;

a reservoir configured to hold a vaporizable material;

a vaporization chamber comprising:

a heater configured to heat the vaporizable material from the reservoir to generate an aerosol;

a housing piece configured to house at least a portion of the heater, wherein the housing piece comprises a housing opening configured to receive at least the portion of the heater; and

an air tube extending from the housing piece, wherein the air tube is configured to deliver the aerosol from the heater to the mouthpiece;

an extension wire extending from the heater;

a bottom cover comprising a bottom portion, wherein the bottom portion comprises at least one air opening;

at least one cartridge electrical contact; and

a distal member positioned at least partially within the cartridge body between the housing piece and the bottom portion of the bottom cover, wherein the distal member comprises:

a proximal side;

a distal side opposite the proximal side;

a lateral side extending between the proximal side and the distal side; and

an extension feature having a cylindrical shape, wherein the extension feature extends from the proximal side of the distal member, wherein the extension feature comprises an opening extending therethrough that allows air to pass through the distal member;

wherein at least a portion of the distal member comprises a perimeter that has a first shape corresponding to a second shape of an inner surface of the cartridge body; and

wherein at least a portion of the extension wire extends at least partially through the distal member;

wherein an air chamber is formed between the distal member and the bottom portion of the bottom cover; and

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:

at least one body electrical contact configured to electrically couple to the at least one cartridge electrical contact of the vaporizer cartridge;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end;

a sensor configured to detect a draw on the mouthpiece, causing activation of the heater; and

a channel extending from the base of the cartridge receiver to the sensor.

19. The vaporizer device of claim **18**, wherein at least the portion of the heater extending at least partially through the distal member contacts the at least one cartridge electrical contact.

20. The vaporizer device of claim **18**, wherein the bottom portion of the bottom cover comprises: a first cartridge electrical contact opening through which the first cartridge electrical contact of the vaporizer cartridge is exposed; a second cartridge electrical contact opening through which the second cartridge electrical contact of the vaporizer cartridge is exposed; and a region positioned between the first cartridge electrical contact opening and the second cartridge electrical contact opening, wherein the bottom cover comprises exactly two air openings, and wherein the air openings are not positioned within the region.

* * * * *



(12) **United States Patent**
Hatton et al.

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(54) **LEAK-RESISTANT VAPORIZER DEVICE**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

1,671,185 A 5/1928 Flynn
1,950,542 A 3/1934 Copell
(Continued)

FOREIGN PATENT DOCUMENTS

AT 507187 A4 3/2010
CA 2920973 C 9/2018
(Continued)

OTHER PUBLICATIONS

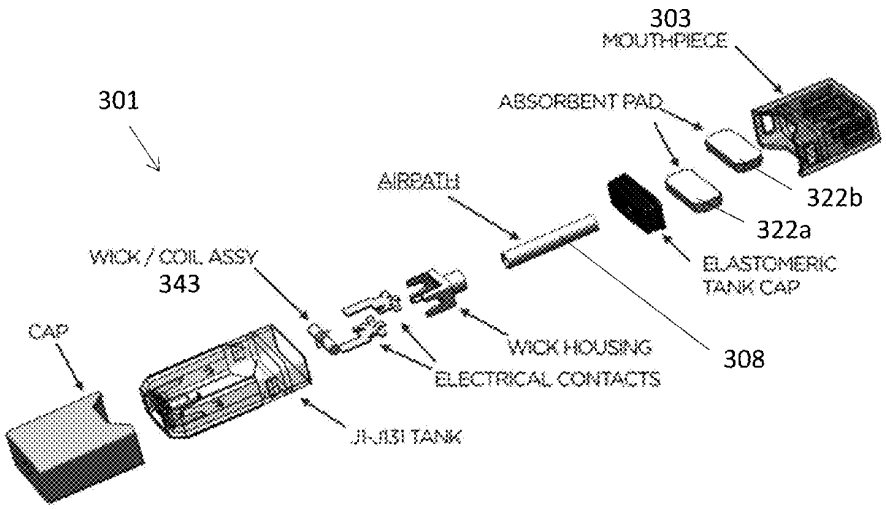
U.S. Appl. No. 15/396,584, filed Dec. 31, 2016, US 20180077967 A1.
(Continued)

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(57) **ABSTRACT**

Vaporizer cartridges and vaporizer apparatuses, and methods for making, using and delivering vapor to a user, that are leak-resistant for use with cannabinoids. In particular, described herein are leak-resistant vaporizer cartridges and apparatuses adapted for use with oil-based vaporizable materials including cannabis oils.

30 Claims, 26 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

2,900,989	A	8/1959	Davidson
4,945,931	A	8/1990	Gori
6,516,796	B1	2/2003	Cox et al.
6,637,430	B1	10/2003	Voges et al.
7,284,553	B2	10/2007	Hochrainer
7,802,569	B2	9/2010	Yeates et al.
8,528,569	B1	9/2013	Newton
8,714,161	B2	5/2014	Liu
8,752,545	B2	6/2014	Buchberger
8,833,364	B2	9/2014	Buchberger
8,899,240	B2	12/2014	Mass
8,948,578	B2	2/2015	Buchberger
9,010,335	B1	4/2015	Scatterday
9,078,474	B2	7/2015	Thompson
9,089,166	B1	7/2015	Scatterday
9,155,336	B2	10/2015	Liu
9,247,773	B2	2/2016	Memari et al.
9,289,014	B2	3/2016	Tucker et al.
9,351,522	B2	5/2016	Safari
9,364,025	B2	6/2016	Liu
9,427,022	B2	8/2016	Levin et al.
9,497,998	B2	11/2016	Chen
9,510,623	B2	12/2016	Tucker et al.
9,526,272	B2	12/2016	Liu
9,648,908	B1	5/2017	Rinehart et al.
9,668,520	B2	6/2017	Boldrini
9,668,522	B2	6/2017	Memari et al.
9,681,688	B1	6/2017	Rinehart et al.
9,763,475	B2	9/2017	Liu
9,763,478	B2	9/2017	Cameron
9,770,055	B2	9/2017	Cameron
9,795,168	B2	10/2017	Zhu
9,833,021	B2	12/2017	Perez et al.
9,844,234	B2	12/2017	Thorens et al.
9,861,135	B2	1/2018	Chen
9,877,519	B2	1/2018	Xiang
9,918,496	B2	3/2018	Kane et al.
9,955,726	B2	5/2018	Brinkley et al.
9,986,762	B2	6/2018	Alarcon et al.
10,058,128	B2	8/2018	Cameron
10,070,668	B2	9/2018	Li et al.
10,080,387	B2	9/2018	Phillips et al.
10,085,481	B2	10/2018	Verleur et al.
10,085,486	B2	10/2018	Cameron
10,130,123	B2	11/2018	Hatton et al.
10,131,532	B2	11/2018	Murison et al.
10,159,282	B2	12/2018	Monsees et al.
10,206,429	B2	2/2019	Davis et al.
10,279,934	B2	5/2019	Christensen et al.
10,299,513	B2	5/2019	Perez et al.
10,383,368	B2	8/2019	Larson
10,426,199	B2	10/2019	Turner et al.
10,492,542	B1	12/2019	Worm et al.
2003/0154991	A1	8/2003	Fournier et al.
2007/0215168	A1	9/2007	Banerjee et al.
2009/0255534	A1	10/2009	Paterno
2010/0186757	A1	7/2010	Crooks et al.
2010/0200008	A1	8/2010	Taieb
2012/0018529	A1	1/2012	Gammon et al.
2012/0318882	A1	12/2012	Abehasera
2013/0192615	A1	8/2013	Tucker et al.
2013/0199528	A1	8/2013	Goodman et al.
2013/0312742	A1	11/2013	Monsees et al.
2014/0041655	A1	2/2014	Barron et al.
2014/0041658	A1	2/2014	Goodman et al.
2014/0150810	A1	6/2014	Hon
2014/0158129	A1	6/2014	Pratt, Jr.
2014/0182612	A1	7/2014	Chen
2014/0202454	A1	7/2014	Buchberger
2014/0238421	A1	8/2014	Shapiro
2014/0261399	A1	9/2014	Murphy
2014/0261408	A1	9/2014	John et al.
2014/0290677	A1	10/2014	Liu
2014/0345635	A1	11/2014	Rabinowitz et al.
2014/0355969	A1	12/2014	Stern
2015/0007836	A1	1/2015	Li et al.
2015/0040929	A1	2/2015	Hon
2015/0136158	A1	5/2015	Stevens et al.
2015/0144147	A1	5/2015	Li et al.
2015/0150305	A1	6/2015	Shenkal
2015/0157054	A1	6/2015	Liu
2015/0164147	A1	6/2015	Verleur et al.
2015/0181941	A1	7/2015	Liu
2015/0184846	A1	7/2015	Liu
2015/0189919	A1	7/2015	Liu
2015/0201674	A1	7/2015	Dooly et al.
2015/0208729	A1	7/2015	Monsees et al.
2015/0216236	A1	8/2015	Bless et al.
2015/0223521	A1	8/2015	Menting et al.
2015/0223522	A1	8/2015	Ampolini et al.
2015/0245654	A1	9/2015	Memari et al.
2015/0245655	A1	9/2015	Memari et al.
2015/0245657	A1	9/2015	Memari et al.
2015/0245665	A1	9/2015	Memari et al.
2015/0245666	A1	9/2015	Memari et al.
2015/0245667	A1	9/2015	Memari et al.
2015/0245668	A1	9/2015	Memari et al.
2015/0257451	A1	9/2015	Brannon et al.
2015/0272217	A1	10/2015	Chen
2015/0282530	A1	10/2015	Johnson et al.
2015/0289565	A1	10/2015	Cadieux et al.
2015/0305406	A1	10/2015	Li et al.
2015/0313287	A1	11/2015	Verleur et al.
2015/0320116	A1	11/2015	Bleloch et al.
2015/0327595	A1	11/2015	Scatterday
2015/0328415	A1	11/2015	Minskoff et al.
2015/0342258	A1	12/2015	Chen
2015/0366267	A1	12/2015	Liu
2016/0000147	A1	1/2016	Li et al.
2016/0000149	A1	1/2016	Scatterday
2016/0007655	A1	1/2016	Li et al.
2016/0044965	A1	2/2016	Liu
2016/0057811	A1	2/2016	Alarcon et al.
2016/0073692	A1	3/2016	Alarcon et al.
2016/0081394	A1	3/2016	Alarcon et al.
2016/0095357	A1	4/2016	Burton
2016/0100632	A1	4/2016	Debono et al.
2016/0120226	A1	5/2016	Rado
2016/0120227	A1	5/2016	Levitz et al.
2016/0128384	A1	5/2016	Luciani
2016/0129205	A1	5/2016	Shahaf et al.
2016/0135504	A1	5/2016	Li et al.
2016/0150823	A1	6/2016	Liu
2016/0150824	A1	6/2016	Memari et al.
2016/0157524	A1	6/2016	Bowen et al.
2016/0174611	A1	6/2016	Monsees et al.
2016/0193434	A1	7/2016	Gleixner et al.
2016/0198767	A1	7/2016	Verleur
2016/0198769	A1	7/2016	Liu
2016/0198770	A1	7/2016	Alarcon

(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0213866	A1	7/2016	Tan
2016/0219934	A1	8/2016	Li et al.
2016/0219937	A1	8/2016	Rado
2016/0235120	A1	8/2016	Liu
2016/0235125	A1	8/2016	Safari
2016/0249684	A1	9/2016	Liu
2016/0262452	A1	9/2016	Zhu
2016/0262459	A1	9/2016	Monsees et al.
2016/0278163	A1	9/2016	Chen
2016/0286860	A1	10/2016	Flayler
2016/0286863	A1	10/2016	Lin
2016/0286865	A1	10/2016	King et al.
2016/0302487	A1	10/2016	Chen
2016/0309785	A1	10/2016	Holtz
2016/0324217	A1	11/2016	Cameron
2016/0325055	A1	11/2016	Cameron
2016/0331022	A1	11/2016	Cameron
2016/0331023	A1	11/2016	Cameron
2016/0331024	A1	11/2016	Cameron
2016/0331025	A1	11/2016	Cameron
2016/0331026	A1	11/2016	Cameron
2016/0331034	A1	11/2016	Cameron
2016/0331037	A1	11/2016	Cameron
2016/0332754	A1	11/2016	Brown et al.
2016/0334847	A1	11/2016	Cameron
2016/0337141	A1	11/2016	Cameron
2016/0337444	A1	11/2016	Cameron
2016/0338413	A1	11/2016	Li et al.
2016/0345621	A1	12/2016	Li et al.
2016/0356751	A1	12/2016	Blackley
2016/0360789	A1	12/2016	Hawes et al.
2016/0363570	A1	12/2016	Blackley
2016/0363917	A1	12/2016	Blackley
2016/0366936	A1	12/2016	Liu
2016/0366943	A1	12/2016	Li et al.
2016/0366945	A1	12/2016	Rado
2016/0366947	A1	12/2016	Monsees et al.
2016/0367925	A1	12/2016	Blackley
2016/0370335	A1	12/2016	Blackley
2016/0374399	A1	12/2016	Monsees et al.
2017/0006922	A1	1/2017	Wang et al.
2017/0013885	A1	1/2017	Qiu
2017/0018000	A1	1/2017	Cameron
2017/0020188	A1	1/2017	Cameron
2017/0020195	A1	1/2017	Cameron
2017/0020196	A1	1/2017	Cameron
2017/0020197	A1	1/2017	Cameron
2017/0035110	A1	2/2017	Keen
2017/0042229	A1	2/2017	Liu
2017/0042246	A1	2/2017	Lau et al.
2017/0049153	A1	2/2017	Guo et al.
2017/0055586	A1	3/2017	Liu
2017/0055588	A1	3/2017	Cameron
2017/0071249	A1	3/2017	Ampolini et al.
2017/0108210	A1	4/2017	Meinhart et al.
2017/0112193	A1	4/2017	Chen
2017/0119057	A1	5/2017	Liu
2017/0119060	A1	5/2017	Li et al.
2017/0196265	A1	7/2017	Liu
2017/0196272	A1	7/2017	Li et al.
2017/0208857	A1	7/2017	Branton et al.
2017/0224013	A1	8/2017	Huang
2017/0231282	A1	8/2017	Bowen et al.
2017/0231286	A1	8/2017	Borkovec et al.
2017/0233114	A1	8/2017	Christensen et al.
2017/0245546	A1	8/2017	Huang
2017/0259170	A1	9/2017	Bowen et al.
2017/0347706	A1	12/2017	Aoun et al.
2017/0360093	A1	12/2017	Fernando
2018/0016040	A1	1/2018	Ewing et al.
2018/0022516	A1	1/2018	Liu
2018/0064169	A1	3/2018	Biel et al.
2018/0160733	A1	6/2018	Leadley et al.
2018/0161525	A1	6/2018	Liu et al.
2018/0168227	A1	6/2018	Fraser et al.

FOREIGN PATENT DOCUMENTS

CN	101263935	A	9/2008
CN	100589726	C	2/2010
CN	201430916	Y	3/2010
CN	204180941	U	3/2015
CN	204217907	U	3/2015
CN	204426692	U	7/2015
CN	105249536	A	1/2016
CN	205456063	U	8/2016
CN	105962419	A	9/2016
DE	202015009688	U1	3/2019
EP	0535695	A2	4/1993
EP	1093936	A1	4/2001
EP	2789248	A1	10/2014
EP	3031339	A1	6/2016
EP	3143884	A2	3/2017
EP	3158883	A2	4/2017
EP	3195738	A2	7/2017
EP	3024344	B1	9/2018
EP	3313215	B1	6/2019
EP	3409597	B1	6/2019
JP	2002231420	A	8/2002
JP	2016525345	A	8/2016
KR	20110006928	U	7/2011
KR	200461404	Y1	7/2012
KR	20-0462610	Y1	9/2012
KR	20120006582	U	9/2012
KR	200473510	Y1	8/2014
KR	101541750	B1	8/2015
KR	101634882	B1	6/2016
KR	200481405	Y1	10/2016
KR	101774283	B1	9/2017
KR	101995956	B1	7/2019
RU	2621596	C2	2/2016
WO	WO-2006021153	A1	3/2006
WO	WO-2009135729	A1	11/2009
WO	WO-2010045671	A1	4/2010
WO	WO-2010118644	A1	10/2010
WO	WO-2012040512	A2	3/2012
WO	WO-2012134117	A2	10/2012
WO	WO-2012173322	A1	12/2012
WO	WO-2012174677	A1	12/2012
WO	WO-2013089358	A1	6/2013
WO	WO-2013089551	A1	6/2013
WO	WO-2014020953	A1	2/2014
WO	WO-2014071747	A1	5/2014
WO	WO-2014101734	A1	7/2014
WO	WO-2014185937	A1	11/2014
WO	WO-2015070398	A1	5/2015
WO	WO-2015070405	A1	5/2015
WO	WO-2015100361	A1	7/2015
WO	WO-2015106440	A1	7/2015
WO	WO-2015107552	A1	7/2015
WO	WO-2015117703	A1	8/2015
WO	WO-2015120589	A1	8/2015
WO	WO-2015128665	A1	9/2015
WO	WO-2015144057	A1	10/2015
WO	WO-2015149311	A1	10/2015
WO	WO-2015149403	A1	10/2015
WO	WO-2015154309	A1	10/2015
WO	WO-2015157900	A1	10/2015
WO	WO-2015161407	A1	10/2015
WO	WO-2015161553	A1	10/2015
WO	WO-2015161557	A1	10/2015
WO	WO-2015165081	A1	11/2015
WO	WO-2015165083	A1	11/2015
WO	WO-2015165105	A1	11/2015
WO	WO-2015172331	A1	11/2015
WO	WO-2015172368	A1	11/2015
WO	WO-2015176230	A1	11/2015
WO	WO-2015176580	A1	11/2015
WO	WO-2015180061	A1	12/2015
WO	WO-2015180088	A1	12/2015
WO	WO-2015184747	A1	12/2015
WO	WO-2015188295	A1	12/2015
WO	WO-2015192377	A1	12/2015
WO	WO-2015196463	A1	12/2015
WO	WO-2016000206	A1	1/2016

(56) **References Cited**

FOREIGN PATENT DOCUMENTS

WO	WO-2016000214	A1	1/2016
WO	WO-2016019353	A1	2/2016
WO	WO-2016023212	A1	2/2016
WO	WO-2016023824	A1	2/2016
WO	WO-2016026104	A1	2/2016
WO	WO-2016029344	A1	3/2016
WO	WO-2016061730	A1	4/2016
WO	WO-2016061859	A1	4/2016
WO	WO-2016074229	A1	5/2016
WO	WO-2016090303	A1	6/2016
WO	WO-2016090602	A1	6/2016
WO	WO-2016095220	A1	6/2016
WO	WO-2016103202	A1	6/2016
WO	WO-2016106476	A1	7/2016
WO	WO-2016106500	A1	7/2016
WO	WO-2016108694	A1	7/2016
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WO	WO-2017163052	A1	9/2017
WO	WO-2017166263	A1	10/2017
WO	WO-2019210402	A1	11/2019

OTHER PUBLICATIONS

U.S. Appl. No. 17/199,370, filed Mar. 11, 2021, US 20210268206 A1.
U.S. Appl. No. 17/199,377, filed Mar. 11, 2021, U.S. Pat. No. 11,369,755.
U.S. Appl. No. 17/204,148, filed Mar. 17, 2021, U.S. Pat. No. 11,369,756.
U.S. Appl. No. 17/364,436, filed Jun 30, 2021, U.S. Pat. No. 11,369,757.
U.S. Appl. No. 18/173,715, filed Feb 23, 2023.
U.S. Appl. No. 18/124,249, filed Mar 21, 2023.

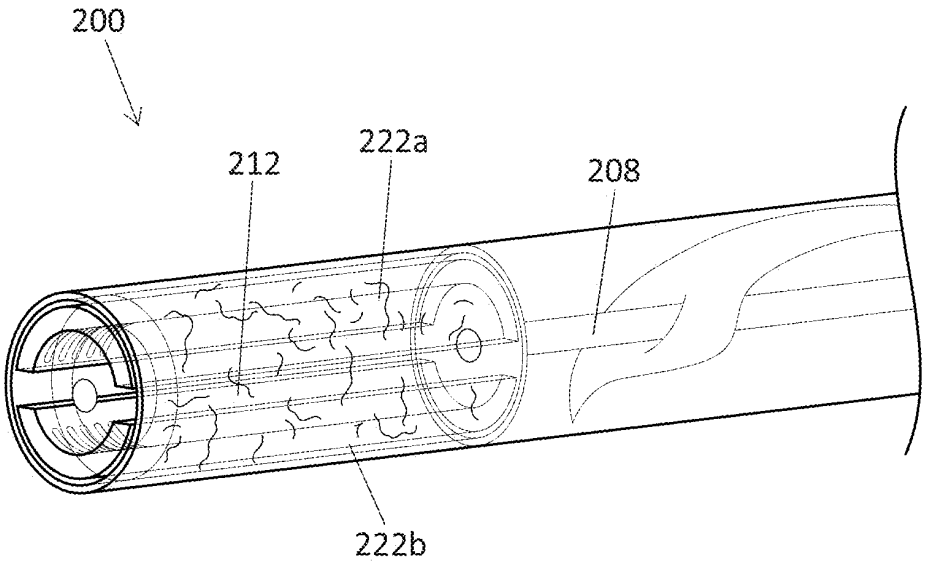


FIG. 1

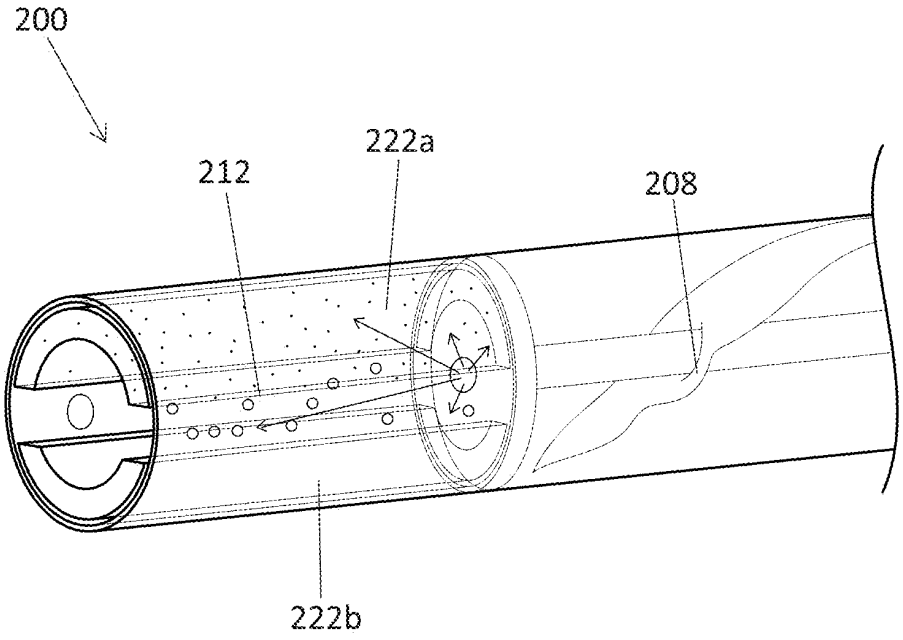


FIG. 2

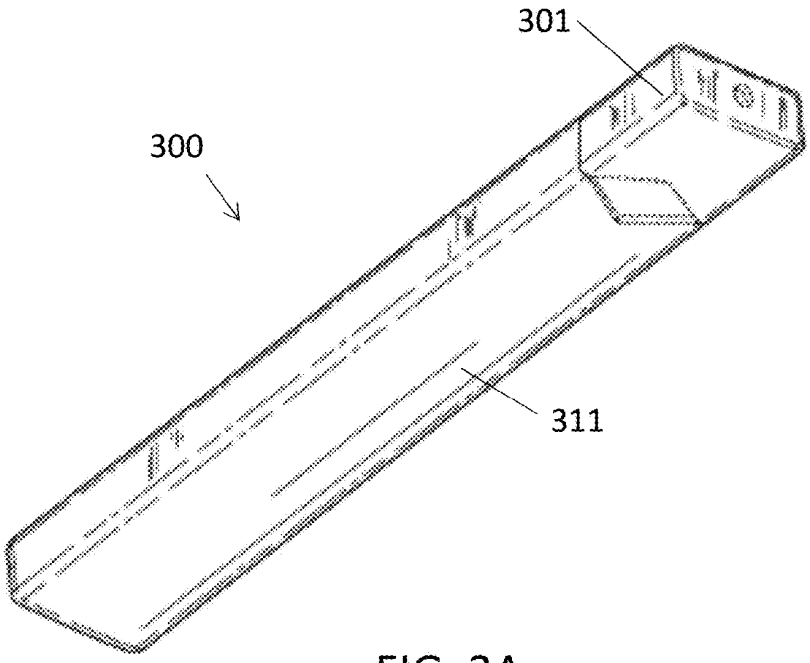

301
300
311

FIG. 3A

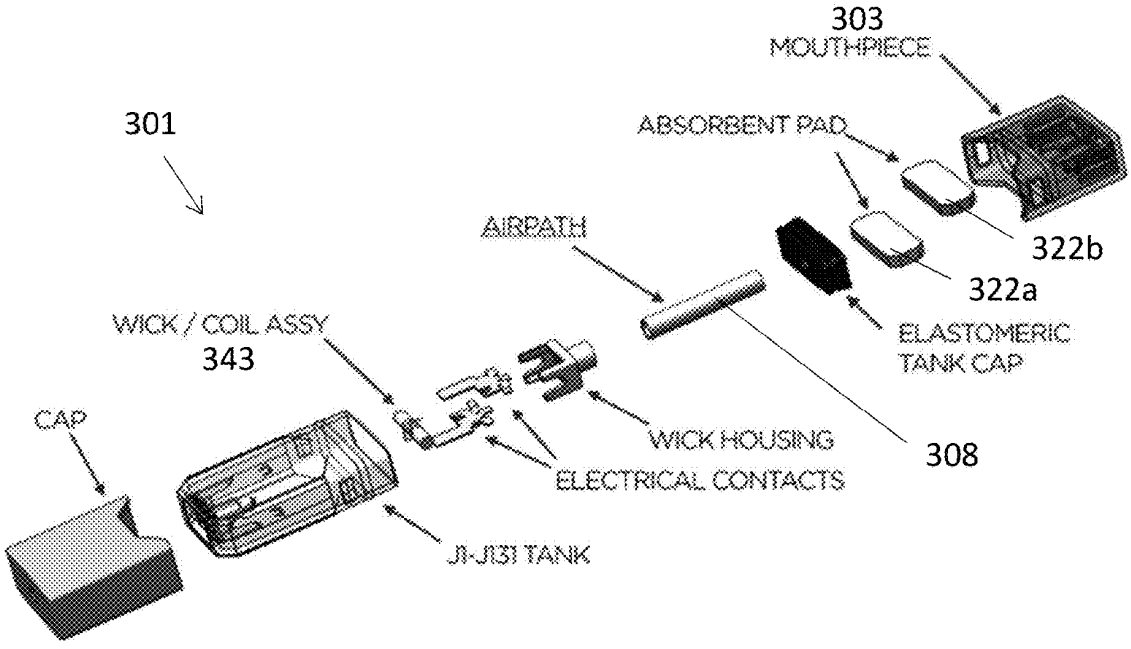

303
MOUTHPIECE
301
ABSORBENT PAD
AIRPATH
322b
322a
ELASTOMERIC
TANK CAP
WICK / COIL ASSY
343
CAP
WICK HOUSING
308
ELECTRICAL CONTACTS
JI-JI3I TANK

FIG. 3B

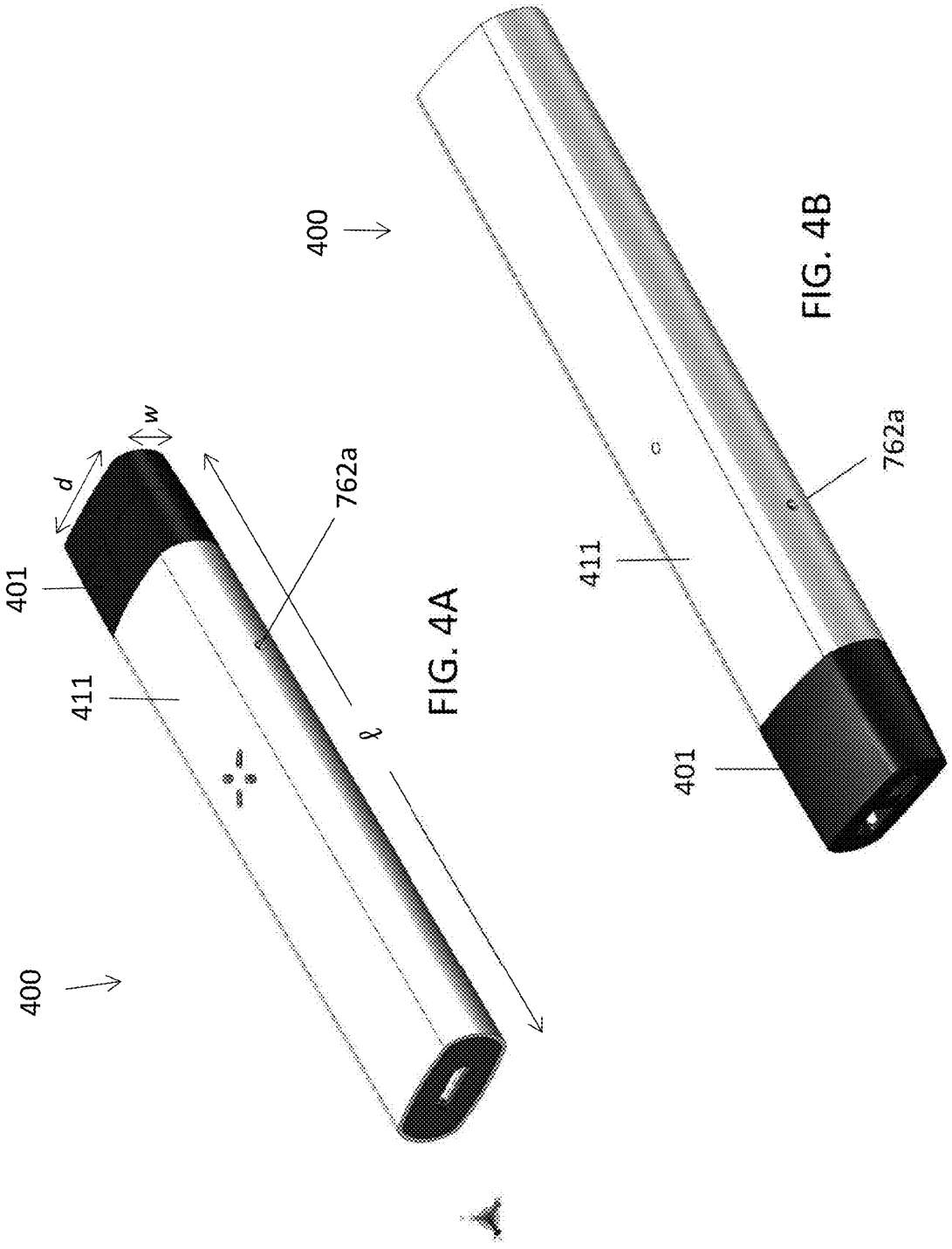


FIG. 4A

FIG. 4B

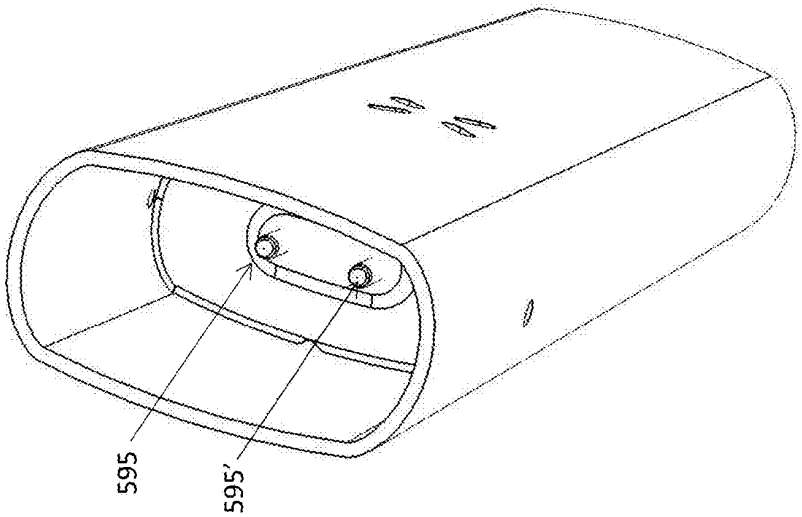


FIG. 5C

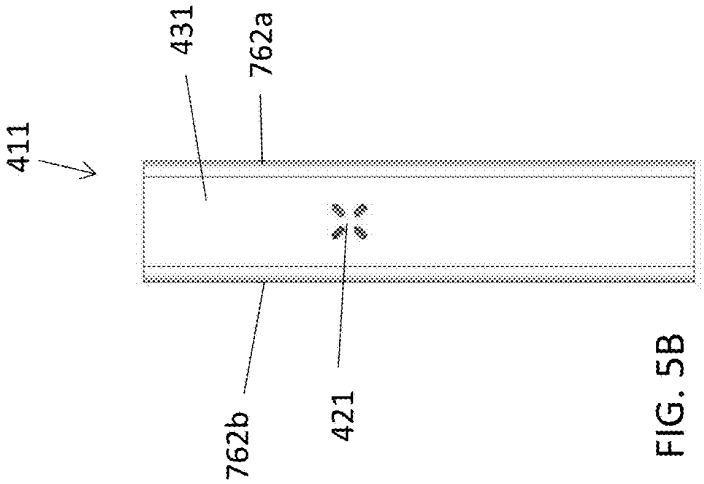


FIG. 5B

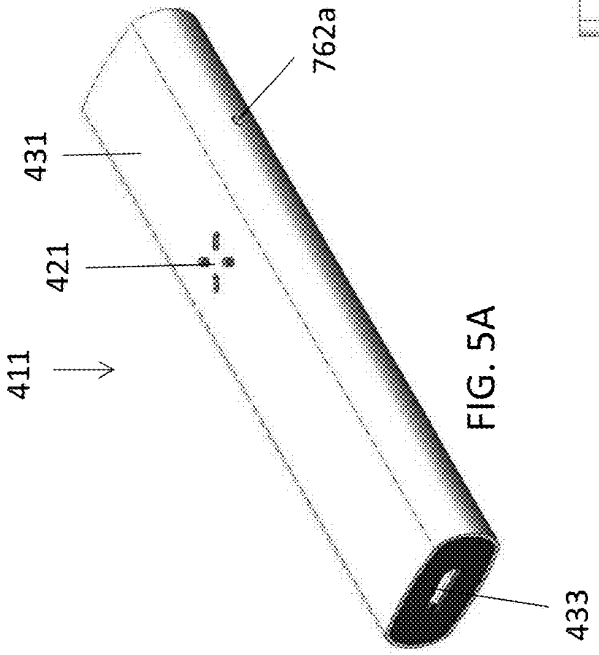


FIG. 5A

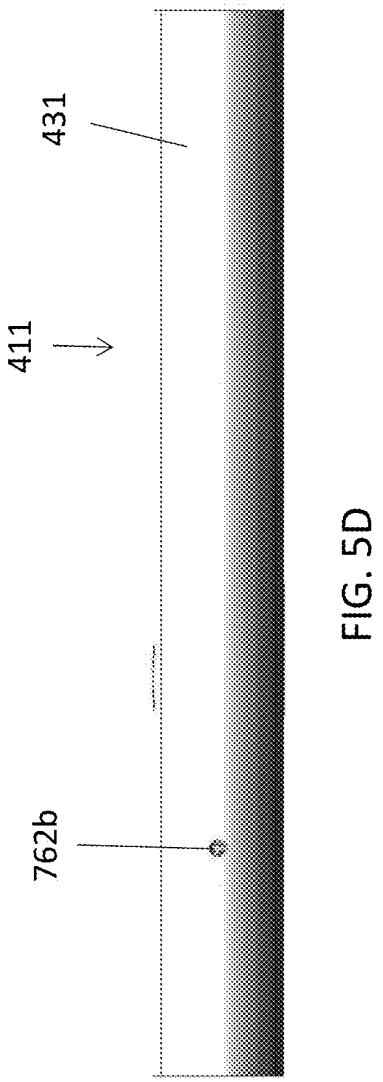


FIG. 5D

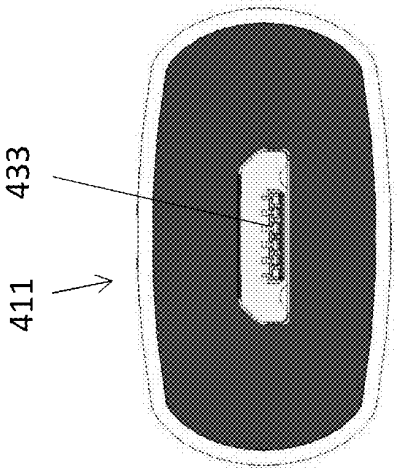


FIG. 5F

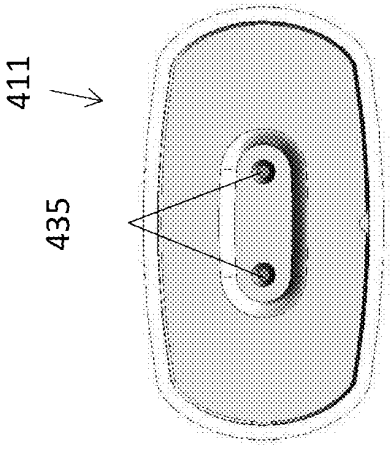


FIG. 5E

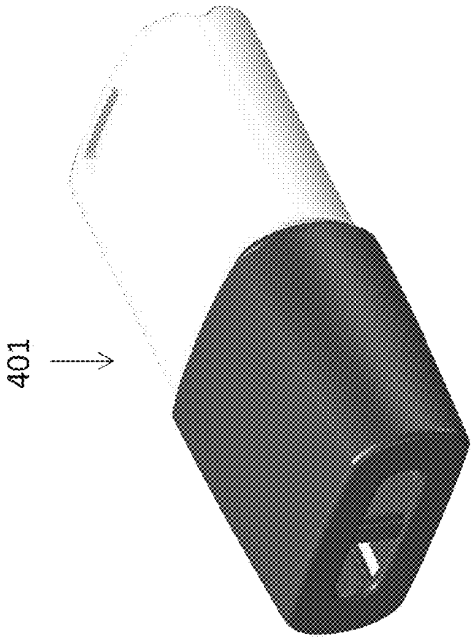


FIG. 6C

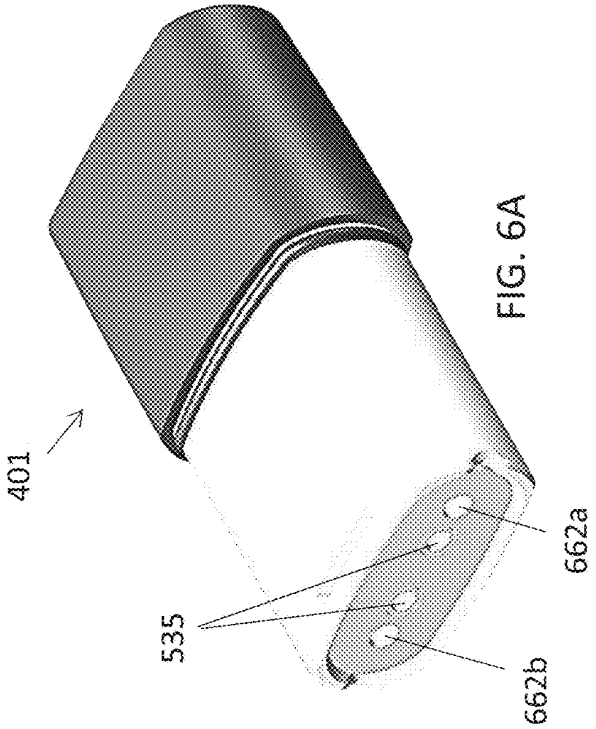


FIG. 6A

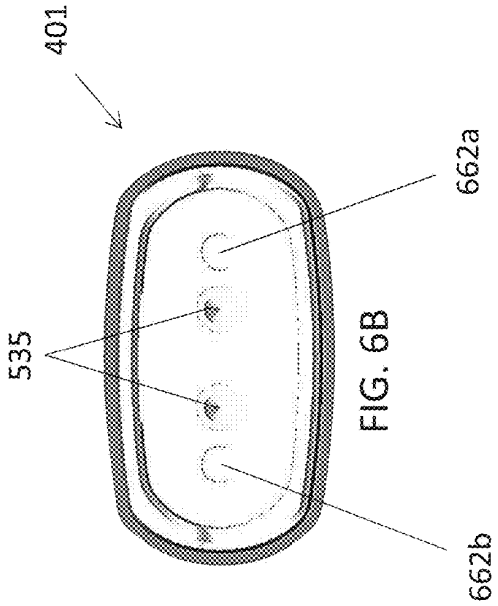


FIG. 6B

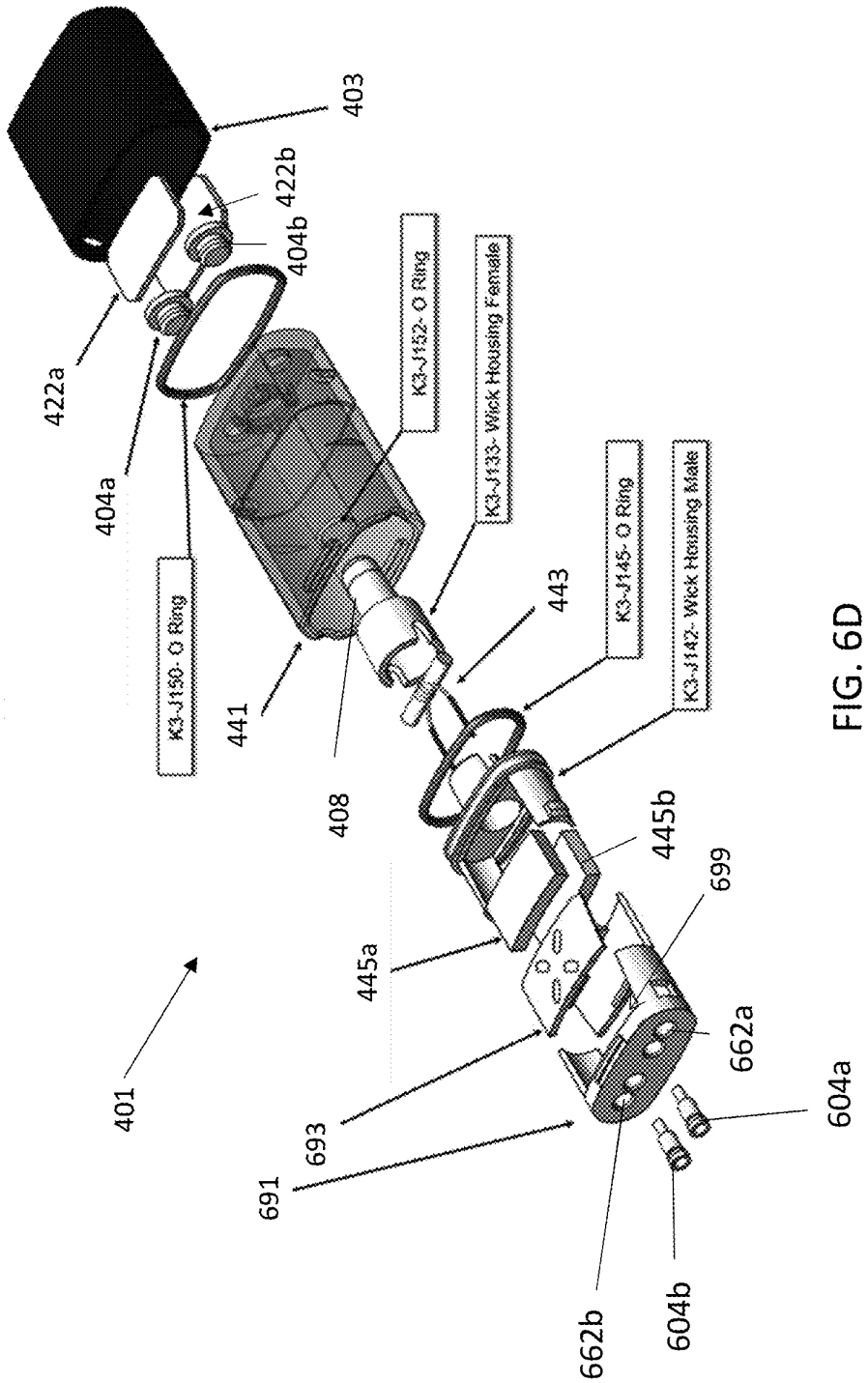

403
422b
404b
422a
404a
K3-J152- O Ring
K3-J133- Wick Housing Female
K3-J150- O Ring
K3-J145- O Ring
K3-J142- Wick Housing Male
443
441
408
445b
699
445a
662a
604a
401
693
691
662b
604b

FIG. 6D

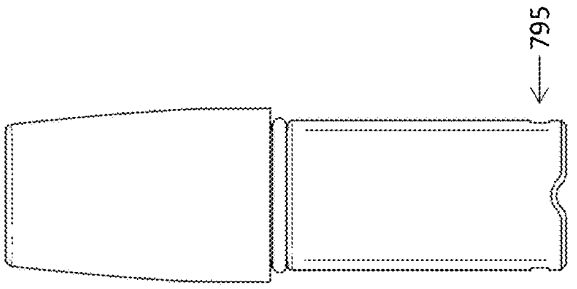


FIG. 7D

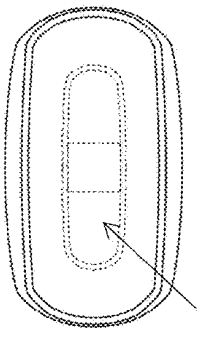


FIG.7F

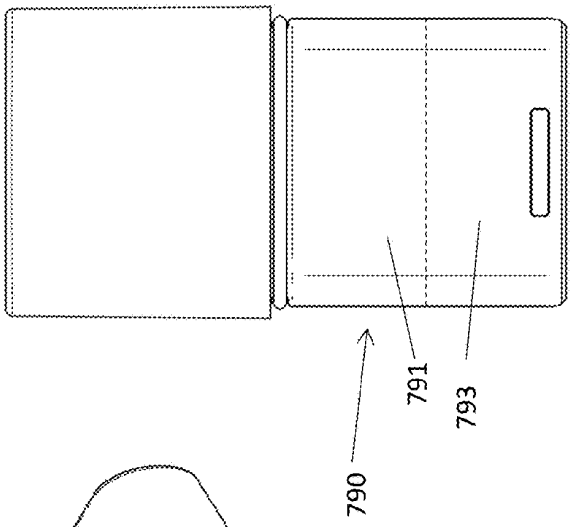


FIG. 7C

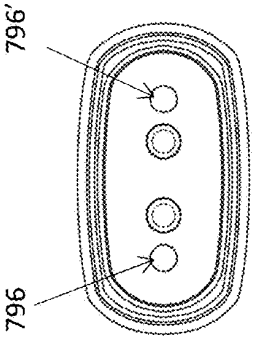


FIG. 7E

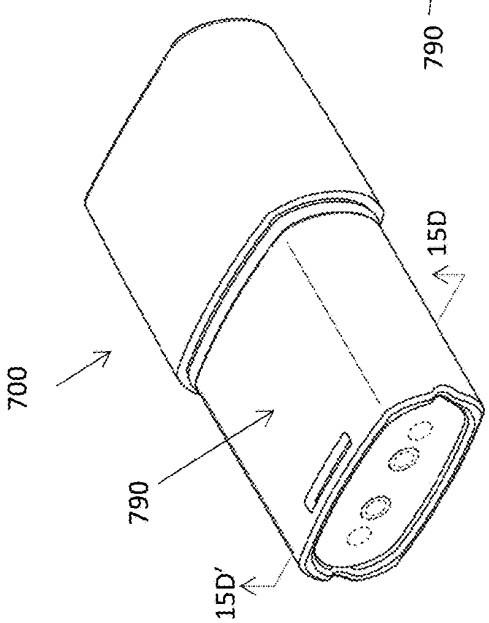


FIG. 7A

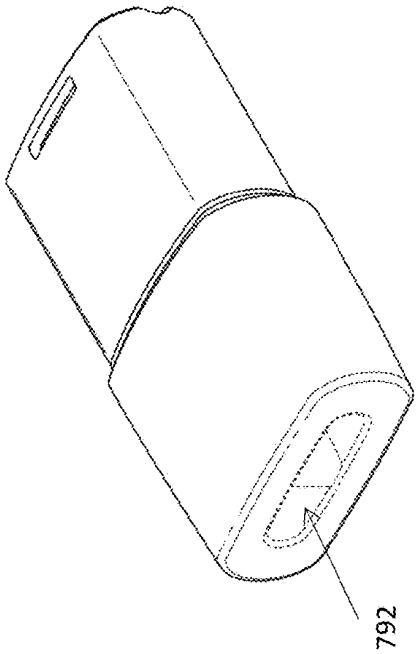


FIG. 7B

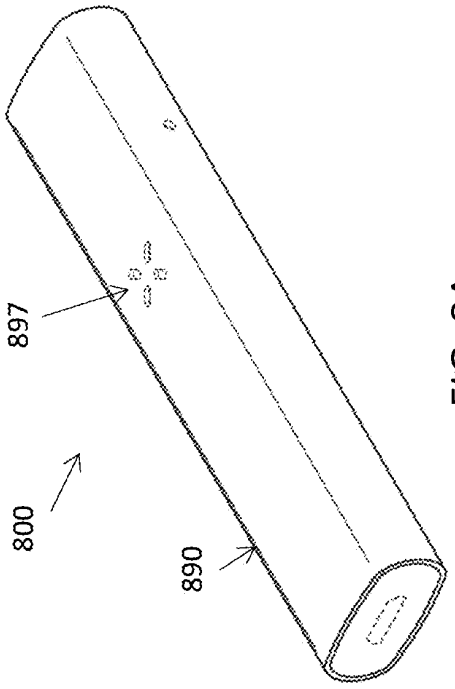


FIG. 8A

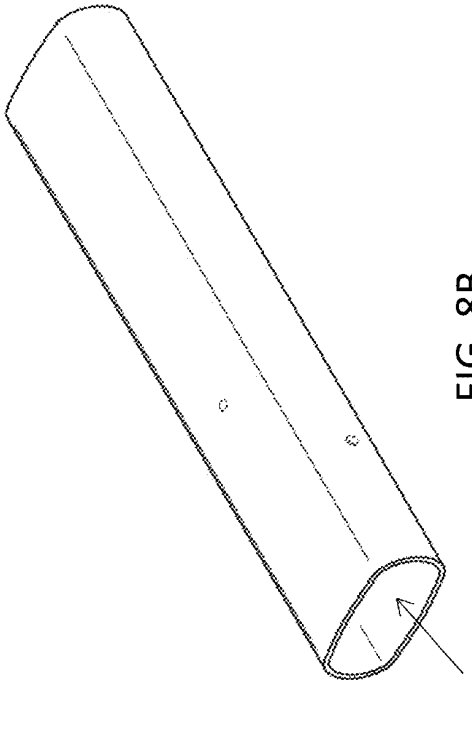


FIG. 8B

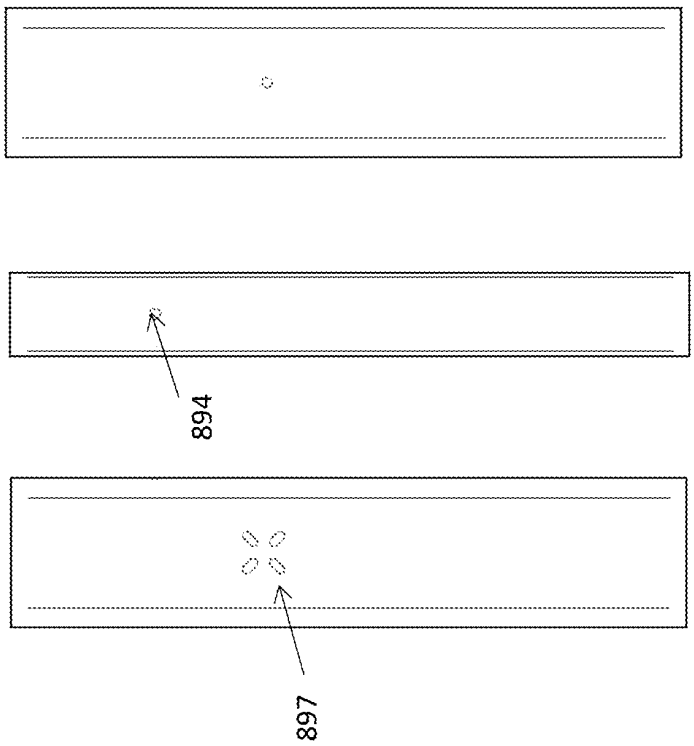


FIG. 8C

FIG. 8D

FIG. 8E

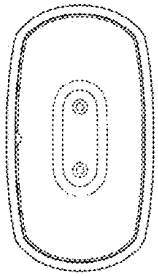


FIG. 8G

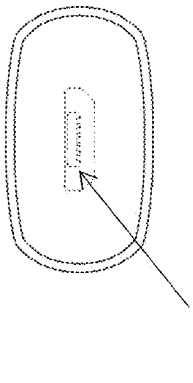


FIG. 8F

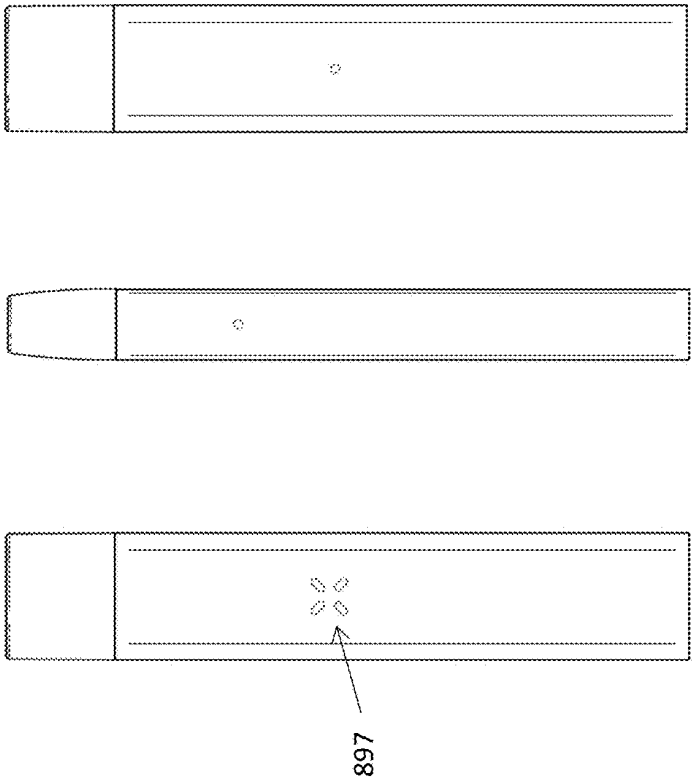


FIG. 9C

FIG. 9D

FIG. 9E

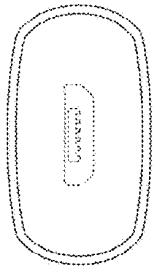


FIG. 9F

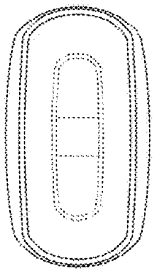


FIG. 9G

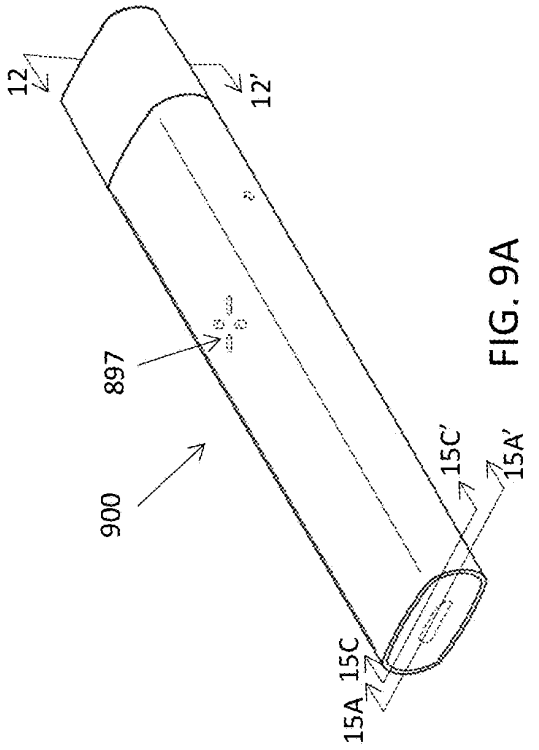


FIG. 9A

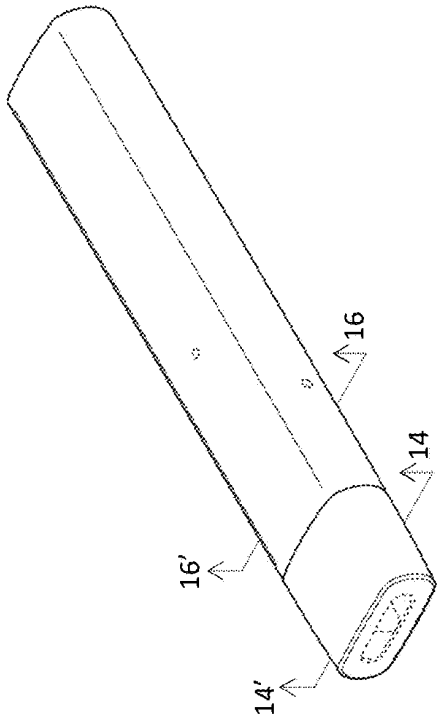


FIG. 9B

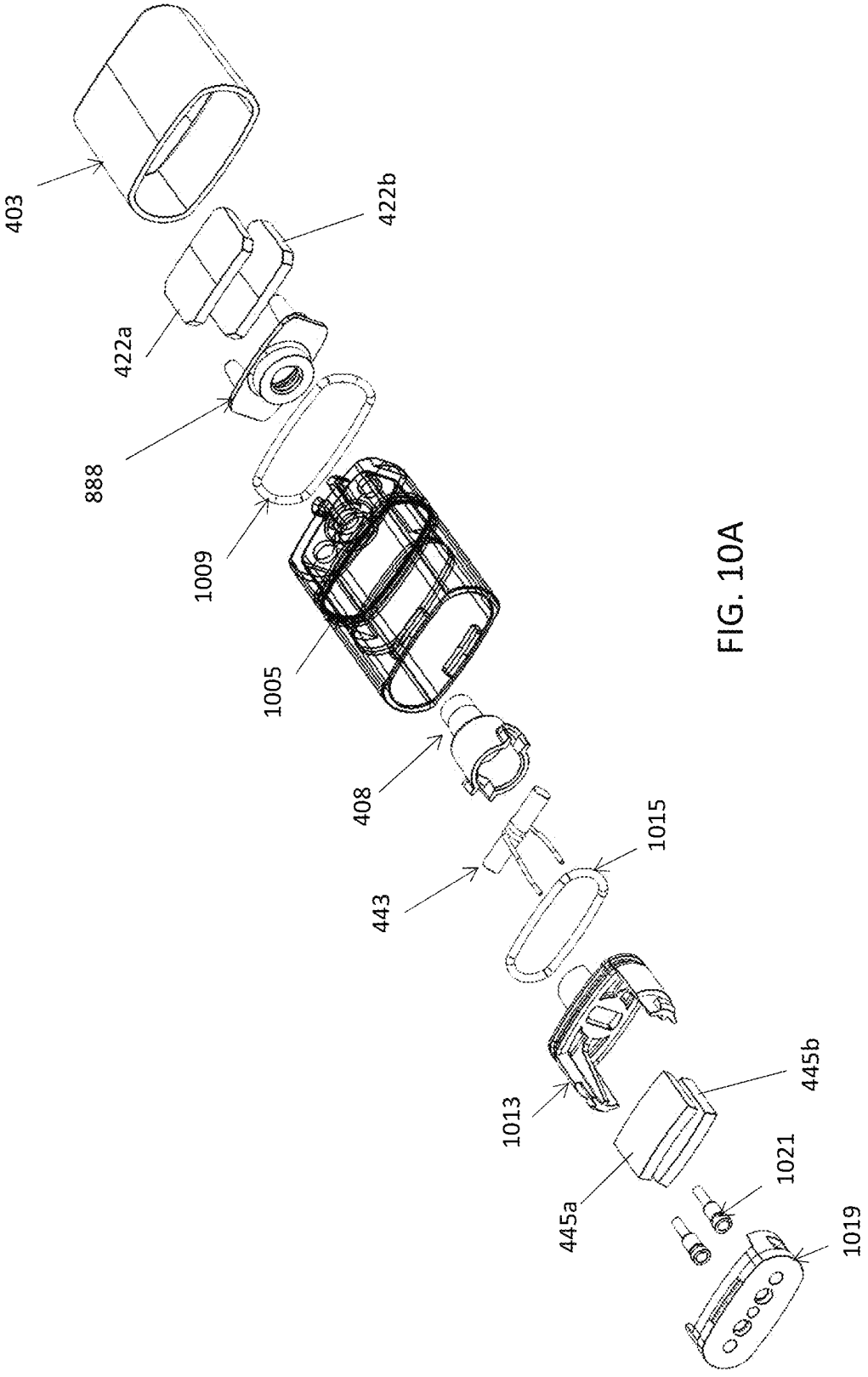

403
422b
422a
888
1009
1005
408
443
1015
1013
445b
445a
1021
1019

FIG. 10A

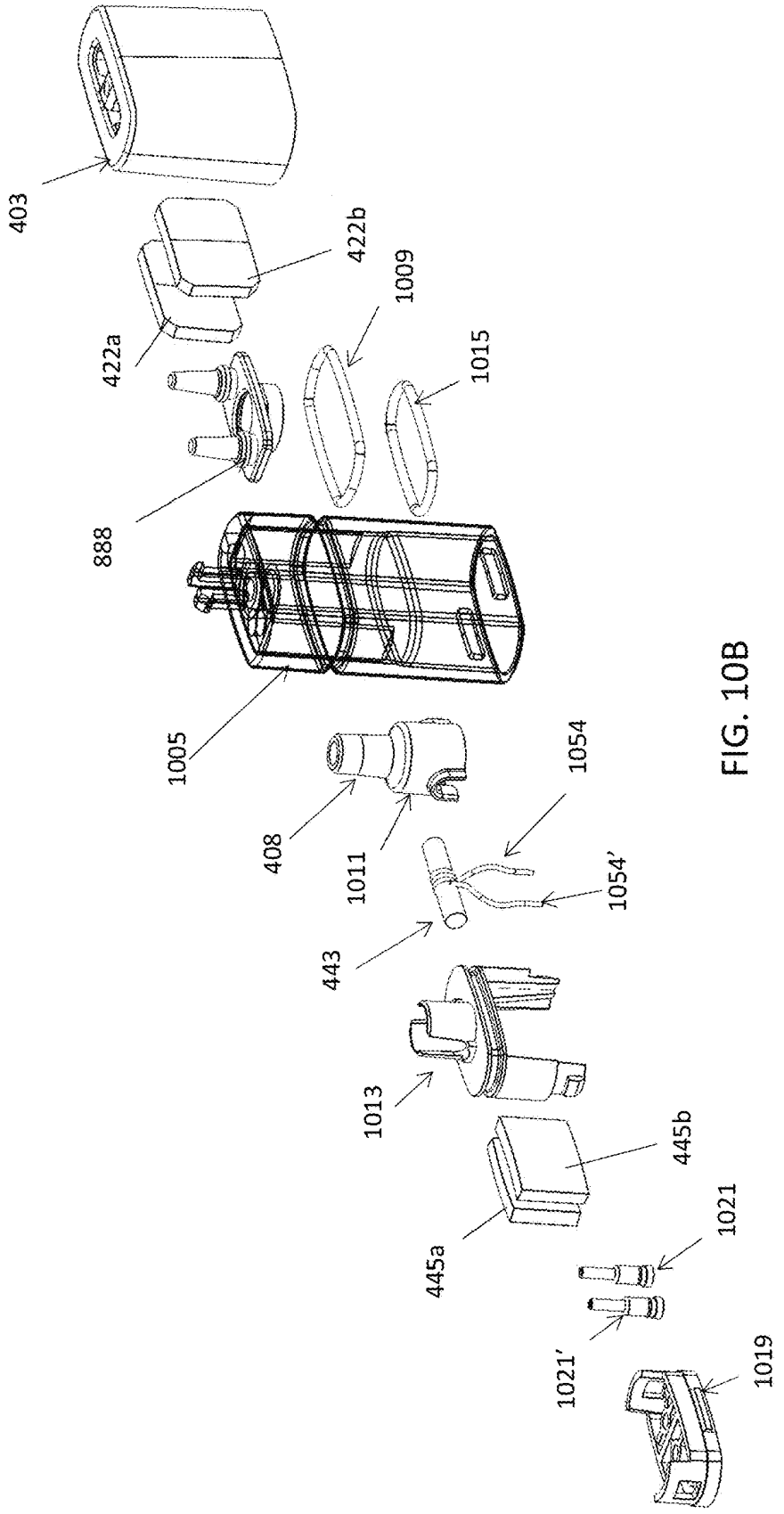

403
422b
1009
422a
1015
888
1005
408
1011
1054
1054'
443
1013
445b
445a
1021
1021'
1019

FIG. 10B

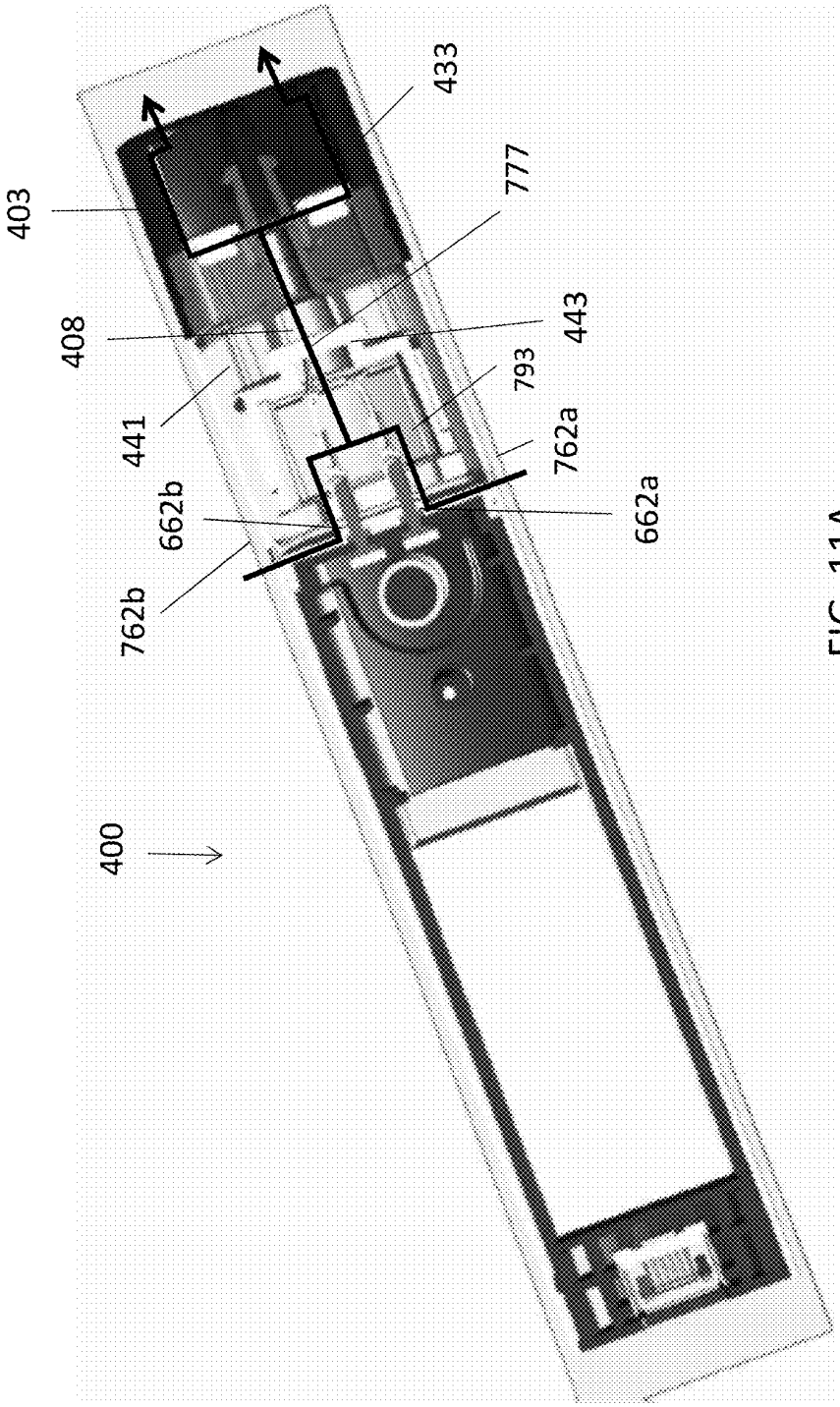


FIG. 11A

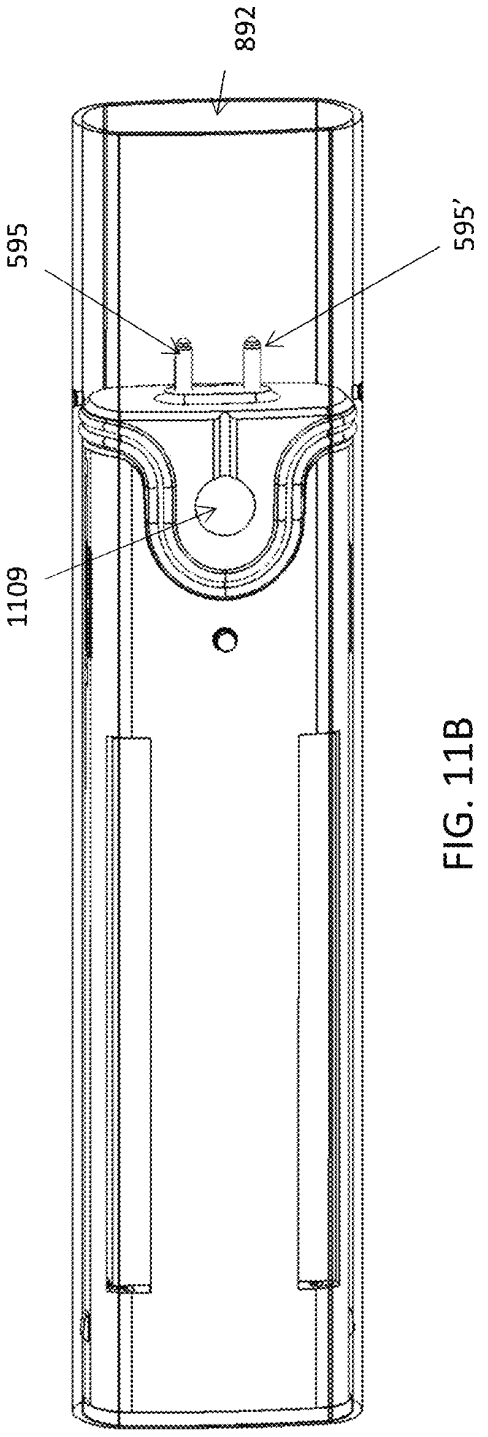


FIG. 11B

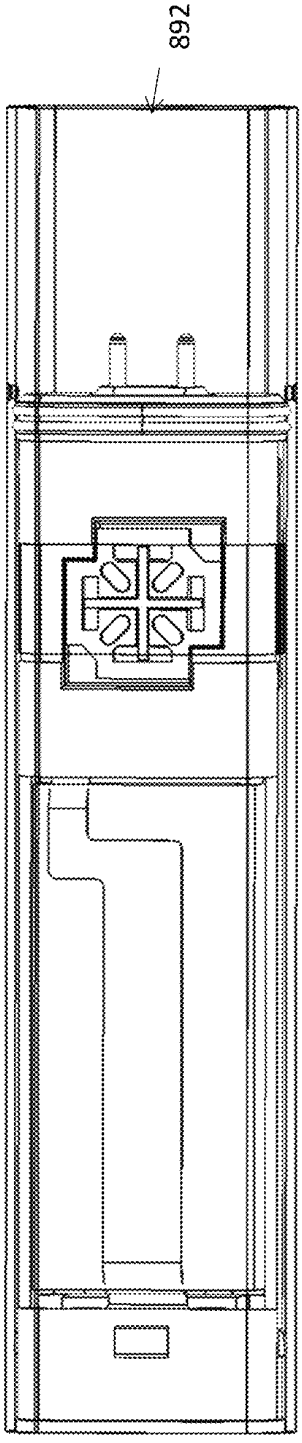


FIG. 11C

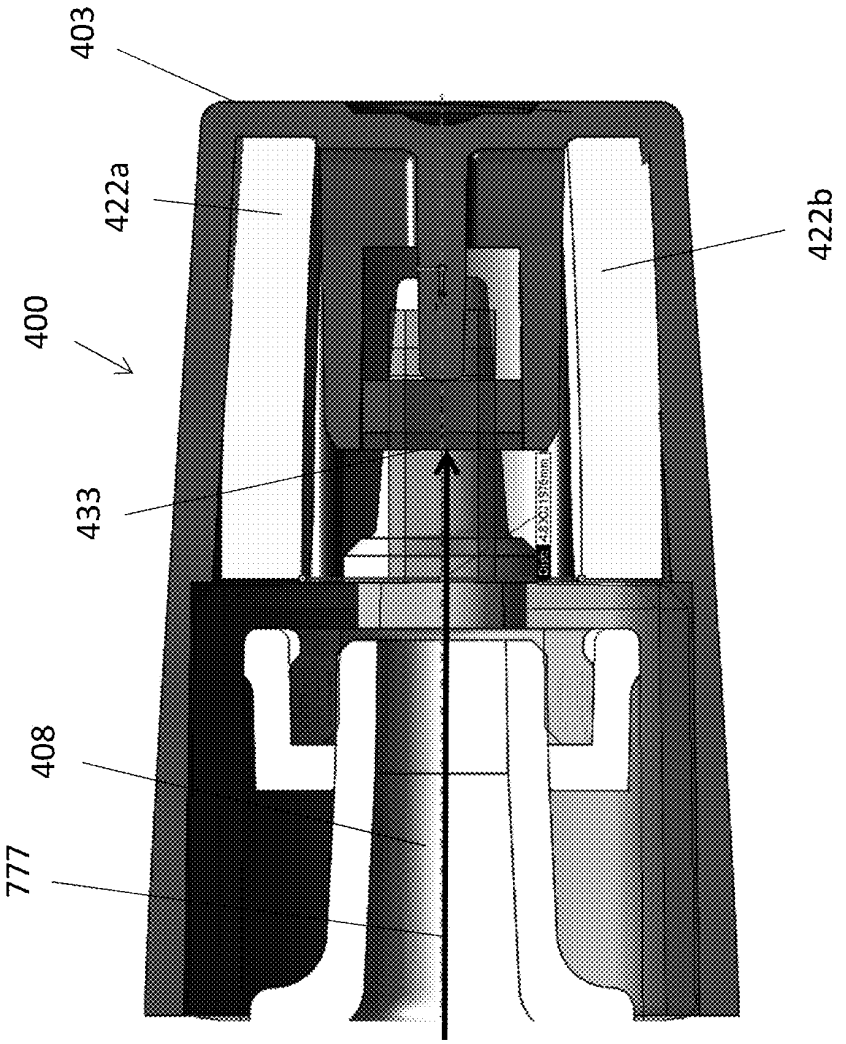


FIG. 12

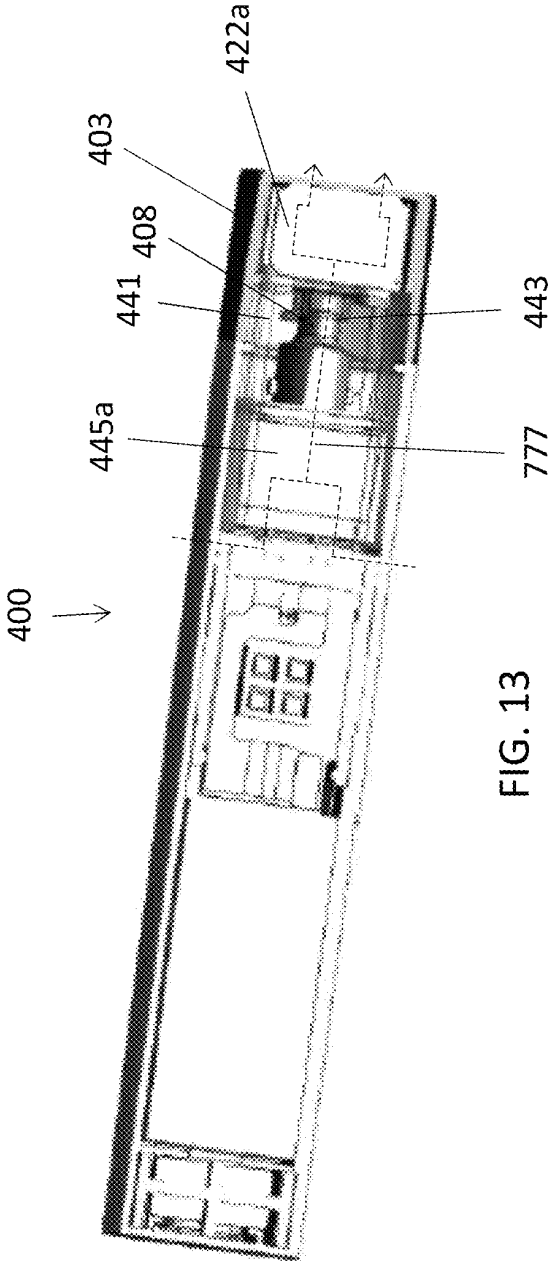


FIG. 13

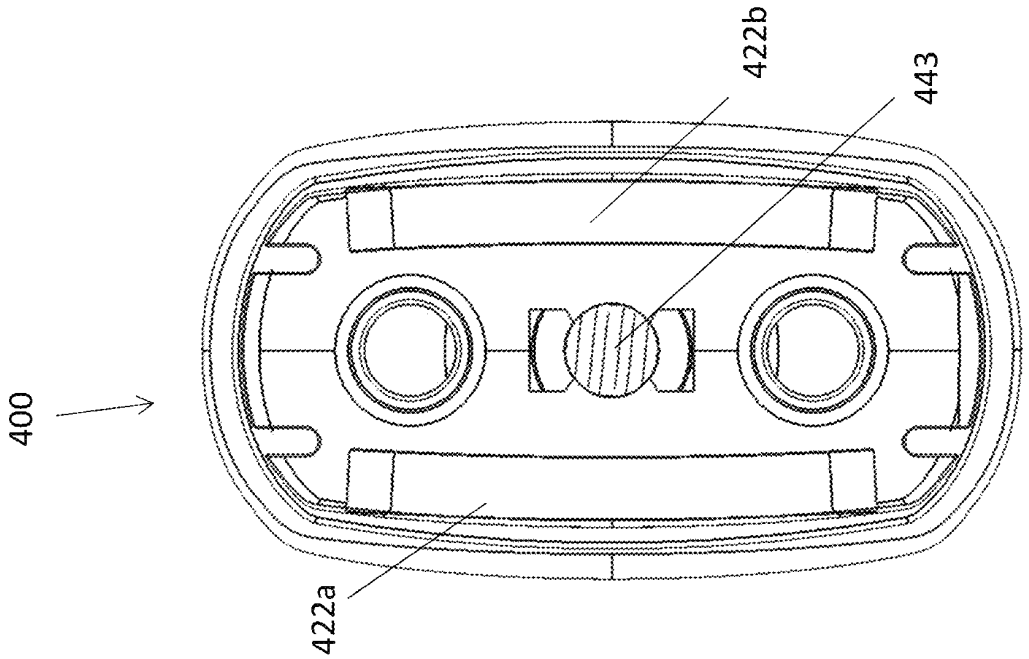


FIG. 14

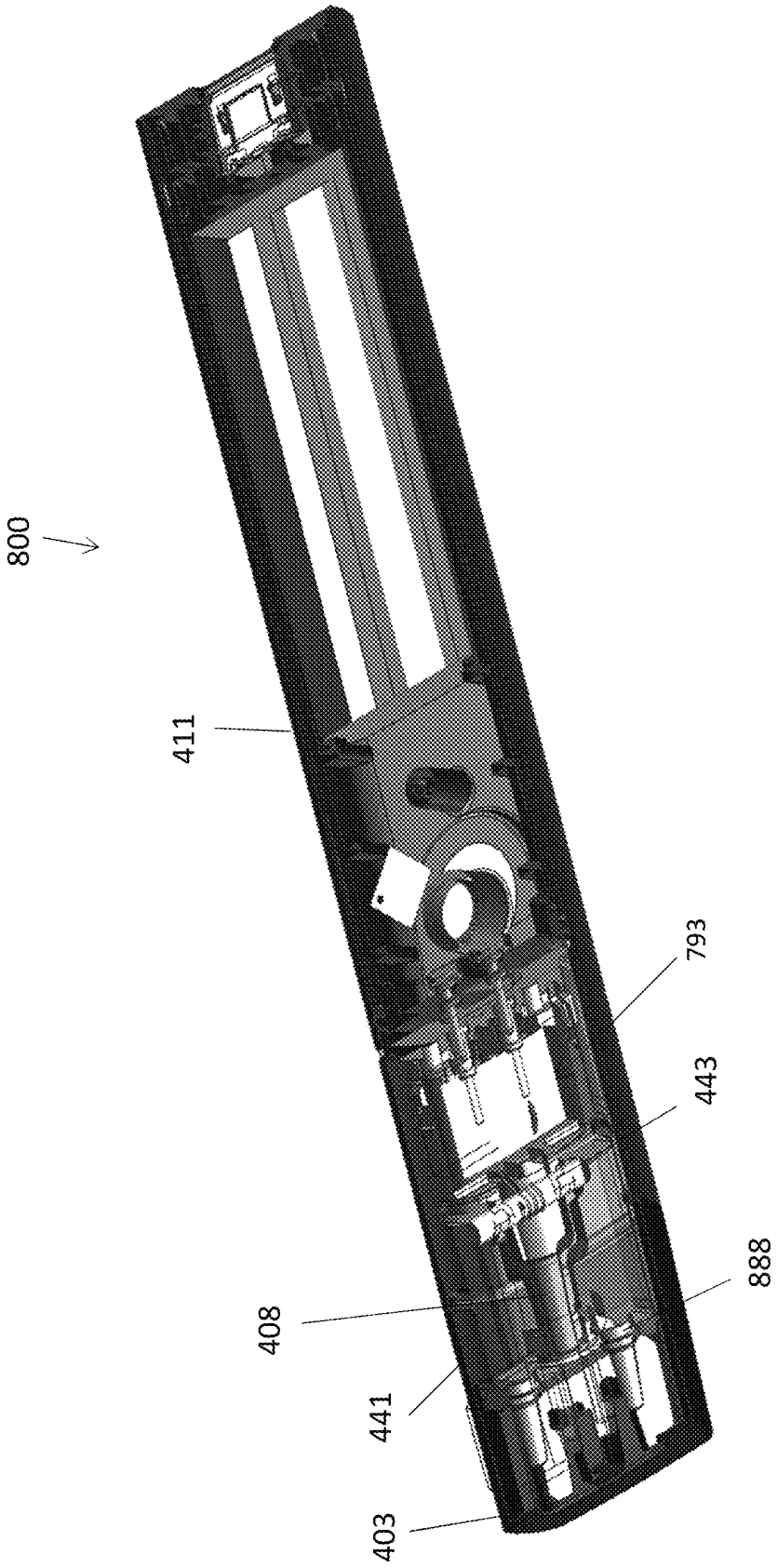


FIG. 15A

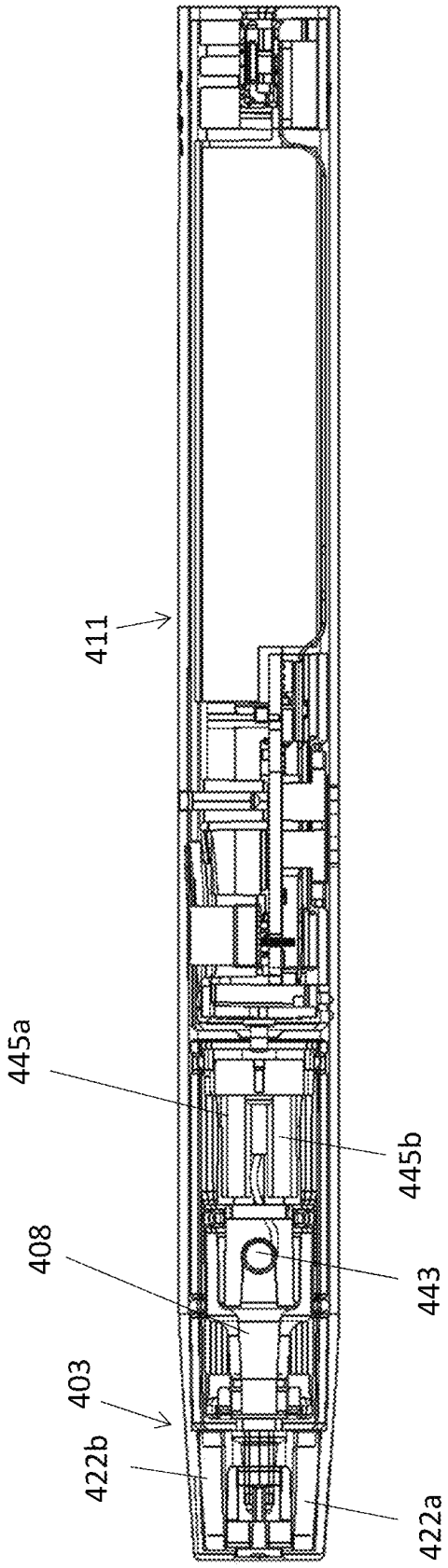


FIG. 15B

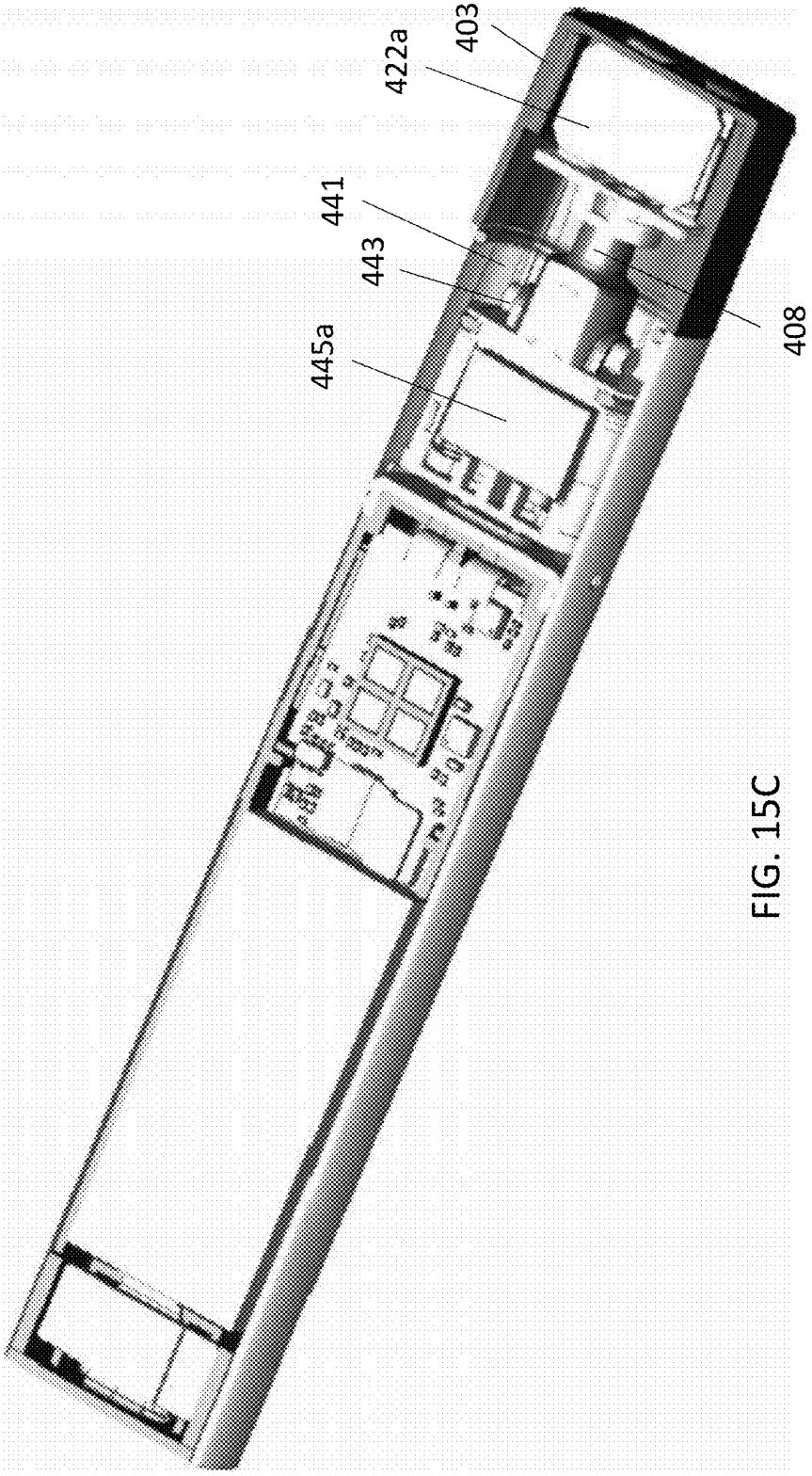


FIG. 15C

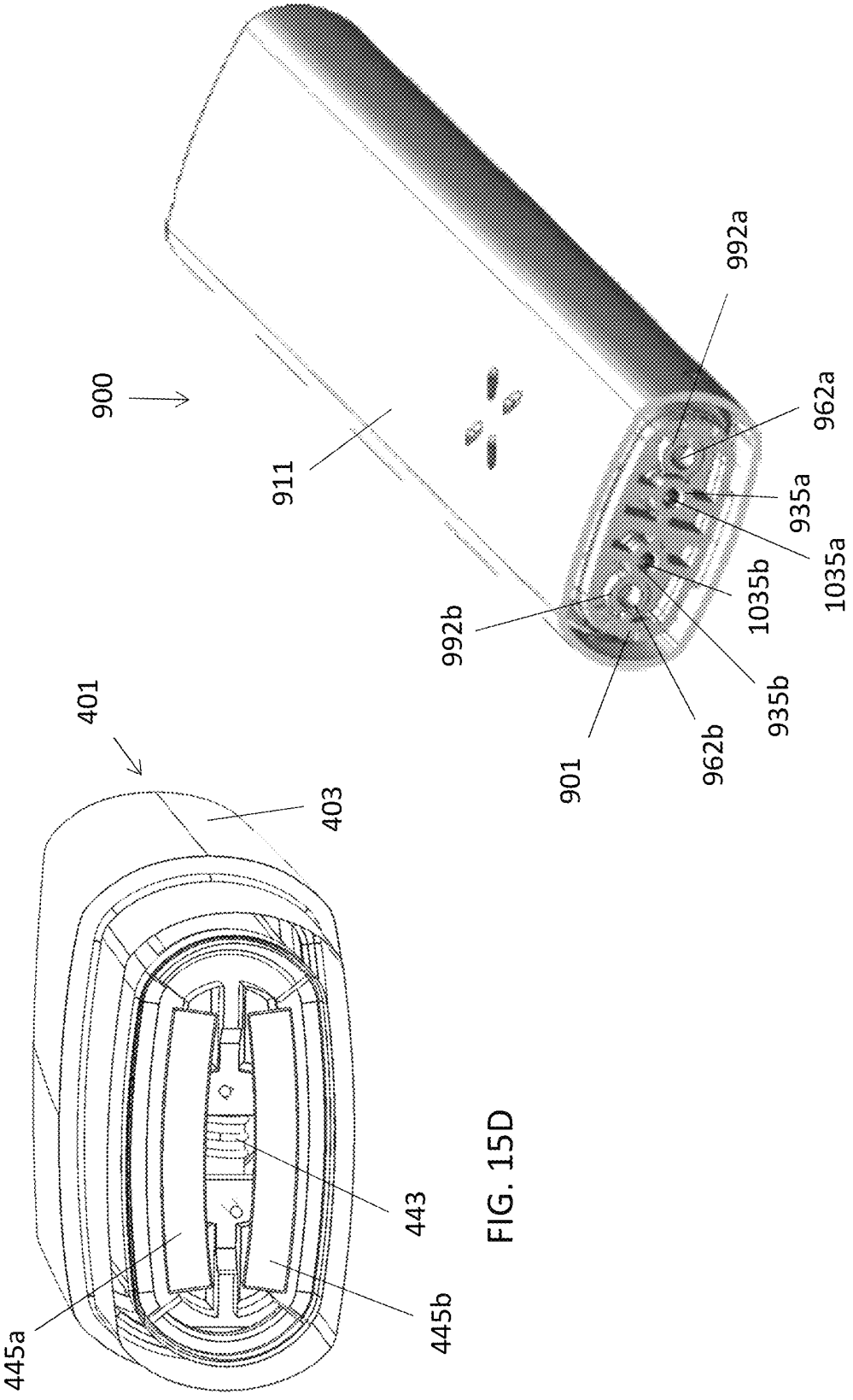


FIG. 16

FIG. 15D

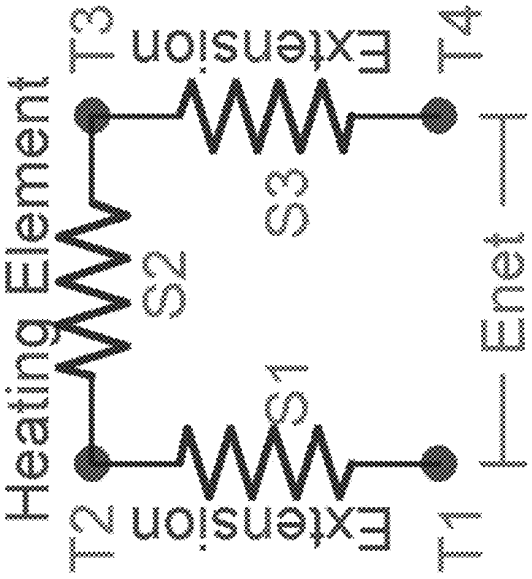

T3
Extension
T4
Heating Element
S3
S2
S1
Enet
T2
Extension
T1

FIG. 17

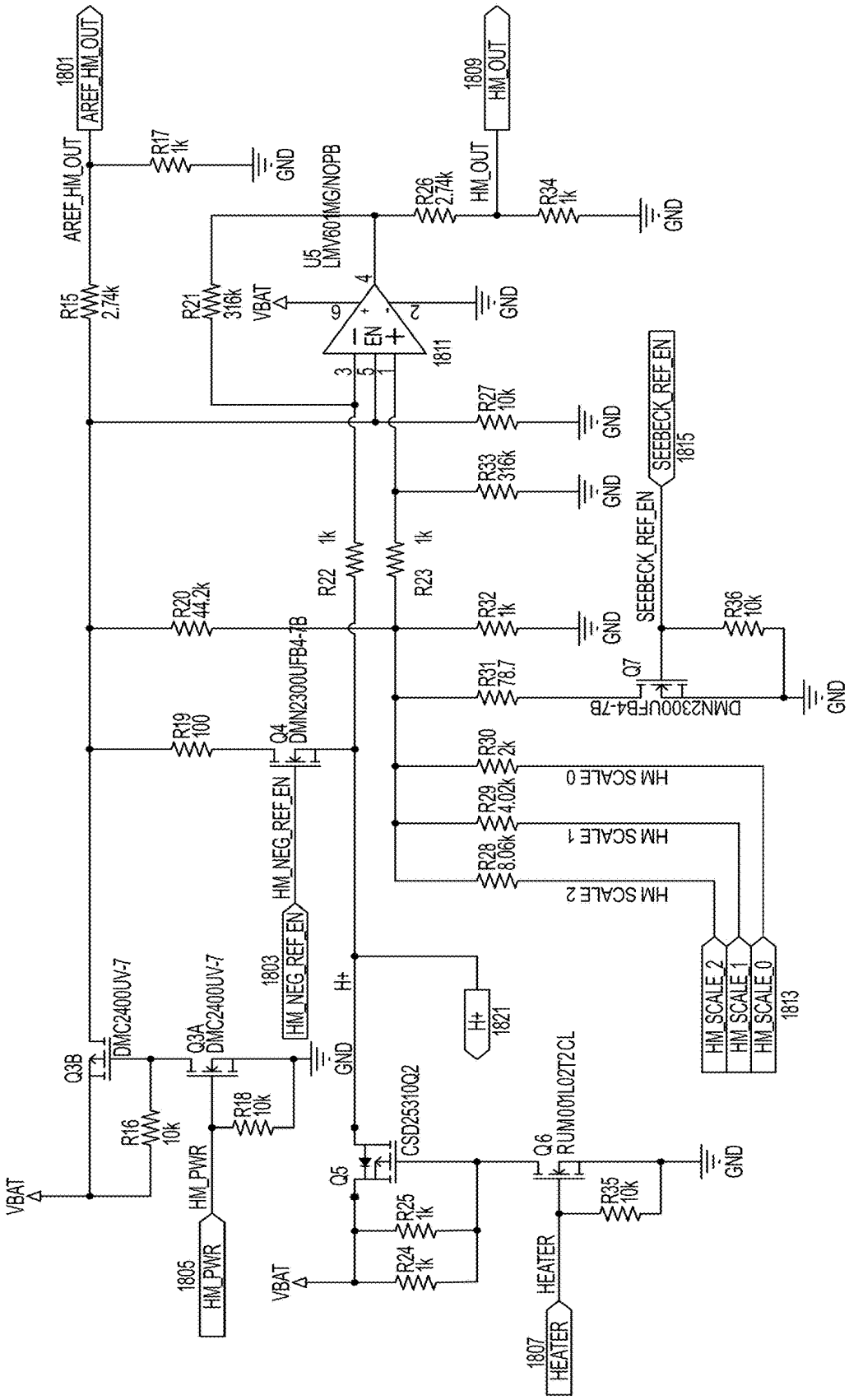

1801
AREF_HM_OUT
R17
1k
GND
1809
HM_OUT
HM_OUT
R26
2.74k
R34
1k
GND
U5
LMV601MG/NOPB
R15
2.74k
R21
316k
VBAT
GND
1811
R27
10k
GND
SEEBECK_REF_EN
1815
R33
316k
GND
R22
1k
R23
1k
R20
44.2k
R32
1k
GND
R36
10k
Q7
DMN2300UFB4-7B
R31
78.7
GND
R19
100
Q4
DMN2300UFB4-7B
R30
2k
HM SCALE 0
R29
4.02k
HM SCALE 1
R28
8.06k
HM SCALE 2
HM_NEG_REF_EN
1803
HM_NEG_REF_EN
H+
H+
1821
HM_SCALE_2
HM_SCALE_1
HM_SCALE_0
1813
Q3B
DMC2400UV-7
Q3A
DMC2400UV-7
GND
R16
10k
R18
10k
CSD25310Q2
Q5
Q6
RUM001L02T2CL
GND
VBAT
HM_PWR
R25
1k
R35
10k
1805
HM_PWR
VBAT
R24
1k
HEATER
1807
HEATER

FIG. 18

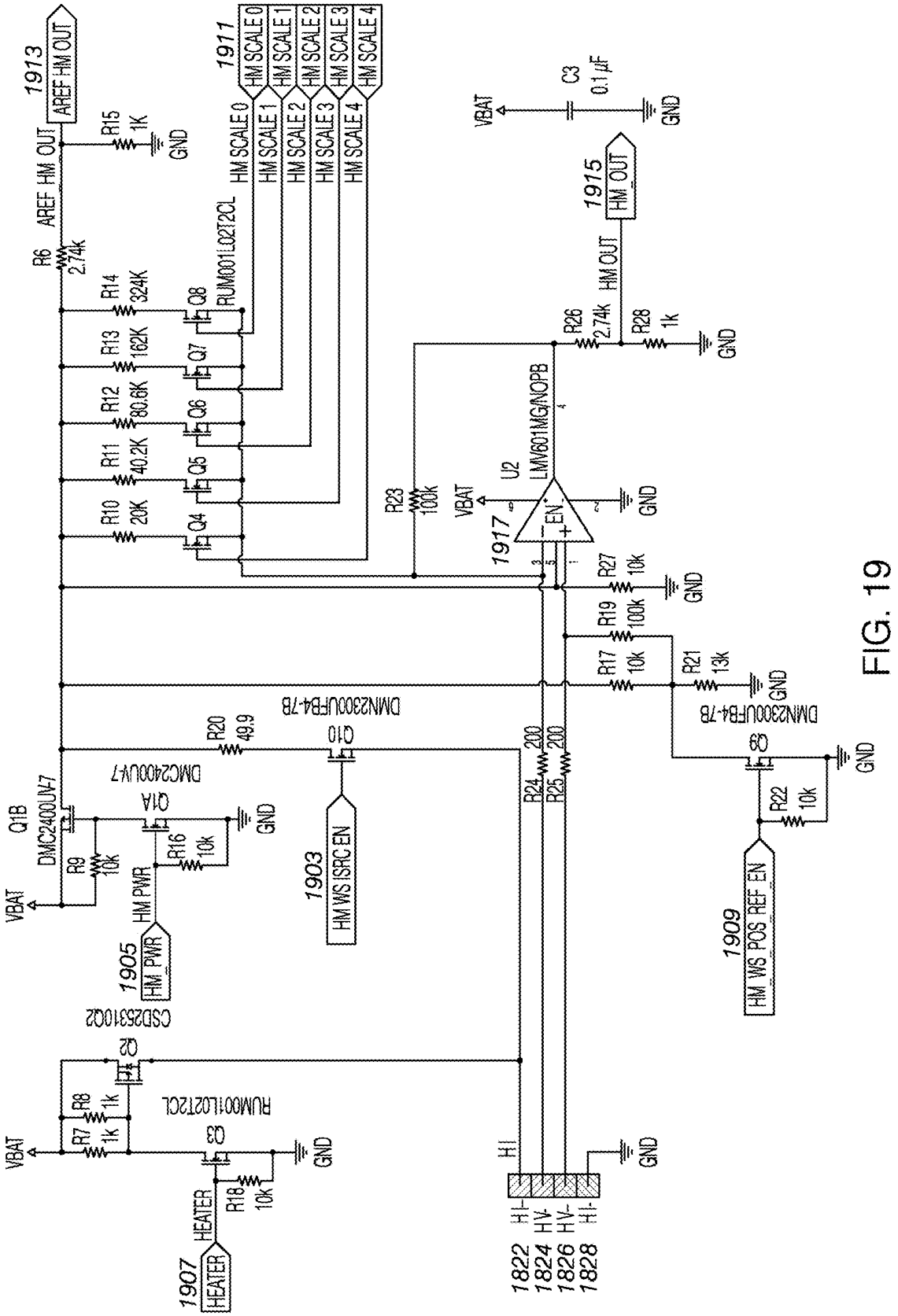

1913
AREF HM OUT
R15
1K
GND
1911
HM SCALE 0
HM SCALE 1
HM SCALE 2
HM SCALE 3
HM SCALE 4
R6
2.74k
R14
324K
R13
162K
R12
80.6K
R11
40.2K
R10
20K
Q8
Q7
Q6
Q5
Q4
RUM001L02T2CL
C3
0.1 µF
VBAT
GND
1915
HM_OUT
HM OUT
R26
2.74k
R28
1k
U2
LMV601MG/NOPB
R23
100k
1917
EN
R27
10k
R19
100k
R17
10k
R21
13k
DMN2300UFB4-7B
R20
49.9
Q10
R24
200
R25
200
Q9
R22
10k
1909
HM_WS_POS_REF_EN
Q1B
DMC2400UV-7
Q1A
R9
10k
R16
10k
HM PWR
1905
HM_PWR
1903
HM WS ISRC EN
CSD25310Q2
Q2
R8
1k
R7
1k
RUM001L02T2CL
Q3
R18
10k
HEATER
1907
HEATER
H1
H1-
HV-
HV-
H1-
1822
1824
1826
1828

FIG. 19

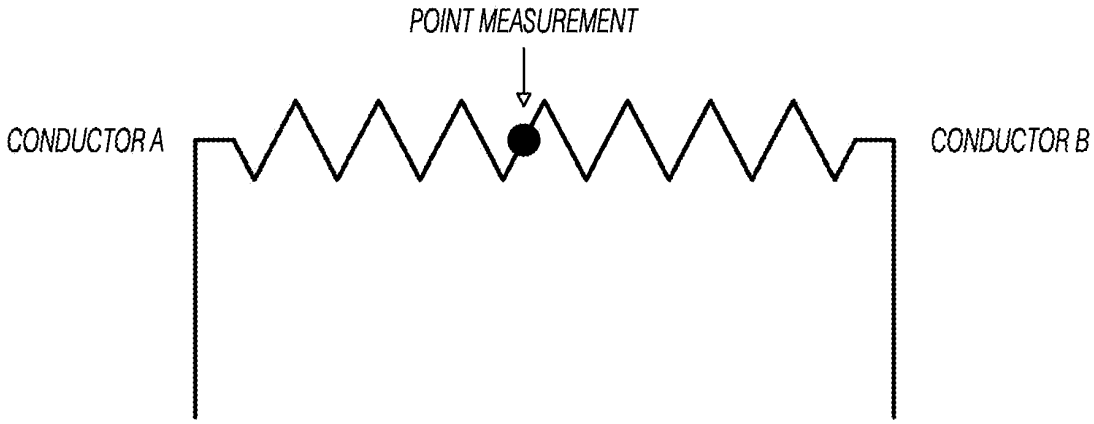


FIG. 20A

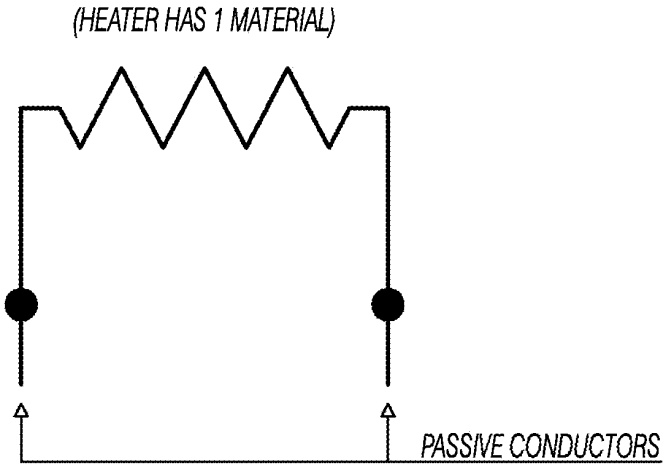


FIG. 20B

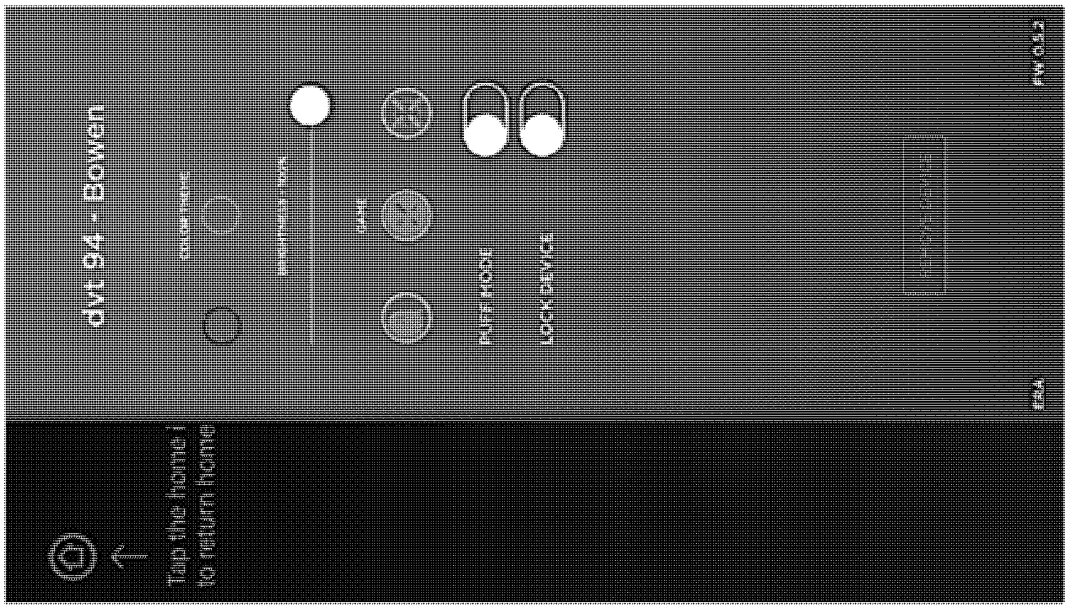

dvt 94 - Bowen
Tap the home i
to return home
PUFF MODE
LOCK DEVICE

FIG. 22

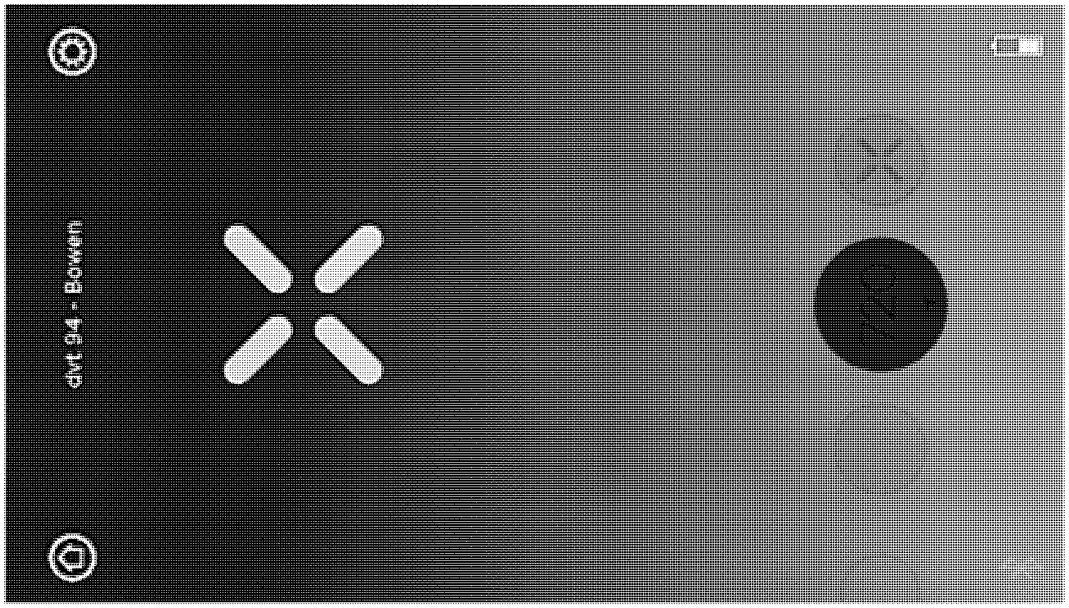

dvt 94 - Bowen

FIG. 21

LEAK-RESISTANT VAPORIZER DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

This patent application is a continuation of U.S. patent application Ser. No. 15/396,584, titled "LEAK-RESISTANT VAPORIZER DEVICE," filed on Dec. 31, 2016, which claims priority to U.S. Provisional Patent Application No. 62/398,494, filed on Sep. 22, 2016 and entitled "VAPORIZER APPARATUSES FOR USE WITH CANNABINOIDS", the disclosure of each of which is incorporated herein by reference in its entirety.

INCORPORATION BY REFERENCE

All publications and patent applications mentioned in this specification are herein incorporated by reference in their entirely to the same extent as if each individual publication or patent application was specifically and individually indicated to be incorporated by reference.

FIELD

Described herein are vaporizer apparatuses, including vaporizer or vaporization devices and vaporizer systems, and methods for making, using and delivering vapor to a user. In particular, vaporizer apparatuses adapted for use with oil-based vaporizable materials including cannabis oils.

BACKGROUND

Electronic devices that produce an inhalable aerosol (e.g., inhalable aerosol devices or alternatively referred to as vaporizers, vaporizer devices, vaporization devices, electronic vaping devices, etc.) typically utilize a vaporizable material that is heated to create an aerosol vapor capable of delivering an active ingredient to a user. Vaporizers have been described for vaporizing solids (herbs, tobacco, cannabis, etc.), liquids (extracts, waxes, etc.) and combinations of both solids and liquids.

Current market inhalable aerosol devices often consist of a tank or cartridge, vaporizable liquid in the tank or cartridge, an air tube, and a wick/coil subassembly that generates the vapor. Air commonly enters the cartridge through the distal end of the product and is forced through the heated zone where the immediate air becomes fully saturated. As the vapor continues its way through the air tube, it comes in contact with cooler surfaces, causing moisture to collect throughout its use. Depending on the complexity of the air path, particle deposition can add to the existing condensation. As a result, some of the liquid can work its way from the tank or cartridge holding the liquid to other areas of the vaporizer, including the mouthpiece and/or the electronics, causing user dissatisfaction and/or problems with the electronic circuitry.

Conventional vaporizers for aqueous (e.g., water, glycerol, etc.) based vaporizable materials do not manage condensation and leakage of the liquid vaporizable material particularly well, and this problem is particularly acute for oils such as cannabis extract oils, in which the liquid material may be particularly oily and/or viscous, and for which evaporation of the liquid material may result in a sticky residue that may impair the operation of the vaporizer. Further, vaporization of cannabis extract liquids may be more technically difficult than vaporization of other liquids (such as nicotine solutions).

For example, conventional e-cigarettes may address moisture build-up by integrating a filter pad in line with air flow. However, having a filter pad in line with the air flow can impede or restrict the air flow as the user draws on the mouthpiece. Moreover, this restriction to draw incrementally climbs as the filter becomes more saturated throughout, often requiring the user to change his or her draw accordingly and increasing the possibility of drawing liquid of the product and into the user's mouth.

In addition, the control of the temperature when vaporizing cannabis extracts may require a high degree of precision. Virtually all vaporizers currently available today would benefit from a higher degree of precision in power management and control of the heater (atomizer). In particular, vaporizers well suited for vaporizing cannabis (e.g., liquid cannabis extract solutions) may benefit from precise and accurate control of the heater forming the vapor.

It would also be beneficial to provide cartridges that do not roll and may rest in a small number of secure positions (e.g., cartridges having non-circular cross-sections) and to provide an immediate approximate (visual) estimate of the amount of material consumed.

Finally, it would be particularly beneficial to provide pre-loaded and tightly controllable cartridges for use in consuming cannabis extract liquids that prevent or reduce leakage of particularly viscous vaporizable materials such as cannabis oils/extracts.

Accordingly, described herein are vaporizers (including vaporizer cartridges) and methods of operating and using them addresses the issues raised above.

SUMMARY OF THE DISCLOSURE

In general, described herein are apparatuses such as devices and systems for vaporizing a material (including, in particular, but not limited to, cannabis extract liquids) and method of using them. For example, described herein are vaporizers, cartridges for use with such vaporizers, and vaporizer control systems.

Described herein are vaporizer cartridges that are pre-loaded (filled) with a cannabis vaporizer material. The vaporizable cannabis material is typically a liquid material, and may be a cannabis extract liquid (cannabis "oil"). Also described herein are vaporizers with or without cartridges that are adapted for use with cannabis liquid extracts. Either or both the vaporizer base (which males with the vaporizer cartridge to form the vaporizer device) and vaporizer cartridge may be adapted specifically for use with cannabis liquid extracts, although any of the apparatuses and methods described herein may be operated with other vaporizable materials, including nicotine solutions and/or solutions having no active ingredient at all (e.g., just including a carrier such as polyether compounds like polyethylene glycol and/or glycerol, or the like, and flavorants).

For example, a cartridge as described herein may include a vaporizable material such as cannabis oil. Cannabis oils present particular challenges when vaporized using a cartridge and/or a handheld vaporizer device. For example, cannabis oil is relatively "sticky" and may be viscous, particularly once it dries out. Thus, leakage may be a more serious consideration and challenge compared to other aqueous vaporizable materials. In particular, leakage of cannabis oil may result in clogging of the device and disturbing the electrical components, particularly the electrical contacts, which may be otherwise "gummed up" by leaked oil. The dried oil is not only sticky, but may also be electrically insulative, and may disrupt the electrical control of the

vaporizer. Described herein are apparatuses and methods to prevent or control leakage and to avoid disruption of electrical contacts between cartridges containing the cannabis extract and the rest of the vaporizer.

For example, the apparatuses described herein may include one or more electrical contacts (e.g., between the cartridge and the vaporizer base) referred to herein as wiping or scraping contacts. These electrical connections may be configured so that as a connection/contact is made between two electrically conductive surfaces, the contact (e.g., on the cartridge and/or the vaporizer base) scrapes the mating surface of the other contact to remove any vaporizable material, including vaporizable material that has dried on the contact. For example, a contact may include a canister with one or more extensions (e.g., wipers, knives, fingers, or scrapers) that are driven against and across the mating surface of the opposite electrical contact to scrape away any leaked vaporizable material (including dried-on material). The complimentary electrical contact may be a pin (including a pogo-pin) electrically conductive connector that is scraped as it enters into the canister by the wiper/scraper(s) therein. Thus, in general, the electrical contact in the vaporizer base may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer cartridge and/or the electrical contact in the vaporizer cartridge may be configured to scrape across and against the corresponding electrical contact surface in the vaporizer base to remove contaminating material. Thus either contact may include a scraping projection (e.g., edge, blade, wire, etc.) that is driven across the opposite surface. Typically two or more contacts are included in the vaporizer cartridge, and each of them may be configured as a scraping or wiping contact. In some variations, it may be desirable to have the scrapers on the connectors of the cartridge, although the scrapers may be present on the vaporizer base instead or in addition.

Any of the cartridges described herein may include a tank or storage region within the cartridge and/or forming a portion of the body of the cartridge. In particular, all or a portion of the cartridge (including the tank) may be clear, transparent and/or translucent so that the level of vaporizable material within the tank can be seen by a user. The tank may be prefilled or fillable. The tank may be sealed closed at the top (near the mouthpiece, which may cover the top of the cartridge). The mouthpiece may be plastic and may be secured over the tank by a snap fit, a friction fit, and adhesive, or the like. For example, the distal end of the elongate and flattened tubular body is configured to be secured by a friction fit within a vaporizer body. As described in greater detail herein, one or more absorbent members. (e.g., sponges, pads, felts, etc.) may be included in the mouthpiece between the tank and the mouthpiece, to prevent leakage of vaporizable material from contacting the portion of the mouthpiece where the user applies her or his lips. The tank may be sealed, e.g., by a tank seal that covers the one or more openings for filling the tank. In some variations, rather than one or more small plugs (which may be difficult to install) the tank may be sealed by a multi-seal component (e.g., a single piece) that seals between the mouthpiece and the top of the tank as and closes off two or more openings into the tank.

During inhalation through the apparatus, the user may draw on the mouthpiece (by inhaling/sucking on the mouthpiece) to draw air through the mouthpiece. The device may be turned on by one or more of: a control on the device (e.g., on an outer surface of the device), but installing the cartridge into the vaporizer base, detecting inhalation, detecting lip contact with the mouthpiece. In some variations, the device is turned on, and the heater rises to an initial set temperature, when the device is in a ready to turn on state and when the user draws on the mouthpiece. The vaporizer may be placed in a ready to turn on state by connecting (or detecting connection of) a cartridge and/or by a switch or control on the outside of the apparatus and/or by the battery level being sufficient to operate the device.

Once the device is turned on, it may be operated by drawing on the mouthpiece to cause the temperature to cause the vaporizer heater (the atomizer) to heat to the desired temperature setting (which may be preset, selected from a plurality of pre-set temperatures or may be user selectable, including using a computer or other device having a processor and user interface that communicates with the device, either wirelessly or via a wired connection, such as a smartphone wirelessly communicating with the device).

Drawing on the mouthpiece typically causes airflow to enter the cartridge receiver region of the vaporizer base through one or more (e.g., two) air openings that are positioned through the wall of the cartridge receiver near a base of the cartridge receiver. Air may pass into the cartridge receiver and up through the cartridge via one or more openings in the base (bottom) of the cartridge. The air may then pass into a heater connector region that also includes one or more (e.g., two, parallel) absorbent pads or sponges for absorbing any leakage of vaporizable material that may enter into this air-filled heater connector region, which is also open to the vaporizing chamber across which a wick and heating coil is extended to form vapor. The two absorbent pads positioned in this air region positioned on the long axis of the cartridge, against the major faces of the cartridge body so that they don't block the air path into the vaporizationchamber from the opening(s) at the base. These absorbent pads (e.g., sponges) may prevent dripping or leakage of the fluid from the vaporization chamber (e.g., off of the wick) even when the heater is not being heated. In order to prevent leakage should the absorbent pads not be sufficient, the opening into the base of the air chamber may include a rim or boss on the inner surface (within the heater connector region at the base of the cartridge) that prevents small amounts of fluid (e.g., vaporization fluid such as cannabis oil) to drip out of the opening(s) into the cartridge (e.g., the air chamber of the cartridge).

The air path from the vaporization chamber to the mouthpiece may have a minimum diameter that is slightly larger than previously described. For example, the minimum diameter of the air path between the vaporization chamber and the mouthpiece may be about 1.5 mm or greater, about 1.6 mm or greater, than about 1.7 mm or greater, than about 1.8 mm or greater, than about 1.9 mm or greater, than about 2 mm or greater, than about 2.1 mm or greater, than about 2.2 mm or greater, than about 2.3 mm or greater, than about 2.4 mm or greater, than about 2.5 mm or greater, etc. For example the minimum diameter may be 2.0 mm or greater.

In any of the variations described herein, the apparatus may include a wick as part of the atomizer (heater). In variations for use with cannabis oil the wick may be larger than typical cartridge wicks and may have a slightly larger pore size, because of the higher viscosity of the cannabis oil as compared to other (including nicotine) aqueous vaporization solutions. For example, the wick may be larger than 1.5 mm in diameter (e.g., about 1.9 mm or larger, about 2.0 mm or larger, about 2.1 mm or larger, about 2.2 mm or larger, about 2.3 mm or larger, about 2.4 mm or larger, about 2.5 mm or larger, etc., including between about 1.8 mm and about 5 mm, between about 1.9 mm and about 4 mm,

between about 2 mm and about 4 mm, etc.). The wick may generally extend across the vaporization chamber, e.g., along or perpendicular to the long axis of the cartridge, and between either the major or minor sides (in oval or flattened cartridges). The wick material may be any appropriate material, particularly those that are biocompatible, have a sufficient pore size, compatible with cannabis oils and may be resistant to heat up to the maximum heating temperature of the apparatus (e.g., will not degrade or combust significantly at temperatures up to about 450° C., 500° C. 550° C., 600° C., 650° C., etc.). For example, the wick may be made of a silica material (e.g., fiberglass).

In any of the heaters described herein, the heater (atomizer) may include a heating coil that may be wrapped around the wick for conductive heating. In any of the variations described herein convective heating of the liquid material (e.g., cannabis oil) wicked by the wick. The heating coil may be any appropriate material, but in particular, electrically resistive materials such as nichrome or other resistive materials, particularly those which change their resistance with heat (e.g., having a resistance that increases linearly and predictably with temperature over the desired range of temperatures, e.g., between 30° C., and 600° C., etc., including stainless steel, titanium, nickel, alloys of nickel, etc.).

The cartridge may have any desired shape or configuration. In some variations it may be beneficial in particular to have a shape that is cylindrical, and particularly a flattened cylinder, such as an approximately oval shape, with curved sides. Two of the sides (though curved) may be major sides, having a larger diameter, and two may be minor sides (though curved), having a smaller diameter. The flattened shape may prevent rolling when the device is placed on its side. In some variations the mouthpiece may extend in a slightly tapered shape. The tank may form a central region of the cartridge, bounded by the mouthpiece at one end (at the top) and the air chamber (at the bottom). A central cannula may form the air path between the vaporization chamber and the mouthpiece. The vaporization chamber and cannula may be surrounded by the tank, and may be visible through the walls of the tank (e.g., the vaporization chamber and cannula may be opaque, transparent or translucent). One or more seals, including o-rings, may be used to seal and secure the mouthpiece from the tank and the air chamber (base of the cartridge) from the tank. For example an inner seal may be between the mouthpiece and the outer wall of the tank (which may include a channel or track for the seal/o-ring) and a second seal (o-ring) may be positioned in an inner wall of the tank between the tank and the walls forming the air chamber and/or vaporization chamber at the base of the cartridge.

In any of the variations described herein it may be useful to provide an indication of the amount of the cartridge vaporized, which may be approximately correlated to the dose of the vaporizable material delivered. In any of the apparatuses described herein, the apparatus may include an output (e.g., LED, LCD or other display, etc.) on the apparatus or on a device in communication (e.g., wireless communication) with the apparatus such as a smartphone, laptop, desktop, pad, or the like. The output may indicate a qualitative and/or quantitative amount of the dose of vapor delivered from a particular cartridge. Dose may be determined using the processor of the apparatus to indicate approximately how much of the material, e.g., cannabis oil, has been consumed based on the power applied to the heater and the duration of heating. A qualitative output may be provided by sequentially illuminating (and/or changing the intensity and/or color of illumination) of a plurality of LEDs. In another example a 'status bar' showing consumption or dose delivered from a cartridge may be displayed on the apparatus body (e.g., the vaporizer body) or another device (e.g., smartphone) in communication therewith. For example, a plurality of LEDs (RGB) may be illuminated to provide qualitative feedback to a user on the operation of the vaporizer. Upon inserting a cartridge, the vaporizer apparatus may display using the LEDs an illumination corresponding to the intensity of the inhalation and/or the progression of consumption of vaporizable material from the cartridge. The processor in the vaporizer apparatus may estimate a dose based on the power applied to the vaporizer and the duration of heating and/or the duration of draw (inhalation). For example, the power applied*duration of draw may be accumulated by the processor, and the value output. In some variations the output may be provided for display on the body of the apparatus (e.g., by illuminating a sequence of LEDs. This may provide immediate visual feedback to the user.

The apparatuses, and particularly the cartridges, described herein may be adapted specifically for use with oils such as cannabis oils. As discussed above, existing cartridges are poorly suited for use with cannabis oils, as they may leak. Leaking of cannabis oils is both messy and detrimental to the operation of the vaporizer, as the leaked cannabis oils may disrupt the electrical connections driving vaporization and may clog or jam the operation of the apparatus. The cartridges described herein may include a number of specific modifications that address these issues; individually, these modifications may be helpful, but as will be described below, in combination these features have proven surprisingly effective at providing a robustly leak-resistant and reliable cartridge when using an oil such as a cannabis oil.

For example a cartridge device for holding a vaporizable cannabinoid material without leaking (e.g., that is substantially leak-resistant) may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having a width and a diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

In particular the combination of the flattened elongate body shape (which may be oval or rectangular) along with the enlarged and enclosed overflow leak chamber (typically having an open volume of greater 0.5× or greater the tank volume) at the distal end, and one or more (e.g., two, three, four, etc.) openings into the overflow leak chamber, which may preferably include a lip region around the openings inside the overflow leak chamber. The use of absorbents pads positioned within the overflow leak chamber (e.g., positioned off-axis, along a major wall of the overflow leak chamber, such as the wall extending in the diameter) provides an effective leakage barrier even when changing altitudes or when the user misuses the cartridge, e.g., user-induced failure modes such as biting or squeezing the mouthpiece, and/or blowing into the mouthpiece. Surprisingly, other combinations of such features are less effective,

particularly in user-induced failure modes. For example, otherwise similar cylindrical devices, e.g., having a width and diameter that are equivalent or nearly equivalent (e.g., a diameter less than 1.2×, or greater than 0.8×, the width) may show greater leakage compared to more flattened devices; the addition of one or more absorbent pads, particularly along the long wall of an overflow leak chamber) show an even greater reduction in leakage.

The one or more openings into the overflow leak chamber may be present on any surface of the cartridge, including through the distal end of the overflow leak chamber. Although placement of the opening at the distal end may otherwise result in an increase in leakage of the highly viscous oil from the cartridge, including the leak chamber and the absorbent pad(s) prevents or reduces leakage. In addition, the one or more openings may be surrounded by a lip within the leak chamber. The lip may have a height above the inner wall of the chamber that is 0.3 mm or greater (e.g., 0.5 mm or greater, 0.7 mm or greater, 0.8 mm or greater, 0.9 mm or greater, 1 mm or greater, 1.2 mm or greater, 1.3 mm or greater, 1.4 mm or greater, 1.5 mm or greater, 2 mm or greater, etc.).

The one or more absorbent pads may be positioned within the overflow leak chamber along the diameter, off-axis relative to an air flow path through overflow leak chamber from the opening to the air path.

In general, the overflow leak chamber may be relatively large, e.g., the volume of the overflow leak chamber (including the absorbent pad(s)) may be between 0.4 and 1.5× the volume of the tank (reservoir). In particular, the volume of the overflow leak chamber may be between 0.4 and 1× the volume of the tank (e.g., 0.4× or greater, 0.5× or greater, 0.6× or greater, 0.7× or greater, etc. than the volume of the tank). Alternatively, this may be described as the length of the overflow leak chamber along the distal to proximal axis relative to the length of the tank, and may be between 0.4× and 2× the length of the tank along the distal to proximal axis (e.g., between 0.4× and 1×, between 0.5× and 2×, between 0.5× and 1.5×, etc.), typically 0.4× or greater. In general, the overflow leak chamber may be enclosed within the distal end of the elongate and flattened tubular body.

In general, the cartridges described herein may be configured for insertion (e.g., by friction fitting) into a vaporizer body. Thus, the cartridge, and particularly the distal end of the cartridge, may be adapted to be inserted securely into the re-usable vaporizer device. The cartridge may therefore have straight (e.g., flat) or inwardly tapered sides and may include one or more friction-engagement regions that couple within the vaporizer. In some variations the distal end region of the cartridge may include a channel, rim, lip, ridge, protrusion, etc. that may engage with a complimentary region in the vaporizer (e.g., in a cartridge receiver in the vaporizer body). Thus, the cartridge may be configured to 'snap' fit into the vaporizer body. For example, the distal end of the elongate and flattened tubular body may include a lip or rim configured to snap into a vaporizer body.

The cartridge may also include one or more (e.g., a pair) of electrical contacts on the distal end of the cartridge (e.g., on the distal end of the overflow leak chamber) in electrical communication with the heater. These electrical contacts may also be configured and adapted to prevent or ameliorate the effects of leakage of oil from the cartridge. For example, the electrical contacts may comprise scraping contacts (also referred to as wiping or wiper contacts), which may include an edge or edge to scrape against the contact (e.g., pogo pin) from the vaporizer before (and/or separately from) making electrical contact. For example, the pair of electrical contacts may comprise pin receptacles. These pin receptacles may include an outer scraping edge with an inner conductive surface.

In any of the variations described herein, the tank may include a cannabinoid solution (e.g., a cannabis oil solution). Thus, the cartridge may be pre-filled with a cannabis oil. The tank volume may be configured to hold between about 0.2 mL and about 2 mL or more of oil. For example, the tank may be configured to hold between about 0.4 mL and about 1.2 mL (e.g., between about 0.4 mL and 0.8 mL, etc.)

The mouthpiece may be configured to fit over the proximal end of the elongate and flattened tubular body, and may be in fluid communication with the air path through the tank. The mouthpiece may include an internal volume; one or more absorbent pads may be positioned within this internal volume. The one or more mouthpiece absorbent pads within the mouthpiece may generally be off-axis relative to the air path (leaving a central air path that is not occluded by the absorbent pads). For example, the mouthpiece absorbent pads may be off-axis relative to an air flow path from the air path and out of the mouthpiece. The mouthpiece absorbent pads may be positioned on the sides of the mouthpiece (e.g., the major sides, corresponding to the diameter of the mouthpiece). The absorbent pad(s) may be between a proximal end of the mouthpiece and the elongate and flattened tubular body.

In any of the devices described herein the air path may extend through the cartridge, from the distal end (e.g., the opening(s) into the overflow leak chamber), past the heater, through and/or around the tank, and out of the mouthpiece. In some variations, the air path comprises a cannula extending through the tank. In general, the elongate body may be transparent or translucent, and any material in the tank may be visible; when the device includes a cannula running through the tank this may also be visible.

The absorbent pads in the overflow leak chamber may be the same material and/or dimensions as those (if present) in the mouthpiece, or they may be different materials and/or dimensions. The one or more absorbent pads may be made of a sponge or felt material. The one or more absorbent pads may comprise a pair of flat absorbent pads arranged in parallel. For example, the one or more absorbent pads may comprise a cotton material. The one or more absorbent pads may be rectangular.

As mentioned, the one or more absorbent pads in the overflow leak chamber may be a pair of absorbent pads positioned within the overflow leak chamber off-axis relative to an air flow path through the overflow leak chamber from the opening to the air path.

The heater (e.g., wick and coil) may be positioned within the air path so that it is parallel, transverse or oblique to the air path. For example, the heater may extend across the air path in a transverse direction.

The elongate and flattened tubular body may have an oval cross-section or a rectangular cross-section transverse to the distal to proximal axis, and may be any appropriate size. For example, the elongate tubular housing may be between about 1 cm and 10 cm long (e.g., between about 2 cm and 7 cm long, etc.). It may be particularly beneficial to have the elongate tubular housing be somewhat short and compact (e.g., less than 8 cm, less than 7 cm, less than 6 cm, less than 5.5 cm, less than 5 cm, etc.)

The sizes of the openings into the air path (through the overflow leak chamber, e.g., at the distal end of the cartridge) may be configured to allow relatively easy draw through the cartridge, while preventing leakage out of the overflow leak path. Leaking may occur from the heater (e.g.,

the exposed wick) which is inserted through the wall of the tank; the air path within the cartridge is open and continuous, which would otherwise allow the material to leak. Thus, for example, the size of the one or more openings may be specified within a range identified as allowing sufficient air flow without permitting excessive leaking. For example, in some variations, the diameter of the opening(s) into the overflow leak chamber is/are between 0.1 mm and 5 mm (e.g., between 0.1 mm and 3 mm, between about 0.1 mm and 2 mm, etc.).

The tank portion of the device may be filled by an opening beneath the mouthpiece, which may be sealed or plugged. For example, the cartridge may include a plug between the mouthpiece and the elongate and flattened tubular body, wherein the plug closes off the tank of the elongate and flattened tubular body.

Any of the cartridge devices for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece on the proximal end of the elongate and flattened tubular body; an enclosed overflow leak chamber at a distal end of the elongate and flattened tubular body. The device of claim **1**, wherein a length of the overflow leak chamber along the distal to proximal axis is 0.5 times or greater than a length of the tank along the distal to proximal axis; an air path extending from the overflow leak chamber through the tank to the mouthpiece; a heater comprising a wick and a heating coil extending within the air path proximal to the overflow leak chamber, an opening through the distal end of the overflow leak chamber, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

For example, a cartridge device for holding a vaporizable cannabinoid material without leaking may include: an elongate and flattened tubular body extending in a distal to a proximal axis and having width and diameter that are transverse to the distal to proximal axis, wherein the diameter is 1.2 times or greater than the width; a tank within a proximal end of the elongate and flattened tubular body, the tank configured to hold the vaporizable cannabinoid material; a mouthpiece at the proximal end of the elongate and flattened tubular body; an overflow leak chamber at a distal end of the elongate and flattened tubular body, wherein a length of the overflow leak chamber along the distal to proximal axis is between 0.5 and 2 times a length of the tank along the distal to proximal axis; an air path extending proximally from the overflow leak chamber through the tank to the mouthpiece, wherein the air path comprises a cannula extending through the middle of the tank; a heater comprising a wick and a heating coil extending within the air path; an opening into the overflow leak chamber from an external surface of the device, wherein the opening is surrounded by a lip within the leak chamber and further wherein the opening is fluidly connected with the air path; and one or more absorbent pads within the overflow leak chamber.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1** and **2** show moisture and vapor deposition on a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **3**A and **3**B show a vaporization device with a pair of filter pads that are off-axis relative to the airflow path of the device.

FIGS. **4**A and **4**B show an exemplary vaporization device. This exemplary device includes two pairs of absorbent filter pads, as described herein. FIGS. **4**A and **4**B show a cartridge placed within the reusable component of the device.

FIGS. **5**A-**5**F illustrate the vaporizer body (e.g., a reusable component of the vaporizer device of FIGS. **4**A and **4**B). FIG. **5**A is a bottom perspective view; FIG. **5**B is a front view, FIG. **5**C is a top perspective view (looking into the cartridge receiver region including electrical contacts), FIG. **5**D is a side view. FIG. **5**E is a top view, and FIG. **5**F is a bottom view, showing the electrical connection to a charger or other wired electrical connection.

FIGS. **6**A-**6**D illustrate the cartridge of the device of FIGS. **4**A and **4**B. FIG. **6**A is a bottom perspective view, FIG. **6**B is a bottom view, FIG. **6**C is a top perspective view (showing the opening into the mouthpiece) and FIG. **6**D is an exploded view of the cartridge of FIG. **6**A.

FIGS. **7**A-**7**F illustrate an alternative view of a cartridge as described herein. FIG. **7**A shows a bottom perspective view; FIG. **7**B is a top perspective view; FIG. **7**C is a front view; FIG. **7**D is a side view; FIG. **7**E is a bottom view; and FIG. **7**F is a top view.

FIGS. **8**A-**8**G show a variation of a vaporizer base of a vaporizer apparatus into which a cartridge such as the one shown in FIGS. **7**A-**7**F may be inserted. FIG. **8**A is a bottom perspective view; FIG. **8**B is a top perspective view showing the cartridge receiver portion of the vaporizer base; FIGS. **8**C, **8**D and SE show front, side and back views, respectively of the vaporizer base; and FIGS. **8**F and **8**G show bottom and top views, respectively of the vaporizer base.

FIGS. **9**A-**9**G show an assembled vaporizer apparatus including a vaporizer cartridge such as the one shown in FIGS. **7**A-**7**F that has been fully seated and retained in a vaporizer base such as the one shown in FIGS. **8**A-**8**G. FIGS. **9**A and **9**B show bottom perspective and top perspective views, respectively of the assembled vaporizer apparatus; FIGS. **9**C, **9**D and **9**E show front, side and back views, respectively of the assembled vaporizer apparatus; FIGS. **9**F and **9**G show bottom and top views, respectively, of the vaporizer apparatus.

FIG. **10**A is an exploded view of the cartridge of FIGS. **7**A-**7**F with the components arranged in line.

FIG. **10**B is an alternative exploded view of the cartridge of FIGS. **7**A-**7**F, showing the component parts positioned adjacent to each other at the approximate vertical position for assembly.

FIG. **11**A is a semi-transparent view (in which the outer casing of the vaporizer base, mouthpiece, and cartridge housing have been a made transparent) showing the air path through the assembled vaporizer apparatus such as the one shown in FIGS. **7**A-**9**G.

FIGS. **11**B and **11**C show front and back views, respectively, of an example of a vaporizer base with the outer housing (case or shell) made transparent, showing the cartridge receiving end including connectors and air entry port therein.

FIG. **12** is an enlarged view of a section through a midline of the proximal (top) region of a cartridge (as shown by dashed line **12**-**12'** in FIG. **9**A), showing the air path from the vaporization chamber to the mouthpiece openings.

FIG. **13** is a section through the midline of a vaporizer apparatus (including a vaporizer base into which a vaporizer cartridge has been coupled), showing the air path during inhalation (puffing, drawing, etc.).

FIG. **14** show a section through a cartridge, just beneath the mouthpiece (as shown by dashed line **14'-14'** in FIG. **9**B) showing the arrangement of the distal pair of absorbent pads offset from the airflow path.

FIG. **15**A is a section through the midline of an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **15**A-**15**A').

FIG. **15**B is another section through an assembled vaporizer apparatus such as the one shown in FIG. **9**A (through line **12**-**12**').

FIG. **15**C shows another section through the assembled vaporizer apparatus (through line **15**C-**15**C' in FIG. **9**B).

FIG. **15**D is a section through a cartridge (through line **15**D-**15**D' of a cartridge such as the one shown in FIG. **7**A) showing a pair of overflow filter pads that are off-axis relative to the airflow path of the device.

FIG. **16** is a section through another of another exemplary vaporization device (at line **16-16'** in FIG. **9**B), near the base of the cartridge and inserted into the cartridge receiver of the vaporizer base.

FIG. **17** is an electrical schematic of a heating element and connectors showing the Seebeck coefficients for a simplified model of the components of the heating circuit.

FIG. **18** is a Seebeck measurement circuit for a vaporizer apparatus correcting for the Seebeck effect, configured as a two-terminal sensing circuit.

FIG. **19** is another example of a Seebeck measurement circuit for a vaporizer apparatus, configured as a four-terminal (four-point) circuit.

FIGS. **20**A and **20**B illustrate two examples of heating coils comprising different component conductors coupled to result in resistive heater from which a temperature measurement may be determined using a Seebeck sensing circuit as described herein.

FIG. **21** is one example of a user interface (UI) for interacting with the apparatuses described herein using an external controller (e.g., smartphone, pad, etc.)

FIG. **22** is another example of a US for interacting with an apparatus as described herein.

DETAILED DESCRIPTION

The apparatuses and methods described herein generally include forming a vapor from a material (including in particular, liquid and oil-type plant materials) using a vaporization device. The vapor may be delivered for inhalation by a user. These apparatuses may be particularly adapted for use with an oil-based vaporizable material, including cannabis oils.

The vaporizer apparatuses, including cartridges (vaporizer cartridges) and reusable vaporizers bases described herein may be used with any appropriate vaporizable material, including aqueous vaporizable materials. These apparatuses may be particularly well adapted for use with viscous, oil-based vaporizable materials, including cannabis oils. For example, any of the cartridges described herein may be used (e.g., filled) with a vaporizable material comprising viscous liquid such as a cannabis oil. In some variations the cannabis oil comprises between 40-100% cannabis oil extract. The viscous oil may include a carrier for improving vapor formation, such as propylene glycol, glycerol, etc., at between 0.01% and 25% (e.g., between 0.1% and 22%, between 1% and 20%, between 1% and 15%, etc.). In some variations the vapor-forming carrier is 1,3-Propanediol. A cannabis oil may include a cannabinoid or cannabinoids (natural and/or synthetic), and/or a terpene or terpenes. For example, any of the vaporizable materials described herein may include one or more (e.g., a mixture of) cannabinoid including one or more of: CBG (Cannabigerol), CBC (Cannabichromene), CBL (Cannabicyclol), CBV (Cannabivarin), THCV (Tetrahydrocannabivarin), CBDV (Cannabidivarin), CBCV (Cannabichromevarin), CBGV (Cannabigerovarin), CBGM (Cannabigerol Monomethyl Ether), Tetrahydrocannabinol, Cannabidiol (CBD), Cannabinol (CBN), one or more Endocannabinoids (e.g., anandamide, 2-Arachidonoylglycerol, 2-Arachidonyl glyceryl ether. N-Arachidonoyl dopamine, Virodhamine, Lysophosphatidylinositol), and/or a synthetic cannabinoids such as one or more of: JWH-018, JWH-073, CP-55940, Dimethylheptylpyran, HU-210, HU-331, SR144528, WIN 55,212-2, JWH-133, Levonantradol (Nantrodolum), and AM-2201. The oil vaporization material may include one or more terpene, such as Hemiterpenes, Monoterpenes (e.g., geraniol, terpineol, limonene, myrcene, linalool, pinene. Iridoids), Sesquiterpenes (e.g., humulene, farnesenes, famesol), Diterpenes (e.g., cafestoI, kahweol, cembrene and taxadiene), Sesterterpenes, (e.g., geranylfarnesol). Triterpenes (e.g., squalene), Sesquarterpenes (e.g., ferrugicadiol and tetraprenylcurcumene). Tetraterpenes (lycopene, gamma-carotene, alpha- and beta-carotenes), Polyterpenes, and Norisoprenoids. For example, an oil vaporization material as described herein may include between 20-80% cannabinoids (e.g., 30-90%, 40-80%, 50-75%, 60-80%, etc.), 0-40% terpenes (e.g., 1-30%, 10-30%, 10-20%, etc.), and 0-25% carrier (e.g., polyethylene glycol).

In any of the oil vaporization materials described herein (including in particular, the cannabinoid-based vaporization materials, the viscosity may be within a predetermined range. The range may be between about 30 cP (centipoise) and 115 KcP (kilocentipoise). For example, the viscosity may be between 40 cP and 113 KcP. Outside of this range, the vaporizable material may fail to wick appropriately to form a vapor as described herein. In particular, the oil may be made sufficiently thin to both permits wicking at a rate that is useful with the apparatuses described herein, while also limiting leaking (e.g., viscosities below that of ~40 cP might result in problems with leaking).

For example, FIGS. **7**A-**7**F illustrate one example of a cartridge that is adapted for use with a viscous oil-based vaporizable material (having a viscosity at room temperature of between 40 cP and 113 KcP), such as a cannabis oil. In this example, the cartridge **700** includes a flattened body that is approximately oval in cross-sectional area (see, e.g., FIGS. **7**E and **7**F showing top and bottom views) and includes a mouthpiece that is attached over a clear body forming a reservoir region holding the vaporizable material. The body **790** may be transparent, translucent or opaque. The mouthpiece may include one or more openings **792** at the proximal end (top) out of which vapor may be inhaled, by drawing breath through the device. The bottom may also include a locking feature (e.g., tab, indent, magnetic lock, etc.) for coupling and securing the cartridge within a cartridge receiver of a vaporizer base, such as the reusable vaporizer base **800** shown in FIGS. **8**A-**8**G. In this example, the body may be elongate and may include an outer shell or cover **890**; the proximal end of the vaporizer base may include an opening forming a cartridge receiver **892**. The cartridge receiver may include one or more opening therethrough (e.g., lateral openings) to allow airflow therein, as described in more detail below. Any of these cartridges may also or alternatively include a rim, ridge, channel, protrusion, lip, etc. along the distal end region for engaging a complimentary portion of the vaporizer device. For example, in FIG. **7**D, the cartridge include a channel or lip

795 at the distal end which may engage with a deflectable or deformable tab or protrusion in the cartridge receiving portion of the vaporizer; this may provide a snap fit. In general, the cartridge may fit within the cartridge receiver of the vaporizer by a friction fit. The snap-fit may provide audible and/or tactile confirmation that the cartridge is held in position. This fit may also lock or hold the cartridge within the receiver, but still allow it to be easily withdrawn to remove the cartridge.

As shown in FIG. 7C, the elongate and flattened body **790** may contain within it the tank region **791** (e.g., holding the vaporizable oil material) and a distal overflow leak chamber **793**. These structures may be formed by the internal components within the elongate and tubular body, as shown below.

FIGS. **10**A and **10**B show exploded view of a cartridge as described herein. In this example, the apparatus includes a cartridge body **1005** that may be clear (transparent), opaque and/or translucent. The cartridge body may form a reservoir for the liquid vaporizable material, and particularly for a viscous liquid vaporizable material such as the cannabinoid oils described herein. The cartridge may include an outer seal (e.g., o-ring **1009**) that seals the mouthpiece **403** over the body **1005**. The reservoir (tank) may be sealed on the top (at the proximal end) under the mouthpiece by a single-piece plug **888** that covers multiple openings which may be used for filling the tank. The vaporization chamber may be formed at the bottom (distal end) of the cartridge; in exemplary cartridges described herein the vaporization chamber is formed from a cannula and housing piece **1011** that includes opening into which the wick (wick portion of wick and coil **443**) passes into the chamber; the walls forming the vaporization chamber separate it from the tank and mate with a back piece **1013** that forms the bottom (distal end) of the tank within the cartridge body. This piece is also sealed (e.g., by an O-ring **1015**) to the cartridge body from within the cartridge body, as shown. An air chamber is then formed between the bottom of the cartridge **1019** and the back piece **1013** of the tank. One or more (e.g., two) air openings **796**, **796'** through this bottom **1019** allow air to pass (after entering the cartridge receiver through one or more openings **894** in the side) into the distal end of the cartridge, into the air chamber region and then up through an opening into the vaporization chamber. The piece forming the bottom of the cartridge **1019** may also accommodate or include one or more (e.g., two) electrical connectors that are configured to mate with the connectors on the vaporizer base. As mentioned, these contacts may be wiper or scraping contacts. In FIGS. **10**A and **10**B, they are shown as cans **1021**, **1021'** having openings into which the pins project to form an electrical contact.

The vaporizer body typically includes a battery and one or more control circuits housed within the cover **890**. The control circuitry may control the heater, which in this example, is present in the cartridge. The heater may generally include a heating coil (resistive heater) in thermal contact with the wick; additional connectors formed of a different material (e.g., conductive material) may connect the heater coil to the electrical contacts on the base of the cartridge; although this may lead to inaccuracies in detecting and controlling temperature electrically, as described below, the control circuitry may include one or more additional circuits, such as Seebeck measurement circuits, that correct for offsets and other inaccuracies in the determination of temperature and therefore the power applied to the apparatus. The control circuitry may also include and may control and/or communicate with a batter regulator (which may regulate the battery output, regulate charging/discharging of the battery, and may provide alerts to indicate when the battery charge is low, etc.). The co control circuitry may also include and may control and/or communicate with an output, such as a display, one or more LEDs, one or more LCDS, a haptic output, or any combination of these. In the example shown in FIGS. **7**A-**9**G, the apparatus includes only four (RGB) LEDs **897**, arranged in a pattern (e.g., a circular, spiral or floral pattern; other patterns may include linear patterns). Any of the apparatuses described herein may also include a wireless communication circuitry that is part of, connected and/or controlled by the control circuitry. The apparatus may be configured to wireless communicate with a remote processor (e.g., smartphone, pad, wearable electronics, etc.); thus the apparatus may receive control information (e.g., for setting temperature, resetting a dose counter, etc.) and/or output information (dose information, operational information, error information, temperature setting information, charge/battery information, etc.).

The apparatus may also include one or more inputs, such as an accelerometer, a lip sensing input, a contact input, or the like. In particular, described herein arm vaporizer apparatuses in which the device does not include any visible buttons, switches or external user input on an outer surface of the cartridge or vaporizer base. Instead, the input may be an accelerometer (coupled to, part of, and/or controlled by the control circuitry). The accelerometer and any accelerometer control circuitry may be configured to detect tapping on the apparatus (e.g., the case) and/or rolling of the apparatus (e.g., around the long axis or the short axis of the device). In some variations the apparatus may also include circuitry for sensing/detecting when a cartridge is connected and/or removed from the vaporizer base. For example, cartridge-detection circuitry may determine when a cartridge is connected to the device based on an electrical state of the electrical contacts within the cartridge reliever in the vaporizer base. For example, FIG. **5**C illustrates the two electrical contacts **595**, **595'**. Without a cartridge inserted into the apparatus the circuit is open (e.g., between **595** and **595'**) with the cartridge inserted, the electrical contacts (shown as pins **595**, **595'** in FIGS. **5**D and **11**B) engage with the contacts (such as wiping contracts, described above, which scrape to remove leaked and/or dried vaporizable material on the electrode contact surfaces). The controller (via a separate or integrated cartridge-detection circuit) may determine that a cartridge has been inserted when the resistance between these contacts changes to within a recognizable range (from the open circuit). Other cartridge detectors may be used alternatively or additionally, including a trip switch (which is activated when the cartridge is present), or the like. Any of the apparatuses described herein may also include one or more breath detectors, including a pressure sensor **1109** (e.g., microphone coil) having a connection to the inside of the cartridge receiver, as shown in FIG. **11**B.

The vaporizer body may also include a connector **899** at the distal end for coupling the device to a charger and/or data connection. The internal battery may be charged when coupling the device to a connector, alternatively other electrical connectors and/or inductive charging may be used.

FIGS. **9**A-**9**G illustrate an example of an apparatus (vaporizer apparatus) in which the cartridge **700** has been inserted completely into the vaporizer body **800**. The resulting device is small, lightweight, hand-held and may be safely stored in a pocket, purse, or the like.

In operation, the user may (once charged sufficiently), may activate the vaporizer by being drawing (inhaling)

through the mouthpiece. The device may detect a draw (e.g., using a pressure sensor, flow sensors, or the like, including a sensor configured to detect a change in temperature or power applied to a hater element, e.g., anemometer detection) and may increase the power to a predetermined temperature preset. The power may be regulated by the controller by detecting the change in resistance of the heating coil and using the temperature coefficient of resistivity to determine the temperature. As described in greater detail below, the temperature determination and/or power applied may be optionally corrected in cases where there are different electrically conductive materials connecting the resistive heater to the power supply/power, in which the Seebeck effect may be an issue, using a sensing circuit to estimate and compensate for this potential source of inaccuracy.

In any of the apparatuses described herein, the temperature may be adjusted or selected by the user. As mentioned, in some variations the apparatus does not include an exterior control or user input, but still allows the user to select the temperature from among a plurality (e.g., two or more, three or more, etc.) of pre-set heating/vaporizing temperatures above 100° C. This may be achieved by allowing the user to coordinate (in time, e.g., within 60 seconds, within 50 seconds, within 40 seconds, within 45 seconds, within 40 seconds, within 30 seconds, within 20 seconds, within 10 seconds, between 1 second and 60 seconds, between 2 seconds and 60 seconds, between 3 seconds and 60 seconds, etc.) a pair of distinct inputs that are based detection of inputs that are internal to the apparatus (e.g., not from controls on the surface of the apparatus), such detection an accelerometer input (e.g., tapping, such as one or more, e.g. 3 or more, taps, rotations of the device in the long axis, etc.) within a predefined time after removing the cartridge and/or inserting the cartridge. For example, the apparatus may enter into a temperature selection mode to allow a user to select the temperature by removing the cartridge after shaking the apparatus (e.g., for 1 or more seconds, e.g., 2 or more seconds, etc.). Once in a temperature selection mode, the user may select from among a number (e.g., 4) or pre-set temperatures by tapping the housing of the device to cycle through the pre-set temperatures, which may be displayed on an output (e.g., LED, monitor, LCD, etc.) on the apparatus.

Any other input on the device that is not (or not connected to) a button, and particularly an external button, may be used in a predetermined activation sequence (e.g., pattern of taps detected by the accelerometer, insertion/removal of cartridge, etc.) or in a set of sequential independent actuations. For example, the apparatus may enter into a temperature selection mode after removing and inserting a cartridge three times in quick successions (e.g., within 5 seconds of each step). In any of the variations described herein, merely shaking the apparatus may display information about the status of the device (e.g., the charge) using the output; the additional non-button input (e.g., removing the cartridge and/or inserting the cartridge) within the predetermined time may then allow the operating temperature to be selected.

In some variations, the apparatus includes multiple (e.g., 4) presets, and an optional additional preset (e.g., 5th preset or more) that may be user-settable. Alternatively or additionally, an external controller (smartphone, pad, computer, etc.) in may communicate with the apparatus to allow setting and/or selecting the operating temperature.

In on example, the apparatus may be operated to allow the user to select the operating temp (set mode) by shaking the device with a cartridge inserted. In some variations this may then change the display (e.g., multi-colored LEDs on the surface of the device), for example, displaying battery life using the multiple LEDs arranged (e.g., in an X pattern **897**, see, e.g., FIG. **8**C). While in this state, removing cartridge enters temp set mode. The device automatically cycles through the 4 (+1 or more, when user defined) presets. The user may then choose one by reinserting the pod at appropriate time. In some variations, the preset temperatures are: 270° C. 320° C., 370° C., 420° C. In some variations the user may modify or include an additional preset within a temp range around each preset, e.g.: within an operational range of between 270-420° C.

As mentioned above, any of the apparatuses described herein may be operated with an external processor to receive input and/or output to control operation of the device. For example, the vaporizer apparatus may be operated with an application software ("app") that allows control of the temperature or other functional setting and/or allows storage, display and/or transmission of operational and/or use information, including dose information. As described herein, an approximate estimate for dose may be determined based on the power applied to the heater (resistive coil) during inhalation (over time), e.g., power applied to coil multiplied by time of draw. This approximate 'dose' estimate may be accumulated over the use of a particular cartridge (e.g., once a cartridge is inserted, it may be accumulated and/or displayed until the cartridge is removed, roughly amounting to a "session" with that cartridge).

For example, FIGS. **21** and **22** illustrate exemplary user interfaces for an application software that allows the user to set and or adjust the pre-set temperatures of the apparatus. In FIG. **21**, the user may select the per-set temperature. FIG. **22** illustrates the use of the app to control the appearance and activity of the apparatus. For example, the user may lock/unlock the apparatus, and track usage (e.g., by does estimation).

In any of the apparatuses described herein the apparatus may allow the user to play one or more interactive "games" with the device. For example, any of these apparatuses may include an entertainment mode that may be entered by manipulating the device (e.g., by tapping, shaking, rotating, puffing in a predetermined pattern, etc.). In general, the entertainment mode may include one or more presentations (e.g., LED light displays, tones/music, patterns of vibrations, or combinations of these) and/or games. The device may be configured to allow selection of the presentation states or game states (games) to be played, or it may randomly select one. In general the games may be interactive, allowing the user to provide input, e.g., via the one or more inputs, such as movement of the device, via motions sensing, touching the device, via a button and/or capacitive sensor (e.g., lip sensing, etc.), puff/airflow sensing, inserting and/or removing the cartridge, etc.

For example, the entertainment mode may include a game such as a pattern-following game, wherein the device presents an output (e.g., one or more LEDS illuminated in a pattern and/or color), and the device (e.g, controller) may determine if a response entered by the user on the input correlates with a predetermined response. In general, the same controller used to control the heater may be used to control the entertainment mode including the games. Alternatively a separate controller may be used, and may communicate with the controller controlling the heater.

The one or more games may include a memory game. For example, in a memory game the device may presents an output sequence and determines if a sequence of responses entered by the user on the input correlates with a predetermined sequence of responses. The one or more games may

include a triggered output game wherein the device presents an output in response to a predetermined user input. For example, the device may illuminate a series differently positioned and/or colored LEDs based on the angle or movement that the user holds the device.

The one or more games may include a chance type game, wherein the device is configured to display a random pattern of one or more of colors, tones or vibrations, in response to a predetermined user input. The entertainment mode may include a display game wherein the output comprises a plurality of LEDs and wherein the device is configured to cycle the LEDs through a predetermined sequence of colors in response to a predetermined user input. The entertainment mode may include a tone game wherein the output comprises a plurality of tones and wherein the device is configured to play a predetermined sequence of tones in response to a predetermined user input.

As mentioned, the device may be configured to be toggled between the normal mode and the entertainment mode by applying one or more predetermined user manipulations to the input. For example, the device may be rotated. In some variations, the device input comprises an accelerometer, and the device may be configured to be toggled between the normal mode and the entertainment mode by rolling or rotating the device (e.g., three or more times) in one or more directions.

In addition to or alternative to the games, the entertainment mode may include an entertainment output (display) that is triggered upon entering into the entertainment mode. For example, as mentioned, the entertainment output may include one or more of: a display of a plurality of colors and/or patterns on the output, a tone or series of tones, a vibration or series of vibrations.

Leak Prevention

Any of the apparatuses described herein may be configured to prevent or reduce leakage of the vaporizable material. As mentioned, leaking an oil-based (and particularly cannabinoid oils) is particularly troublesome in a vaporizer because the vaporizable material may dry as a sticky, tarry substance that is both messy and may disrupt operation of the apparatus, particular the reusable (e.g., vaporizer base) portion.

For example, any of the apparatuses described herein may include one or more absorbent pads or members that are oriented to prevent leakage without disrupting the airflow or formation of vapor. In general, moisture and particles from the vapor can be deposited on a filter pad that is off-axis relative to the vapor path. The vaporization device may be a handheld vaporization device.

As described above, any of the vaporization apparatuses (device and systems) may comprise a heating element, including a resistive heating element. The heating element may heat the material such that the temperature of the material increases. Vapor may be generated as a result of heating the material.

In some cases, a vaporization device may have an "atomizer" or "cartomizer" configured to heat an aerosol forming solution (e.g., vaporizable material). The vaporizable material may be heated to a sufficient temperature such that it may vaporize (e.g., between 200° C., and 500° C., e.g., between 250-450° C., between 270-420° C., etc.). The apparatus or method may include one or more pre-set vaporization temperatures and the apparatus or method may control (via controller including feedback logic) the temperature to a predetermined and/or selected temperature.

An atomizer may comprise a small heating element configured to heat and/or vaporize at least a portion of the vaporizable material and a wicking material that may draw a liquid vaporizable material into the atomizer (e.g., heater). When the apparatus includes a wicking material, the wicking material may comprise silica fibers, cotton, ceramic, hemp, stainless steel mesh, and/or rope cables. The wicking material may be configured to draw the liquid vaporizable material in to the atomizer without a pump or other mechanical moving part. A resistance wire may be wrapped around the wicking material and then connected to a positive and negative pole of a current source (e.g., energy source). The resistance wire may be a coil. When the resistance wire is activated, the resistance wire (or coil) may have a temperature increase as a result of the current flowing through the resistive wire to generate heat. The heat may be transferred to at least a portion of the vaporizable material through conductive, convective, and/or radiative heat transfer such that at least a portion of the vaporizable material vaporizes.

Alternatively or in addition to the atomizer, the vaporization device may be configured as a "cartomizer" to generate an aerosol from the vaporizable material for inhalation by the user. The cartomizer may comprise a cartridge and an atomizer. The cartomizer may comprise a heating element surrounded by a liquid-soaked poly-foam that acts as holder for the vaporizable material (e.g., the liquid). The cartomizer may be reusable, rebuildable, refillable, and/or disposable. The cartomizer may be used with a tank for extra storage of a vaporizable material.

Air may be drawn into the vaporization device to carry the vaporized aerosol away from the heating element, where it then cools and condenses to form liquid particles suspended in air, which may then be drawn out of the mouthpiece by the user. For example, any of the apparatuses described herein may include a draw channel or passage. The draw channel may be in fluid communication with the heater so that vapor formed by the heater passes into the draw channel, which is also in fluid communication with the mouthpiece, which may be integrated with the device (including a cartridge).

One or more aspects of the vaporization device may be designed and/or controlled in order to deliver a vapor with one or more specified properties to the user. For example, aspects of the vaporization device that may be designed and/or controlled to deliver the vapor with specified properties may comprise the heating temperature, heating mechanism, device air inlets, internal volume of the device, and/or composition of the material.

Energy may be required to operate the heating element. The energy may be derived from a battery in electrical communication with the heating element. Alternatively, a chemical reaction (e.g., combustion or other exothermic reaction) may provide energy to the heating element.

The term "aerosol" may generally refer to a colloid of fine solid particles or liquid droplets in air or another gas. In general, the aerosols described herein are liquid aerosols of primarily (e.g., >80%, >85%, >90%, >95%) liquid particles in air. The liquid or solid particles in an aerosol may have varying diameters of average mass that may range from monodisperse aerosols, producible in the laboratory, and containing particles of uniform size, to polydisperse colloidal systems, exhibiting a range of particle sizes. As the sizes of these particles become larger, they have a greater settling speed which causes them to settle out of the aerosol faster, making the appearance of the aerosol less dense and to shorten the time in which the aerosol will linger in air. Interestingly, an aerosol with smaller particles will appear thicker or denser because it has more particles. Particle number has a much bigger impact on light scattering than

particle size (at least for the considered ranges of particle size), thus allowing for a vapor cloud with many more smaller particles to appear denser than a cloud having fewer, but larger particle sizes.

A vapor may generally refer to a substance in the gas phase at a temperature lower than its critical point. As used herein, a vapor may include a liquid aerosol. For convenience the term vapor and aerosol, which may generally refer to liquid aerosols, may be used interchangeably herein, as is common in the art of electronic vaporization devices.

The methods and apparatuses described herein have a wide range of applications for inhalation of an active substance, such as botanicals, pharmaceuticals, nutraceuticals, or any other substance for inhalation to provide a benefit or sensation to an end user. In some embodiments, the devices described herein include a tank having a liquid containing an active ingredient, such as nicotine, cannabis, or a cannabinoid.

The term "cannabis" refers to plants of the genus Cannabis and loose-leaf products or extracts thereof. As mentioned above, the term "cannabinoid" refers to plant based or synthetic chemical compounds capable of acting on cannabinoid receptors and inducing a biological effect. Cannabinoids include acids, salts, and bioactive stereo isomers. Exemplary cannabinoids include tetrahydrocannabinol (THC), cannabigerolic acid (CBGA), cannabigerol (CBG), tetrahydrocannabinolic acid (THCA), cannabichromene (CBC), cannabicyclol (CBL), cannabivarin (CBV), cannabichromevarin (CBCV), cannabigerovarin (CBGV), cannabigerol Monomethyl Ether (CBGM), delta-8-tetrahydrocannabinol (D8THC), delta-9-tetrahydrocannabinol (D9THC), tetrahydrocannabivarin (THCV), cannabinolic acid (CBNA), Cannabinol (CBN), cannabidiolic acid (CBDA), Cannabidivaric acid (CBDVA), cannabidiol (CBD), cannabichromenic acid (CBCA), Cannabichromene (CBC), or cannabicyclolic acid (CBLA) and/or any salt or stereo isomer of the above.

The devices described herein for generating an inhalable aerosol may include a body having a battery, a cartridge or tank including or configured to include the vaporizable material, at least input (e.g., in some variations without any input on an outer surface of the apparatus, e.g., "button less"), and circuitry for controlling the device.

An exemplary vaporization device **200** is shown in FIGS. **1** and **2**. The vaporization device **200** includes two filter pads **222***a,b*. The filter pads **222***a,b* are positioned off of the central axis of the air path **212**. As the vapor travels down the air tube **208** and begins to return to liquid state, both condensation and particle aggregation will occur. As the vapor exits the air tube **208** into the air path **212**, the moisture (see FIG. **1**) and larger particles (sec FIG. **2**) can filter onto the pads **222***a,b* (i.e., via gravity) without interfering with the user's draw on the device.

The one or more pads for use with any of the embodiments described herein (including pads **222***a,b*) can be made of an absorbent material. The absorbent material can both wick moisture quickly and allow it to disperse quickly therethrough. Thus, the absorbent material can be hydrophilic. Exemplary materials include cotton, e.g., a nonwoven cotton lintner paper, felt, cellulose, or hydrophilic polymers. Further, the one or more pads can be curved, as shown in FIGS. **1** and **2** or can be substantially flat panels. In some embodiments, the one or more pads can each be made of two or more thin sheets of layered material.

The one or more pads can be positioned within or proximate to the mouthpiece so as to capture moisture just prior to inhalation by the user. Further, in some embodiments, as shown in FIGS. **1** and **2**, the one or more pads can be pushed up against the interior surface of the vaporizer so as to minimize interference with other components of the vaporizer. In other embodiments, the one or more pads can be pulled away from the interior walls so as to maximize the surface area available for moisture absorption. The pads can be rectangular, circular, ovoid, triangular, square, or other shape. The shape and size of the pads can be chosen so as to minimize interference with the air path while maximizing moisture and particle collection.

Another exemplary vaporizer **300** utilizing moisture deposition pads **322***a,b* is shown in FIGS. **3**A and **3**B. The vaporizer **300** includes a cartridge **301** that is attachable to a reusable component **300** (which can include the electronics to power the device, etc.). As shown in FIGS. **3**A and **3**B, the cartridge **301** can include a tank **302**, a heater assembly **343**, an air tube **308**, and a mouthpiece **303**. The pads **322***a,b* can be rectangular, flat, and positioned in parallel within the mouthpiece **303** on either side of the air tube **308** (i.e., off-axis with the air tube **308**). The vaporizer **300** can further include any of the features described in U.S. application Ser. No. 15/053,927, titled "VAPORIZATION DEVICE SYSTEMS AND METHODS." filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1, the entirety of which is incorporated by reference herein.

Another exemplary vaporizer **400** that can utilize one or more pads is shown in FIGS. **4**A-**6**B. As shown in FIGS. **4**A and **4**B, the vaporizer **400** includes a reusable component **411** and a cartridge **401**. The diameter of device **400** is greater than the width (e.g., greater than 1.2×, 1.3×, 1.4×, 1.5×, 1.6×, 1.7×, 1.8× 1.9×, etc.), making the device have a substantially long and flat appearance and feel.

Referring to FIGS. **5**A and **5**B, the reusable component **411** includes a shell **431**, which can include the electronics for operating the vaporizer. Further, the reusable component **411** can include a visual indicator **421**, such as an LED, for signaling the operating status of the vaporizer **400**. The distal end of the reusable component **411** (shown in FIG. **5**F) includes a charging element **433** configured for charging the device. Further, the proximal end of the device (FIG. **5**E) includes contacts **435** for maintaining an electrical connection with the cartridge **401**.

The cartridge **401** is shown in FIGS. **6**A-**6**D. As best shown in the exploded view of FIG. **6**D the cartridge **401** includes a tank **441** configured to hold a liquid vaporizable material therein, a heater (e.g, a wick and coil assembly) **443** configured to heat the vaporizable material in the tank **441**, and an air tube **408** extending from the tank to a mouthpiece **403**. Contacts **535** are configured to connect with contacts **435** on the reusable component **411** to provide power to activate the wick and coil assembly **443**. At the distal end of the cartridge the walls of the elongate and flattened tubular body **441** and a bottom cover piece **691** form an overflow leak chamber **699**, which is shown with a pair of absorbent pads **495***a,b* are positioned along the long walls (along the diameter) of the overflow leak chamber. An option felt cover **693** may be included (also acting as an absorbent member).

As shown in FIGS. **4**A-**5**D, the device **400** further includes openings, configured as air inlets **762***a,b*, on the side of the shell **431**. The air inlets are proximate to openings (air inlets) **662***a,b* on the distal end of the cartridge **401** (see FIGS. **6**A and **6**B) opening into the overflow leak chamber (not visible). Referring to FIG. **11**A (which is a cross-section of the device **400** at the center), the air flow path **777** from inlets **762***a,b* to inlets **662***a,b*, extends through the tube **408** until it reaches the stop **433** (see FIG. **12**) and then divides into two separate paths that extend along the inner surface of

the mouthpiece **402** (between the pads **422***a,b*) and out through the outlets of the mouthpiece **403**.

As shown in FIGS. **6**D and **12-14**, parallel absorbent pads **422***a,b* can be positioned within the mouthpiece **403**. The absorbent pads **422***a,b* are rectangular and parallel with one another. The absorbent pads **422***a,b* are positioned substantially parallel to the flat side of the device **400** (parallel with the plane of the length l and width w in FIG. **4**A) and parallel with one another. In some embodiments, the pads **422***a,b* can be biased fully against the inside walls of the mouthpiece **403** so as to easily capture liquid that rolls along the walls. A distance between the two pads **422***a,b* can be, for example, between 3 and 6 mm, such as between 4 and 5 mm, e.g., approximately 4.8 mm. The gap between the absorbent pads **422***a,b* advantageously prevents the pads from interfering with the air flow path when a user draws on the mouthpiece **403**.

Further, as shown in FIGS. **6**D, **12** and **13** in some embodiments, over-flow pads **445***a,b* are positioned proximate to the tank **441**, i.e., within an overflow leak chamber below the tank, to absorb liquid that may leak out of the tank **441** during use. The over-flow pads **445***a,b* can be similarly placed parallel to one another and/or against the sides of the shell **431** as described above with respect to pads **422***a,b*.

FIG. **13** (which is a cross-section of the device **400** through the pads **422***a,b* and **445***a,b*) shows the air flow path **777** in dotted lines relative to the placement of the pads **442***a,b* and **445***a,b*. The air path **777** extends alongside all of the pads **422***a,b* without extending therethrough. That is, the pads **422***a,b* and **445***a,b* extend off-axis relative to the air path **777** and do not interfere with user draw. However, the pads **422***a,b* and **445***a,b* are positioned so that the air path **777** travels along, besides, and/or in contact with the pads **422***a,b* and **445***a,b* for an extended period of time so as to allow maximum absorption of liquid.

In use (i.e., when the user draws on the device), the device **400** can be held horizontally with the width, w, in the vertical direction and the diameter, d, in the horizontal direction. As such, at least one of the pads **422***a,b* and/or **445***a,b* will be substantially horizontal while the user draws on the device, ensuring that gravity will pull any moisture or particles down onto the lower pad **422***a,b* and/or **445***a,b*. Further, having two pads **422***a,b* and/or **445***a,b* advantageously ensures that moisture will be caught whether the user holds the device with pad **422***a* or **445***a* on top or **422***b* or **445***b* on top. This can both prevent interference with the electronics of the device and prevent the user from getting any liquid from the tank in his or her mouth when drawing on the device.

Referring to FIGS. **15**A-**15**D, exemplary device **800** is similar to device **400** (similar reference numbers are therefore used) except that it includes a single plug **888** in the proximal section of the cartridge **801** (i.e., as opposed to the two tank seals **604***a,b* shown in FIG. **6**D). The plug **888** is configured to simultaneously seal both outlets of the mouthpiece **403** while also sealing around the tube **408**.

Although sets of absorbent pads are shown and described with respect to the embodiments herein, only a single off-axis (i.e. "off air path") pad can be used in each location. Likewise, more than two (e.g., 3, 4, 5, or more) off-axis pads, such as strips of absorbent material, may be used. Similarly, only a single set of pads can be used.

In some embodiments, the absorbent pads can be located only in the cartridge area (i.e., in the disposable portion). In other embodiments, additional absorbent pads can also be used in the reusable portion of the device.

The wick for use with any of the embodiments herein can be large to handle higher viscosity liquids (e.g., liquids with cannabinoids). For example, the wick can be greater than 1.5 mm in diameter, such as approximately 2 mm in diameter.

Referring to FIG. **16**, in some embodiments, the openings (also referred to as air inlets) **962***a,b* to the cartridge **901** can include a protective annular ring **992***a,b* or seal therearound that extends away from the inner wall of the cartridge **901**. This ring can help prevent any spilled liquid from splashing into the inlets **962***a,b*. This ring may be lip or ridge projecting into the overflow leak chamber, as shown in FIG. **16**.

Referring still to FIG. **16**, in some embodiments, the contacts **935** of the reusable portion **911** of the device **900** can be pin contacts while the contacts **1035** of the cartridge **901** can be annular contacts or pin receptacles configured to mate with the pins. Further, in some embodiments, pin receptacles **1035** can include spring-loaded wiping mechanisms on the inner diameter thereof. The spring-loaded wiping mechanisms can be configured to wipe the pins as they pass therethrough. As a result, any vapor residue on the pins can be removed to maintain the proper electrical connection there between.

Power and Temperature Control

In any of the apparatuses described herein, the vaporizer apparatus may be controlled so that the temperature used to vaporize the vaporizable material is maintained within a preset range (e.g., one or more preset temperatures as discussed above, within +/−a few degrees (e.g., +/−3° C., 2° C., 1° C., 0.5° C., etc.). In general, the microcontroller may control the temperature of the resistive heater (e.g., resistive coil, etc.) based on a change in resistance due to temperature (e.g., TCR). For example, a heater may be any appropriate resistive heater, such as a resistive coil. The heater is typically coupled to the heater controller via two or more connectors (electrically conductive wires or lines) so that the heater controller applies power (e.g., from the power source) to the heater. The heater controller may include regulatory control logic to regulate the temperature of the heater by adjusting the applied power. The heater controller may include a dedicated or general-purpose processor, circuitry, or the like and is generally connected to the power source and may receive input from the power source to regulate the applied power to the heater.

For example, any of the apparatuses described herein may include logic for determining the temperature of the heater based on the TCR of the heating element (resistive coil), based on sensed resistance of the coil. The resistance of the heater (e.g., a resistive heater) may be measured (R_{heater}) and the controller may use the known properties of the heater (e.g., the temperature coefficient of resistance) for the heater to determine the temperature of the heater. For example, the resistance of the heater may be detected by a detection circuit connected at the electrical contacts that connect to the cartridge, and this resistance compared to a target resistance, which is typically the resistance of the resistive heater at the target temperature. In some cases this resistance may be estimated from the resistance of the resistive hearing element at ambient temperature (baseline).

In some variations, a reference resistor ($R_{reference}$) may be used to set the target resistance. The ratio of the heater resistance to the reference resistance ($R_{heater}/R_{reference}$) is linearly related to the temperature (above room temp) of the heater, and may be directly converted to a calibrated temperature. For example, a change in temperature of the heater relative to room temperature may be calculated using an expression such as $(R_{heater}/R_{reference}-1)*(1/TCR)$, where TCR is the temperature coefficient of resistivity for the

heater. In one example, TCR for a particular device heater is 0.00014/° C. In determining the partial doses and doses described herein, the temperature value used (e.g., the temperature of the vaporizable material during a dose interval, T_i, described in more detail below) may refer to the unit less resistive ratio (e.g., $R_{heater}/R_{reference}$) or it may refer to the normalized/corrected temperature (e.g., in ° C.).

When controlling a vaporization device by comparing a measure resistance of a resistive heater to a target resistance, the target resistance may be initially calculated and may be factory preset and/or calibrated by a user-initiated event. For example, the target resistance of the resistive heater during operation of the apparatus may be set by the percent change in baseline resistance plus the baseline resistance of the resistive heater, as will be described in more detail below. As mentioned, the resistance of the heating element at ambient is the baseline resistance. For example, the target resistance may be based on the resistance of the resistive heater at an ambient temperature and a target change in temperature of the resistive heater.

As mentioned above, the target resistance of the resistive heater may be based on a target heating element temperature. Any of the apparatuses and methods for using them herein may include determining the target resistance of the resistive heater based on a resistance of the resistive heater at ambient temperature and a percent change in a resistance of the resistive heater at an ambient temperature.

In any of the methods and apparatuses described heron, the resistance of the resistive heater may be measured (using a resistive measurement circuit) and compared to a target resistance by using a voltage divider. Alternatively or additionally any of the methods and apparatuses described herein may compare a measured resistance of the resistive heater to a target resistance using a Wheatstone bridge and thereby adjust the power to increase/decrease the applied power based on this comparison.

In any of the variations described herein, adjusting the applied power to the resistive heater may comprise comparing the resistance (actual resistance) of the resistive heater to a target resistance using a voltage divider, Wheatstone bridge, amplified Wheatstone bridge, or RC charge time circuit.

When using resistance and/or power applied to determine the temperature of the apparatus and/or to control temperature for vaporization, the inventors have determined that there may be a surprising disparity between the actual temperature and that predetected or determined using resistance of the heater alone. This problem because particularly acute when the distance between the heating element (e.g. resistive coil) and the electrical input into the cartridge (the power contacts from the vaporizer base) is longer, or there is a change in the conductive material between the heater and the contacts, as shown in FIG. **15**A. Where there is a change in the conductive material between the contacts, the electrical wiring and the resistive coil, thermoelectric effects arising due to this change in electrical characteristics (resistance) may give rise to inaccuracies when determining the power applied.

In the exemplary cartridges described above, the heating coil is connected to the electrical contacts by extension wires **1054**, **1054'** (see, e.g., FIG. **10**B). Because the extension wires are different materials, a voltage (EMF) may be generated at the junction between the different electrical conductors when there is a temperature gradient. This thermoelectric effect may be referred to as the Seebeck effect, and may generate a voltage that is based on the material properties of the different conductors. In the variations described above, although the heating coil, extensions and wick are nearly symmetric, during normal usage there may be uneven temperatures across the three, developing a temperature gradient. This may result in an uneven voltage being generated; this disparity may then lead to inaccuracies in controlling the heater (applied power) and/or estimation of the temperature.

Although at any particular time, the effect may be relatively minor (and therefore overlooked), the cumulative effect may lead to dramatic reductions in accuracy and temperature control; other systems may attempt to avoid this problem by modifying the resistance of the material used for the resistive heater, requiring a larger power; although this may reduce the overall contribution of the offset EMF voltage due to the thermoelectric property mismatch, it also requires a larger wattage and therefore battery (and resulting power) be applied.

Instead, any of the apparatuses described herein may include a precision resistance measurement circuit to track resistance of the heating element (e.g., a coil made from resistive heating alloy wire) when not heating and heating to control the temperature of the coil based on changes in coil resistance from room temperature to vaporization temperatures, as discussed above. For example, in some variations, the measurement circuit is an amplified Wheatstone bridge where the heating element (when connected) is one half of one of the two voltage dividers in the Wheatstone bridge and the two divider voltages are inputs to a differential op amp circuit. This control circuit may be modified as described herein to account for the mismatch in thermoelectric properties leading to the offset voltage.

Currently known resistance measurement systems typically use a two-terminal sensing or four-terminal sensing circuit, and are prone to measurement error when the load to be measured is also a voltage source or has an additional unknown voltage applied to it. As just mentioned above, in vaporizers that use resistive heating elements (often coils), extension leads are often used to mute power to the heating element with minimal Joule heating and losses in the path between the heating element (where Joule heating is desired) and the voltage source (often a battery or power supply). For manufacturability, these extension leads are often the only connection between the device (or contacts that connect to the device) and the heating element, so measurement of the resistance of the heating element invariably includes the resistance of the extension leads and measurement error arising from the mismatched thermoelectric properties (Seebeck error). The heating element and extension leads (three conductors if considered individually) each have some temperature gradient along their lengths, and this temperature gradient generates an electromotive force (EMF, which is also a measureable voltage when the conductor is open circuit) in each conductor, which is $E_{emf}=-S\nabla\Gamma$, where S is the Seebeck coefficient of the conductor which depends heavily on the conductor material (but also on temperature of the conductor) and $\nabla\Gamma$ is the temperature gradient across the material. Because ideal materials for the heating element and extension leads often have different Seebeck coefficients, and since the temperatures at the two connection points between each extension lead and the heating element are likely to differ while heating (due to acceptable asymmetries in both heating element assembly and heat transferred from the heating element and extension leads that are expected in a mass-produced product), there will be a net EMF across the extensions and heating element (seen as one load in any vaporization system where one set of extension leads electrically connects the heating element to the device)

which will skew the resistance measurement, making temperature control of the heating element using measured resistance impossible without correction for this effect. More generally, measured resistance of the heating element will be skewed by the mismatched thermoelectric properties (e.g., the Seebeck effect) whenever there is a temperature difference between and material transition at the two heating element terminals where contacts or extensions are connected.

A simplified model of a heating element with two extension leads of the same material is shown in FIG. **17**. In this example, the heating element and extension lead combination connects to the device at the open ends of the extension leads shown above, so the resistance measurement of the heating element is taken through the extension leads connecting to it. S1 and S3 are constant coefficients that depend on the material properties (Seebeck coefficients) of each of the two extension lead materials, and S2 is the Seebeck coefficient of the heating element. T1 and T4 are temperatures at the ends of the extensions that electrically connect to the vaporization device. T2 and T3 are temperatures of the connections between the extension leads and heating element (which may be welds, crimps, solder joints, or other electrical connections). The EMF, E_{net} is expected to skew the resistance measurement if E_{net} is non-zero. E_{net} from the Seebeck effect is expected to be:

$$E_{net}=-S1(T2-T1)-S2(T3-T2)-S3(T4-T3).$$

To illustrate how temperature differences between T2 and T3 can create a non-zero Enet, consider a further simplified model where temperatures at the two open (as shown) ends of the conductive path are assumed to be the same and close to the device temperature (T1=T4), which is an acceptable simplification in systems like ours where extensions connect to electrical contacts with large thermal mass at T1 and T4. Seebeck coefficients for the two extensions are assumed to be the same since the two extension leads are of the same material (S1=S3). This reduces the above expression to:

$$E_{net}=(S2-S1)(T2-T3)$$

From the above expression, if S2 and S1 are not equal (heating element and extension leads have different Seebeck coefficients) and T2 and T3 are not equal (non-zero net temp gradient across the two points where heating element meets extensions), Enet will not be zero, and it will skew the resistance measurement taken by the device. For comparison, if there are no extension leads, EMF for the heating element alone can be considered:

$$E_{net}=S2(T2-T3)$$

When the heating element is connected directly to electrical contacts that are large thermal masses, it is expected (and can be measured) that T2 and T3 are very close and Seebeck effect introduces negligible error in resistance measurement. In other systems where extension leads are used, the Seebeck effect will skew measured resistance, making temperature control impossible when Seebeck effect is not corrected for.

Additionally, some systems without extension leads may still see a temperature difference between T2 and T3 depending on the device and heating element assembly. If this temperature difference is significant, this effect will have to be corrected for if accurate resistance measurements is desired.

The simple model above with extension leads and heating element is provided to illustrate the source of heating element EMP. In most systems there will be additional material transitions and temperature gradients in each material in the resistance measurement path. As described below, a complete understanding or modeling of all material transitions and junction temperatures is not needed to correct for this effect. The heating element EMF (caused by the Seebeck effect) can simply be measured and used to correct for the error it introduces in resistance measurements.

In a vaporization devices that uses measured heating element resistance for temperature control of the heating element as described above, heating element EMF may also measure and used to control the power applied and/or estimates of temperature. The Seebeck effect may be observed to be the main contributor to heating element EMF and is the only known contributor to heating element EMF when no current (or constant current) has been flowing through the element for some time. Measured heating element EMF can be used to correct for resistance measurement error caused by heating element EMF. The resistance measurement (skewed by Seebeck EMF) and the Seebeck EMF measurement together can be used to calculate accurate heating element resistances, which can be used to control average temperature of the heating element.

The effect of heating element EMF on the resistance measurement depends on the measurement circuit used. Heating element EMF will produce measurement error in all known resistance measurement circuits, so heating element EMF may be separately measured to correct for the error it causes in the resistance measurement. Sensitivity of the resistance measurement to heating element EMF may be understood so that measured heating element EMF can be used correctly to calculate heating element resistance from the two measurements taken. For example, the same differential op-amp used for the resistance measurement may also be used for the heating element EMF measurement. In the resistance measurement, the heating element may be powered through a voltage divider so that there is a measurable voltage across the heater which is compared against a reference voltage or summed with other reference voltages and amplified by the differential op amp circuit. For heating element EMF measurement, no voltage is applied to the heating element, which allows for direct measurement of the EMF, which is compared against another close reference voltage and amplified by the same differential op amp circuit used for the resistance measurement.

Because the same amplification circuit may be used, the sensitivities of both the resistance measurement and the heating element EMF measurement to heating element EMF will be the same. The two measurements may then be used to calculate accurate heating element resistances, the raw reading difference between measured heating element EMFs when the device is heating and when device has not been heating for some time (note that Seebeck EMF is 0 when heating element reaches thermal equilibrium in device) and may be subtracted from the raw resistance measurement reading before other calculations are performed to yield heating element resistance from corrected resistance measurement reading.

FIG. **18** illustrates one example of a measurement circuit that may be used as part of a vaporization apparatus. Operation of this circuit to control heating element resistance while heating may be as follows (with signal and component names below referencing signals and components from schematic of FIG. **18**); except for H+ **1821**, all output boxes (**1801**, **1803**, **1805**, **1807**, **1809**, **1811**, **1813**) are connected to the microcontroller, which is not shown; timing noted below is for one exemplary software imple-

mentation and may be different or modified for different implementations). Heating element is connected between H+ **1821** and GND.

In FIG. **18**, when device is heating. HEATER **1807** is driven with PWM to connect VBAT to H+ **1821** through Q5 (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element. When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement). HEATER **1807** is held off and HM_PWR **1805** is held on (powering differential op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 us of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1809**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1809** between AREF_HM_OUT **1801** and GND during the last 68 μs of the measurement window. For the heating element resistance measurement, HM_NEG_REF_EN **1803** is on to bias the heating element so that the voltage divider formed by R19 and the heating element can compared by the differential op amp circuit (comprised of U5, R21, R22, R23, and R33) against a fixed voltage divider formed by R20 and R32, and some combination of R28, R29, and R30, which are used to keep HM_OUT **1809** in a usable voltage range between AREF_HM_OUT **1801** and GND for the range of heating element resistances that the device might see. HM_SCALE_0-2 **1813** are either allowed to float (high impedance) or connected to GND within the microcontroller to use R28-30 to set the resistance measurement range of the circuit.

For the heating element EMF measurement. HM_NEG_REF_EN **1803** is off to allow H+ to float to a voltage that is the heating element EMF (relative GND) and SEEBECK_REF_EN **1815** is on to make the fixed reference used by the differential op amp circuit close enough to heating element EMF that HM_OUT **1809** will be usable (will be between AREF_HM_OUT **1801** and GND) over the range of heating element EMFs expected when heating element is heated. Heating element EMF may be as high as +/−3 mV. The heating element EMF measurement circuit can measure between +/−5 mV. The measurement circuit yields a non-zero ADC value when device has not been heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations. Resistance calculations are as follows:

> Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset

Resistance measurement sensitivities and offsets may depend on the active resistance measurement scale (selected using HM_SCALE_0-2 **1813**) and may be solved for using circuit component values and then included in the device (e.g., in the firmware, hardware or software of the apparatus).

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs, temperature curve.

The resistance measurement circuit may be a two-terminal sensing circuit, as just discussed. In other variations, a four-terminal sensing may be used to mitigate effects of variable contact resistance and trace or lead resistance in series with the heating element resistance measurement. Changing contact resistance and trace/lead resistance have a negligible impact on resistance measurement and temperature control, but these effects may be more pronounced in variations which have a lower resistance heating element and different heating element and device assembly. In this case, a four-terminal (also known as four-point) resistance and EMF measurement circuit, such as the one shown in FIG. **19**, may be used.

Operation of the circuit shown in FIG. **19** to control heating element resistance while heating may be done as follows (with signal and component names below referencing signals and components from schematic above; signals **1903**, **1905**, **1907**, **1909**, **1911**, **1913**, **1915**, **1917**) are connected to the microcontroller, which is not shown; timing noted below is exemplary only, and may be different). In FIG. **19**, HI+ **1822** and HV+ **1826** connect directly to one terminal of the heating element, while HV− **1828** and HI− **1824** connect directly to the other terminal of the heating element.

When device is heating, HEATER **1907** is driven with PWM to connect VBAT to H+ **1822** through Q2 (powering heating element with battery voltage) at some duty cycle to generate a known power in the heating element.

When device is heating or in a wake state but not heating, every 3.9 ms (256 Hz measurement), HEATER **197** is held off and HM_PWR **1905** is held on (powering the differential summing op-amp circuit and voltage references required for measurements) for 268 μs so that either the heating element resistance or heating element EMF can be measured. Heating element resistance and EMF are each measured every 7.8 ms (each is measured during every other measurement window). The first 200 μs of this 268 μs measurement window is settling time for the op-amp output as seen by microcontroller (HM_OUT **1915**) to stabilize. ADC is performed by the microcontroller on HM_OUT **1915** between AREF_HM_OUT **1913** and GND during the last 68 μs of the measurement window.

For the heating element resistance measurement. HM_WS_ISRC_EN **1903** is on to bias the heating element through R20 and HI+/− terminals so that the voltage across HV+/− can measured by the differential summing op amp circuit (comprised of U2, R19, R23-25, and optionally R10-14, R17, and R21). HM_WS_POS_REF_EN **1903** is on to sum GND through R19 with HV+ through R25. Some combination of HM_SCALE_0-5 are on to sum HV− through R24 with VBAT through some respective combination of R10-14 to keep HM_OUT **1915** in a usable voltage range between AREF_HM_OUT **1913** and GND for the range of heating element resistances that the device might see.

For the heating element EMF measurement. HM_WS_ISRC_EN **1903** is off to allow HV+ to float to a voltage that is the heating element EMF (relative HV−), HM_WS_POS_REF_EN **1909** is off to sum the R17, R21, R19 voltage divider through R19 with HV+ through R25, and HM_SCALE0-4 **1911** are all off to provide no summing and only negative feedback at the negative input of the op-amp. This differential summing configuration keeps HM_OUT **1915** in a usable range (will be between AREF_HM_OUT **1913** and GND) over the range of heating element EMFs expected when heating element is heated. With the values shown above, the heating element EMF measurement circuit can measure between +/− 3.5 mV. The measurement circuit yields a non-zero ADC value when device has not been

heating for some time and EMF is 0; this value is used to "zero" the heating element EMF readings when used in resistance calculations.

Resistance calculations are as follows:

Heating Element Resistance=(resistance measurement ADC raw−(EMF measurement ADC raw−EMF measurement ADC zero))*resistance measurement sensitivity+resistance measurement offset Resistance measurement sensitivities and offsets depend on the active resistance measurement scale (selected using HM_SCALE_0-4 **1911**) and may be solved for using circuit component values and then included in the device.

Baseline resistance (measured resistance when heating element has not been heated for some time) may be used to calculate a target resistance that corresponds to a target average heating element temperature based on the heating element's resistivity vs, temperature curve.

As described above, the mismatch in thermoelectric properties and the resulting EM (e.g., the Seebeck EMF) has been found by the inventors to be a potential source of resistance measurement error after data taken from controlled tests of vaporizer prototypes (e.g., using heating elements with extension leads). A single heating element run with temp control of the heating element (using measured heating element resistance without correction for this EMF) may consistently run with much higher power when connected in one polarity vs, the other polarity. It was discovered that asymmetries in the heating element (in this case the wick and coil) assembly could consistently produce hotter temperatures at one of the two heating element/extension lead junctions, resulting in consistent offset voltage at operating temperatures that skewed the resistance measurement in one direction with the heating element connected in one polarity and in the other direction with heating element connected in the other polarity. Although measured resistance was controlled during these tests, these devices were not accurately controlling heating element temperatures because measurements were skewed by this offset EMF resulting from the mismatch in thermoelectric properties of the components. With the correction described above, used to correct for the error in resistance measurement, it is observed that heating element polarity does not have an effect on the power required to hold the heating element at operating temperatures during controlled testing, which suggests that this correction yields accurate calculated heating element resistances that remove the effect of the offset EMF, providing much more accurate temperature control of the heating element than when not corrected.

Thus, in any of the variations described herein, the apparatus may include an offset correction circuit (also referred to as a Seebeck correction circuit) to correct for the offset voltage resulting from the mismatch in thermoelectric properties between the resistive heating coil and the conductive connectors linking the resistive heating coil to the power input (e.g., from the vaporizer base, including the vaporizer power controller) in the cartridge. The offset correction circuit may be located in the vaporizer base and connected between the coupling connectors **595**, **595'** to couple with the cartridge connectors and determine the offset voltage due to the mismatch in thermoelectric properties of the heating (resistive) coil and the wires linking the coil to the connector on the cartridge. Also described herein are methods of correcting for the mismatch (Seebeck effect) in thermoelectric properties between the coil and the wires (electrical extensions) connecting to the electrical connectors.

Dose Monitoring

As mentioned above, any of the apparatuses described herein may also or alternatively detect and display the dose of material applied. U.S. patent application Ser. No. 14/960,259 (filed on Dec. 4, 2015, and published as US-2016-0157524-A1), herein incorporated by reference in its entirety, describes examples of methods for determining dose (and apparatuses including dose determination). Generally these methods may be used to accurately calculate dose based on the power applied to the heater and the temperature of the heater (or a material in contact with the heater) during an immediately before a small increment of time; total dose may be determined by summing these small increments up over a desired time range. These methods may be incorporated herein, and may be made even more accurate by correcting the power applied as described above (e.g., accounting for the offset EMF due to the Seebeck effect).

Alternatively or additionally, described herein are methods and apparatuses that may provide a rough approximation of dose based on the power applied over time to vaporize the material within the cartridge. This may be referred to herein as the consumption (of the vaporizable material in the cartridge, an indication of consumption) of the cartridge or vaporizable material, or the like. In general, the apparatus may aggregate the power during operation of the apparatus (e.g., the power applied over time during a puff/inhalation and/or the power applied over this time multiplied times the duration of the inhalation).

The apparatus may further provide an output of the amount of consumption. This output may be, in particular, a qualitative approximation. For example, the output may be incrementally increasing the number, intensity and/or color of one or more LEDs on the surface of the apparatus. For example, in this case, the consumption amount (dose) is not an absolute amount, but is an indicator or readout of the power applied to vaporize the material (power applied to the coils) over time. In FIG. **9**C, for example, when the user first installs a cartridge and the apparatus is set up to display consumption/dose, the four LEDS **897** may initially be unlit or lit to the neutral color (e.g., white). As the user draws on the device and vaporizes the material within the cartridge, the number of LEDS illuminated may be increased and the intensity and/or color of illumination may be increased to indicate increasing dosage or consumption; for example the calculation of power applied over time may determine based on a number or predetermined increments, whether to increase the number of illuminated LEDS of a particular color and/or intensity, to change color and/or intensity, etc.

The accumulated dose may be reset manually (e.g., using an app, shaking the device, etc.) or by removing the cartridge. Alternatively or additionally to the qualitative output described above, a quantitative estimate based on the power may be displayed or output to a remote processor (e.g. smartphone, etc.).

Thermocouple as Heater

In any of the apparatuses described herein, the heater may be configured as a thermocouple junction. See, e.g., FIGS. **20**A and **20**B. Thus, a thermocouple junction (comprising materials having dissimilar thermoelectric properties) may be used to measure temperature at a point along the heater coil. As discussed above, this may allow an apparatus to resistively determine temperature along the heater coil using the thermoelectric properties described above. Thus, similar to what is described above, the heating element performs both as a heater and a temperature sensor. For example, a resistive heater may comprised of two dissimilar conductors

(e.g., stainless steel and titanium) welded together, as shown in FIG. **20**A. When the heater (heating coil) heats up, the dissimilar material will be heated differentially, resulting in a temperature gradient and a resulting offset voltage (EMF), due to the Seebeck effect discussed above, at the junction of the two dissimilar materials. This effect may be used to determine the temperature at that junction (whereas typically, we determine the average temperature of the entire heater by using TCR, temperature coefficient of resistance, as also discussed above.

The Seebeck effect also occurs at the junction between the heater end poles and passive electrical conduits. Although the correction circuits discussed above are aimed at correcting for the effect, it may also be possible to take advantage of the effect for a more localized temperature measurement. Compare. FIG. **20**B to FIG. **20**A, for example. In FIG. **20**A, the junction is located in the middle of the heating element, and determining the offset voltage in this case, which is based on the temperature, may allow accurate temperature determination. This embodiment may be particularly relevant for a convection vaporizer, where you likely have a (relatively) large heater and you care about the temperature at just the air outlet end.

In vaporization systems where the heating element is connected to the device through extension leads, if Seebeck coefficients are known for both materials, the measured Seebeck EMF can be used to determine the net temperature gradient across the heating element. With some modeling, this measurement could be used to approximately control maximum heating element temperature instead of or in addition to average heating element temperature. This measurement can also be used to perform quality control where the heating element assembly is manufactured. In vaporization systems where the heating element is connected to the device through extension leads and the heating element is used to primarily heat air, if Seebeck coefficients are known for both materials. Seebeck EMF can be used to determine the net temperature gradient across the heating element, which with a known air flow path and thermal modeling of the system can be used to predict average air temperature at some point down-stream of the heating element. As mentioned above, this may be particularly advantageous in convection (hot-air) vaporization systems as two measurements (resistance and Seebeck EMF) taken from the actuator can allow for accurate temperature control of air lowing from the outlet of the heating element without additional sensors in the air path or connected to the heating element.

As shown in FIG. **20**A, the Seebeck effect alone or the Seebeck effect in conjunction with resistance measurement can be used for temperature control of a heating element that has a material transition (junction) at the position where temperature is to be controlled. This is essentially creating a thermocouple out of resistive heating alloys so that the Seebeck EMF can be measured in order to control temperature at the hot junction of the thermocouple resistive heater. The junction could be positioned where the heating element is expected to be hottest to control maximum temperature of the heating element. The control algorithm could use a target average temperature of the heating element (calculated using resistance and EMF measurements) as well as a maximum acceptable max temperature of the heating element (calculated using just the EMF measurement). A device that knows both the average temperature of the heating element and the maximum temperature of the heating element could know more about the temperature gradient along the heating element and be better at predicting mass of material vaporized while heating than a device that only knows either maximum or average heating element temperature (device knowing precise mass of material vaporized is critical for dose-control in vaporizers). If extensions are used in such a system, they could be the same material as the intended heating element but much larger gauge for reduced losses in the extensions. Alternatively, extensions with Seebeck coefficients that are very similar to the Seebeck coefficients of the two heating element sections could be used so that Seebeck EMF is still usable for temp control of the hot junction (small contribution of heating element/extension junctions to net Seebeck EMF).

Vaporizers without Cartridges

Any of the features described herein may be incorporated into a vaporizer apparatus that does not require the uses of a separate (e.g., removable cartridge), including vaporizer apparatuses such as loose-leaf vaporizer apparatuses.

Such apparatuses are described, for example, in each of the following applications, herein incorporated by reference in their entirety: U.S. patent application Ser. No. 13/837,438, filed on Mar. 15, 2013, Publication No. US 2013-0312742 A1; U.S. patent application Ser. No. 15/166,001, filed on May 26, 2016, Publication No. US 2016-0262459 A1; U.S. patent application Ser. No. 14/581,666, filed on Dec. 23, 2014, Publication No. US 2015-0208729 A1; U.S. patent application Ser. No. 15/053,927, filed on Feb. 25, 2016, Publication No. US 2016-0174611 A1; U.S. patent application Ser. No. 15/257,748, filed on Sep. 6, 2016; U.S. patent application Ser. No. 15/257,760, filed on Sep. 6, 2016. Publication No. US 2016-0374399 A1; and U.S. patent application Ser. No. 15/257,768, filed on Sep. 6, 2016, Publication No. US 2016-0366947 A1.

For example such a device may include preset and allow the user to enter temp set mode by holding down on a button (on or under the mouthpiece) for >0.6 seconds. Pressing the button again cycles through the 4+1 presets. To exit temp set, again hold the button for >0.6 sec. The presets may be, e.g.: 180 C, 193 C, 204 C, 216 C.

Any of the apparatuses described herein may include haptic feedback that may include distinct profiles for different events: For example:

/‾\—trapezoid—power on, and Bluetooth connect

||—quick click—manual power off, and Bluetooth disconnect

|‾||‾|—2 long clicks—temp reached

|‾|—1 long click—entered low temp standby, and auto shutoff

Also the user may change the intensity of these envelopes via the app.

Although the disclosure, including the figures, described herein may described and/or exemplify these different variations separately, it should be understood that all or some, or components of them, may be combined.

Although various illustrative embodiments are described above, any of a number of changes may be made to various embodiments without departing from the scope of the invention as described by the claims. For example, the order in which various described method steps are performed may often be changed in alternative embodiments, and in other alternative embodiments one or more method steps may be skipped altogether. Optional features of various device and system embodiments may be included in some embodiments and not in others. Therefore, the foregoing description is provided primarily for exemplary purposes and should not be interpreted to limit the scope of the invention as it is set forth in the claims.

When a feature or element is herein referred to as being "on" another feature or element, it can be directly on the

other feature or element or intervening features and/or elements may also be present. In contrast, when a feature or element is referred to as being "directly on" another feature or element, there are no intervening features or elements present. It will also be understood that, when a feature or element is referred to as being "connected", "attached" or "coupled" to another feature or element, it can be directly connected, attached or coupled to the other feature or element or intervening features or elements may be present. In contrast, when a feature or element is referred to as being "directly connected", "directly attached" or "directly coupled" to another feature or element, there are no intervening features or elements present. Although described or shown with respect to one embodiment, the features and elements so described or shown can apply to other embodiments. It will also be appreciated by those of skill in the art that references to a structure or feature that is disposed "adjacent" another feature may have portions that overlap or underlie the adjacent feature.

Terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. For example, as used herein, the singular forms "a". "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, steps, operations, elements, components, and/or groups thereof. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items and may be abbreviated as "/".

Spatially relative terms, such as "under", "below", "lower", "over", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if a device in the figures is inverted, elements described as "under" or "beneath" other elements or features would then be oriented "over" the other elements or features. Thus, the exemplary term "under" can encompass both an orientation of over and under. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly. Similarly, the terms "upwardly". "downwardly", "vertical", "horizontal" and the like are used herein for the purpose of explanation only unless specifically indicated otherwise.

Although the terms "first" and "second" may be used herein to describe various features/elements (including steps), these features/elements should not be limited by these terms, unless the context indicates otherwise. These terms may be used to distinguish one feature/element from another feature/element. Thus, a first feature/element discussed below could be termed a second feature/element, and similarly, a second feature/element discussed below could be termed a first feature/element without departing from the teachings of the present invention.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising" means various components can be co-jointly employed in the methods and articles (e.g., compositions and apparatuses including device and methods). For example, the term "comprising" will be understood to imply the inclusion of any stated elements or steps but not the exclusion of any other elements or steps.

As used herein in the specification and claims, including as used in the examples and unless otherwise expressly specified, all numbers may be read as if prefaced by the word "about" or "approximately," even if the term does not expressly appear. The phrase "about" or "approximately" may be used when describing magnitude and/or position to indicate that the value and/or position described is within a reasonable expected range of values and/or positions. For example, a numeric value may have a value that is +/−0.1% of the stated value (or range of values), +/−1% of the stated value (or range of values), +/−2% of the stated value (or range of values), +/−5% of the stated value (or range of values), +/−10% of the stated value (or range of values), etc. Any numerical values given herein should also be understood to include about or approximately that value, unless the context indicates otherwise.

The examples and illustrations included herein show, by way of illustration and not of limitation, specific embodiments in which the subject matter may be practiced. As mentioned, other embodiments may be utilized and derived there from, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. Such embodiments of the inventive subject matter may be referred to herein individually or collectively by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept, if more than one is, in fact, disclosed. Thus, although specific embodiments have been illustrated and described herein, any arrangement calculated to achieve the same purpose may be substituted for the specific embodiments shown. This disclosure is intended to cover any and all adaptations or variations of various embodiments. Combinations of the above embodiments, and other embodiments not specifically described herein, will be apparent to those of skill in the art upon reviewing the above description.

What is claimed is:

1. A vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;

a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to hold a vaporizable material;

a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;

a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;

a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;

a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;

a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and

a vaporization chamber comprising:

a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol

a wicking material comprising ceramic;

a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and

an air tube configured to deliver the aerosol to the mouthpiece.

2. The vaporizer cartridge of claim **1**, wherein at least a portion of the housing piece is cylindrical.

3. The vaporizer cartridge of claim **1**, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within a cartridge receiver of the vaporizer body.

4. The vaporizer cartridge of claim **1**, further comprising a gasket positioned between the reservoir and the bottom cover.

5. A vaporizer device, comprising:

the vaporizer cartridge of claim **1**; and

the vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:

the first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;

the second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end.

6. The vaporizer device of claim **5**, further comprising: a pressure sensor configured to detect a draw on the mouthpiece to activate the vaporizer device; and a channel extending from the base of the cartridge receiver to the pressure sensor.

7. The vaporizer device of claim **5**, further comprising one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heating element of the vaporizer cartridge.

8. The vaporizer cartridge of claim **1**, wherein the bottom cover consists of two air openings comprising the first air opening and a second air opening.

9. The vaporizer cartridge of claim **1**, consisting of two cartridge electrical contacts comprising the first cartridge electrical contact and the second cartridge electrical contact.

10. The vaporizer cartridge of claim **1**, wherein the bottom cover comprises a bottom portion, and wherein the bottom portion comprises: the first air opening; a second air opening; a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; and a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.

11. A vaporizer device, comprising:

a vaporizer cartridge comprising:

a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;

a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;

a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to hold a vaporizable material;

a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;

a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;

a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;

a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;

a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and

a vaporization chamber comprising:

a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol;

a wicking material comprising ceramic;

a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and

an air tube configured to deliver the aerosol to the mouthpiece; and

a vaporizer body, comprising:

a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:

a first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;

a second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;

an insertion end into which the vaporizer cartridge is inserted; and

a base opposite the insertion end;

a pressure sensor configured to detect a change in pressure, causing activation of the vaporizer device; and

a channel extending between the base of the cartridge receiver and the pressure sensor.

12. The vaporizer device of claim **11**, wherein the vaporizer body further comprises one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heating element of the vaporizer cartridge.

13. The vaporizer device of claim **11**, wherein at least a portion of the housing piece is cylindrical.

14. The vaporizer device of claim **11**, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within the cartridge receiver of the vaporizer body.

15. The vaporizer device of claim **11**, wherein the bottom cover consists of two air openings comprising the first air opening and a second air opening.

16. The vaporizer device of claim **11**, wherein the vaporizer cartridge consists of two cartridge electrical contacts comprising the first cartridge electrical contact and the second cartridge electrical contact.

17. The vaporizer device of claim **11**, wherein the bottom cover comprises a bottom portion, and wherein the bottom portion comprises the first air opening; a second air opening; a first cartridge electrical contact opening through which the first cartridge electrical contact is exposed; and a second cartridge electrical contact opening through which the second cartridge electrical contact is exposed.

18. A vaporizer cartridge comprising:
a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;
a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to hold a vaporizable material;
a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;
a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;
at least one pad positioned within an interior of the mouthpiece;
a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;
a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;
a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and
a vaporization chamber comprising:
a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol;
a wicking material comprising ceramic;
a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and
an air tube configured to deliver the aerosol to the mouthpiece.

19. The vaporizer cartridge of claim 18, wherein at least a portion of the housing piece is cylindrical.

20. The vaporizer cartridge of claim 18, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within a cartridge receiver of the vaporizer body.

21. The vaporizer cartridge of claim 18, further comprising a gasket positioned between the reservoir and the bottom cover.

22. The vaporizer cartridge of claim 18, wherein the at least one pad includes two pads.

23. A vaporizer device, comprising:
the vaporizer cartridge of claim 18; and
the vaporizer body, comprising:
a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:
the first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;
the second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;
an insertion end into which the vaporizer cartridge is inserted; and
a base opposite the insertion end.

24. The vaporizer device of claim 23, further comprising:
a pressure sensor configured to detect a draw on the mouthpiece to activate the vaporizer device; and a channel extending from the base of the cartridge receiver to the pressure sensor.

25. The vaporizer device of claim 23, further comprising one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heating element of the vaporizer cartridge.

26. A vaporizer device, comprising:
a vaporizer cartridge comprising:
a cartridge body comprising a proximal body end and a distal body end opposite the proximal body end;
a mouthpiece coupled to the proximal body end, wherein the mouthpiece comprises an outlet;
a reservoir comprising an internal volume at least partially defined by the cartridge body, wherein the internal volume is configured to hold a vaporizable material;
a first reservoir seal configured to cover a first reservoir opening exposing the internal volume of the reservoir;
a second reservoir seal configured to cover a second reservoir opening exposing the internal volume of the reservoir, wherein the first reservoir seal and the second reservoir seal are positioned within an interior of the mouthpiece;
at least one pad positioned within an interior of the mouthpiece;
a bottom cover comprising a bottom portion positioned distally relative to the cartridge body, wherein the bottom portion comprises at least a first air opening;
a first cartridge electrical contact configured to contact a first body electrical contact on a vaporizer body;
a second cartridge electrical contact configured to contact a second body electrical contact on the vaporizer body; and
a vaporization chamber comprising:
a heating element configured to heat the vaporizable material from the reservoir to generate an aerosol;
a wicking material comprising ceramic;
a housing piece configured to house at least a portion of the wicking material, wherein the housing piece comprises a housing opening into which at least the portion of the wicking material passes into the housing piece; and
an air tube configured to deliver the aerosol to the mouthpiece; and
a vaporizer body, comprising:
a cartridge receiver configured to insertably receive the vaporizer cartridge, wherein the cartridge receiver comprises:
a first body electrical contact configured to electrically couple to the first cartridge electrical contact of the vaporizer cartridge;
a second body electrical contact configured to electrically couple to the second cartridge electrical contact of the vaporizer cartridge;
an insertion end into which the vaporizer cartridge is inserted; and
a base opposite the insertion end;
a pressure sensor configured to detect a change in pressure, causing activation of the vaporizer device; and
a channel extending between the base of the cartridge receiver and the pressure sensor.

27. The vaporizer device of claim 26, wherein the vaporizer body further comprises one or more LEDs, wherein the vaporizer device is configured to cause the one or more LEDs to illuminate during the generation of the aerosol by the heating element of the vaporizer cartridge.

28. The vaporizer device of claim **26**, wherein at least a portion of the housing piece is cylindrical.

29. The vaporizer device of claim **26**, wherein the vaporizer cartridge is configured to be magnetically coupled and secured within the cartridge receiver of the vaporizer body.

30. The vaporizer device of claim **26**, wherein the at least one pad includes two pads.

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PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

Washington, D.C.

In the Matter of	
CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	**Inv. No. 337-TA-1392**

ORDER NO. 29: GRANTING-IN-PART COMPLAINANT'S MOTION *IN LIMINE* NO. 3 TO PRECLUDE RESPONDENTS FROM PRESENTING EVIDENCE OR SOLICITING TESTIMONY THAT RELATES TO UNAUTHORIZED PUBLIC INTEREST ISSUES, AND TO STRIKE PORTIONS OF RESPONDENTS' PRE-HEARING BRIEF REGARDING SAME

(October 18, 2024)

On September 27, 2024, Complainant PAX Labs., Inc. ("PAX") moved (Mot. 1392-015) to preclude Respondents STIIIZY IP LLC f/k/a STIIIZY, LLC, STIIIZY Inc. d/b/a Shryne Group Inc., ALD Group Limited, and ALD (Hong Kong) Holdings Limited (collectively, "Respondents") from presenting evidence or soliciting testimony that addresses or relates to the issues raised in the ALD Respondents' Motion for Summary Determination that PAX Fails to Satisfy the Domestic Industry Economic Prong (Mot. 1392-011) and to strike Section VII.B (Pages 216-249) of Respondents' Pre-Hearing Brief. PAX asserts that these arguments relate to a public interest issue that is outside the scope of this investigation. Respondents opposed the motion on October 11, 2024.

Having reviewed the pleadings and the attached evidence, Motion No. 1392-015 is GRANTED-IN-PART. Section VII.B.1 is struck from Respondents' pre-hearing brief, as well as the redacted portion on page 216 (*see* Ex. A). The redacted portions of Q/As 21-24, 170, 172-175,

as shown in attached Exhibit B, are struck from Mr. Kline's witness statement (RX-0475C). The remainder of PAX's motion is denied.

Within seven days of the date of this document, the parties shall submit a joint statement as to whether they seek to have any portion of this document deleted from the public version. If the parties do seek to have portions of this document deleted from the public version, they must submit a single proposed public version of this order with any proposed redactions in the manner specified by Ground Rule 1.5. To the extent possible, the proposed redactions should be made electronically, in a PDF of the issued order, using the "Redact Tool" within Adobe Acrobat, wherein the proposed redactions are submitted as "marked" but not yet "applied." The submission shall be made by email to Moore337@usitc.gov and need not be filed with the Commission Secretary.

SO ORDERED.

Bryan F. Moore
Administrative Law Judge

Exhibit A

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION
WASHINGTON, D.C.

Before the Honorable Bryan F. Moore
Administrative Law Judge

In the Matter of **CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME**	Investigation No. 337-TA-1392

RESPONDENTS' PREHEARING BRIEF

VII. PAX HAS NOT SHOWN THAT IT HAS A DOMESTIC INDUSTRY

In a patent-based investigation, a violation of Section 337 can be found "only if an industry in the United States, relating to the articles protected by the patent . . . concerned, exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). Under Commission precedent, the "domestic industry requirement" of Section 337 consists of an economic prong and a technical prong. C*ertain Stringed Musical Instruments and Components Thereof,* Inv. No. 337-TA-586, Comm'n Op. at 12-14, 2009 WL 5134139 (U.S.I.T.C. Dec. 2009). The complainant bears the burden of establishing that the domestic industry requirement is satisfied. *See Certain Set-Top Boxes and Components Thereof,* Inv. No. 337-TA-454, Final Initial Determination at 294, 2002 WL 31556392 (U.S.I.T.C. June 21, 2002) (unreviewed by Commission in relevant part). PAX has not met its burden of establishing a domestic industry as to the economic prong of domestic industry.

Section 337 requires that "an industry in the United States, relating to the articles protected by the patent . . . exists or is in the process of being established." 19 U.S.C. § 1337(a)(2). Typically, a complainant must show that a domestic industry existed at the time a complaint was filed. *See*, *e.g.*, *Certain Display Controllers with Upscaling Functionality and Prods. Containing Same*, Inv. No. 337-TA-481, Order No. 27, 5 (Apr. 28, 2003) ("*Display Controllers*"). Section 337(a)(3) specifies:

> For purposes of paragraph (2), an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned—
>
> (A) significant investment in plant and equipment;
> (B) significant employment of labor or capital; or
> (C) substantial investment in its exploitation, including engineering, research and development, or licensing.

Satisfaction of any prong is sufficient to meet the economic prong of the domestic industry

requirement. *Certain Integrated Circuits, Chipsets and Products Containing Same*, Inv. No. 337-TA-428, Order No. 10 (May 4, 2000).

The burden is on the complainant to show by a preponderance of evidence that the economic prong of the domestic industry requirement is met. *See*, *e.g.*, *Certain Multimedia Display and Navigation Devices and Systems, Components Thereof, and Products Containing Same*, Inv. No. 337-TA-694, Comm'n Op. at 5 (July 22, 2011) ("*Navigation Devices"*). For each of prongs (A), (B), and (C), activities that would be typical of any importer or seller do not constitute a domestic industry. *Certain Male Prophylactic Devices*, Inv. No. 337-TA-546, Comm'n Op. at 39 (Aug. 1, 2007) ("*Male Prophylactic Devices*"). "The economic prong requirement exists to assure that domestic production-related activities, as opposed to those of a mere importer, are protected by the statute." *Id.* (citation omitted) (emphasis added).

Under prongs (A) and (B), a complainant must substantiate the significance of its investments in plant and equipment or labor and capital with respect to the articles protected by the patent. *Certain Ground Fault Circuit Interrupters and Products Containing Same*, Inv. No. 337-TA-739, Comm'n Op. at 78 (June 8, 2012). For section 337(a)(3)(C), the complainant must show a nexus between the claimed investment and asserted patent. *Certain Integrated Circuit Chips and Products Containing the Same*, Inv. No. 337-TA-859, Comm'n Op. at 38 (Aug. 22, 2014) ("*Integrated Circuit Chips*"). Prong (C) has "an additional requirement that the investment constitutes an exploitation of the asserted patent." *Integrated Circuit Chips*, Comm'n Op. at 48.

Whether an investment is significant or substantial "is not measured in the abstract or in an absolute sense, but rather is assessed with respect to the nature of the activities and how they are 'significant' to the articles protected by the intellectual property right." *Certain Printing and Imaging Devices and Components Thereof*, Inv. No. 337-TA-690, Comm'n Op. at 26 (Feb. 17,

2011) ("*Printing Devices*").

In addition to showing qualitative significance, the complainant must perform a quantitative analysis. *Lelo Inc. v. Int'l Trade Comm'n*, 786 F.3d 879, 885 (Fed. Cir. 2015). The Federal Circuit has clarified that "qualitative factors alone are insufficient to show 'significant investment in plant and equipment' and 'significant employment of labor or capital' under prongs (A) and (B) of the § 337 domestic industry requirement." *Id*. There is no threshold monetary amount that a complainant must meet. *See, e.g., Certain Stringed Musical Instruments and Components Thereof*, Inv. No. 337-TA-586, Comm'n Op. at 25-26 (May 16, 2008); *Male Prophylactic Devices*, Comm'n Op. at 39 ("[T]here is no mathematical threshold test.").

Rather, the inquiry depends on "the facts in each investigation, the article of commerce, and the realities of the marketplace." *Printing Device* at 27. "The determination takes into account the nature of the investment and/or employment activities, the industry in question, and the complainant's relative size." *Id.* Thus, evidence to "substantiate the significance of [a complainant's] activities with respect to the [domestic industry articles protected by the asserted patent]" is required. *Certain Solid State Storage Drives, Stacked Elecs. Components, & Prods. Containing Same*, Inv. No. 337-TA-1097, Comm'n Op. at 33 (June 29, 2018) ("*Solid State Storage Devices*").

"There are a number of factors and approaches taken by the Commission in making this determination. For example, comparing complainant's domestic expenditures to its foreign expenditures is one of the possible factors that the Commission could but . . . is not required to consider." *Certain Optoelectronic Devices for Fiber Optic Communications*, Inv. No 337-TA-860, Comm'n Op. at 18-19 (May 9, 2014). The Commission has also compared domestic expenditures to sales revenues and manufacturing costs. *See, e.g., Certain Automated Teller Machines, ATM*

Modules, Components Thereof and Products Containing Same, Inv. No. 337-TA-972, Final ID at 190-91 (Feb. 1, 2017) ("*Automated Teller Machines*"), *unreviewed on relevant findings*, Notice at 3 (Jan. 30, 2017).

In *Lelo*, the Federal Circuit noted that the Commission found the complainant's investments were quantitatively "modest," which the court took to mean "insignificant." *Lelo*, 786 F.3d at 885. The Federal Circuit agreed with the Commission's finding that investment and employment under subparagraphs (A) and (B) were modest and insignificant, but said the Commission erred when it "disregarded the quantitative data to reach its domestic industry finding based on qualitative data." *Id*. "Qualitative factors cannot compensate for quantitative data that indicate insignificant investment and employment." *Id*. It then reversed the Commission's determination and held that the complainant did not satisfy the domestic industry requirement of section 337. *Id*.

A. Respondents Do Not Take a Position On The Technical Prong Of Domestic Industry.

Respondents do not take a position on the technical prong of domestic industry.

B. PAX Has Not Shown That It Satisfies the Economic Prong of the Domestic Industry

PAX fails to meet its burden under the economic prong of the domestic industry requirement. [redacted] Second, PAX's alleged investments occurred before PAX owned the asserted patents. Third, PAX failed to show a domestic industry exists on the date it filed its complaint and PAX does not contend that it has a domestic industry in the process of being established. Finally, should the Commission overlook the first three fatal flaws, the

[redacted]

1. The Commission Should Reject PAX's Investments Directed Toward Federally Illegal Activities

PAX has stipulated that [redacted] of its asserted domestic industry product pods are filled with, and ultimately sold to consumers containing, federally illegal Marijuana oil pursuant to its voluntary agreements with producers and distributors of federally illegal Marijuana oils. PAX admits that it intends for its asserted domestic industry pods to be filled with these federally illegal Marijuana oils—mostly manufactured in accordance with PAX's propriety Marijuana oil formulations pursuant to the voluntary agreements. Accordingly, [redacted] of PAX's asserted domestic industry expenses were indisputably investments in an illegal conspiracy to manufacture, distribute, dispense, and possess Marijuana oil in violation of 21 U.S.C. § 846. PAX simply lacks any evidence to demonstrate that any nonnegligible portion of the remaining [redacted] of PAX's alleged domestic industry activities is directed toward federally legal commerce. Accordingly, PAX fails to establish qualitative and quantitative significance or substantiality of its domestic industry investment directed to federally *legal* commerce.

PAX does not simply provide its asserted domestic industry pods to its Marijuana oil [redacted] while ignoring what vaporizable oil will fill them. Rather, PAX is intimately involved at virtually every stage of the Marijuana oil manufacturing, distribution, and sales process, ensuring that its Marijuana oil-filled pods reach consumers so that they may imbibe PAX's "premium" versions of this federally illegal drug.

There can be no doubt that [redacted] of PAX's domestic industry commerce is part and parcel of PAX's illegal federal drug conspiracy to manufacture, distribute, dispense, and possess Marijuana oils. As to the unaccounted for [redacted] of PAX's pods that may or may not be filled with

federally illegal Marijuana oil, PAX simply has *no* evidence to indicate what portion of this small fraction of its business (if any) *might* be directed toward legal commerce. Thus, the commerce underlying the *entirety* of PAX's economic prong allegations, is federally illegal.

Resolution of this Investigation then turns on one simple question of law: *Can a complainant rely on investments made in furtherance of an illegal, criminal drug distribution conspiracy to satisfy the requirements of 19 USC § 1337 (a)(3)?* The 300-year-old common law "Illegality Rule" and precedent from Federal Courts, the USPTO, and the ITC compel a resounding "*No!"* PAX cannot satisfy the economic prong of the domestic industry requirement must follow.

a. Background

i. PAX and Its Marijuana Oil-Based Business Model

PAX proudly and publicly proclaims that it is "a leading global cannabis brand." JX-0410 (2022-12-06 Article). PAX knows that Marijuana and its derivatives are federally illegal notwithstanding the establishment of state-legal markets in a subset of U.S. states. RX-0468 (PAX Website); [redacted] Thus, in an apparent attempt to minimize potential federal criminal liability while accessing the growing and lucrative state-legal—but federally illegal—recreational and medical Marijuana markets, PAX ostensibly developed a business model where it could become a profitable Marijuana company without "touching" Marijuana or Marijuana oils[4]. *See, e.g.* [redacted]; JX-0046 (June 21, 2024 Complainant's Interrogatory Responses), 53-57; [redacted]

PAX allegedly sells its vaporizer pods exclusively to its wholly owned subsidiary, Peace

[4] [redacted]

& Haight Inc. ("P&H"), which in turn sells such pods to [redacted] *E.g.,* JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), pp. 53-57; Ex E at 17:3-23. [redacted] *Id.;* JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), 59-64; [redacted] JX-0177C (CBI Stipulation), ¶¶ 4, 6, 8; JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), 53-55 [redacted] and sells the products to licensed retail dispensaries"), 56-64; JX-0045C (Oar Depo.), 17:20-23, 29:14-30:6, 42:7-44:2, 45:12-46:12, 50:4-51:3, 98:20-99:12, 102:21-105:19, 108:25-109:3, 114:3-117:5; *e.g.,* JX-0409 (Third Amended Final Bell Agreement).

PAX also markets its Marijuana oil-filled pods directly to consumers. *E.g.,* JX-0410 (2022-12-06 Article), JX-0048 (PAX Journal), JX-0411C (PAX Veteran Campaign Overview), JX-0413 (PAX Website), RX-0465 (PAX Website), RX-0466 (PAX Website), RX-0467 (PAX Website), RX-0468 (PAX Website), RX-0469 (PAX Website). And, via its website, PAX ultimately directs potential consumers to local Marijuana dispensaries where they can purchase PAX pods filled with

Marijuana oil made according to PAX's formulations and meeting PAX's rigorous testing standards. JX-0177C (CBI Stipulation), ¶¶ 11, 9; JX-0413 (PAX Website); RX-0465 (PAX Website).

Although PAX allegedly only sells empty pods to its brand partners and co-manufacturers, PAX admits that the market for its empty domestic industry pods directly corresponds to the market for pods filled with cannabis oils. JX-0045C (Oar Depo.), 124:3-125:10; *see also, e.g.,* JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), pp. 53-55. That is, but for the lucrative downstream sales of PAX's Marijuana oil-filled pods, there would be no commerce in the empty, asserted domestic industry pods. *Id.* Indeed, PAX's asserted domestic industry pods are never intended be sold to end consumers empty, not offered for sale to end consumers empty, and never intended to be filled or refilled by end consumers. JX-0045C (Oar Depo.), 34:13-21.

Ultimately, PAX admits that [redacted] of its asserted domestic industry pods are filled with Marijuana oils and, in turn, that [redacted] are filled with a federally-legal oil. JX-0177C (CBI Stipulation), ¶1. Furthermore, PAX—having stipulated to the [redacted] figure specifically to avoid discovery on this issues—has no evidence as to what portion (if any) of the [redacted] of its filled pods are federally legal. *E.g.,* JX-0177C (CBI Stipulation), p.1 (first whereas clause); JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), pp. 53-65 [redacted]

Notably, in opposing Summary Determination on this issue, PAX entirely declined to contest the forgoing description of its business model, or any related factual assertions. EDIS Doc. No. 831363 (Sept. 3, 2024).

ii. The Asserted Patents

The Asserted Patents are directed to Vaporizer cartridges and vaporizer apparatuses… that are leak-resistant for use with cannabinoids [and] adapted for use with … Cannabis oils. JX-0001

('756 patent), Abstract. Their common disclosure recites, as the first of numerous "[e]xemplary cannabinoids," "tetrahydrocannabinol (THC)." *Id.* at 19:26-44.

iii. PAX's Domestic Industry Allegations

PAX asserts it has satisfied the economic prong of the domestic industry requirement under prongs (A) and (B) of Section 337(a)(3). JX-4748C (Putnam WS), Q/A43. All asserted domestic industry expenses are investments directed to (i) PAX's pods or (ii) PAX's vaporizer batteries designed by PAX to exclusively work with such pods—and only when such pods are filled with oil. *Id.* at Q/A39, 44-45; *see also* JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), 61 [redacted] It asserts investments in Capital Equipment, Plant, and Labor. JX-4748C (Putnam WS), Q/A34-35, 38. Although PAX purports to allocate investments among the Asserted Patents, it has entirely declined to even attempt to allocate such investments based on whether they are in furtherance of legal commerce or federally illegal commerce. RX-475C (Kline WS), Q/A22-23.

b. LEGAL STANDARDS

i. The Controlled Substances Act, 21 U.S.C. 801 *et seq*.

Marijuana and derivatives thereof are criminally prohibited. Controlled Substances Act, 21 U.S.C. 801 *et seq*. ("CSA"). Marijuana is defined as "all parts of the plant Cannabis sativa L., whether growing or not; the seeds thereof; the resin extracted from any part of such plant; and every compound, manufacture, salt, derivative, mixture, or preparation of such plant, its seeds or resin"—except, in relevant part, "hemp. " 21 USC § 802(16). Hemp, in turn, is defined as "the plant Cannabis sativa L. and any part of that plant, including the seeds thereof and all derivatives,

extracts, cannabinoids, isomers, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol [THC] concentration of not more than 0.3 percent ….” 7 USC § 1639o (1). “[A]ny material, compound, mixture, or preparation, which contains any quantity of … or which contains any of their salts, isomers, and salts of isomers” of Marijuana and “Tetrahydrocannabinols, except for tetrahydrocannabinols in hemp” are classified as Schedule I controlled substances under the CSA. 21 USC § 812 (c) Schedule I (c)(10) & (17). Manufacturing, distributing, dispensing, and even possessing Marijuana or derivatives thereof are criminal violations of federal law. 21 USC § 841(a) & 844(a).

The CSA also prohibits willing participation in conspiracies to manufacture, distribute, dispense, or possess Marijuana oil. 21 U.S.C. § 846 (“Any person who attempts or conspires to commit any offense defined in this subchapter shall be subject to the same penalties as those prescribed for the offense, the commission of which was the object of the attempt or conspiracy.”). The elements of a CSA conspiracy under 21 U.S.C. § 846 are (1) an agreement to commit a crime under the CSA (2) knowledge of the agreement; and (3) voluntarily joining of the agreement. *E.g., United States v. Ruan,* 56 F.4th 1291, 1299 (11th Cir. 2023); *United States v. Morillo*, 158 F.3d 18, 23 (1st Cir. 1998). For example, “[t]he knowing agreement to distribute drugs in violation of § 841(a)(1) is itself the completed crime of a distribution conspiracy.” *United States v. Wheat*, 988 F.3d 299, 306 (6th Cir. 2021).

ii. The Illegality Rule

Dating back to at least 1725, when an English court refused to consider a lawsuit where one highwayman sued his former partner for cheating him out of the proceeds of their robberies, the common law has maintained the doctrine of *Ex turpi causa non oritur action*—from a dishonorable cause an action does not arise. William J. McNichol, Jr., *The New Highwayman: Enforcement of U.S. Patents on Cannabis Products*, 101 J. Pat. & Trademark Off. Soc’y

("JPTOS") 24, 40 (2019). As articulated by the Supreme Court nearly 150 years ago: "No court will lend its aid to a man who founds his cause of action upon an … illegal act." *Higgins v. McCrea*, 116 U.S. 671, 686 (1886). In modern times, this common law doctrine is alive and well and commonly referred to as "the Illegality Rule."[5] McNichol, 101 JPTOS at 40.

While the federal government has, in recent years, implemented "*laissez-faire* policies on marijuana" with respect to state-regulated Marijuana commerce and has largely refrained from enforcing the CSA in such contexts, Marijuana commerce invariably remains illegal under federal law. *Standing Akimbo, LLC v. United States*, 141 S. Ct. 2236, 2238 (2021) (denying cert. for state-legal Marijuana dispensary challenging I.R.S. investigation regarding 26 U.S.C.§ 280E, an onerous tax provision directed to, *inter alia*, Marijuana commerce)[6].

And regardless of whether Marijuana may be federally legalized soon[7], it is not now, it was not at the time PAX filed its Complaint, and it most certainly was not when PAX made *any* of its

[5] The Supreme Court has more recent times, confirmed the doctrine. *E.g., Kaiser Steel Corp. v. Mullins*, 455 U.S. 72, 77 (1982). Other high courts following this same common law tradition have explained that the Illegality Rule is needed to "maintain internal consistency in the law" and reflects a policy of "judicial abstention" that prevents exercise of the power of the state where "the ordinary rules of law would give effect to advantages derived from an illegal act." *Hall v. Herbert*, [1993] 2 S.C.R. 159 (Canadian Supreme Court); *Jetivia v. Bilta*, [2015] UKSC 23 (UK Supreme Court); *see* McNichol, 101 JPTOS at 49, 44. And, the Illegality Rule is not limited to the contract context. *E.g., Sensoria, LLC v. Kaweske*, 581 F. Supp. 3d 1243, 1259 (D. Colo. 2022).

[6] *Id.* at 2237-38.

[7] It may be reasonable to expect that Marijuana will soon be rescheduled from a Schedule I drug (criminally prohibited in virtually all circumstances) to a Schedule III drug (permitted for medical uses under strict provisions of the CSA). Schedules of Controlled Substances: Rescheduling of Marijuana, 89 Fed. Reg. 44597 (May 21, 2024). However, even assuming, *arguendo,* that such rescheduling occurs before the July 7, 2025, target date in this Investigation, PAX has no evidence that it has made *any* efforts such that *any* of its Marijuana oil-filled pods might be sold legally after rescheduling—*i.e.*, (i) prescribed by a physician licensed to prescribe such Schedule III controlled substances by the U.S. Drug Enforcement Agency ("DEA")), *e.g.*, 21 U.S.C. § 823(L); (ii) sold by pharmacies licensed to dispense such Schedule III controlled substances by the DEA, as opposed federally-unregulated Marijuana dispensaries, *e.g.*, § 823(f); (iii) filled with Marijuana oil manufactured by licensed Schedule III drug manufacturers in strict accordance with the CSA and

asserted domestic industry expenditures. The federal government's tolerance of state-regulated Marijuana commerce does not mean that the federal government condones such federally illegal commerce, let alone that the federal government permits the utilization of its limited resources—*i.e*., those of the U.S. International Trade Commission and, perhaps, U.S. Customs and Border Protection—to protect a federally illegal domestic industry from allegedly unfair importations. Such a result would be "absurd." *See AK Futures LLC v. Boyd St. Distro, LLC*, 35 F.4th 682, 689 (9th Cir. 2022).

Thus, PAX's repeated refrain in its Summary Determination opposition that downstream sales of Marijuana-filled PAX pods by partner entities is "completely legal" is completely false. EDIS Doc. No. 831363 (Sept. 3, 2024), pp. 1, 4, *see also id*. 6, 14-16 (attempting to imply a lack of involvement in downstream sales notwithstanding undisputed facts to the contrary). Even if federal criminal prosecutions are vanishingly rare; that such prosecutions are barred with respect to medical marijuana commerce, *id.* at 1-2, 8-9—as opposed to recreational Marijuana commerce, (which PAX has also failed to apportion); and the federal government demands tax revenue from Marijuana businesses *id.* at 8 n.1, Marijuana remains federally illegal as a matter of law.

DEA regulations, *e.g.*, § 823(e); and (iv) approved by the FDA pursuant to the Food, Drugs, and Cosmetics Act, 21 U.S.C. §301 *et seq*. But even assuming PAX had such evidence (it does not), rescheduling would have no effect because: (a) as a matter of law, domestic industry is assessed at the time of filing the Complaint, *Motiva, LLC v. Int'l Trade Comm'n*, 716 F.3d 596, 601 (Fed. Cir. 2013), and (b) rescheduling would not confer any federal legality to Marijuana oil pod commerce directed toward recreational (as opposed to medical) Marijuana commerce, which PAX has declined to apportion.

(a) Federal Courts Regularly Refuse to Intervene on Behalf of Entities Engaging in Federally Illegal Marijuana Commerce

Consistent with the Supreme Court's 19th century directive in *Higgins,* Federal Courts substantially decline to "lend [] aid" to businesses whose causes of action are founded upon state-legal, but federally illegal, Marijuana commerce. 116 U.S. at 686.

First, many Federal Courts have abstained from lawsuits brought by Marijuana companies challenging unfair state Marijuana licensing regulations and their application.[8] Such judicial abstention has also been applied against companies that do not produce, process, distribute, or even possess Marijuana *per se*, but rather merely support state-legal, but federally illegal, Marijuana industry.[9]

Second, state-legal, but federally illegal, Marijuana companies have faced extraordinary difficulty in availing themselves of federal bankruptcy protections. This is because

> bankruptcy laws and bankruptcy courts are purely creatures of federal law. Accordingly, bankruptcy courts have consistently dismissed cases where debtors engaged in ongoing CSA violations, or where a debtor's reorganization efforts depend on funds which can be considered proceeds of CSA violations.

[8] *Georgia Atlas, Inc. v. Turnage*, 594 F. Supp. 3d 1339, 1344-46 (N.D. Ga. 2022) (dismissing out of state corporation's due process case regarding application for medical Marijuana licenses for lack of standing:"[W]hile reasonable people can disagree about the harm in federal courts getting involved when the contraband is marijuana, such a ruling could certainly place federal courts in precarious situations if the contraband involved is more universally abhorred."); *Original Invs., LLC v. State*, 542 F. Supp. 3d 1230 (W.D. Okla. 2021) ("Defendants' Illegality Argument is Dispositive"). *But see NoNe Patients Grp. v. United Cannabis Patients & Caregivers of Maine*, 45 F.4th 542, 544, 554 (1st Cir. 2022) (affirming, over dissent, that the Maine Medical Use of Marijuana Act's "residency requirement is a facially protectionist state regulation of an interstate market in medical marijuana that continues to operate even in the face of the CSA," "Nothing on the face of the CSA purports to bless interstate discrimination in the market for medical marijuana. The CSA in that respect stands in stark contrast to notable instances of Congress blessing such interstate discrimination.").

[9] *E.g., Viridis Lab'ys, LLC v. Kluytman*, No. 1:22-CV-283, 2023 WL 5058087, *1, 3 (W.D. Mich. June 20, 2023), *report and recommendation adopted,* No. 1:22-CV-283, 2023 WL 4861698 (W.D. Mich. July 31, 2023).

In re Way To Grow, Inc., 597 B.R. 111, 117 (Bankr. D. Colo. 2018), *aff'd sub nom.* 610 B.R. 338 (D. Colo. 2019).[10] Notably, Section 337 and the ITC are also "purely creatures of federal law." *Id.*

Third, state-legal, but federally illegal, Marijuana industry participants have found a wide variety of causes of action summarily dismissed for failure to state a cognizable claim under Fed. R. Civ. P. 12(b)(6) or due to the inability of a Federal Court to provide legal or equitable relief that does not run afoul of the CSA.[11] These cases include RICO claims, false advertising claims, theft, fraud, securities violations, and contract claims seeking awards of equity and/or revenue.[12]

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[10] See, *e.g., In re Arenas*, 535 B.R. 845, 853 (B.A.P. 10th Cir. 2015) (dismissing bankruptcy case because it would be "impossible" for the trustee to lawfully administer the estate); *In re Mayer*, No. 2:21-BK-06572-DPC, 2022 WL 18715955, *4, *6 (Bankr. D. Ariz. Jan. 31, 2022); *In re Rent-Rite Super Kegs W. Ltd.,* 484 B.R. 799, 805 (Bankr. D. Colo. 2012) ("Unless and until Congress changes that law, the Debtor's operations constitute a continuing criminal violation of the CSA and a federal court cannot be asked to enforce the protections of the Bankruptcy Code in aid of a Debtor whose activities constitute a continuing federal crime.").

[11] *E.g., Fourth Corner Credit Union v. Fed. Rsrv. Bank of Kansas City,* 861 F.3d 1052, 1055 (10th Cir. 2017) (vacating and remanding, with instructions to dismiss *without prejudice* as the only way to procedurally reconcile three disparate and substantively unreconcilable Circuit Judge opinions, a district court's Rule 12(b)(6) dismissal of a Marijuana industry credit union's case seeking issuance of a "master account" from Federal Reserve Bank due to CSA violations).

[12] *E.g.*, *Shulman v. Kaplan*, 58 F.4th 404, 411–12 (9th Cir. 2023) ("Although some states, such as California, have changed their legal regimes pertaining to the use, cultivation, distribution, and sale of cannabis since the enactment of RICO and the CSA, these activities are still clearly illegal under federal law. Indeed, were we to substitute a drug like heroin for cannabis for the purposes of our analysis, the conclusion seems obvious: Congress could not have intended to allow a heroin dealer to recover RICO damages from someone who, by mail and wire fraud, stole a shipment of heroin. Otherwise, RICO would serve to protect the same variety of conduct it was intended to combat. For these reasons, we hold that Appellants lack a statutory right to bring a claim under RICO."); *Sensoria, LLC v. Kaweske*, 581 F. Supp. 3d at 1260, 1272 (Dismissing all claims, except fraud claims where Plaintiffs might seek return of their principal investment); *Sensoria, LLC v. Kaweske*, 548 F. Supp. 3d 1011, 1026–27 (D. Colo. 2021)("Marijuana is not an indirect or tangential aspect of the dispute. It lies at the heart of the business and thus the lawsuit.") ; *J. Lilly, LLC v. Clearspan Fabric Structures Int'l, Inc.*, No. 3:18-CV-01104-HZ, 2020 WL 1855190, *11 (D. Or. Apr. 13, 2020) ("The Court raised *sua sponte* the question of whether a federal court sitting in diversity can award a party lost profits generated from the sale of marijuana and ordered the parties to brief the issue. [It] … cannot award Plaintiff the lost profits it seeks."); *Shulman v. Kaplan*, No. 219CV05413ABFFMX, 2020 WL 7094063, *3 (C.D. Cal. Oct. 29, 2020); *Polk v. Gontmakher*, No. 2:18-cv-01434, 2019 WL 4058970, *2 (W.D. Wash. Aug. 28, 2019). *But see,*

(b) The USPTO, the Federal Circuit, and Sister Courts of Appeal all Interpret "Use in Commerce" as "*Legal* Use in Commerce"

The Lanham Act permits Federal Trademark Registration on the principal register only when "the mark is in use in commerce." 15 USC § 1051(a)(3)(C). The Federal Trademark statute broadly defines "commerce" as "all commerce which *may* lawfully be regulated by Congress"—which, according to Congress, includes the regulation of the manufacture, distribution, and possession of controlled substances, including Marijuana. 15 USC § 1127; *see, e.g.,* 21 U.S.C. § 801(3)-(6); *Gonzales v. Raich*, 545 U.S. 1 (2005) (upholding CSA enforcement on Supremacy Clause grounds as to state-legal Marijuana commerce). Further, the Lanham Act defines "use in commerce" without any reference or requirement that such "commerce" be legal under federal or state law. 15 USC § 1127 ("The term 'use in commerce' means the bona fide use of a mark in the ordinary course of trade, and not made merely to reserve a right in a mark. …"). And, because the Lanham Act expressly requires "lawful use in commerce" before a trademark applicant's mark can be placed on the supplemental register, general rules of statutory construction suggest that the "lawful" requirement should not apply to applications for registration of a mark on the principal register. 15 USC § 1091(a) (emphasis added); *see, e.g., Russello v. United States,* 464 U.S. 16, 23 (1983) ("Where Congress includes particular language in one section of a statute but omits it in another section of the same Act, it is generally presumed that Congress acts intentionally and purposely in the disparate inclusion or exclusion."); *accord Barry v. McDonough,* 101 F.4th 1348, 1356 (Fed. Cir. 2024); *see also* 15 U.S.C. § 1052 (d) (requiring "lawful use in commerce" for concurrent registration of trademarks).

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e.g., *Kenney v. Helix TCS, Inc.*, 939 F.3d 1106, 1112 (10th Cir. 2019) (applying Fair Labor Standards Act to cannabis business).

Despite the seemingly clear construction of the "use in commerce" requirement, the Federal Courts and the USPTO have long and uniformly interpreted it as requiring "lawful use in commerce." *E.g., CreAgri, Inc. v. USANA Health Scis., Inc.,* 474 F.3d 626, 630 (9th Cir. 2007) ("[T]he inquiry does not stop with use in commerce. It has long been the policy of the PTO's Trademark Trial and Appeal Board that use in commerce only creates trademark rights when the use is lawful.")*; United Phosphorus, Ltd. v. Midland Fumigant, Inc.,* 205 F.3d 1219, 1225 (10th Cir. 2000) (discussing "the well-reasoned proposition that shipping goods in violation of federal law cannot qualify as the 'use in commerce' necessary to establish trademark rights."); *Lane Cap. Mgmt., Inc. v. Lane Cap. Mgmt., Inc*., 192 F.3d 337, 349 (2d Cir. 1999) (discussing unlawful use defense, but affirming the lower court's rejection of it as waived); *Gray v. Daffy Dan's Bargaintown*, 823 F.2d 522, 526 (Fed.Cir.1987) ("A valid application cannot be filed at all for registration of a mark without 'lawful use in commerce,' ..."); *In Re Morgan Brown*, 119 U.S.P.Q.2d 1350, *1 (T.T.A.B. July 14, 2016) ("We have consistently held that, to qualify for a federal service mark registration, the use of a mark in commerce must be 'lawful.'"); *Clorox Co. v. Armour–Dial, Inc.*, 214 U.S.P.Q. 850, 851 (1982) ("'use in commerce' means a 'lawful use in commerce'"); 37 C.F.R. §2.69 ("When the sale or transportation of any product for which registration of a trademark is sought is regulated under an Act of Congress, the Patent and Trademark Office may make appropriate inquiry as to compliance with such Act for the sole purpose of determining lawfulness of the commerce recited in the application.").[13]

[13] Pre-Lanham Act Supreme Court trademark opinions arrived at substantially the same result, but on different grounds. *Worden v. Cal. Fig Syrup Co*., 187 U.S. 516, 535 (1903) ("This is a fraud upon the public. It is true it may be a harmless humbug to palm off upon the public as syrup of figs what is syrup of senna, but it is nevertheless of such a character that a court of equity will not encourage it by extending any relief to the person who seeks to protect a business which has grown out of and is dependent upon such deceit."); *Manhattan Med. Co. v. Wood*, 108 U.S. 218, 227 (1883); *see also Shondel v. McDermott*, 775 F.2d 859, 868 (7th Cir.1985).

As explained by the Ninth Circuit in a manner reflecting the common law Illegality Rule:

> "[O]nly *lawful* use in commerce can give rise to trademark priority." This rule prevents **the absurd result of the government "extending the benefits** of trademark **protection to a seller based upon actions the seller took in violation of that government's own laws**."

AK Futures LLC, 35 F.4th at 689 (quoting *CreAgri,* 474 F.3d at 630; brackets in original; emphasis added). A similar, and more broadly applicable, articulation of the Illegality Rule in the property rights context was offered by the USPTO more than 65 years prior:

> Reduced to its simplest terms, the question is: May property rights be acquired as a result of unlawful acts? The obvious answer to the question in its simplified form is in the negative. No decision in a trademark case has been found which is directly in point; but in other fields of the law which might reasonably be analogous, i.e. real property and personal property, where claimed ownership was based on acquisition by unlawful means, the principle is so well-established that citation of authorities is unnecessary.

Coahoma Chem. Co., Inc. v. Smith, 113 U.S.P.Q. (BNA) ¶ 413, 420 (Com'r Pat. & Trademarks May 27, 1957).

The strictness of Federal Courts' and the USPTO's interpretation of the "use in commerce" requirement extends even further than being a pre-requisite for federal trademark registration. For example, at least one District Court held that federally illegal (but state legal) use of a mark in commerce cannot establish a cognizable prior use defense against a junior (but fully legal) user of the mark. *Kiva Health Brands LLC v. Kiva Brands Inc.*, 402 F. Supp. 3d 877, 890 (N.D. Cal. 2019) ("KBI's prior use was illegal under federal law [because] all KBI products contain cannabis. …To hold that KBI's prior use of the KIVA mark on a product that is illegal under federal law is a legitimate defense to KHB's federal trademark would 'put the government in the anomalous position of extending the benefits of trademark protection to a seller based upon actions the seller took in violation of that government's own laws.'") (citations omitted). And, the USPTO has even adopted a *per se* rule that, unless the intended use of a mark is legal at the time of filing of an Intent

to Use application, the application will not be allowed because an applicant cannot, as a matter of law, possess *bona fide* intent to use a mark legally in the future.[14]

(c) ITC Domestic Industry Precedent is in Accord

Unlike in district court, where non-practicing entities are free to enforce their patents without regard to commercial market participation, relief at the ITC is only open to patentees who can prove that they have established a domestic industry worthy of protection.[15] That is, at the ITC, proving substantial and significant Domestic Industry expenses tied to the asserted patents is a prerequisite for any relief: *It is the price of admission*. 19 USC § 1337 (a)(3). In this manner, the ITC's domestic industry requirement is analogous to Trademark law's "use in commerce" requirement. *See, e.g., Gray*, 823 F.2d at 525-526 (indicating, in the context of concurrent use registration, that the "lawful use in commerce" requirement is "'jurisdictional in nature'"). Neither the Lanham Act (other than for the supplemental register and concurrent registration) nor 19 USC § 1337 expressly recite that their respective requisite domestic commerce be "lawful," but extensive precedent and the common law Illegality Rule make clear that *complete* legality must be required for an entity to enjoy the federal benefits of either.

The doors of federal courthouses are closed to issuing orders in support of illegal commerce. The doors of the U.S. International Trade Commission must follow suit—and, at a minimum, reject any asserted domestic industry investments expenditures unquestionably directed in furtherance of federally illegal commerce. Case in point, former CALJ Charles E. Bullock

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[14] *In re PharmaCann LLC*, 123 USPQ2d 1122, 1124 (TTAB June 16, 2017); *In re JJ206*, LLC, 120 U.S.P.Q.2d (BNA) 1568, 1569 (T.T.A.B. 2016) ("if the goods on which a mark is intended to be used are unlawful, there can be no bona fide intent to use the mark in lawful commerce"); TMEP § 907 ("the mark or the identified goods or services are unlawful, actual lawful use in commerce is not possible.").

[15] 19 U.S.C. Sec. 1337(a)(2), (3); *see also Lelo v. U.S. Int'l Trade Comm'n*, 786 F.3d 879, 883 (Fed. Cir. 2015); *Motorola Mobility, LLC v. Int'l Trade Comm'n*, 737 F.3d 1345, 1351 (Fed. Cir. 2013).

recently agreed with adverse parties that "costs due to illegal labor should be excluded from [] DI calculations." *Certain Pouch-Type Battery Cells, Battery Modules, and Battery Packs, and Products Containing the Same*, Inv. No. 337-TA-1179, Order 34 (Aug. 20, 2020) (granting motion to compel discovery of costs related to illegal immigrant labor as relevant to economic prong investments).

Additionally, the Federal Circuit's recent affirmance in *Philip Morris Prod. S.A. v. Int'l Trade Comm'n Commission* strongly implied that expenditures directed toward *actually* "illegal" domestic industries are *not* cognizable under the economic prong. 63 F.4th 1328, 1341 (Fed. Cir. 2023). There, the Federal Circuit "was presented with the singular question of whether the economic prong of the domestic industry analysis excludes products that have not received regulatory authorization as of the filing of the complaint." *Id.* at 1341. Appellant-respondent Philip Morris argued that the intervenor-complainant R.J. Reynolds's domestic industry nicotine-vaporization products had not received FDA approval and were thereby rendered "illegal and unusable in a domestic industry analysis." *Id.* The court rejected this argument because the alleged non-compliance with FDA regulations was not "illegal."

> That the regulatory process, for which there was an explicit grace period, was not complete at the time that Reynolds filed the complaint does not mean the domestic industry products were "illegal," as Philip Morris insists.

Id. at 1342. By affirming on this ground (i.e., that Reynolds domestic industry was not illegal) after expressly interpreting 19 U.S.C. §1337(a)—as opposed to holding that a domestic industry's illegality need not undermine the economic prong assertions, the Federal Circuit signaled that expenditures in furtherance of a truly illegal domestic industry are not cognizable. 63 F.4th at 1392.

c. AS A MATTER OF LAW, PAX CANNOT ESTABLISH THAT IT MEETS THE ECONOMIC PRONG OF THE DOMESTIC INDUSTRY REQUIREMENT

PAX's own admissions (and documents) demonstrate that it cannot satisfy the economic prong of the domestic industry requirement. PAX has stipulated that [redacted] of all of its asserted domestic industry expenditures were made to support its federally illegal commerce. *E.g.,* JX-0177C (CBI Stipulation). And, PAX has offered no discovery that might indicate that a non-negligible portion of the [redacted] was directed toward federally legal commerce (let alone meet it burden to prove what that portion might be or how it could be significant). There is no factual dispute. PAX cannot be permitted to rely on expenditures made in support of its federally illegal domestic industry to invoke the federal benefits, protections, and power of the U.S. International Trade Commission and U.S. Customs and Border Protection to gain a competitive advantage for, and in furtherance of, its federally illegal Marijuana oil-filled vaporizer pod business.

i. PAX Admits that it Knowingly and Voluntarily Made and Participated in Many Agreements to Commit Crimes under the CSA

While the CSA also prohibits sales of "drug paraphernalia" 21 U.S.C. §863(a)(1), such prohibition is ***entirely irrelevant*** to the illegality of PAX's asserted domestic industry expenses because there is no dispute that PAX's empty pods and batteries (like ALD's) fall under the exemption of § 863(f)(1). *See* EDIS Doc. No. 831438 (September 4, 2024), pp.6-7. But the fact that PAX's asserted domestic industry product sales do not violate 21 U.S.C. §863(a)(1) does ***not*** mean they do not violate 21 U.S.C. § 846.

[redacted] of PAX's asserted domestic industry product sales occur only because PAX conspires with numerous entities to ensure the downstream result of Marijuana oil-filled pods being sold to consumers in violation of federal law. Regardless of whether the U.S. Government

has accused PAX of a crime or whether any other entity might be guilty of the same, [redacted] of PAX's sales of empty pods and batteries are part and parcel of PAX's violation of 21 U.S.C. § 846. PAX's undisputed business model leaves no doubt that this is the case and PAX has no colorable argument to the contrary.

The elements of a CSA conspiracy under 21 U.S.C. § 846 are (1) an agreement to commit a crime under the CSA; (2) knowledge of the agreement; and (3) voluntary joining of the agreement. *E.g., Ruan*, 56 F.4th at 1299. Such CSA crimes include "knowingly or intentionally" manufacturing, distributing, dispensing, or possessing a controlled substance without authorization. 21 U.S.C. §§ 841(a), 844(a).

(a) PAX Stipulated That [redacted] of PAX's Alleged Domestic Industry Expenditures Were Made in Furtherance of Its Illegal Marijuana Conspiracy.

PAX has made multiple express and implicit agreements—including with its co-manufacturers, brand partners, downstream Marijuana dispensaries, and ultimately consumers—to commit the federal crimes of at least Marijuana oil manufacturing, Marijuana oil distribution, Marijuana oil possession, and Marijuana oil sales (all within the alleged domestic industry pods).

PAX unequivocally admits that nearly all of its alleged domestic industry pods are filled with federal illegal substances:

> [redacted] of PAX's domestic industry Pods from 2021 to 2023 were filled [redacted] with cannabis oils that are derived from Marijuana (or "Marihuana" as defined by Federal Law) and contain non-negligible amounts of Delta-9-Tetrahydrocannabinol (THC).

JX-0177C (CBI Stipulation), ¶1. Such pods were filled with Marijuana oil pursuant to written agreements between PAX (via its wholly owned-subsidiary P&H):

> Under PAX's current business model, PAX's wholly-owned subsidiary Peace & Haight [redacted]

[redacted]

JX-0177C (CBI Stipulation), ¶6. Because [redacted] such agreements and arrangements were voluntary. *Id.* PAX's corporate designee confirmed the same. JX-0045C (Oar Depo.), 115:7-116:24.

PAX's conspiratorial agreements are evinced by at least PAX's [redacted], PAX's product packaging, PAX's website, PAX's corporate admissions, PAX's internal documents, and PAX's marketing/sales materials. Although conspiracy under 21 U.S.C. § 846 does not require an affirmative act,[16] PAX (both in its own name and via P&H[17]) have engaged in many. For example:

- PAX/P&H has [redacted];

[16] *Morillo*, 158 F.3d at 23 (1st Cir. 1998).

[17] To the extent PAX argues that actions of its wholly owned subsidiary P&H in furtherance of the CSA conspiracy cannot be attributed to PAX, the law is clear that the corporate veil may be pierced in such instances. *E.g., United States v. Bestfoods,* 524 U.S. 51, 62 (1998)*; Wordtech Sys., Inc v. Integrated Networks Sols., Inc*., 609 F.3d 1308, 1314 (Fed. Cir. 2010). Thus, P&H's [redacted] cannot be divorced from PAX's participation in the CSA conspiracy due to mere corporate formalities. In any event, PAX, itself, has engaged in the CSA conspiracy, including via at least providing its asserted domestic industry pods to P&H with the intention that they be filled with Marijuana oil by downstream conspirators (*e.g.*, [redacted]) and sold to further downstream conspirators [redacted] and supporting downstream sales efforts (*e.g.*, via marketing efforts directing consumers to Marijuana dispensaries that sell filled pods). And, PAX has made voluntary agreements with P&H to profit from the downstream sales of Marijuana oil-filled pods .

JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), pp. 53-55; *see also* JX-0409 (Third Amended Final Bell Agreement); JX-0045C (Oar Depo.), 17:7-13, 108:25-109:23.

- PAX has [redacted] *See*, *e.g.,* JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), p. 55 [redacted]; JX-0045C (Oar Depo.), 110:15-112:1; JX-0411C (PAX Veteran Campaign Overview), PAX-00044398 (excerpted below).



- PAX/P&H provides [redacted] JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), 53-57; [redacted] JX-0410 (2022-12-06 Article), PAX-00042226 [redacted]
- PAX provides [redacted]; JX-0409 (Third Amended Final Bell Agreement), e.g., PAX-00039651 (¶4), PAX-00039686-690 ([redacted]), PAX-00039693; JX-0046 (June, 21, 2024 Complainant's Interrogatory Responses), 35 [redacted]

[redacted]

- [redacted]

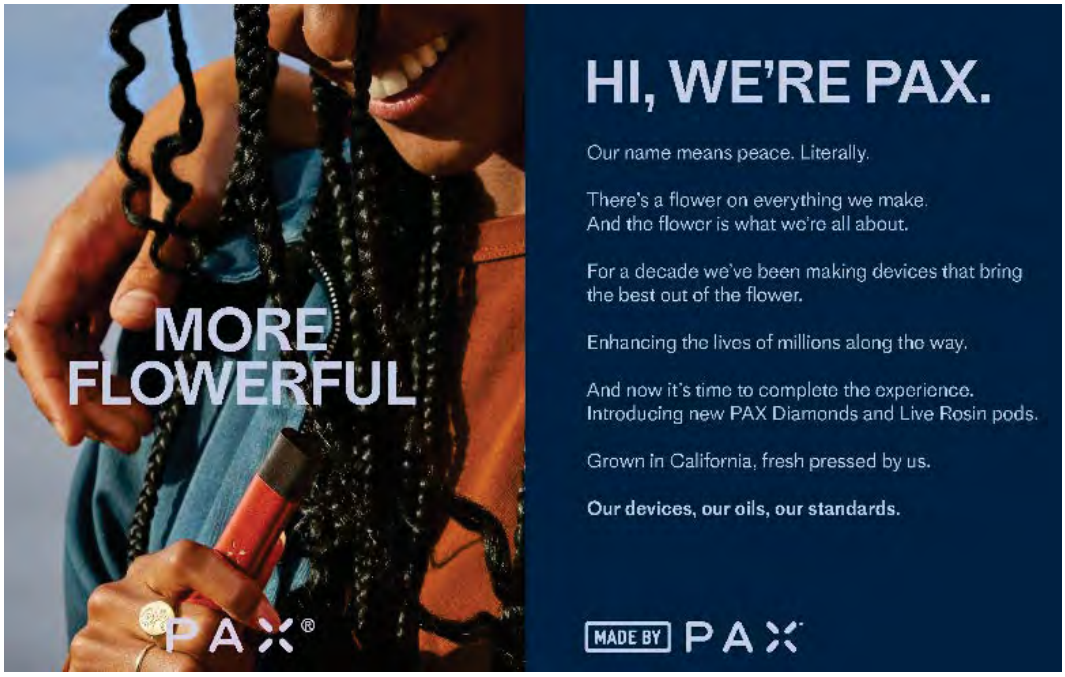
- PAX/P&H requires extensive testing of the Marijuana oils that fill its pods and receives Certificates of Analysis for [redacted]' Marijuana oil batches that fill PAX's asserted domestic industry pods; such Certificates report THC levels. JX-0177C (CBI Stipulation), ¶8; JX-0045C (Oar Depo.), 29:14-31:2, 34:2-12, 50:4-51:3, 104:4-105:18; JX-0048 (PAX Journal) ("We understand that the quality of the oil is crucial, which is why we take great care to ensure that all PAX branded pods start with pure, all-natural cannabis. We subject our products to twice as much testing than the average cartridge, and our oil batches are tested 4-5 times before being released to the market. This ensures that you're getting a product that meets the highest standards of quality and purity.")
- PAX/P&H [redacted]

  Such packaging, at least when distributed to dispensaries and/or consumers, includes

PAX's house branding, the pod's respective Marijuana oils' THC content (per PAX/P&H's formulation), flavor/cultivar/strain name (PAX's), and product line (PAX's). *Id.; e.g.,* JX-0045C (Oar Depo.), 45:9-46:12; JX-0410 (2022-12-06 Article) (excerpted below)



- PAX touts to consumers that it ensures the quality of the Marijuana oils that fill its asserted domestic industry pods. PAX uses the marketing slogan [redacted] *E.g.,* JX-0412C (PAX Marketing Material), PAX-00045419 (excerpted below);



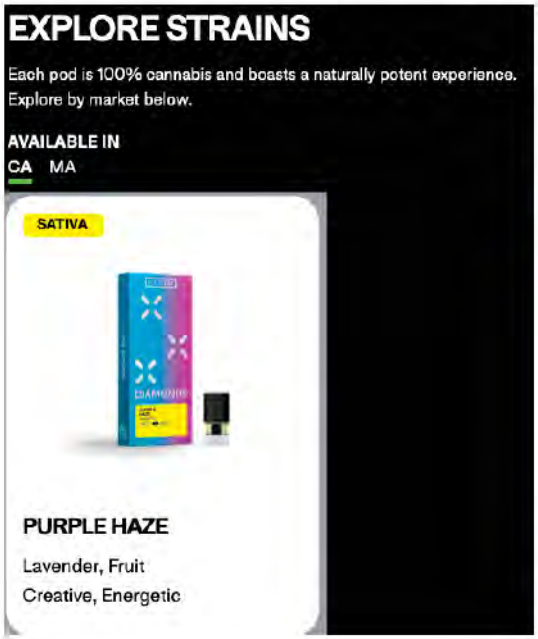
JX-0413 (PAX Website) [redacted]

- PAX [redacted] JX-0049 (Marketing Photos), [redacted]



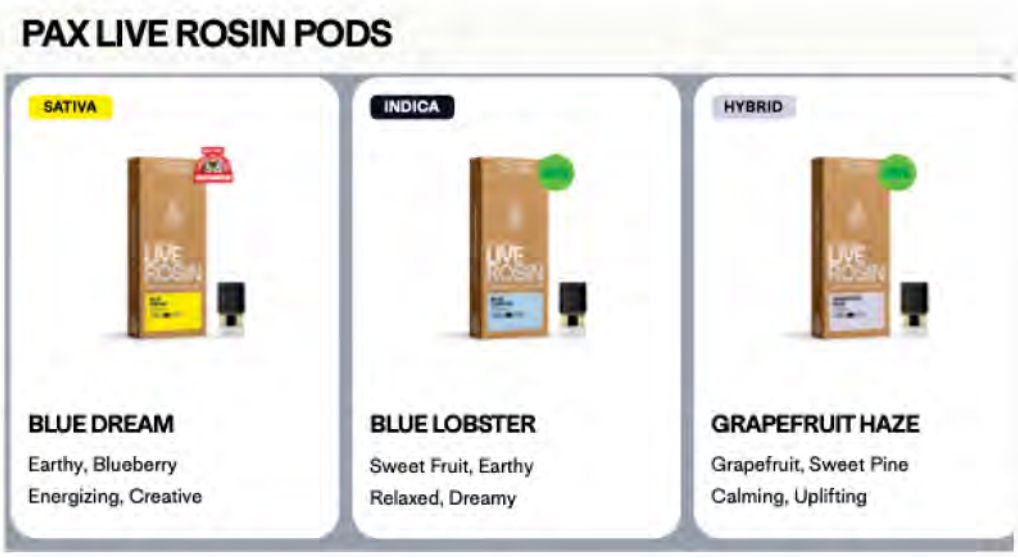
JX-0413 (PAX Website) ("The lineup of ERA pods gives cannabis enthusiasts more

choices, whether seeking purity, potency, price, or all three."); RX-0466 (PAX Website) (excerpted below left); RX-0467 (PAX Website) (excerpted below right);



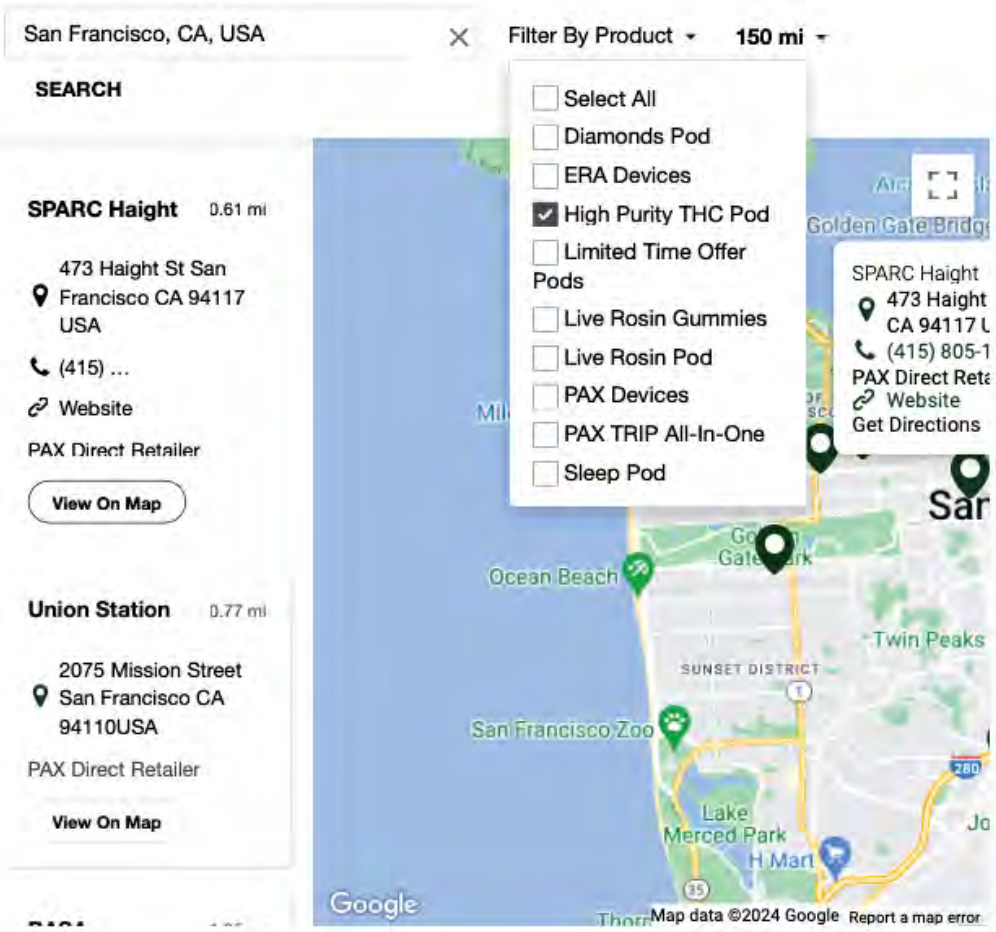


RX-0470 (PAX Website) (excerpted below)





- PAX's website has geography-based search functionality—a "store locator"—that directs potential Marijuana oil consumers to local, federally illegal Marijuana dispensaries so that consumers may purchase PAX's asserted domestic industry pods filled with Marijuana oils [redacted]. *See*, *e.g.*, JX-0413 (PAX Website) ("High Purity THC pods are available in California, Colorado, Massachusetts, and New York. Use our store locator to find PAX Era pods and Era vape pens in your area."); RX-0465 (PAX Website) (excerpted below).



Ultimately, PAX's own admissions and documents make its participation in a Marijuana oil manufacturing, distributing, dispensing, and possession conspiracy manifest.

PAX's sales of [redacted] of its domestic industry products, and accordingly [redacted] of its asserted domestic industry expenditures, are all in furtherance of this conspiracy. They cannot be considered when evaluating PAX's alleged economic prong investments.

ii. On the Evidentiary Record, the ALJ Should Presume that *None* of PAX's Asserted Domestic Industry Expenditures Were Directed Toward Federally Legal Commerce

(a) PAX Has No Evidence to Establish that Any Appreciable Amount of Its Alleged Domestic

Industry Expenditures Was Directed Toward Federally Legal Commerce

PAX lacks evidence to demonstrate that *any* non-negligible percentage of its domestic industry pods are filled with federally legal substances. Accordingly, PAX cannot prove that *any* discernable portion of its asserted domestic industry expenditures were directed to federally legal commerce.

PAX contends that *some* of it pods [redacted] are not ultimately filled with federally illegal Marijuana oil, but rather contain [redacted] to the exclusion of federally prohibited substances. [redacted]

However, PAX lacks *any* evidence to show what amount (*e.g.*, 0.1%, 1.5%, 4%, etc.) of the unaccounted-for [redacted] of its domestic industry pods was filled with legal versus illegal substances: PAX's contention interrogatory responses, economic expert opinion, and document production are all silent on this point. As a result, PAX has failed to establish *any* federally legal domestic industry investments. Because PAX bears the burden to prove a cognizable domestic industry, PAX must be deemed to have <u>*zero*</u> domestic industry investments or expenditures made in furtherance of a federally *legal* domestic industry.

Nonetheless, even assuming, *arguendo*, that PAX had any competent evidence that some

discernable amount [redacted] of its asserted domestic industry was directed to federally legal commerce (it does not), PAX's admission that [redacted] of its asserted domestic industry commerce consisted of federally illegal activities renders that remaining [redacted] of legal commerce insignificant and insubstantial.

Ultimately, only a small, insubstantial, insignificant, and (now that discovery has closed) undiscernible fraction of PAX's asserted domestic industry pods *might* stand outside PAX's 21 U.S.C. § 846 drug conspiracy. Thus, PAX cannot meet its burden show that *any* meaningful proportion of its asserted domestic industry is directed toward legal commerce. In turn, PAX's economic prong case must fail as a matter of law.

(b) An Unapportioned Amount of PAX's Alleged Domestic Industry Expenditures Reflect PAX's Own Direct Violations of the CSA

In addition to its undeniable CSA conspiracy violations, PAX has, itself, *directly* violated the CSA. Specifically, PAX admits that its employees used federally illegal Marijuana oil in leak-testing its domestic industry pods. JX-0045C (Oar Depo.), 87:12-21. This admission demonstrates that at least *some* portion of PAX's asserted plant, labor, and capital equipment domestic industry expenses was *directly* used by PAX in the commission of a CSA crime—*i.e.*, *at least* possession of federally illegal Marijuana oil. 21 U.S.C. §844 (a).

Because PAX bears the burden to demonstrate that it has met the economic prong requirement, PAX also bears the burden to apportion such expenses by legal status in view of its express admissions that its domestic industry activities directly involved a criminal CSA violation—which cannot be counted in the economic prong analysis. [redacted]

iii. PAX's Cannot Rely on Domestic Industry Expenditures Directed Toward Federally Illegal Marijuana Commerce

The only way PAX can meet the domestic industry requirement of Section 337(a)(3)—assuming, *arguendo*, it is not fatally flawed for other reasons discussed herein (it is)—is if the ALJ, and ultimately the Commission, condone and affirmatively credits PAX's investments and expenditures[18] toward its admittedly illegal domestic industry. The Illegality Rule and the Federal Courts uniform treatment of "commerce" in an analogous context (trademarks)—as well as common sense—cannot tolerate such a result. *See generally* Section III.D above.

In *Pouch-Type Battery Cells*, where the respondent suspected the complainant may have been relying on illegal immigrant labor to meet its economic prong burden, the complainant wisely declined to take the untenable position that illegal immigrant labor could be relied on for economic prong investments. Inv. No. 337-TA-1179, Order 34 (Aug. 20, 2020). But here, because PAX ostensibly contends that the 300-year-old common law Illegality Rule does not apply to its federally illegal Marijuana oil pod commerce, the ALJ is *technically* presented with an issue of first impression.

PAX's reliance on an unpublished and readily distinguishable hearing transcript to contest this point is meritless. EDIS Doc. No. 831438 (September 4, 2024), 11; *Gene Pool Techs., Inc. v. Coastal Harvest,* 5:21-cv-01328, D.I. 101 at 13:21-17:24, (C.D. Cal. Nov. 22, 2022). As an initial matter, in a district court patent case, as opposed to an ITC Investigation, domestic industry expenditures lack relevance. Moreover, the primary reason PAX recites as to why the *Gene Pool* court permitted that case to proceed is, by analogy, wholly inapplicable here. In *Gene Pool*, the patentee did "not seek damages based on its own cultivation or sales of marijuana." *Id.* Here, the

[18] *See., e.g., Lelo Inc.*, 786 F.3d at 883 ("The plain meaning of an 'investment' is 'an expenditure of money for income or profit ….'").

patentee seeks an exclusion order (the analogous redress available at the ITC) based on its asserted domestic industry that exists [redacted] **only** by virtue of PAX's conspiracy to have its downstream partners sell Marijuana oil to consumers in PAX's pods, in PAX's packaging, in PAX's name, using PAX's Marijuana oil formulations filled using PAX's equipment, in compliance with PAX's Marijuana oil testing requirement, and often after consumers are directed to Marijuana dispensaries by PAX's website and enticed by PAX's marketing. The second reason from *Gene Pool*, "that the patents do not mention cannabis or marijuana" is also not true here. *Id.* Finally, *Gene Pool* merely held that the illegality doctrine should not bar the entire case. Here, the Investigation has not been barred and Respondents have not argued it should have been. *Cf.* EDIS Doc. No. 831438 (September 4, 2024), 10 (citing *Certain Oil-Vaping Cartridges, Components Thereof, & Prod. Containing the Same,* Inv. No. 337-TA-1286, Comm'n Op., 2023 WL 4994428, *13 (USITC Aug. 1, 2023)[19].) Respondents' merely contend that the illegality doctrine should preclude PAX from relying on alleged domestic industry expenditures made in furtherance of its profitable violations of 21 U.S.C. § 846.

Respondents respectfully submit that the ALJ should "prevent[] the absurd result of the government extending the benefits of [unfair import] protection to a seller based upon actions the seller took in violation of that government's own laws." *AK Futures,* 35 F.4th at 689 (emphasis added). Any position PAX takes to the contrary is simply not credible.

d. CONCLUSION

As a matter of law, PAX failed to meet its burden of proof under the economic prong of the domestic industry. [redacted] of its alleged domestic industry investments are admittedly

[19] Notably, OUII in that Investigation advocated for rejecting asserted domestic industry expenditures made in violation of the CSA. EDIS Doc. No. 779979 (Aug. 26, 2022) (Staff Post-Hearing Initial Brief), pp 84-87. CALJ Cheney did not reach the issue in his Initial Determination. EDIS Doc. No. 791709 (ID on Violation), 95-102.

directed towards federally illegal Marijuana commerce and simply cannot be counted; and PAX lacks evidence to show that any appreciable portion of the remaining [redacted] of its asserted domestic industry is directed toward federal legal commerce. Modern precedent with ancient roots compels the legal conclusion that PAX's alleged expenditures and investments toward its federally illegal domestic industry in Marijuana oil-filled pods cannot qualify as investments under Section 337(a)(3). PAX cannot satisfy the economic prong of the domestic industry requirement (as to any asserted patent) as a matter of law.

2. The Commission Should Reject PAX's Investments Before PAX Owned the Asserted Patents

PAX relies entirely on investments from the years 2021-23 to prove its alleged domestic industry. PAX's made the alleged investments it relies upon before PAX owned the Asserted Patents. Under the terms of the license PAX had to the Asserted Patents when the investments were made, PAX could not enforce the patents without the intervention of the patent owner, Juul Labs Inc. JX-0421.

PAX only obtained ownership of the Asserted Patents in January 2024. Before January 2024, and certainly for the entirety of 2021-23, PAX was a licensee of the Asserted Patents under the terms of a license agreement with Juul Labs Inc. dated June 30, 2017. *Id*. As per section 6.2.1 of that agreement, Juul retained all rights to enforce the Asserted Patents to itself. JX-0421, 6 ("Licensor has the sole right and discretion to prevent or abate any actual or threatened misappropriation or infringement and attempt to resolve any claims relating to the Licensor's Intellectual Property, including by (a) prosecuting or defending any opposition, derivation, interference, declaratory judgment, federal district court, US International Trade Commission or other proceeding of any kind…"). PAX had no right or ability before January 2024 to contribute to its own domestic industry *with respect to the Asserted Patents* because PAX did not own the

Asserted Patents. Only Juul, as the owner of the Asserted Patents between 2021 and 2023, could have sued for infringement and establish a domestic industry with respect to the Asserted Patents during that time. Juul is not a party to this Investigation and PAX has not asserted that any of Juul's investments satisfy the economic prong. None of PAX's investments should count here because PAX relies on investments only from 2021 to 2023 during which PAX did not own the Asserted Patents.

The Commission has counted investments in licensing, research and development, and engineering under Prong C that occurred before a patent issued towards a domestic industry. *See, e.g., Certain Video Game Systems and Controllers*, Inv. No. 337-TA-743, Comm'n Op., 2011 WL 1523774, *4 (Apr. 14, 2011). PAX cannot rely on that precedent here, however, because PAX is not asserting a domestic industry based on Prong C. PAX can cite no precedent to support its position that investments before it owned the patents or had the right to assert the patents can count towards a domestic industry under Prongs A or B.

Even if the Commission would consider pre-ownership investments in Prongs A and B towards PAX's domestic industry, many of PAX's alleged investments occurred before the Asserted Patents issued. Specifically, the '580 patent issued on September 19, 2023, the '527 patent issued on September 26, 2023, and the '756 patent and the '757 patent both issued on June 28, 2022. JX-0001 ('756 patent); JX-0002 ('757 patent); JX-0003 ('580 patent); JX-0004 ('527 patent). The Commission has interpreted Prongs A and B to concern "investments in plant and equipment and labor and capital *with respect to the articles protected by the patent*." *Certain Ground Faults Interrupters and Prods. Containing Same*, Inv. No. 337-TA-739, 2012 WL 2394435, *50, Comm'n Op. at 78 (June 8, 2012) (emphasis added). Here, any alleged investment by PAX in Prongs A or B before an Asserted Patent issued cannot be "with respect to [an] article[]

protected by the patent" because the patent did not exist pre-issuance. Another problem is that the Commission cannot properly examine PAX's investments because PAX did not distinguish between pre-issuance investments and post-issuance investments on a patent-by-patent basis. Without such a showing, the Commission cannot credit any post-issuance investments here. For these reasons, the Commission should find PAX failed to prove a domestic industry under Prong A and B.

3. PAX Failed to Show a Domestic Industry on the Date the Complaint was Filed and Its Alleged Investments are Unreliable and those of a Mere Importer

PAX provided information from 2021 to 2023 to support its alleged domestic industry. [redacted] *see also* *supra* Sec. VII.B.2. [redacted]

not shown that Respondents have violated section 337.

Ground Rule 1.6 Certification: The word count of this brief, exclusive of the captions, any table of contents or authorities, words in figures, the word count certificate, the signature block, and the certificate of service, is 59,990 words.

Dated: September 20, 2024

Respectfully submitted,

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Exhibit B

PUBLIC VERSION

UNITED STATES INTERNATIONAL TRADE COMMISSION

WASHINGTON, D.C.

Before the Honorable Bryan F. Moore

Administrative Law Judge

In the Matter of CERTAIN OIL VAPORIZING DEVICES, COMPONENTS THEREOF, AND PRODUCTS CONTAINING THE SAME	Investigation No. 337-TA-1392

EXPERT WITNESS STATEMENT OF PHILIP W. KLINE

September 13, 2024

[redacted]

7. Is JX-0360 (Kline CV) a true and accurate copy of your curriculum vitae?

Yes, it is.

2 SCOPE OF ASSIGNMENT

8. What does JX-0360 (Kline CV) describe?

It describes my education, testimony experiences, consulting experiences, leadership positions, awards, and publications.

9. Who have you been retained by in this matter?

I was retained by Mei & Mark LLP ("Counsel") on behalf of ALD Group Limited and ALD (Hong Kong) Holdings Limited (collectively "ALD"). I understand that the ALD and STIIIZY Respondents are a part of a joint defense group in this litigation. As such, I also provide my opinions on behalf of the STIIIZY Respondents.

10. What was your assignment in this matter?

My assignment was to assess and respond to the expert opinions of Dr. Jonathan Putnam ("Putnam Witness Statement"), with respect to the economic prong of the domestic industry.

11. Were you asked to give any technical opinions?

No, I was not. I am not a technical expert. My analysis focusses on the economic aspects of domestic industry.

12. Were you asked to interpret the law?

No, I was not. I am not a lawyer and I relied on counsel for the Respondents for legal guidance.

13. Did you provide an expert report in this matter?

Yes, I provided an expert report responding to Dr. Putnam's opinions with respect to the economic prong of the domestic industry on July 30, 2024.

14. Are you being compensated for your time on this matter?

Yes, EconEdge LLC is compensated hourly for my time.

15. Does your compensation depend on the outcome of this matter?

No, it does not.

16. Does your compensation depend on your performance in this matter?

No, it does not.

Your Honor, Respondent respectfully tenders Mr. Kline as an expert in the area of economics, particularly with respect to those issues germane to the ITC's domestic industry economic prong.

3 INFORMATION CONSIDERED

17. What types of information have you considered in connection with your work in this matter?

In connection with my work in this matter, I have reviewed and assessed at least the following types of information:

- The Asserted Patents;
- Complaint of PAX Labs Inc.;
- PAX and ALD's Responses and Objections to Certain Set of Interrogatories;
- Expert Report of Dr. Jonathan Putnam;
- Declaration of Michael Oar;
- Declaration of Michael John Patag;
- Declaration of Alex Ringrose;
- Deposition of Michael John Patag;
- Deposition of Michael Oar;
- PAX's produced financial documents;
- Other produced documents; and
- Publicly available information.

A complete list of the materials I considered is in JX-0361.

18. Are there any other sources of information that you considered since submitting your expert reports?

Yes, I read the Witness Statement of Dr. Putnam, which was submitted after the issuance of my expert report.

4 SUMMARY OF OPINIONS

19. What is your overall conclusion in this matter?

Based upon my review of Dr. Putnam's witness statement and the evidence available to me in this matter, I have concluded that Dr. Putnam has failed to demonstrate that a domestic industry for the DI Products existed at the time of the filing of the Complaint.

I have reached this conclusion based on the following:

- Dr. Putnam's lookback period is arbitrary and not tied to the facts of the case.

[redacted]

I will explain how I arrived at these values in these charts in a moment.

21. What is your understanding of PAX's reliance on [redacted]?

I understand from Counsel that PAX is not permitted to rely [redacted] to seek relief from federal agencies such as the U.S. International Trade Commission.

22. Has Dr. Putnam accounted for these activities in his analysis?

[redacted]

23. What is the result of Dr. Putnam's lack of exclusion of these activities?

[redacted]

24. How would the exclusion of these activities affect your conclusion?

[redacted] As shown in JX-0177 (Stipulation of the Parties, Investigation No. 337-TA-1392, July 24, 2024), I understand that the parties stipulated that approximately 5% of PAX's investments in the DI Products do not pertain to [redacted]

5 CANNABIS VAPORIZER MARKET & ASSERTED PATENTS

25. To what market does the present matter pertain?

The present matter pertains to the cannabis vaporizer market.

[redacted]

169. Is the fact that the [redacted] dispositive of the significance of these DI investments?

No. [redacted]

170. [redacted]

171. Why is this fact important to note?

I understand from Counsel that PAX bears the burden to show satisfaction of the economic prong of the domestic industry requirement.

[redacted]

172. Does Dr. Putnam's analysis account for investments in DI Products that pertain to these [redacted]?

[redacted].

173. Can PAX rely on [redacted] to seek relief from the ITC?

I understand from Counsel that PAX is not permitted to rely on [redacted] to seek relief from federal agencies such as the U.S. International Trade Commission.

174. Does Dr. Putnam's analysis establish that PAX's investments in the DI Products pertaining to legal activities are significant?

[redacted]

175. How would your conclusion regarding the significance of PAX's DI investments have changed had you accounted for [redacted]?

[redacted].

176. Please look at RDX-0005.21, which includes a list of all Exhibits that have been marked. Are these the exhibits discussed during your testimony?

Yes.

177. Are these documents complete and accurate, to the best of your knowledge?

Yes.

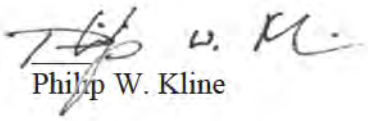
178. Are your answers to these questions true and correct to the best of your knowledge and belief?

Yes

179. Does this witness statement contain your answers to questions from counsel?

Yes.

Respectfully,



Philip W. Kline

September 13, 2024
Date

[redacted]

Certain Oil Vaporizing Devices, Components Thereof, and Products Containing the Same; Inv. No. 337-TA-1392 (Violation)

337-1392 Violation

CERTIFICATE OF SERVICE

I, Lisa R. Barton, hereby certify that the parties listed have entered an appearance in the above captioned investigation, and a copy of the PUBLIC CERTIFICATE OF SERVICE was served upon the following parties via first class mail and air mail where necessary.

Document	Security	Document Type	Official Rec'd	Title
835821	Public	Order	10/28/2024 04:15 PM	Granting-in-Part Complainant's Motion in Limine No. 3 to Preclude Respondents from Presenting Evi...

Service Date: October 28, 2024

/s

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CERTIFICATE OF SERVICE

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19 U.S.C. § 1337 - Unfair practices in import trade

(a) Unlawful activities; covered industries; definitions

(1) Subject to paragraph (2), the following are unlawful, and when found by the Commission to exist shall be dealt with, in addition to any other provision of law, as provided in this section:

(A) Unfair methods of competition and unfair acts in the importation of articles (other than articles provided for in subparagraphs (B), (C), (D), and (E)) into the United States, or in the sale of such articles by the owner, importer, or consignee, the threat or effect of which is--

(i) to destroy or substantially injure an industry in the United States;

(ii) to prevent the establishment of such an industry; or

(iii) to restrain or monopolize trade and commerce in the United States.

(B) The importation into the United States, the sale for importation, or the sale within the United States after importation by the owner, importer, or consignee, of articles that--

(i) infringe a valid and enforceable United States patent or a valid and enforceable United States copyright registered under Title 17; or

(ii) are made, produced, processed, or mined under, or by means of, a process covered by the claims of a valid and enforceable United States patent.

(C) The importation into the United States, the sale for importation, or the sale within the United States after importation by the owner, importer, or consignee, of articles that infringe a valid and enforceable United States trademark registered under the Trademark Act of 1946.

(D) The importation into the United States, the sale for importation, or the sale within the United States after importation by the owner, importer, or consignee, of a semiconductor chip product in a manner that constitutes infringement of a mask work registered under chapter 9 of Title 17.

(E) The importation into the United States, the sale for importation, or the sale

within the United States after importation by the owner, importer, or consigner, of an article that constitutes infringement of the exclusive rights in a design protected under chapter 13 of Title 17.

(2) Subparagraphs (B), (C), (D), and (E) of paragraph (1) apply only if an industry in the United States, relating to the articles protected by the patent, copyright, trademark, mask work, or design concerned, exists or is in the process of being established.

(3) For purposes of paragraph (2), an industry in the United States shall be considered to exist if there is in the United States, with respect to the articles protected by the patent, copyright, trademark, mask work, or design concerned--

(A) significant investment in plant and equipment;

(B) significant employment of labor or capital; or

(C) substantial investment in its exploitation, including engineering, research and development, or licensing.

(4) For the purposes of this section, the phrase "owner, importer, or consignee" includes any agent of the owner, importer, or consignee.

(b) Investigation of violations by Commission

(1) The Commission shall investigate any alleged violation of this section on complaint under oath or upon its initiative. Upon commencing any such investigation, the Commission shall publish notice thereof in the Federal Register. The Commission shall conclude any such investigation and make its determination under this section at the earliest practicable time after the date of publication of notice of such investigation. To promote expeditious adjudication, the Commission shall, within 45 days after an investigation is initiated, establish a target date for its final determination.

(2) During the course of each investigation under this section, the Commission shall consult with, and seek advice and information from, the Department of Health and Human Services, the Department of Justice, the Federal Trade Commission, and such other departments and agencies as it considers appropriate.

(3) Whenever, in the course of an investigation under this section, the Commission

has reason to believe, based on information before it, that a matter, in whole or in part, may come within the purview of part II of subtitle IV of this chapter, it shall promptly notify the Secretary of Commerce so that such action may be taken as is otherwise authorized by such part II. If the Commission has reason to believe that the matter before it (A) is based solely on alleged acts and effects which are within the purview of section 1671 or 1673 of this title, or (B) relates to an alleged copyright infringement with respect to which action is prohibited by section 1008 of Title 17, the Commission shall terminate, or not institute, any investigation into the matter. If the Commission has reason to believe the matter before it is based in part on alleged acts and effects which are within the purview of section 1671 or 1673 of this title, and in part on alleged acts and effects which may, independently from or in conjunction with those within the purview of such section, establish a basis for relief under this section, then it may institute or continue an investigation into the matter. If the Commission notifies the Secretary or the administering authority (as defined in section 1677(1) of this title) with respect to a matter under this paragraph, the Commission may suspend its investigation during the time the matter is before the Secretary or administering authority for final decision. Any final decision by the administering authority under section 1671 or 1673 of this title with respect to the matter within such section 1671 or 1673 of this title of which the Commission has notified the Secretary or administering authority shall be conclusive upon the Commission with respect to the issue of less-than-fair-value sales or subsidization and the matters necessary for such decision.

(c) Determinations; review

The Commission shall determine, with respect to each investigation conducted by it under this section, whether or not there is a violation of this section, except that the Commission may, by issuing a consent order or on the basis of an agreement between the private parties to the investigation, including an agreement to present the matter for arbitration, terminate any such investigation, in whole or in part, without making such a determination. Each determination under subsection (d) or (e) shall be made on the record after notice and opportunity for a hearing in conformity with the provisions of subchapter II of chapter 5 of Title 5. All legal and equitable defenses may be presented in all cases. A respondent may raise any counterclaim in a manner prescribed by the Commission. Immediately after a counterclaim is received by the Commission, the respondent raising such counterclaim shall file a notice of removal with a United States district court in which venue for any of the counterclaims raised by the party would exist under section 1391 of Title 28. Any counterclaim raised pursuant to this section shall relate back to the date of the original complaint in the proceeding before the Commission. Action on such counterclaim shall not delay or

affect the proceeding under this section, including the legal and equitable defenses that may be raised under this subsection. Any person adversely affected by a final determination of the Commission under subsection (d), (e), (f), or (g) may appeal such determination, within 60 days after the determination becomes final, to the United States Court of Appeals for the Federal Circuit for review in accordance with chapter 7 of Title 5. Notwithstanding the foregoing provisions of this subsection, Commission determinations under subsections (d), (e), (f), and (g) with respect to its findings on the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, the amount and nature of bond, or the appropriate remedy shall be reviewable in accordance with section 706 of Title 5. Determinations by the Commission under subsections (e), (f), and (j) with respect to forfeiture of bonds and under subsection (h) with respect to the imposition of sanctions for abuse of discovery or abuse of process shall also be reviewable in accordance with section 706 of Title 5.

(d) Exclusion of articles from entry

(1) If the Commission determines, as a result of an investigation under this section, that there is a violation of this section, it shall direct that the articles concerned, imported by any person violating the provision of this section, be excluded from entry into the United States, unless, after considering the effect of such exclusion upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, it finds that such articles should not be excluded from entry. The Commission shall notify the Secretary of the Treasury of its action under this subsection directing such exclusion from entry, and upon receipt of such notice, the Secretary shall, through the proper officers, refuse such entry.

(2) The authority of the Commission to order an exclusion from entry of articles shall be limited to persons determined by the Commission to be violating this section unless the Commission determines that--

(A) a general exclusion from entry of articles is necessary to prevent circumvention of an exclusion order limited to products of named persons; or

(B) there is a pattern of violation of this section and it is difficult to identify the source of infringing products.

(e) Exclusion of articles from entry during investigation except under bond;

procedures applicable; preliminary relief

(1) If, during the course of an investigation under this section, the Commission determines that there is reason to believe that there is a violation of this section, it may direct that the articles concerned, imported by any person with respect to whom there is reason to believe that such person is violating this section, be excluded from entry into the United States, unless, after considering the effect of such exclusion upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, it finds that such articles should not be excluded from entry. The Commission shall notify the Secretary of the Treasury of its action under this subsection directing such exclusion from entry, and upon receipt of such notice, the Secretary shall, through the proper officers, refuse such entry, except that such articles shall be entitled to entry under bond prescribed by the Secretary in an amount determined by the Commission to be sufficient to protect the complainant from any injury. If the Commission later determines that the respondent has violated the provisions of this section, the bond may be forfeited to the complainant.

(2) A complainant may petition the Commission for the issuance of an order under this subsection. The Commission shall make a determination with regard to such petition by no later than the 90th day after the date on which the Commission's notice of investigation is published in the Federal Register. The Commission may extend the 90-day period for an additional 60 days in a case it designates as a more complicated case. The Commission shall publish in the Federal Register its reasons why it designated the case as being more complicated. The Commission may require the complainant to post a bond as a prerequisite to the issuance of an order under this subsection. If the Commission later determines that the respondent has not violated the provisions of this section, the bond may be forfeited to the respondent.

(3) The Commission may grant preliminary relief under this subsection or subsection (f) to the same extent as preliminary injunctions and temporary restraining orders may be granted under the Federal Rules of Civil Procedure.

(4) The Commission shall prescribe the terms and conditions under which bonds may be forfeited under paragraphs (1) and (2).

(f) Cease and desist orders; civil penalty for violation of orders

(1) In addition to, or in lieu of, taking action under subsection (d) or (e), the Commission may issue and cause to be served on any person violating this section,

or believed to be violating this section, as the case may be, an order directing such person to cease and desist from engaging in the unfair methods or acts involved, unless after considering the effect of such order upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, it finds that such order should not be issued. The Commission may at any time, upon such notice and in such manner as it deems proper, modify or revoke any such order, and, in the case of a revocation, may take action under subsection (d) or (e), as the case may be. If a temporary cease and desist order is issued in addition to, or in lieu of, an exclusion order under subsection (e), the Commission may require the complainant to post a bond, in an amount determined by the Commission to be sufficient to protect the respondent from any injury, as a prerequisite to the issuance of an order under this subsection. If the Commission later determines that the respondent has not violated the provisions of this section, the bond may be forfeited to the respondent. The Commission shall prescribe the terms and conditions under which the bonds may be forfeited under this paragraph.

(2) Any person who violates an order issued by the Commission under paragraph (1) after it has become final shall forfeit and pay to the United States a civil penalty for each day on which an importation of articles, or their sale, occurs in violation of the order of not more than the greater of $100,000 or twice the domestic value of the articles entered or sold on such day in violation of the order. Such penalty shall accrue to the United States and may be recovered for the United States in a civil action brought by the Commission in the Federal District Court for the District of Columbia or for the district in which the violation occurs. In such actions, the United States district courts may issue mandatory injunctions incorporating the relief sought by the Commission as they deem appropriate in the enforcement of such final orders of the Commission.

(g) Exclusion from entry or cease and desist order; conditions and procedures applicable

(1) If--

(A) a complaint is filed against a person under this section;

(B) the complaint and a notice of investigation are served on the person;

(C) the person fails to respond to the complaint and notice or otherwise fails to appear to answer the complaint and notice;

(D) the person fails to show good cause why the person should not be found in default; and

(E) the complainant seeks relief limited solely to that person;

the Commission shall presume the facts alleged in the complaint to be true and shall, upon request, issue an exclusion from entry or a cease and desist order, or both, limited to that person unless, after considering the effect of such exclusion or order upon the public health and welfare, competitive conditions in the United States economy, the production of like or directly competitive articles in the United States, and United States consumers, the Commission finds that such exclusion or order should not be issued.

(2) In addition to the authority of the Commission to issue a general exclusion from entry of articles when a respondent appears to contest an investigation concerning a violation of the provisions of this section, a general exclusion from entry of articles, regardless of the source or importer of the articles, may be issued if--

(A) no person appears to contest an investigation concerning a violation of the provisions of this section,

(B) such a violation is established by substantial, reliable, and probative evidence, and

(C) the requirements of subsection (d)(2) are met.

(h) Sanctions for abuse of discovery and abuse of process

The Commission may by rule prescribe sanctions for abuse of discovery and abuse of process to the extent authorized by Rule 11 and Rule 37 of the Federal Rules of Civil Procedure.

(i) Forfeiture

(1) In addition to taking action under subsection (d), the Commission may issue an order providing that any article imported in violation of the provisions of this section be seized and forfeited to the United States if--

(A) the owner, importer, or consignee of the article previously attempted to import

the article into the United States;

(B) the article was previously denied entry into the United States by reason of an order issued under subsection (d); and

(C) upon such previous denial of entry, the Secretary of the Treasury provided the owner, importer, or consignee of the article written notice of--

(i) such order, and

(ii) the seizure and forfeiture that would result from any further attempt to import the article into the United States.

(2) The Commission shall notify the Secretary of the Treasury of any order issued under this subsection and, upon receipt of such notice, the Secretary of the Treasury shall enforce such order in accordance with the provisions of this section.

(3) Upon the attempted entry of articles subject to an order issued under this subsection, the Secretary of the Treasury shall immediately notify all ports of entry of the attempted importation and shall identify the persons notified under paragraph (1)(C).

(4) The Secretary of the Treasury shall provide--

(A) the written notice described in paragraph (1)(C) to the owner, importer, or consignee of any article that is denied entry into the United States by reason of an order issued under subsection (d); and

(B) a copy of such written notice to the Commission.

(j) Referral to President

(1) If the Commission determines that there is a violation of this section, or that, for purposes of subsection (e), there is reason to believe that there is such a violation, it shall--

(A) publish such determination in the Federal Register, and

(B) transmit to the President a copy of such determination and the action taken under subsection (d), (e), (f), (g), or (i), with respect thereto, together with the

record upon which such determination is based.

(2) If, before the close of the 60-day period beginning on the day after the day on which he receives a copy of such determination, the President, for policy reasons, disapproves such determination and notifies the Commission of his disapproval, then, effective on the date of such notice, such determination and the action taken under subsection (d), (e), (f), (g), or (i) with respect thereto shall have no force or effect.

(3) Subject to the provisions of paragraph (2), such determination shall, except for purposes of subsection (c), be effective upon publication thereof in the Federal Register, and the action taken under subsection (d), (e), (f), (g), or (i), with respect thereto shall be effective as provided in such subsections, except that articles directed to be excluded from entry under subsection (d) or subject to a cease and desist order under subsection (f) shall, until such determination becomes final, be entitled to entry under bond prescribed by the Secretary in an amount determined by the Commission to be sufficient to protect the complainant from any injury. If the determination becomes final, the bond may be forfeited to the complainant. The Commission shall prescribe the terms and conditions under which bonds may be forfeited under this paragraph.

(4) If the President does not disapprove such determination within such 60-day period, or if he notifies the Commission before the close of such period that he approves such determination, then, for purposes of paragraph (3) and subsection (c) such determination shall become final on the day after the close of such period or the day on which the President notifies the Commission of his approval, as the case may be.

(k) Period of effectiveness; termination of violation or modification or rescission of exclusion or order

(1) Except as provided in subsections (f) and (j), any exclusion from entry or order under this section shall continue in effect until the Commission finds, and in the case of exclusion from entry notifies the Secretary of the Treasury, that the conditions which led to such exclusion from entry or order no longer exist.

(2) If any person who has previously been found by the Commission to be in violation of this section petitions the Commission for a determination that the petitioner is no longer in violation of this section or for a modification or rescission of an exclusion from entry or order under subsection (d), (e), (f), (g), or (i)--

(A) the burden of proof in any proceeding before the Commission regarding such petition shall be on the petitioner; and

(B) relief may be granted by the Commission with respect to such petition--

(i) on the basis of new evidence or evidence that could not have been presented at the prior proceeding, or

(ii) on grounds which would permit relief from a judgment or order under the Federal Rules of Civil Procedure.

(l) Importation by or for United States

Any exclusion from entry or order under subsection (d), (e), (f), (g), or (i), in cases based on a proceeding involving a patent, copyright, mask work, or design under subsection (a)(1), shall not apply to any articles imported by and for the use of the United States, or imported for, and to be used for, the United States with the authorization or consent of the Government. Whenever any article would have been excluded from entry or would not have been entered pursuant to the provisions of such subsections but for the operation of this subsection, an owner of the patent, copyright, mask work, or design adversely affected shall be entitled to reasonable and entire compensation in an action before the United States Court of Federal Claims pursuant to the procedures of section 1498 of Title 28.

(m) "United States" defined

For purposes of this section and sections 1338 and 1340 of this title, the term "United States" means the customs territory of the United States as defined in general note 2 of the Harmonized Tariff Schedule of the United States.

(n) Disclosure of confidential information

(1) Information submitted to the Commission or exchanged among the parties in connection with proceedings under this section which is properly designated as confidential pursuant to Commission rules may not be disclosed (except under a protective order issued under regulations of the Commission which authorizes limited disclosure of such information) to any person (other than a person described in paragraph (2)) without the consent of the person submitting it.

(2) Notwithstanding the prohibition contained in paragraph (1), information referred

to in that paragraph may be disclosed to--

(A) an officer or employee of the Commission who is directly concerned with--

(i) carrying out the investigation or related proceeding in connection with which the information is submitted,

(ii) the administration of a bond posted pursuant to subsection (e), (f), or (j),

(iii) the administration or enforcement of an exclusion order issued pursuant to subsection (d), (e), or (g), a cease and desist order issued pursuant to subsection (f), or a consent order issued pursuant to subsection (c),

(iv) proceedings for the modification or rescission of a temporary or permanent order issued under subsection (d), (e), (f), (g), or (i), or a consent order issued under this section, or

(v) maintaining the administrative record of the investigation or related proceeding,

(B) an officer or employee of the United States Government who is directly involved in the review under subsection (j), or

(C) an officer or employee of the United States Customs Service who is directly involved in administering an exclusion from entry under subsection (d), (e), or (g) resulting from the investigation or related proceeding in connection with which the information is submitted.

CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITATIONS

1. This brief complies with the type-volume limitation of Fed. Cir. R. 32(b)(1) because this brief contains 8,252 words, excluding the parts of the brief exempted by Fed. Cir. R. 32(b)(2) and Fed. R. App. P. 32(f).

2. This brief complies with the typeface requirements of Fed. R. App. P. 32(a)(5) and the type style requirements of Fed. R. App. P. 32(a)(6) because this brief has been prepared in a proportionally spaced typeface using Microsoft Word in 14-point font and Times New Roman type style.

Dated: September 10, 2026

/s/ *Laurence M. Sandell*
Laurence M. Sandell

CERTIFICATE OF SERVICE

I hereby certify that on September 10, 2026, I electronically filed the foregoing Brief of Appellants with the United States Court of Appeals for the Federal Circuit through the Court's CM/ECF system. All parties are represented by registered CM/ECF users and will be served by the CM/ECF system.

Pursuant to agreement, the confidential version of the foregoing was also served on counsel for all parties by electronic mail.

/s/ *Laurence M. Sandell*
Laurence M. Sandell