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UNITED STATES DISTRICT COURT
DISTRICT OF ARIZONA
PHOENIX DIVISION

VPR Brands, LP, Plaintiff/Counterclaim Defendant, v. Jupiter Research, LLC, Defendant/Counterclaim Plaintiff.	No. CV-20-02185-PHX-DJH **PLAINTIFF'S OPENING CLAIM CONSTRUCTION BRIEF**

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Plaintiff, VPR Brands, LP ("VPR") by and through its undersigned counsel, respectfully submits its opening claim construction brief pursuant to the Scheduling Order in this case entered February 26, 2021 (ECF 19), supported by the accompanying Declaration of Dr. George Yanulis ("Yanulis Decl."). Dr. Yanulis is a PhD engineer with expertise in bio-medical devices. He is offered by VPR as a technical expert and person skilled in the art (POSITA) at issue.

VPR asserts U.S. Patent No. 8,205,622 titled "Electronic Cigarette" (the "'622 Patent" or "patent-in-suit"). The '622 Patent claims priority to Chinese Patent Application No. 2009100801475 (the "'475 application"), which is incorporated by reference in its entirety in the '622 Patent specification. ('622 Patent col. 1, ln. 3-5.)

I. INTRODUCTION

The invention claimed in the '622 Patent covers a novel electronic cigarette ("e-cigarette") that is efficient to manufacture, easy to use, and closely simulates cigarette smoking. ('622 Patent, col. 2, ln. 23-25). All electronic cigarettes work by vaporization. Whereby a liquid is introduced, in a metered amount, to a high temperature heating element, which causes the liquid to be "vaporized" for inhalation by the user. The act of using an e-cigarette is colloquially known as "vaping."

VPR is a technology company whose assets include issued U.S. and Chinese patents for atomization-related products, including technology for medical marijuana oil vaporizers, dab pen and flower vaporizer products and components. VPR is engaged in product development for the vapor or vaping market, including e-liquids, vaporizers and electronic cigarettes (also known as e-cigarettes) which are devices which deliver

nicotine and or cannabis and cannabidiol (CBD) through atomization or vaping, and without smoke and other chemical constituents typically found in traditional products.

Jupiter distributes one or more electronic cigarette products that practice all the steps of at least one claim of the '622 Patent. One of Jupiter's electronic cigarette products is known as LIQUID 6. Jupiter's LIQUID 6 is an electronic cigarette that contains a rechargeable battery that functions as a power source which supplies electric power to an electronic inhaler. In addition to the power source, the inhaler also includes an electric airflow sensor to detect air movement generated by a user's inhaling or puffing act.

The parties dispute the construction of the following three claim elements contained in claims 13 through 18 of the patent-in-suit.

Claim Term	**Appears in Claims**
diaphragm microphone	14, 17
electronic inhaler	13-18
time period and a magnitude of the electric current	13-15

VPR has proposed a construction based on the intrinsic evidence of the patent-in-suit as understood by POSITA. Jupiter has proposed a construction that is based on extraneous considerations that, if adopted, would improperly impose limitations on

VPR's invention. For the reasons that follow, VPR's three constructions should be adopted and Jupiter's should be rejected.

II. BACKGROUND OF THE INVENTION

VPR's invention overcomes the following drawbacks of prior art e-cigarettes that were available prior to the invention. ('622 Patent, col. 2, ln. 19-22.)

Prior to VPR's invention, e-cigarettes had several limitations: (1) circuit complexity that was costly to manufacture and maintain; (2) mechanical failures and limitations such as, fluid leakage, liquid reversal[1], users directly handling nicotine-liquid, discontinuous vaporizing, difficulty inhaling, and sub-standard sanitation; and (3) unreliable airflow sensors, which had short lifespans and were too sensitive to external changes, such as outside temperature and humidity. ('622 Patent, col. 2, ln 4-12.)

VPR's invention surpasses the prior art in several ways. *First*, VPR's invention features a cost-effective simplified circuit construction that allows for precise control of the vaporization process, by employing a "Single Chip Micyoco." "Micyoco" is a short-hand term of art used to refer to a microcontroller with an embedded processor system. (Yanulis Decl. ¶¶ 9-13). The Micyoco processes the input signal and provides output instructions controlling the magnitude and duration of the current sent to the heating/vaporization element.

Second, VPR's invention features a cost-effective and disposable atomizer structure that can be discarded when the e-liquid "chamber" is empty ('622 Patent, col. 3,

[1] liquid reversal refers to the liquid going into the mouth of the user when the user puffs on the electronic cigarette

ln 6-9.) *Third*, VPR's invention employs an electronic airflow sensor that detects a user "puffing" on the e-cigarette. When the user puffs or inhales, the airflow sensor sends a signal directly to the Single Chip Micyoco. ('622 Patent, Summary of the Invention, col. 2, ln. 65 – col. 3, ln. 43.)

A summary of a preferred embodiment of the Invention is provided in col. 2 of the specification and it lays out a roadmap of the terms referenced in this brief:

> In a preferred embodiment, the connection between the electronic inhaler and electronic atomizer through the connectors on both parts forms an entire electronic cigarette. When the user puffs on the electronic cigarette through the air-puffing hole on the first end of the atomizer, the electronic sensor detects an airflow and converts it to a signal, which then wakes up the single chip micyoco to record the signal. The single chip micyoco guided by its embedded software instructions may turn on the electric power source to supply an electricity current with a predefined time length. This electric current preferably flows through the electric heat wire inside the atomizer tube, which then heats up the heat equalizer with absorbed liquid from the liquid-container. The heated equalizer converts the liquid into a form of vapor mist which is finally drawn into the month of the user. This completes an entire cycle of vaporizing process from which the user gets satisfaction of "smoking."

('622 Patent, col. 2, ln. 48-64).

III. LEGAL STANDARD

A patent infringement analysis under 35 U.S.C. § 271 requires, as a first step, that the Court construe the meaning of the disputed patent claim terms as a matter of law. *See Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 976 (Fed. Cir. 1995), aff'd, 517 U.S. 370 (1996).

The purpose of claim construction is for the Court to determine what the disputed claim terms mean "'in order to understand and explain, but not to change, the scope'" of

the claim. *Inv. Tech. Group, Inc. v. Liquidnet Holdings, Inc.*, 2010 U.S. Dist. LEXIS 3588 *7 (S.D.N.Y. 2010), *quoting DeMarini Sports, Inc. v. Worth, Inc.*, 239 F.3d 1314, 1322 (Fed. Cir. 2001) (internal quotations omitted). Claims are "construed without reference to the accused device [or product]." *SRI Int'l v. Matsushita Elec. Corp. of Am.*, 775 F.2d 1107, 1118 (Fed Cir. 1985).

Claim terms are not construed in a vacuum, *Medrad, Inc. v. MRI Devices Corp.*, 401 F.3d 1313, 1319 (Fed. Cir. 2005). It is well-settled that, in interpreting an asserted claim, the court should look first to the intrinsic evidence of record, i.e., the patent itself, including the claims, the specification and, if in evidence, the prosecution history. *See Markman*, 52 F.3d at 979, 34 USPQ2d at 1329. Such intrinsic evidence is the most significant source of the legally operative meaning of disputed claim language. *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996).

A. Intrinsic Evidence

Within the "intrinsic evidence," courts first look to the words of the claims. *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d. 1313, 1324 (Fed. Cir. 2002); *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996). The words of the claims are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc); accord, *InterDigital Commc'ns, LLC v. Int'l Trade Comm'n*, 690 F.3d 1318, 1324 (Fed. Cir. 2012); *Vitronics*, 90 F.3d at 1582. The ordinary and customary meaning of a claim term may be determined solely by viewing the term within the context of the claim's overall language. See, *Phillips*, 415

F.3d at 1314 ("[T]he use of a term within the claim provides a firm basis for construing the term.").

Claim terms should be construed in a manner that is consistent with the scope of the patent's specification. See *Markman*, 52 F.3d at 979. The specification is the best guide for construing the claims. See *Phillips*, 415 F.3d at 1315; *Vitronics*, 90 F.3d at 1582. Courts must construe claim terms consistent with the rule that limitations in the specification may not be read into the claims. *Laitram Corp. v. NEC Corp.*, 163 F.3d 1342, 1347 (Fed. Cir. 1998); *Comark Commc'ns, Inc. v. Harris Corp.*, 156 F.3d 1182, 1186 (Fed. Cir. 1998); *SRI Int'l*, 775 F.2d at1121.

Courts should define disputed claims by looking "first to the intrinsic evidence of record, i.e., the patent itself, including the claims, the specification and, if in evidence, the prosecution history." *Vitronics*, 90 F.3d at 1582 (internal quotations omitted).

1. The claims define the invention.

Claim construction "begins and ends" with the words of the claims. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1248 (Fed. Cir. 1998). "Quite apart from the written description and the prosecution history, the claims themselves provide substantial guidance as to the meaning of particular claim terms." *Phillips*, 415 F.3d at 1314. "[T]he context in which a term is used in the asserted claim can be highly instructive." *Id*. "Other claims of the patent in question, both asserted and unasserted, can also be valuable sources of enlightenment as to the meaning of a claim term." *Id*. "Differences among claims can also be a useful guide in understanding the meaning of particular claim terms." *Id*.

"[T]he person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." *Merck & Co. v. Teva Pharms. USA, Inc.*, 347 F.3d 1367, 1371 (Fed. Cir. 2003). "Because the meaning of a claim term as understood by persons of skill in the art is often not immediately apparent, and because patentees frequently use terms idiosyncratically, the court looks to 'those sources available to the public that show what a person of skill in the art would have understood disputed claim language to mean.'" *Id*. (quoting *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004)). "Those sources include 'the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.'" *Id.* "[C]laims must be construed so as to be consistent with the specification, of which they are a part." *Merck*, 347 F.3d at 1371.

2. Limitations from the specification may not be read into the claims

"Although claims must be read in light of the specification of which they are part, ... it is improper to read limitations from the written description into a claim." *Tate Access Floors, Inc. v. Maxess Techs., Inc.*, 222 F.3d 958, 966 (Fed. Cir. 2000); *Va. Panel Corp. v. MAC Panel Co.*, 133 F.3d 860, 866 (Fed. Cir. 1997) ("Device claims are not limited to devices which operate precisely as the embodiments described in detail in the patent.").

Claims should only be interpreted in a restricted manner if the patentee has demonstrated a clear intention to limit the claim scope using "words or expressions of

manifest exclusion or restriction." *Liebel-Flarsheim v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004). "When more than one embodiment is disclosed, as a matter of law, the court 'do[es] not interpret claim terms in a way that excludes disclosed examples in the specification.'" *Beacon Adhesives, Inc. v. United States*, 134 Fed. Cl. 26, 36 (2017)(quoting *Verizon Servs. Corp. v. Vonage Holdings Corp.*, 503 F.3d 1295, 1305 (Fed. Cir. 2007).

B. Extrinsic Evidence

Extrinsic evidence includes dictionaries, technical treatises, and expert declarations that the Court may use to help understand the underlying technology and the manner in which one skilled in the art might use the claim terms. *Phillips*, 415 F.3d at 1318. An expert's supported assertions as to a term's definition is helpful to the Court when there is an ambiguity. *Id*.

Ultimately, however, "extrinsic evidence" is not as significant as "intrinsic evidence" in defining claim terms. *Phillips*, at 1317. Courts should discount any extrinsic evidence "that is clearly at odds with the claim construction mandated by the claims themselves, the written description, and the prosecution history, in other words, with the written record of the patent." *Id*. at 1318 (quoting *Key Pharm. v. Hercon Labs. Corp.*, 161 F.3d 709, 716 (Fed. Cir. 1998)) (internal quotations omitted).

Once the proper meaning of a term used in a claim has been determined, the term must have the same meaning for al1 claims in which it appears. *Phillips*, at 1314

(citations omitted); *Inverness Med. Switzerland GmbH v. Princeton Biomeditech Corp*., 309 F.3d 1365, 1371 (Fed. Cir. 2002).

IV. CONSTRUCTION OF THE CLAIM TERMS

A. Disputed terms of the '622 Patent

1. diaphragm microphone

Claim Term	VPR's Proposed Construction	Jupiter's Proposed Construction
diaphragm microphone	A device for converting pressure waves into electrical energy using a thin sheet of material that is capable of vibrating.	A device, used in recording or transmitting sound, for converting sound waves into electrical currents or voltages containing a flexible diaphragm that vibrates as it makes contact with sound waves and converts sound waves into analogous electrical waves. The diaphragm movement modulates an electrical current by various methods such as changing a capacitance or producing a voltage based on the vibration of the diaphragm.

VPR's proposed construction is based on the ordinary meaning of the term "diaphragm microphone" as understood in the art and used in the '622 Patent specification. (Yanulis Decl. ¶15). Jupiter's construction improperly narrows the definition of "diaphragm microphone" by importing limitations from unwarranted extrinsic evidence that is inconsistent with the '622 Patent claims and specification (i.e the intrinsic evidence), and must be rejected. *Phillips*, at 1317.

A "microphone" refers to a device used to detect sound waves. Microphones detect sound and provide a signal used to amplify, record or transmit the sound detected. The microphone described in the '622 patent is not used to amplify the voices of singers

on stage. Rather, one skilled in the art readily understands from the '622 patent specification that the diaphragm microphone of the claimed invention is the type that detects airflow, rather than the type used for the amplification, recording or transmission sound as described by Jupiter.

A microphone uses a thin membrane, called a diaphragm, to detect sound waves. (Yanulis Decl. ¶18). The thin diaphragm membrane vibrates in response to changes in pressure caused by sound waves or, in the case of the present invention, airflow across the diaphragm. (Yanulis Decl. ¶19). The patent claims make clear that the diaphragm microphone is an airflow sensor that detects the airflow generated by the user "puffing" on the e-cigarette when the airflow passes across the diaphragm. ('622 Patent, Claims 14 and 17, reciting "the airflow sensor is diaphragm microphone.").

A diaphragm microphone is sensitive to airflow. The present invention relies on that sensitivity to detect airflow caused by a user's "puffing" or inhaling action and converts the vibrations created by that airflow into an electrical signal. The patent-oin-suit recites "[t]he user puffs on the end of the electronic cigarette with the air-puffing hole to activate the CPU processor through detection of an airflow signal…". ('622 Patent, col. 5, ln. 62-64). The airflow signal is converted into an electrical signal by the microphone and sent to a microprocessor/control unit ("micyoco") which, in turn, controls the vaporization process by "generat[ing] an electric current flowing through the electric heating wire, which achieves vaporization of the solution inside the liquid container." ('622 Patent, col. 5, ln. 62-64).

Jupiter's proposed construction does not rely on the intrinsic evidence. Jupiter's construction uses extrinsic evidence of the colloquial definition of a microphone. Jupiter's construction renders the "diaphragm microphone" claim element nonsensical. Construing the "diaphragm microphone" term as Jupiter urges in the context of the specification (and, generally, in the art of e-cigarettes and vaporizers), makes no sense whatsoever. See, e.g., *SIMO Holdings Inc. v. Hong Kong uCloudlink Network Tech. Ltd.*, 983 F.3d 1367, 1380 (Fed. Cir. 2021)(citing, *Joao v. Sleepy Hollow Bank*, 348 F. Supp. 2d 120, 124 (S.D.N.Y. 2004)(refusing to adopt the "grammatically correct" interpretation of a claim term where it "would render the claims utter nonsense.")).

Adding a limitation that the diaphragm microphone for the e-cigarette of the present invention must either "record[] or transmit[] sound" "render[s] the claim utter nonsense" to one skilled in the art, and Jupiter's proposed construction must be rejected. *Joao,* 348 F. Supp. 2d at 124.

Accordingly, this court should adopt VPR's proposed construction of the term "diaphragm microphone" because it is based on the intrinsic evidence as understood by POSITA.

2. electronic inhaler

Claim Term	VPR's Proposed Construction	Jupiter's Proposed Construction
electronic inhaler	A tubular housing comprising one or more electrical components and one or more holes to allow airflow.	An inhaler tube receiving electrical power, having an electrical connection with an electronic atomizer, a cigarette cap with holes for air inflow, LED indicator, electric power source, annular tube with cap, integrated circuit board with CPU processor, electric airflow sensor, sensor supporter,

		electric connector, inserted rush pith surrounded by a silica gel insulator, that fits together with the electronic atomizer.

VPR's proposed construction is based upon the ordinary meaning of the term "electronic inhaler" as understood in the art, in the context of the '622 Patent specification. An inhaler is well understood in the art of e-cigarettes (and similar medicine-delivery devices) as the portion of inhalation device that the user "puffs" on to draw air through the device.[2] (Yanulis Decl. ¶20).

Moreover, the '622 patent further specifies the electronic inhaler to preferably include one or more of an electric power source, electric sensor, single chip micyoco, and and LED indicator. The preferred embodiment of the inhaler, however, does not limit the definition of the inhaler to include the above components.

Furthermore, the '622 patent further explains that on the first end of the inhaler tube may be a cigarette cap with a small hole for airflow. On the second end of the tube may be an electric connector with either outskirt screw thread or a DC socket.

Jupiter's construction seeks to improperly narrow the definition of an "electronic inhaler" by importing limitations from the specification (and other claim elements), and from specific embodiments, that limit the term "inhaler." Jupiter's limitations have no place in the definition of this term.

For example, Jupiter's construction requires various components including "an electrical connection with an electronic atomizer, a cigarette cap with holes for air inflow,

[2] Once the atomizer is activated, the "puffing" action also delivers the vaporized medical substance (or nicotine in the case of e-cigarettes) to the user.

LED indicator, electric power source, annular tube with cap, integrated circuit board with CPU processor, electric airflow sensor, sensor supporter, electric connector, [and] inserted rush pith surrounded by a silica gel insulator." The intrinsic evidence of the patent-in-suit does not support Jupiter's attempt to require these components in order to define the claim term "electronic inhaler."

The term "inhaler" as used in the claims of the patent-in-suit does not contain the limitations Jupiter proposes, and reading Jupiter's limitations into the claims from specific embodiments of the invention is improper. See, e.g., *Epistar Corp. v. Lowes Companies, Inc.*, 326 F. Supp. 3d 952, 960 (C.D. Cal. 2018)("limitations of the described embodiments of the invention must not be read into the claims").

The "622 Patent explicitly states that the additional elements are optional features of a preferred embodiment, and not requirements for the term inhaler.

> The inhaler ***preferably includes*** one or more of an electric power source, electric sensor, single chip micyoco, and LED indicator. The electric power source, which can be a rechargeable or non-rechargeable battery, supplies electricity to the atomizer to vaporize a liquid inside an atomizer chamber.

('622 Patent, col. 2, ln. 30-35) (emphasis added).

Several of the limitations that Jupiter attempts to read into the definition for "electronic inhaler" are, in fact, separate claim elements for the claims at issue, such as the electric power source, CPU processor, and electric airflow sensor. Reading these limitations into the definition of "electronic inhaler" would improperly render the elements superfluous. See *Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1372 (Fed. Cir. 2005)("A claim construction that gives meaning to all the terms of the claim is

preferred over one that does not do so.")(citing *Elekta Instrument S.A. v. O.U.R. Sci. Int'l, Inc*., 214 F.3d 1302, 1307 (Fed. Cir.2000) (construing claim to avoid rendering the [] claim limitation superfluous); *Gen. Am. Transp. Corp. v. Cryo–Trans, Inc*., 93 F.3d 766, 770 (Fed. Cir.1996) (rejecting the district court's claim construction because it rendered superfluous the claim requirement for openings adjacent to the end walls)).

VPR's proposed construction for the "electronic inhaler" represents the ordinary meaning as understood in the art, consistent with the intrinsic evidence. Jupiter's proposed definition improperly imports additional limitations from the specification and from separate elements of the claims at issue. VPR's construction , and should be adopted by the Court.

3. time period and a magnitude of the electric current

Claim Term	VPR's Proposed Construction	Jupiter's Proposed Construction
time period and a magnitude of the electric current	The duration of time and the strength of the current that is provided to the heating element.	Time period is undefined. Magnitude is the magnitude of electric current supplied by the power source.

VPR respectfully submits that the term "time period" as used in the '622 patent has an ordinary and plain meaning. A "time period" is well understood as a period (or duration) of time that something occurs. As used in the '622 patent, the "time period of the electric current" is the amount of time (duration) that the power supply provides the electric current to the heating element. (Yanulis Decl. ¶34).

The '622 Patent provides context to the term when describing a function of the SCM: "wherein the Single Chip Micyoco receives the signal from the electric airflow sensor, instructs the electric power source to send an electric current to the electronic

atomizer, and **a time period and a magnitude** of the electric current." ('622 Patent, col. 7-8, ln. 45-46,1-3.)

However, Jupiter's proposal states that the term "time period is undefined". Jupiter is incorrect. This proposal should not be given any merit as it lacks any logical explanation, especially when viewed in light of the '622 patent specification. "A time period", refers to the duration or "amount of time". (Yanulis Decl. ¶36).

Additionally, Jupiter seeks to define a term by using that same term in its definition, stating "magnitude is the magnitude…". Defining "magnitude" as "magnitude" is circular reasoning. As used in the '622 Patent, "magnitude" refers to the strength or "the amount of charge flowing at a particular point". (Yanulis Decl. ¶37).

B. Agreed upon claims and constructions

The parties agree on the following constructions of the following terms:

Claim Term	Appears in Claims	Proposed Construction
Single Chip Micyoco	13,14,15,16	A microcontroller including a processor, software instructions to be executed by the processor, memory, and I/O processed by the processor.
electronic cigarette	13,14,15,16,17,18	A device operating with the aid of electricity containing a substance that is vaporized/atomized and inhaled
Tubular	13,14,15,16,17,18	A hollow length of material having substantially parallel sides defining an open space
Electronic atomizer	13,14,15,16,17,18	A device that converts a solution of a liquid form through vaporization or atomization to a gas form, using electric current.
Power Source	13,14,15,16,17,18	A rechargeable or non-rechargeable battery
LED indicator	15,16	A light emitting diode that lights up when the electric current flows and it is turned off when the electric current stops flowing
Electric airflow sensor	13,14,15,16,17,18	An electric sensor to detect air movement generated by a user's inhaling or puffing act.

Claim Term	Appears in Claims	Proposed Construction
That is detecting air flow	13, 14, 15, 17, 18	detecting air movement generated by a user's inhaling or puffing act
(sending a) signal	13, 14, 15	Any signal provided by the airflow sensor responsive to airflow.
instructs	13, 14, 15	Provides a signal that tells the power supply to provide or not provide electricity to the inhaler and atomizer.
Cigarette Cap	16	A cap with holes attached to the device.
Circuit Board	16	A board on which electronic components are mounted.
detachably attached	17	Able to be connected and then separated.
Electric connector	16, 18	A conductive contact
air puffing hole	17, 18	Hole through which air can be drawn by a user.
detecting an airflow	13, 14, 15, 17, 18	Determining that a user is inducing airflow into or out of the device.
heat equalizer	18	A thermally conductive material capable of withstanding high temperatures that distributes the heat from a heat source.
supporting piece	18	A piece made of material able to withstand high temperatures that supports that supports one or more electrical components.

V. CONCLUSION

VPR's proposed constructions are based upon the intrinsic evidence as understood by POSITA. Jupiter's disputed constructions are not based on the intrinsic evidence, improperly import extrinsic limitations into the claims, and find no support in the context of the claims and the specification. Accordingly, this Court should adopt VPR's proposed constructions for each of the disputed claim terms, and adopt the agreed upon proposed construction for the agreed claim terms.

Dated: November 22, 2021

Respectfully submitted,

/s/ Eliezer Lekht

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CERTIFICATE OF SERVICE

The undersigned does hereby certify that on November 22, 2021, a true and correct copy of the foregoing document was served by electronic mail by the Court's CM/ECF System to all parties listed below on the Service List.

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UNITED STATES DISTRICT COURT
DISTRICT OF ARIZONA
PHOENIX DIVISION

VPR Brands, LP,

Plaintiff/Counterclaim Defendant,

v.

Jupiter Research, LLC,

Defendant/Counterclaim Plaintiff.

No. CV-20-02185-PHX-DJH

EXPERT REPORT and DECLARATION OF DR. GEORGE YANULIS

1. I am a biomedical engineer. I operate GY Medical Device Consulting, LLC, an engineering consulting firm. I'm consulting as a paid expert for VPR Brands, LP in this matter, my consulting rate is set at $400 per hour.

2. I have over thirty years of biomedical engineering experience in the medical devices field.

3. During this time, I've earned several engineering awards. See Exhibit A. I published scholarly papers in the field of biomedical engineering, including topics

such as the development of a heart failure therapy monitoring system (see, https://engagedscholarship.csuohio.edu/cgi/viewcontent.cgi?article=1313&context=etdarchive. I am a member of and participate in professional engineering associations, including IEEE Engineering in Medicine & Biology, Association for the Advancement of Medical Instrumentation, and Heart Rhythm Society. See Exhibit A.

4. My education includes Bachelor of Arts degree in Premedical Studies/Chemistry (Syracuse University. 1977), Masters in Biomedical Engineering (University of Virginia, 1981), Masters in Bioengineering (University of Pittsburgh, 2002), and Doctorate in Engineering (Cleveland State University, 2008). See Exhibit A.

5. In the above captioned suit, VPR asserts U.S. Patent No. 8,205,622 (the "'622 Patent" or "patent -in-suit") titled "Electronic Cigarette." The '622 Patent claims priority to Chinese Patent Application No. 2009100801475 (the "'475 application"), which is incorporated by reference in its entirety in the '622 Patent specification. See, '622 Patent at Col. 1, lines 3-5.

6. I consider myself to have at least the qualifications of a person having ordinary skill in the art (PHOSITA) related to the claimed invention of the current above referenced suit, United States Patent Nos. 8,205,622 (the '622 patent).

7. I submit this declaration for the purpose of establishing how a PHOSITA would understand the claim terms of the patent in suit.

SINGLE CHIP MICYOCO

8. The '622 patent includes numerous disclosures and embodiments. A PHOSITA would recognize that the relevant claims in this suit relate to the embodiments of the '622 patent which utilizes a Single Chip Micyoco ("SCM") to control the atomizing unit's temperature and duration by using an airflow sensor in the form of a diaphragm microphone to monitor the change in air pressure to send a signal to power the battery of the device which in turn provides current to the atomizer, thereby activating the vaporizing process.

9. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "*Single Chip Micyoco*" as used in Claims 13, 14, 15, and 16, to mean:

> *A microcontroller including a processor, software instructions to be executed by the processor, memory, and I/O processed by the processor.*

10. For example, the '622 patent states in pertinent part:

> When the user puffs on the electronic cigarette through the air-puffing hole on the first end of the atomizer, the electronic sensor detects an airflow and converts it to a signal, which then wakes up the **single chip micyoco** to record the signal. The **single chip micyoco** guided by its embedded software instructions may turn on the electric power source to supply an electricity current with a predefined time length".

Col. 2, lines 51-57

11. In the next column, the patent specification refers to the "Single Chip Micyoco" as a microprocessor to describe the same process. For example, the '622 patent states in pertinent part:

> …airflow generated by the user's puffing and creating a signal for the **microprocessor** to activate the electric circuit. Once the circuit is activated, the electric power source sends an electric current to the system and the connected integrated atomizer, and the vaporizing process begins. When the puffing stops, the **microprocessor** instructs the electric power source to stop supplying the electricity current, and the vaporizing process stops.

Col. 3, lines 26-33.

12. The patent specification also refers to the "Single Chip Micyoco" as a CPU (i.e. a processor) to describe the same process. For example, the '622 patent states in pertinent part:

> The user puffs on the end of the electronic cigarette with the air-puffing hole to activate the CPU processor through detection of an airflow signal and generate an electric current flowing through the electric heating wire, which achieves vaporization of the solution inside the liquid container.

Col. 5, lines 62-67

13. Therefore, from the specification, it is clear that the '622 patent uses the term "Single Chip Micyoco", interchangeably with the terms "Microprocessor", and "CPU (i.e. a "processor").

14. A Single Chip Micyoco is the term used in the art to describe the combination of components to formulate a computer on a single chip. In other words, a Single Chip Microcomputer. In certain regions, the terms "micyoco" is simply an alternative shorthand for the terms "microcontroller," "microprocessor," or "microcomputer." Attached herewith as Exhibit B, is a true and correct copy of an excerpt from an article published by Kynix Semiconductor Limited, a professional electronic components distributor[1], which states in pertinent part:

> Single-chip Microcomputer, also called microcontroller, is not a chip to complete a logical function, but a computer system integrated into a chip. It is equivalent to a microcomputer. Compared with the computer, the microcontroller only lacks the I/O device.

See Exhibit B.

DIAPHRAGM MICROPHONE

15. A plain reading of the '622 patent would enable a PHOSITA to readily understand the term "diaphragm microphone" as used in Claims 13, 14, 15, and 16, to mean:

[1] Publicly available at the web URL: http://www.kynixsemiconductor.com/News/31.html

> *A device for converting pressure waves into electrical energy using a thin sheet of material that is capable of vibrating.*

16. For example, the '622 patent states: "…the airflow sensor is a diaphragm microphone. Col. 6, lines 37-38. Additionally, claim 14 of the '622 patent specifically defines "diaphragm microphone" as "wherein the electric airflow sensor is a diaphragm microphone." See Col. 8, lines 4-5.

17. Additionally, claim 17 of the '622 patent further explains "diaphragm microphone" by describing the airflow sensor as "an electric airflow sensor configured to turn on and off the electric power source by way of detecting an airflow, and the airflow sensor is a diaphragm microphone." See Col. 8, lines 37-40.

18. Attached herewith as Exhibit C, is a true and correct copy of an excerpt from Sterling Audio, which specializes in high-end studio condenser microphones[2], which states in pertinent part:

> *The diaphragm is the component of the microphone capsule that vibrates in response to sound waves. Diaphragm material, design, thickness and diameter—or size—all help to determine a microphone's frequency, transient and polar responsiveness.*

See, Exhibit C.

[2] Publicly available at the web URL: https://sterlingaudio.net/understanding-microphones/#:~:text=The%20diaphragm%20is%20the%20component,%E2%80%94large%2C%20medium%20and%20small.

19. A PHOSITA further recognizes that a diaphragm microphone is a tool to pick up sound waves (or other changes in pressure). The sound waves (or pressure change) cause the membrane to vibrate, which, in turn triggers an electrical signal that can be sent to a processor.

ELECTRONIC INHALER

20. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "*electronic inhaler"* as used in Claims 13, 14, 15, 16, 17, and 18 to mean:

> *A tubular housing comprising one or more electrical components and one or more holes to allow airflow*

21. For example, the '622 patent states in pertinent part:

> The inhaler preferably includes one or more of an electric power source, electric sensor, single chip micyoco, and LED indicator. The electric power source, which can be a rechargeable or non-rechargeable battery, supplies electricity to the atomizer to vaporize a liquid inside an atomizer chamber. On the first end of the inhaler tube may be a cigarette cap with a small hole for airflow. On the second end of the tube may be an electric connector with either outskirt screw thread or a DC socket.

See Col. 2, lines 30-38.

ELECTRONIC ATOMIZER

22. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "*electronic atomizer"* as used in Claims 13, 14, 15, 16, 17, and 18 to mean:

> A device that converts a solution of a liquid form through vaporization or atomization to a gas form, using electric current.

23. For example, the Abstract of the '622 Patent describes what is inside the electronic atomizer: "[i]nside the electronic atomizer are an electric connector, electric heating wire, liquid container, and atomizer cap with an air-puffing hole."

24. Moreover, the '622 patent states: "wherein the tubular electronic atomizer includes a container and media within the container, the media is soaked with a solution to be atomized, and between the container and the media there is a side-space for airflow." See Col. 6, lines 30-34

25. Claim 18 also specifies the components of the electronic atomizer to include: "an electric connector, a leak-proof piece, a supporting piece, a heat equalizer coupled with an electric heating wire, the container filled with the media, and the air-puffing hole." See Col. 8, lines 42-45.

26. Finally, the term "atomizer" is a common and well-known term in the art. Attached herewith as Exhibit D, is a true and correct copy of an excerpt from Wikipedia, an online encyclopedia[3], which states in pertinent part:

> An atomizer consists of a small heating element that vaporizes e-liquid and a wicking material that draws liquid onto the coil. Along with a battery and e-liquid the atomizer is the main component of every personal vaporizer. When

[3] Publicly available at the web URL: https://en.wikipedia.org/wiki/Construction_of_electronic_cigarettes.

> activated, the resistance wire coil heats up and vaporizes the liquid, which is then inhaled by the user.

See, Exhibit D.

27. Or as simplified by the National Institute on Drug Abuse, an atomizer is simply another term for the "heat element," Attached herewith as Exhibit E, is a true and correct copy of an excerpt from DrugAbuse.gov, a National Institute on Drug Abuse,[4] where the opening bullet points, state: "a heating element (atomizer)."

INSTRUCTS

28. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "instructs" as used in Claims 13, 14, and 15, to mean:

> *The Single Chip Micyoco provides a signal to control the time period & magnitude of the electric current*

29. For example, the Abstract of the '622 Patent describes "instructs" in the context of the SCM controlling the device. "The sensor's role is to collect an airflow signal that triggers the Single Chip Micyoco, which in turn **instructs** the electronic cigarette to supply electric power to the inhaler and atomizer connected through an electric connector." Id.

30. The term "instructs" is used throughout the patent to mean a signal which controls the electric current going to the atomizer. For example, the '622 patent states:

[4] Publicly available at the web URL: https://www.drugabuse.gov/publications/drugfacts/vaping-devices-electronic-cigarettes.

> When the puffing stops, the microprocessor **instructs** the electric power source to stop supplying the electricity current, and the vaporizing process stops.

Col. 3, lines 31-33.

31. Additionally, the same term is used to describe the signal sent from the SCM to begin the atomizing process. For example, the '622 patent states:

> The single chip micyoco **instructs** the electric power source to supply electricity to the system by its embedded computer programs when a signal is generated through the airflow detected by the electric sensor from the user's puffing action.

Col. 4, lines 18-23

32. Therefore, the term "instructs" means to send a signal in order to control a function of the device, here, a signal to turn on/off the power source.

33. Attached herewith as Exhibit F, is a true and correct copy of an excerpt from Merriam Webster Dictionary[5], which provides the definition of "instruct" as: "to provide with authoritative information or advice; to give an order or command." See, Exhibit F.

[5] Publicly available at the web URL: https://www.merriam-webster.com/dictionary/instruct

TIME PERIOD & MAGNITUDE OF THE ELECTRIC CURRENT

34. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "time period & magnitude of the electric current" as used in Claims 13, 14, and 15, to mean:

> *The duration of time and the strength of the current is provided to the heating element*

35. For example, the '622 patent states:

> the electronic cigarette further comprising an electric airflow sensor that is used to turn on and off the electric power source by way of detecting an airflow and sending a signal to a Single Chip Micyoco, wherein the Single Chip Micyoco receives the signal from the electric airflow sensor, instructs the electric power source to send an electric current to the electronic atomizer, and **a time period and a magnitude** of the electric current.

Col. 7-8, lines 41-46,1-3

36. A PHOSITA readily understands the definition of the term "time period" to mean "an amount of time". Attached herewith as Exhibit G, is a true and correct copy of an excerpt from TheFreeDictionary.[6]

[6] Publicly available at the web URL: https://www.thefreedictionary.com/time+period

37. Additionally, a PHOSITA readily understands the term "magnitude" to mean "the amount of charge flowing at a particular point." Attached herewith as Exhibit H, is a true and correct copy of an excerpt from Quora.[7]

ELECTRIC CONNECTOR

38. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "*electric connector"* as used in Claims 16 and 18, to mean:

A conductive contact

39. For example, the '622 patent states:

> The first electric connector with an outskirt screw thread is partially embedded in the inhaler tube, which can be connected to the second electric connector of the electric atomizer to form an electronic cigarette.

Col 5. lines 21-24. .

40. The First electric connector is generally made of copper or another metal conductor. See Col. 5, lines 27-28.

41. A PHOSITA readily understands the term "an electrical connector" to mean "an electromechanical device used to join electrical conductors and create an electrical circuit." Attached herewith as Exhibit I, is a true and correct copy of an excerpt from Wikipedia.[8]

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[7] Publicly available at the web URL: https://www.quora.com/What-is-the-magnitude-of-current

[8] Publicly available at the web URL: https://en.wikipedia.org/wiki/Electrical_connector

SUPPORTING PIECE

42. A plain reading of the '622 patent would enable a PHOSITA to readily understand that the term "*supporting piece"* as used in Claim 18, to mean:

> *A piece made of material able to withstand high temperatures that supports one or more electrical components*

43. For example, the '622 patent states:

> The electronic atomizer may include a liquid-container or a chamber inside the atomizer tube, which preferably also includes a heat equalizer that has an electric heat wire, a **supporting piece** which holds up the heat equalizer, and an electric connector.

Col. 2, lines 39-43 (emphasis added)

44. A PHOSITA readily understands the term "supporting piece" to mean "to bear or hold up." Attached herewith as Exhibit J, a true and correct copy of an excerpt from Dictionary.com.[9]

45. Additionally, a PHOSITA would readily understand the term "supporting piece" in the context of the '622 patent to understand that the supporting piece is heat resistant, and designed to support electrical components of the claimed e-cigarette because the supporting piece has to hold up the heat equalizer.

[9] Publicly available at the web URL: https://www.dictionary.com/browse/support

HEAT EQUALIZER

46. A plain reading of the '622 patent would enable a PHOSITA to readily understand the term "*heat equalizer*" as used in Claim 18, to mean:

> *A thermally conductive material capable of withstanding high temperatures that distributes the heat from a heat source.*

47. For example, when describing the heat equalizer, the '622 patent states: "[a]nother technical advance of the integrated atomizer is the material of the heat equalizer, which plays the key role in ensuring of large vapor volumes and the elimination of the disconnected vaporization problem. This material of the heat equalizer, which may be made of a non-toxic inorganic material, is required to withstand a high temperature up to 2000 degrees centigrade." Col. 3, lines 14-20

48. Further, the '622 patent states: "[t]he electric heating wire twined on the heat equalizer can be made from tungsten or another electric heating material, which produces heat when the electric current flows therethrough." Col 4. lines 55-58.

49. Finally, Claim 4 of the '622 patent goes into more detail when describing the heat equalizer, stating: "wherein the heat equalizer ensures that the heat generated by the electric wire is uniform" see Col 6. lines 55-56.

Executed on November 22, 2021.

DR. GEORGE YANULIS

Exhibit

A

George E. Yanulis
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216 – 571 – 1532
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19103 CRESENZO CT, APT 306, FORT MYERS, FL 33967
WWW.LINKEDIN.COM/IN/YANULIS | WWW.GYMEDICALDEVICECONSULTING.COM

PROFESSIONAL ACTIVITIES

06/2014–Present: *MEDICAL DEVICE CONSULTING LLC-President/Principal Engineer, Ft Myers, FL* - **Clinical Engineering/Medical Device Consultant Expert -** including consulting on heart bypass systems and involved in the research & development of a heart failure therapy monitoring system

01/2015-12/2017: *Temple University* **- *Adjunct Professor, Bioengineering Engineering Department***

03/2014–Present: *B. H. Barkalow & Associates*-***Clinical Engineering Consultant,* Newaygo, MI**

11/2010–Present: *Laughlin Engineering Firm, LLC,* ***Senior Medical Device Consultant***

08/2009-12/2013: *College of Staten Island,* ***Adjunct Faculty***, Engineering and Physics Department

10/2008–3/2009: *Cleve Med (*Cleveland Medical *Devices Inc.)*, ***Consultant*** on a NIH design Grant related to ECG electrode design

08/2005–08/2008: *Cleveland Clinic Foundation*, Doctoral Student in Applied Biomedical Engineering, Pre- and Post-Doctoral Associate and Research Assistant-**Doctorate in Engineering, Cleveland State University/Cleveland Clinic, 8/2008**

08/2000–07/2002: *University of Pittsburgh*, Pittsburgh, PA Graduate Student and Research Assistant/Teaching Assistant - **Master of Science (Bioengineering), University of Pittsburgh, 5/2002**

05/1999–06/2000: *University of Pennsylvania Health System*, Philadelphia, PA
Clinical Engineering Consultant

08/1997-0/8/2000: *Drexel University***, Graduate Student in Biomedical Engineering and Teaching Assistant**

10/1996 – 05/1997 – *James A. Haley Veterans Hospital,* Tampa, Florida *Research Assistant* **-** conducted pulse oximetry research under the direction of John E. Scharf, MD

08/1990-08/1994: *University of Alabama at Birmingham*-**Research Assistant & Graduate Student in Biomedical Engineering**

4/1989-8/1990: *SUNY at Upstate***, Syracuse, NY, Research Assistant**

10/1987-3/1989: *Malcolm F Grow AFB, MD***, USAF Active Reserves**, *1st Lt & Clinical Engineer*, Received Honorable Discharge

5/1986-10/1987: *RCA-Moorestown* **Logistics Engineer, Moorestown, NJ**

5/1985-5/1986: *Philadelphia Naval Shipyard,* **US Naval Logistics Engineer**

08/1983-3/1984: *Matriculated as Osteopathic Medical Student*, Chicago, IL

05/1982-8/1983: *US patent and Trademark Office* - **Assistant Patent Examiner**, US patent and Trademark Office

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EDUCATION

Doctorate in Engineering Biomedical Engineering	**Cleveland State University/Cleveland Clinic** Cleveland, OH	2008
Master of Science Bioengineering	**University of Pittsburgh** Pittsburgh, PA	2002
Master of Engineering Biomedical Engineering	**University of Virginia** Charlottesville, VA	1981
Bachelor of Arts Premedical Studies/Chemistry	**Syracuse University** Syracuse, NY	1977

HEART FAILURE THERAPY/LVAD R&D EXPERTISE

- Involved and continue to be involved in the R&D of ventricular assist devices and bridge to transplantation & destination devices for both adult and pediatric patients (2016 – present)
- Have and continue to be involved as a Medical Device Consultant/ Expert Witness (written over 30 Expert Reports and have deposed on 6 different occasions)
- Extensive expertise in cardiac device implant and ablation device product design and design and execution of animal studies, including over 200 implants and 500 physiological monitoring studies (canine model).
- Have Performed ECG signal detection & cardiac pressure/volume analysis (canine model) -2005 – 2008 – Cleveland Clinic Foundation
- Provided all engineering analysis and fabrication including participating in the implants in the OR (Cleveland Clinic Foundation– 2005-2008)
- Expert witness for a Heart Bypass System (2017- 2018)
- Reviewed Design History Files for Cardiac Perfusion Systems
- Reviewed Quality Assurance Testing and Results for atrial fibribilation (AF) therapy and other heart failure (HF) devices

- I have been Expert Witness on both cardiac pacemaker and implantable cardioverter-**defibrillator (**ICD) devices for Medtronic; St Jude Medical/Abbott; and Boston Scientific (BSCI) and 2 tertiary health systems (over 25 to date)
- Evaluated cardiac pacing and ICD lead/system failures
- Reviewed cardiac pacing and ICD monitoring sessions
- Expertise in the use radio frequency ablation systems for cardiac ablation therapy systems as a Consultant (for a health care system) and has part of my doctoral research at the Cleveland Clinic
- Review of materials related to BSCI cardiac ablation therapy system
- Participated in Ablation Therapy Devices/cardiac pacemaker devices being tested on the canine model as a doctoral student (Cleveland Clinic 2005-2009) --Doctoral Dissertation Link: **Yanulis GE**. A novel cardiac pacing paradigm for atrial fibrillation and heart failure patients [dissertation]. [Cleveland (OH)]: Cleveland State University; 2008 May. 106 p.
- Served as a Device Consultant for a startup venture involved in the R&D of an Ablation Therapy System as far as the (2018)
- Had evaluated clinical users' needs been satisfied in view of specific end user requirements for US and United Kingdom medical device start-up firms, patients, and the clinician.

MEDICAL DEVICE EXPERT WITNESS EXPERIENCES

- Performed several Human Factors Analysis on both cardiovascular and orthopedic devices (2014-Present)
- Expertise in technical file review including the following for atrial ablation therapy system (2015); several cardiac pacemaker device cases; ICDs (2014-2016); heart bypass systems (2017-2018)
- Have been involved in the review of several design history files for cardiac device implants
- Evaluated design verification and validation protocols and reports for over 40 different medical devices (2014-Present)
- Have reviewed over 1000 MAUDE database (refer to separate attachment of selected devices which I have served as an Expert Witness/Medical Device Consultant (2011-Present)

- Have Reviewed several MDR(s), Complaint Investigations, CAPA(s), Non-conformance(S) and Change Control(s) for all types of cardiac device and cardiac imaging systems (2011 – Present)
- Expertise in developing Final Evaluation Report(s) related to their current validation and verification tasks and provided recommendations as part of their submission to the FDA subsequent to an FDA site visit which had been approved by & Development and Quality Review Divisions at BSCI, Therakos, Inc, St. Jude/Abbott, and Medtronic (2012-Present).

Additional Heart failure (HF) therapy device patient expertise

- Co-Investigated the implementation of coupled pacing (CP) (a novel pacing paradigm) for controlling the ventricular rate of mechanical contraction (VRMC) – 2005 -2008 - Study Results demonstrated that acute application of CP resulted in both a negative chronotropic (mechanical not electrical rate) and a positive inotropic response during acutely induced atrial fibrillation (AF)
  https://www.annalsthoracicsurgery.org/article/S0003-4975(08)00735-2/fulltext
- Performed Preclinical Device Trials on cardiac pacing algorithms (Cleveland Clinic, 2005-2008)

ADDITIONAL WORK & RESEARCH & DEVELOPMENT WORK RELATED TO LEFT VENTRICULAR FUNCTION STUDIES

- After inducing AF by rapid pacing in six dogs, we applied the following pacing modalities: rapid right ventricular (RV) pacing, rapid CRT, CRT with an additional RV paced beat (CP) at a specific delay (CRT + CP), and CRT with vagal stimulation (CRT-VS).
- Obtained Left ventricular (LV) pressure recordings and echocardiography for 2D strain analysis were performed. CRT + CP reduced the ventricular response rate and increased the LV systolic pressure and cardiac output compared with CRT alone (Cleveland Clinic, 2005-2008)
  https://academic.oup.com/europace/article/12/3/430/476248
- Mentored and Taught over 200 undergraduate bioengineering students at Temple University (2015-2017) in two cardiac systems/physiology coursework in:
  - Systems Physiology- BIOE 5500
    - Cardiovascular Anatomy & Physiology (materials presented)

        - Cardiovascular Control
        - Flow in cardiovascular system
    - Cardiac Devices- BIOE 4287 (materials presented)
        - The Cardiac Conduction System
        - Cardiac Pacing and Defibrillation
        - Cardiopulmonary Bypass and Cardioplegia
        - Animal Models for Cardiac Research
        - Clinical Trials Formulation
        - End-Stage Congestive Heart Failure: Ventricular Assist Devices
        - CADs elated to the design of cardiac valves
        - FDA cardiac regulated expertise
- Reviewed a Heart Bypass Template Risk Analysis and Risk Management Materials (2017-2018)
- Reviewed System's Perfusion Bypass Records
- Vascular prostheses, artificial hearts/ventricular assist devices, and extracorporeal/ intravenous oxygenators
- Expertise in biocompatibility of cardiac devices and orthopedic devices

MEDICAL DEVICE EXPERT WITNESS EXPERIENCES HARDWARE/SOFTWARE INTERFACE EXPERTISE/EXPERIENCES

- The Philips IntelliVue MX800 Patient Monitor for monitoring, recording, and alarming of multiple physiological parameters of adults, pediatrics, and neonates in hospital environments by trained health care professionals.
- The Philips M3001A MultiMeasurement Module (MMS)
- Echocardiographic acquisitions performed with a Vivid 7 machine (GE Healthcare)
- cSound 2.0 software beamforming technology used in Vivid 7 machine systems
- PDP 11 assembly programming
- Collaborated with Data Science Corporation (DSI) on several projects that included advanced ECG signal detection and pressure-volume loop analysis (Cleveland Clinic 2018-2009)
- Expertise in the R&D of Positron-emission tomography (PET) generators and PET imaging systems, Radio frequency ablation and mapping systems

- Expertise in Image Reconstruction Techniques for Computerized Tomographic (CT) Coronary Artery Calcium Quantification, Reconstruction methods used in helical and multi-slice CT
- Expertise in Fourier Analysis of Discrete-Time Signals – Fast-Fourier Transform and Discrete Filter Design, Sampling and Discrete-Time Signal Analysis, and
- Continuous Time Signal and Non-Continuous Time Signal Analysis

IMAGING SYSTEMS RELATED COUSEWORK TAKEN

- Biomedical Signal Processing
- Computation and Modeling in Biomedical Engineering
- Cardiovascular systems and dynamic modeling
- Computer applications/techniques used in medicine

IMAGING SYSTEMS & CARDIAC DEVICE COUSE WORK TAUGHT (TEMPLE UNIVERSITY – 2015-2017

- Biomedical Signal Processing
- Cardiac Systems Course

MEDICAL DEVICE EXPERT WITNESS EXPERIENCES INTELLECTUAL PROPERTY EXPERTISE

- I have written 3 Invalidly Reports and Two Infringement Analysis Reports for two medical devices
- I have been employed as an Assistant Patent Examiner at the U.S. Patent and Trademark Office. In that capacity, I examined patent applications for potential novel applications in the medical infusion and sharp systems area for such applicants as Baxter Travenol Laboratories, Abbott Labs, and other patent applicants (1982-1983). I was enrolled in the USPTO's Patent Examiner's Training Program and received the USPTO's Superior Achievement Award (May, 1983).

DEPOSITIONS GIVEN BY DR. GEORGE YANULIS AS OF 4/27/2020

Case Name	Court	Date Filed	Party Affiliation
Hitachi Medical Systems v. South West Mississippi Anesthesia,	United States District Court Middle District of Louisiana Civil	July 31, 2013	South West Mississippi Anesthesia, P.A.

P.A.	Action No. 12-273BAJ-SCR July		
Robert Bowie and Susan Bowie v. Arthrex, Inc. and Surgical Systems, Inc.	Superior Court of Maine Androscoggin County Civil Action No. CV2014-74	April 25, 2014	Robert Bowie and Susan Bowie
Thomas R. Ruxlow v. DuPuy Orthopedics, Inc. and Johnson & Johnson	United States District Court Southern District of Iowa Central Division Civil Action 4:13-CV-428	October 8, 2013	Thomas Ruxlow
George Koulas v. DuPuy Orthopedics, Inc	United States District Court District of Hawaii Civil No. 13-00713 BMK	Dec 27, 2013	George Koulas
Theotis Latimore v. Botsford Hospital, John Parmely, D.O., John Parmely, D.O., P.C., Specialist in General Surgery, Harun Zekirovski, D.O, Covidien LP and/or Covidien PLC, formerly known as Covidien LTD, and Medtronic, Inc., successor corp.	STATE OF MICHIGAN IN THE CIRCUIT COURT FOR THE COUNTY OF OAKLAND Case No. 14-138209-NH	October 30, 2014	Theotis Latimore
Jake Lovato, Individually Lovato and as Personal Representative of the Wrongful Death Estate of Altagracia Gloria Lovato (Plaintiffs), vs. Board of Regents of the University of New Mexico Board of regents of The University of New Mexico, Defendants.	First Judicial District Court County of Santa Fe State of New Mexico No. D-101-CV-201301167	April 24, 2013	Board of Regents of the University of New Mexico

PUBLICATIONS (PEER REVIEW PUBLICATIONS)

Lim P, **Yanulis GE**, Verhaert D, Greenberg NL, Grimm RA, Tchou PJ, Lellouche N, Wallick DW. Coupled pacing improves left ventricular function during simulated atrial fibrillation without mechanical dyssynchrony. *Europace*. 2010 Mar;12(3):430-6. doi: 10.1093/europace/eup440

Yanulis GE, Lim P, Ahmad A, Popović ZB, Wallick DW. Coupled pacing reverses the effects of persistent atrial fibrillation on the left ventricle. *Ann Thorac Surg*. 2008 Sep;86(3):984-7. doi: 10.1016/j.athoracsur.2008.03.085

Yanulis GE. A novel cardiac pacing paradigm for atrial fibrillation and heart failure patients [dissertation]. [Cleveland (OH)]: Cleveland State University; 2008 May. 106 p.

Cingoz F, **Yanulis GE**, Ching E, Fukamachi K, Wallick DW. Use of conventional dual chamber pacemakers with custom lead adapters to induce atrial fibrillation or heart failure in dogs. *Ann Thorac Surg*. 2007 May;83(5):1858-62.

ABSTRACTS

- Two abstracts presented on heart failure research at American College of Cardiology meeting
  - March 2008

PRESENTATIONS

- Rutgers Medical School, Cardiology Department
  - March 2013
- Rutgers College of Engineering, Biomedical Engineering
  - 2012
- Cleveland State University
  - April 2008

HONORS / AWARDS

- Cleveland Clinic Research Innovation Award
  - September 2008
- Cleveland Clinic Research Innovation Award
  - October 2007
- Honorable Discharge, USAF Medical Service Corp, 1st
  - March 1989
- Superior Achievement Award, United States Patent Office
  - 1983
- Member of Tau Beta Pi Engineering Honorary

PROFESSIONAL AFFILIATIONS / SOCIETIES

- Association for the Advancement of Medical Instrumentation
- Heart Rhythm Society
- IEEE Engineering in Medicine & Biology

EXHIBIT B

URL	http://www.kynixsemiconductor.com/News/31.html
Date captured	November 22th 2021, 2:55:37PM
Last updated	November 22th 2021, 2:55:37PM
Hash	ecbf6b2b89fd41000c30afc1ca8d4896a6581cc0d3975210d644f67f90aae9ba

Analyzing the Application of Microcontroller in Electronic Technology

Abstract

Single-chip Microcomputer,also called microcontroller, is not a chip to complete a logical function, but a computer system integrated into a chip. It is equivalent to a micro computer. Compared with the computer, t microcontroller only lacks the I/O device. In a word, a chip becomes a computer. It is small in size, light in quality and cheap in price, and provides convenient conditions for learning, application and development. At the same time, learning how to use microcontroller is the best choice to understand the principle and structu of the computer.

The use of microcontroller has been widely used, such as intelligent instrument, real-time industrial control, communication equipment, navigation system, household appliances and so on. Once all kinds of products a used on single chip, they can play a role in upgrading products. They often use an adjective before the produ name, such as intelligent type, such as intelligent washing machine, etc.

Catalog

I Introduction

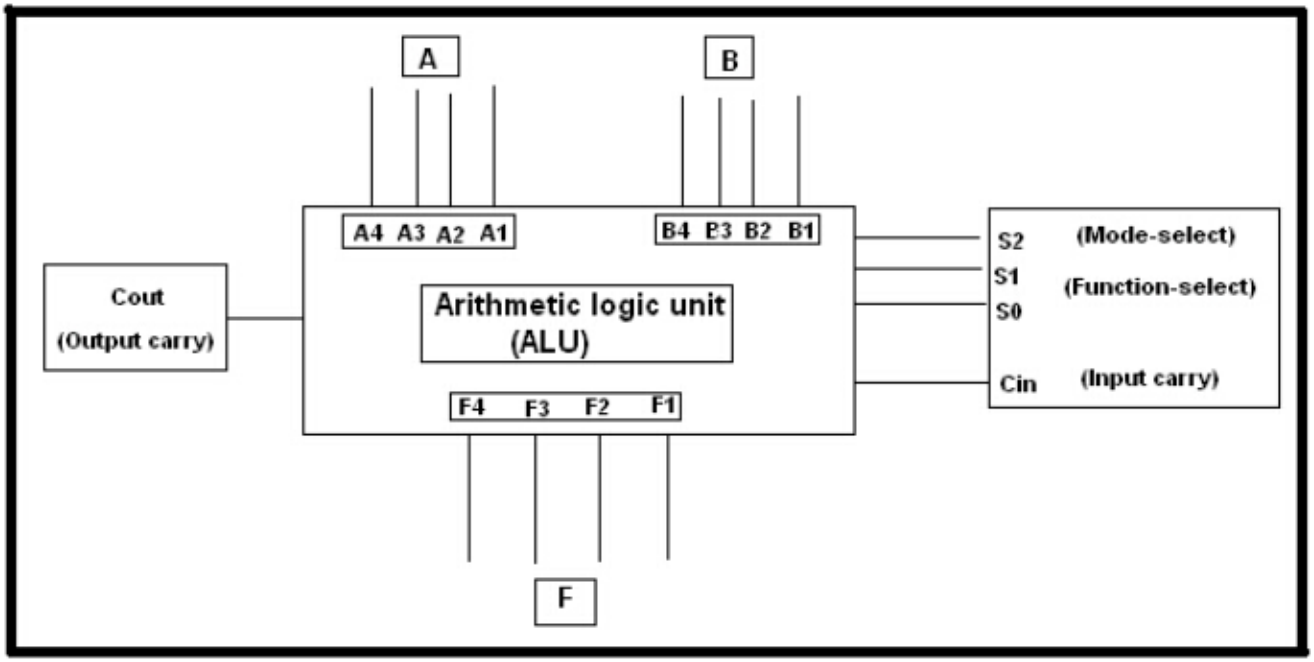
MCU (**microcontrollers**) is an integrated circuit chip is the use of large scale integrated circuit technology to data processing capability of CPU, RAM, ROM, a variety of I/O port and interrupt system, timer/counter function (may also include a display drive circuit, pulse width modulation circuitanalog multiplexer the A/D converter circuit) integrated into a small and complete micro computer system composed of a piece of silicon widely used in the field of industrial control. From the 80s of last century, the 4-bit and 8-bit singlechip developed to the present high speed MCU of 300M.

What is a Microcontroller?

II The Characteristics of Microcontroller and Its Basic Composition

Compared with other embedded system, microcontroller has a small size while the high degree of integratio with high reliability and control function; low power consumption and low voltage, so it is for the manufacturing and production of portable products; have good scalability and excellent performance, its wid range of applications, including office automation equipment real time process control, all kinds of instrume and medical related equipment, automobile electronic products and computer network communication technology and so on, thus, SCM is a very strong practical embedded system. The basic composition compris the following parts:

1. Calculator, the ALU is the core component, the main function is to complete the binary arithmetic and logi operations, auxiliary equipment operators including TMP, B, accumulator register register ACC, Boolean processor and program state register mark PSW and so on;



Block Diagram of a 4-bit ALU

2. The neural CPU controller the timing control logic circuit, instruction register and decoder module;

3. Memory, each memory cell in the memory is corresponding to an address, the use of 2 hexadecimal numb 16;

4. Input devices and output devices.

III Working principle of Microcontroller

It can be said that MCU in electronic technology application is more and more popular, thanks to its excellen storage function, and RAM microcontroller must occur smoothly through the A contact memory accumulato If you want to transfer all data to the external RAM A only through the accumulator, also in the data reading process should be through A in order to achieve read accumulator. There is an obvious difference between th working mechanism and the internal RAM, that is, the internal RAM can transmit and read the data directly, b the external RAM can not. A microcontroller is a highly integrated circuit chip. The process of executing the program is the process of executing instructions one by one. The so-called instruction refers to the related operations that need to be executed by microcomputer, which is written in the form of command. Usually a basic operation corresponds to one instruction, which is determined by the instruction system of the MCU by the designer. As the microcontroller follows a particular sequence in the process of execution, so the progran instructions are stored in one by one according to the order of the same, SCM in the execution of the progra only when these instructions can be executed and then taken out one by one, but requires a program path.

PC to the instruction address tracing during program execution give the corresponding instruction execution program address to PC, then gets the PC command will automatically increase the corresponding content, usually decided by the amount of instruction length.

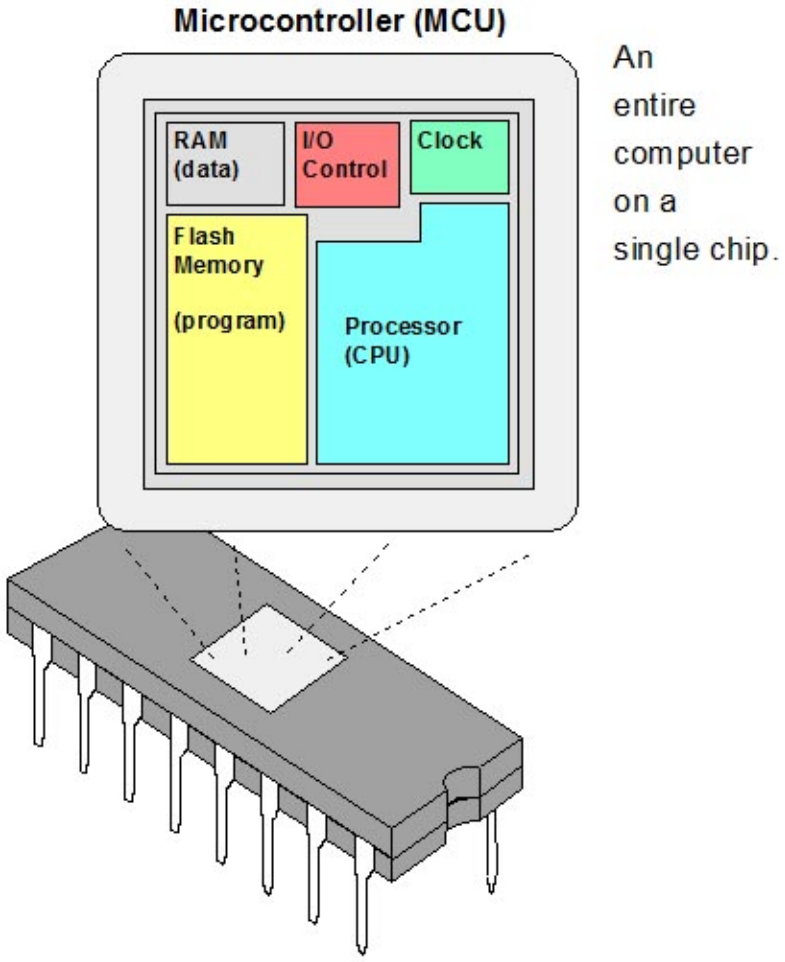
How Microcontrollers Work?

IV Application of Microcontroller in Electronic Technology

The microcontroller penetrates into every field of our life, and it is almost impossible to find a trace of a microcontroller in which field. Missile navigation equipment, aircraft instrumentation control, computer network communications and data transmission, real-time control and data processing of industrial automati process, extensive use of various smart IC card, civilian-luxury-car security system, video recorder, camera control, automatic washing machine, and program-controlled toys electronic pets etc. all these cannot do without scm. Not to mention robots in the field of automatic control, intelligent instruments, medical devices and all kinds of intelligent machinery. Therefore, the study, development and application of microcontroller v bring up a batch of computer applications and intelligent control scientists and engineers.Micro-controller is widely used in the fields of instrumentation, household appliances, medical equipment, intelligent manageme and process control of aerospace and special equipment, etc..

1. Application in the Field of Household Appliances

Now in the replacement of household appliances, marketing and other aspects, more and more extensive application of single-chip, such as electronic toys or advanced video games, will use microcontroller to realize its control function; and the washing machine can use the microcontroller identification the type of clothes a dirty degree, so as to automatically choose the washing strength and washing time; SCM(Single Chip Micyoc can control type and degree of recognition in the preservation of food in the refrigerator, realize the automa selection of refrigeration temperature and storage time; the microwave oven can also automatically determin the heating temperature and heating time through the single recognition of food species and so on, these appliances in the application of SCM technology, both the performance and the function, has made great progress with the traditional technology.



SCM(Single Chip Micyoco)

2. Application in the Field of Medical Equipment

Modern medical conditions are more and more developed. People pay more and more attention to the technology of medical sterilization. However, some small hospitals and small clinics in remote areas are still very simple, so they cannot effectively control the quality of disinfection. With the development of single-chi technology, its small volume, powerful function, flexible expansibility, convenient application has become increasingly prominent, therefore, in the medical ventilator analyzer and monitor, ultrasonic diagnostic equipment and hospital beds call system has been widely used in equipment.

3. Application in the Field of Industrial Control

In fact, the first single is from industry began to rise, since its application in industrial control field is still very wide, a variety of data acquisition system and intelligent control system using microcontroller technology, su as intelligent management, factory assembly line of intelligent elevator, alarm system and so on, are based o technology and computer chip network constitutes a two level control system.

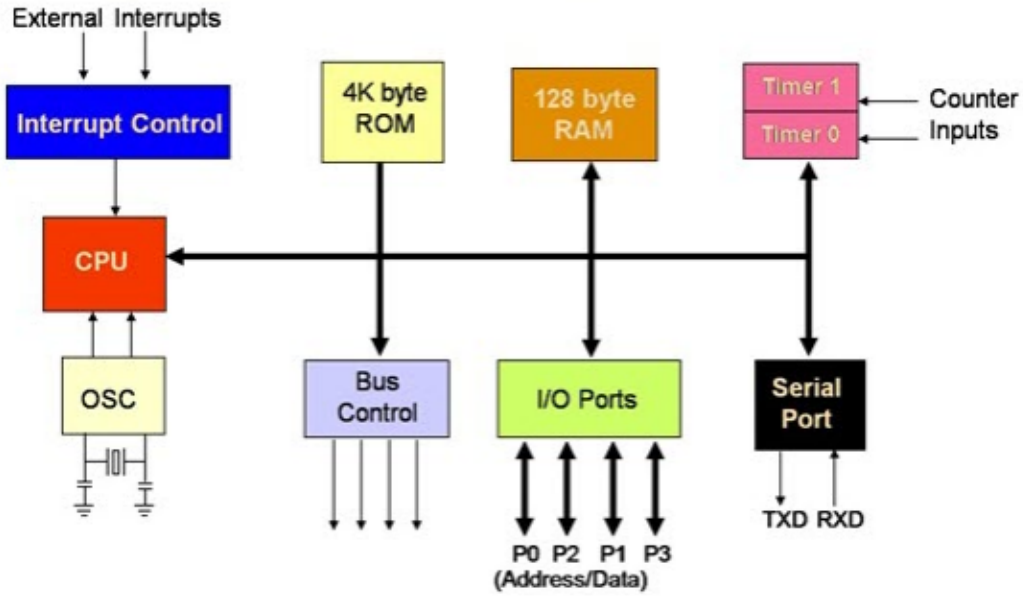
4. Application in the Field of Instrument

As mentioned above, SCM has the characteristics of high integration, small volume, strong control function a flexibility of expansion, and has fast processing speed and high reliability, so it is widely applied in the field o intelligent instrumentation. To some extent, driven by a microcomputer control instrument technology revolution, the traditional measurement, through the MCU technology to realize the integration of digital anc intelligent instrument technology and multi function, compared with the traditional electronic circuits or digi circuit, the more powerful and comprehensive more prominent.

V 8051 Microcontroller Basics

1. What is 8051 Microcontroller?

8051 is an 8-bit family of microcontroller developed by Intel in the year 1981. This is one of the most popular family of microcontroller being used all across the world. This microcontroller was also referred as "system a chip" because it has 128 bytes of RAM, 4Kbytes of ROM, 2 Timers, 1 Serial port, and four ports on a single chip. The CPU can work for only 8bits of data at a time because 8051 is an 8-bit processor. In case the data is larger than 8 bits then it has to be broken into parts so that the CPU can process conveniently. Most manufacturers have put 4Kbytes of ROM even though the quantity of ROM can be exceeded up to 64 K byte



Internal Architecture of 8051 Microcontroller

2. Function of Microcontroller 8051

(1) 8 bit data bus, 16 bit address bus CPU;

(2) Has Boolean processing ability and bit processing ability;

(3) The Harvard structure, the program memory and the data memory address space are independent, and th program is easy to be designed.

(4) The 64KB program memory of the same address and the 64KB data memory;

(5) 0-8KB program memory (8031 no, 8051 with 4KB, 8052 with 8KB, 89C55 with 20KB); Data memory in

(6) 128 bytes (8051 with 256 bytes);

(7) 32 bi-directional I/O lines that can be addressed by bit.

(8) Two 16 bit timing / counter (8052 with 3);

(9) A full duplex serial I/O interface;

(10) The interruption structure of more than 10. interrupt sources has two interrupt priorities.

(11) Internal clock oscillator

3. 8051 Microcontroller Features

(1) The microprocessor (CPU) is the core.

(2) The CPU is connected to the other components through the three bus.

(3) Bus: an information transmission line that serves multiple components

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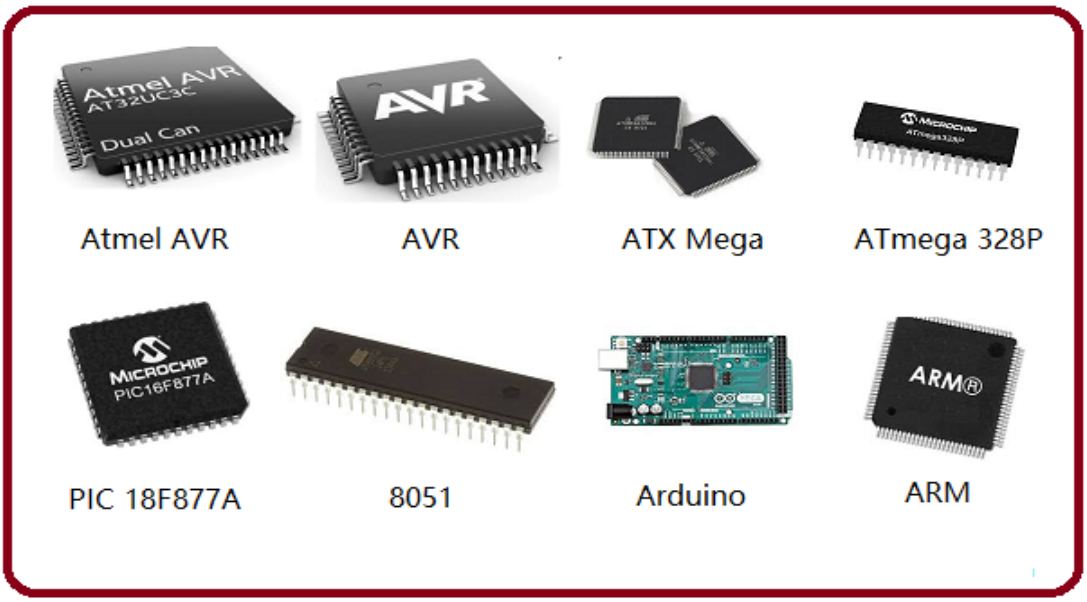
VI Types of Microcontroller and its Programming Languages

1. The Selection of the Model

At present, there are many kinds of singlechip, such as 8051, PIC, MS430, AVR and so on. Although the microcontroller model is different, the internal resources of the chip are all similar, and the use of these resources is very similar. It can be said to learn one kind, other kinds are all together. The 8051 series is the o model. Although the MCU is not the most powerful, it is the most widely used teaching resource, and the software support and hardware development are very mature. For beginners, we choose the AT89S52 model that has the online programming function of ISP.



Common Types of Microcontrollers

2. The Choice of Programming Language

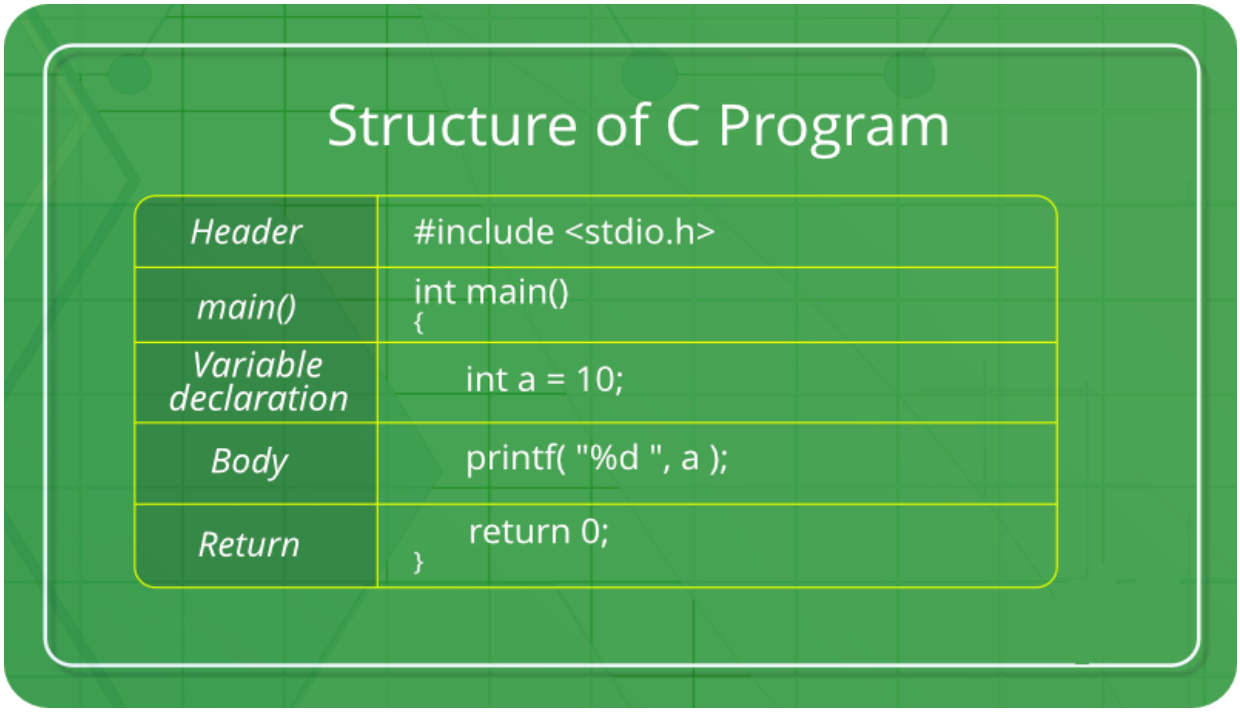
As compared to MCU C language and assembly language, has the instruction system of the microcontroller does not require any knowledge, can be used directly in C programming language with operation MCU; modular programming technology is convenient, which has been programmed is very easy to transplant; MC C language commonly used grammar less useful for writing small fast programs etc., we choose C language a a programming language.

VII Design and Development of Microcontroller in Experimental Plate

Singlechip is a very practical, very hands-on course. MCU learning method is the most effective both in theor and practice study, side drill, step by step, which can be used to understand and grasp the instruction. Therefore, before the design of the teaching project, we must first design and develop the experimental boar for learning, so that every teaching project can be completed on the experimental board. The experimental board can be bought off the shelf, and it can also be designed according to the actual needs of the teaching. the process of compiling, we designed and developed 5 modules for experiment based on teaching needs. They are single-chip module, instruction module, LED display module, seven segment digital tube module an LCD display module.

The project of "design of delay light" is described as follows: using a P1.0 foot of a microcontroller to control light-emitting diode, and lighting up and flickering according to the 1s interval, namely the design of the del lamp. At the same time, the learning objectives are as follows:

(1) understanding the basic structure of the C language program.



The structure of a C Program

(2) learn the while () statement, the for statement and the use of no parameter functions.

(3) learn to enter the simulation and debug state of Kiel software, and use the parameters of the "sec" colum in the register window to calculate the related time of the program execution.

This allows students to clarify the tasks and relevant knowledge that the teaching project requires from the beginning, that is, learning objectives are specific and clear.

VIII Book Recommendation

1. Microcontrollers and Microcomputers Principles of Software and Hardware Engineering

Microcontrollers and Microcomputers: Principles of Software and Hardware Engineering, Second Edition, is a ideal introductory text for an embedded system or microcontroller course. While most texts discuss only one specific microcontroller, this book offers a unique approach by covering the common ground among all microcontrollers in one volume. Since the text does not focus on a particular processor, it can be used with processor-specific material--such as manufacturer's data sheets and reference manuals--or with texts, includi author Fredrick M. Cady's Software and Hardware Engineering: Motorola M68HC11 or Software and Hardwar Engineering: Motorola M68HC12. Now fully updated, the second edition covers the fundamental operation o standard microcontroller features, including parallel and serial I/O interfaces, interrupts, analog-to-digital conversion, and timers, focusing on the electrical interfaces as needed. It devotes one chapter to showing ho a variety of devices can be used, and emphasizes C program software development, design, and debugging.

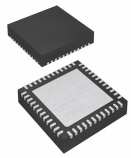
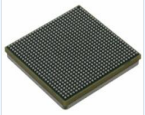
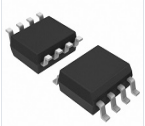
--Frederick M Cady (Auth

2. Microcontroller-Based Projects, 2nd Edition

This Book is collection of 51 microcontrollers-based projects, which appeared in Electronics For You from 200 to 2013. It is a compilation of 51 construction projects tested at EFY Labs. This is the second edition of the Microcontroller Based Project book. Therefore, it has all the materials covered in the first edition, and also includes 25 new projects with some new microcontrollers not covered in the first edition. This book, a collect of 51 microcontroller-based projects, which appeared in Electronics For You during 2001-2012 is brought out for the benefit of our new readers.The book has been divided into five sections same as in the first edition viz Security Systems, Domestic Applications, Industrial Applications, Measurement, Display Systems and Robotic However, many new projects have been introduced in second edition.

--EFY Enterprises Pvt Ltd (Auth

Ordering & Quality

Photo	Mfr. Part #	Company	Description	Package	PDF	Qty
	SS15P3S-M3/86A	Vishay	DIODE SCHOTTKY 30V 15A TO277A	TO-277, 3-PowerDFN	SS15P3S-M3/86A Datasheet	87640 Inquir
	LFE2-6SE-5FN256C	Lattice Semiconductor	IC FPGA 190 I/O 256BGA	256-BGA	LFE2-6SE-5FN256C Datasheet	270 Inquir
	MC9S08LL8CGT	NXP	IC MCU 8BIT 10KB FLASH 48QFN	48-VFQFN Exposed Pad	MC9S08LL8CGT Datasheet	3739 Inquir
	MPC8544CVTALFA	NXP / Freescale	IC MPU MPC85XX 667MHZ 783FCBGA	BGA	MPC8544CVTALFA Datasheet	69 Inquir
	MAX4507EAP	Maxim Integrated	IC SIGNAL LINE PROTECTOR 20-SSOP	20-SSOP (0.209", 5.30mm Width)	MAX4507EAP Datasheet	2254 Inquir
	K9F4G08UOA-P1BO	SAMSUNG	4G-bit NAND Flash Memory with spare 128M-bit		K9F4G08UOA-P1BO Datasheet	5960 Inquir

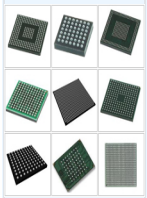
						
	PWR263S-20-3300F	Bourns	RES SMD 330 OHM 1% 20W D2PAK	TO-263-3, D²Pak (2 Leads + Tab), TO-263AB	PWR263S-20-3300F Datasheet	108 Inquir
	CY7C131E-55NXI	Cypress Semiconductor	SRAM 8Kb (1Kb x 8) 55ns Dual-Port SRAM		CY7C131E-55NXI Datasheet	96 Inquir
	MR301-24	NEC		DIP	MR301-24 Datasheet	121 Inquir
	STPS340U	STMicroelectronics	DIODE SCHOTTKY 40V 3A SMB	SMB	STPS340U Datasheet	55388 Inquir

EXHIBIT C

STERLING

UNDERSTANDING MICS

Microphones can generally be classified according to their transducer type, diaphragm size, polar patterns and preamp circuitry.

Transducer Types

A transducer is a device that converts energy from one type to another. In microphones, this transducer is known as a “capsule” and is responsible for turning sound waves into an electrical signal.

Microphones can employ a number of different types of capsules. The most commonly used capsules for recording applications are dynamic, condenser and ribbon.

Dynamic microphones are typically robust, inexpensive and less sensitive to ambient sound, making them ideal for use in settings where they may be subject to intense handling and/or damage or where rejection of nearby sound sources is important.

Condenser microphones are the most commonly used type for recording applications due to their sensitivity to sound. This sensitivity is created by charging the condenser element with an electrical current either via a battery or phantom power. 48 volts of phantom power is typically available on a mixer’s microphone preamps as well as most standalone microphone preamps.

Ribbon microphones are the most fragile of the three capsule types mentioned here due to the suspension of a very thin ribbon element within the capsule. The delicacy of this design makes ribbon microphones exceptionally well suited for picking up the nuances of intricate sound sources. Recent technological advancements have helped to improve the sturdiness of the ribbon design significantly and it is now much lauded by contemporary engineers for recording guitar amplifiers and other high sound pressure level (SPL) sources.

Polar Patterns

A polar or “pickup” pattern is the shape of the area that a given microphone is able to “pick up” sound. A microphone capsule’s polar response area is different across all frequencies.

Most microphones are single pattern, in that they will pick up sound from one area. Some microphones are multi-pattern, in that the user can select the polar pattern that is most useful for a particular application. The most common polar patterns are cardioids, supercardioid, hypercardioid, omnidirectional and bi-directional or “Figure 8”.

The cardioid polar pattern is the most common because it is effective at capturing sound only in front of the diaphragm, reducing unwanted external reflections, leakage or “bleeding” from other sound sources such as other vocalists, instruments or equipment. In general, directional polar patters are used to reject unwanted ambient sound, and less directional patters are used to capture more ambient sound.

Professional recording studios often employ isolation booths to eliminate this problem, but awareness of your surroundings and patience, forethought and experimentation in microphone positioning can still yield excellent results.

To determine which microphone/polar pattern to use, it is important to have an understanding of your recording environment and its inherent and adaptable acoustic properties.

Diaphragm Size

The diaphragm is the component of the microphone capsule that vibrates in response to sound waves. Diaphragm material, design, thickness and diameter—or size—all help to determine a microphone's frequency, transient and polar responsiveness.

Diaphragms can be categorized into three sizes—large, medium and small. Larger diaphragm microphones are typically more sensitive due to their increased surface area, but also have a more limited frequency response since sound waves have to move more mass.

Small diaphragm microphones are capable of handling higher sound pressure levels due to their stiffer diaphragms. They also have an increased frequency response, particularly in the higher end of the frequency spectrum. Their decreased sensitivity relative to large diaphragm microphones makes them less susceptible to proximity effect and ambient noise due to their directional characteristics.

Preamp Circuitry

Sound that has been converted into an electric signal by the microphone capsule is of a very low level and requires pre-amplification before it is again amplified by a microphone preamp. The design of this preamp circuitry is one of the defining characteristics of any microphone.

There are two basic types of microphone preamps, field effect transistors (FETs) and vacuum tubes. As solid state devices, FET circuits are typically rugged,

efficient and low noise, resulting in clean, responsive and predictable performance. These qualities make FET microphones versatile for a variety of recording applications.

Vacuum tubes, while less efficient, are popular for their ability to produce harmonic content as a result of saturation of the tube circuit, which results in a “warm” sound characterized by fullness and depth. This attribute makes them a favorite for recording vocals. Tubes perform at their best after they have been in use for an hour or more and the tube has had sufficient time to warm up.

All microphones should be handled with care, but tube microphones are particularly fragile and extra care should be exercised in setup, use and storage. Tubes also wear out with time and need to be replaced. Fortunately, this can generally be done by the user.

Room Acoustics

The orientation of the microphone relevant to the acoustic space is an important variable in microphone positioning. “Room sound” can add a unique and desirable character to recorded tracks, particularly when acoustic elements such as absorption, diffusion and reflection are accounted for in the architectural design. This is the case in many recording studios, houses of worship, concert halls and performing arts centers.

However, not all engineers have the luxury of such recording environments and must adjust their microphone positioning techniques accordingly. It is nevertheless possible to minimize the effect of less optimal environments through a variety of methods. One particular variable to consider is unwanted reflections. Here are some suggestions to minimize its effect:

- Move the sound source (e.g. a vocalist) back from hard surfaces in order to allow strong sonic reflections to fall off in intensity before reaching the microphone
- Use acoustic baffles to help isolate the vocalist
- Use a mic-stand mountable reflection filter
- Install acoustic treatment materials
- Reduce the distance between the sound source and the microphone

This last suggestion above—reducing the distance between the vocalist and the microphone—can help to increase the ratio of direct sound to indirect sound, i.e. sound that has reflected off of another surface before arriving at the microphone, as well as increasing the signal to noise ratio—minimizing the amount of unwanted sound by maximizing the volume of the sound you want to record.

Acoustics is a complex science worthy of a series of articles. The important thing to recognize is that sound travels in all directions and is absorbed, diffused and reflected by every surface to varying degrees. Simple awareness of this phenomenon will help you manage the impact of your environment on your recordings.

Bob Rock, musician, engineer and producer for such legends as Metallica, Motley Crue, David Lee Roth, Bon Jovi, Michael Buble, Bush, The Cult, The Offspring, and 311. Music Hall of Fame inductees and Juno winner.

For many engineers and recording artists, using microphones is the most interesting and rewarding part of the recording process. Microphones can be seen as instruments in themselves due to their widely varied designs, applications and their undeniable influence on the final sound of any recording. Knowing a little about why microphones are designed the way they are and how they have been used to capture some of your favorite music will give you valuable insight into using them most effectively. Microphones are also electronics. As transducers, they convert acoustic energy into electrical energy and are therefore subject to the same electrical properties that govern other electronics. A basic understanding of electricity can go a long way in helping you

to get the most from your microphones and overcome the challenges that can be associated with acoustics and the transfer and processing of electrical energy.

Using microphones requires a unique blend of art and science to achieve the best results. Fortunately, generations of audio engineers have created a bank of useful knowledge upon which to draw. This information is a great place to start as you learn to develop your own style and technique for using microphones. Just remember that the some of the most influential techniques in use today were a result of continuous experimentation. Don't be afraid to try something new. Like the engineers that came before you, you may discover a technique that influences the art and science of recording for generations to come!

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EXHIBIT D

URL	https://en.wikipedia.org/wiki/Construction_of_electronic_cigarettes
Date captured	November 22th 2021, 2:47:41PM
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Construction of electronic cigarettes

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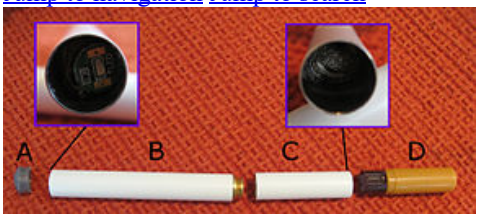
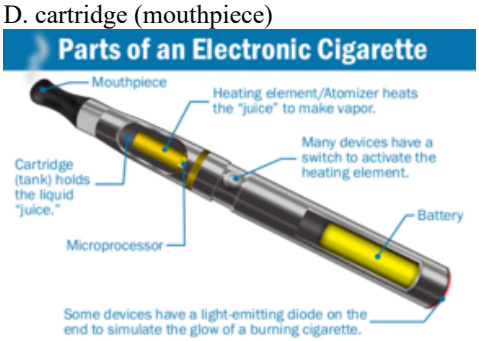


Disassembled parts of a first-generation e-cigarette.
A. LED light cover
B. battery (also houses circuitry)
C. atomizer (heating element)
D. cartridge (mouthpiece)



Parts of a second-generation e-cigarette.

An electronic cigarette is a handheld battery-powered vaporizer that simulates smoking, but without tobacco combustion.[1] E-cigarette components include a mouthpiece (drip tip[2]), a cartridge (liquid storage area), a heating element/atomizer, a microprocessor, a battery, and some of them have an LED light on the end.[3] An exception to this are mechanical e-cigarettes (mods) which contain no electronics and the circuit is closed by using a mechanical action switch.[4] An atomizer consists of a small heating element, or coil, that vaporizes e-liquid and a wicking material that draws liquid onto the coil.[5] When the user inhales a flow sensor activates the heating element that atomizes the liquid solution;[6] most devices are manually activated by a push-button.[7] The e-liquid reaches a temperature of roughly 100–250 °C (212–482 °F) within a chamber to create an aerosolized vapor.[8] The user inhales an aerosol, which is commonly but inaccurately called vapor, rather than cigarette smoke.[9] Vaping is different from smoking, but there are some similarities, including the hand-to-mouth action of smoking and a vapor that looks like cigarette smoke.[1] The aerosol provides a flavor and feel similar to tobacco smoking.[1] A traditional cigarette is smooth and light but an e-cigarette is rigid, cold and slightly heavier.[1] There is a learning curve to use e-cigarettes properly.[10] E-cigarettes are cigarette-shaped,[11] and there are many other variations.[12] E-cigarettes that resemble pens or USB memory sticks are also sold that may be used unobtrusively.[13]

There are three main types of e-cigarettes: cigalikes, looking like cigarettes; eGos, bigger than cigalikes with refillable liquid tanks; and mods, assembled from basic parts or by altering existing products.[14] Cigalikes are either disposable or come with rechargeable batteries and replaceable nicotine cartridges.[15] A cigalike e-cigarette contains a cartomizer, which is connected to a battery.[16] A "cartomizer" (a portmanteau of cartridge and atomizer[17]) or "carto" consists of an atomizer surrounded by a liquid-soaked poly-foam that acts as an e-liquid holder.[5] Clearomizers or "clearos", not unlike cartotanks, use a clear tank in which an atomizer is inserted.[18] A rebuildable atomizer or an RBA is an atomizer that allows users to assemble or "build" the wick and coil themselves instead of replacing them with off-the-shelf atomizer "heads".[19] The power source is the biggest component of an e-cigarette,[20] which is frequently a rechargeable lithium-ion battery.[12]

As the e-cigarette industry continues to evolve, new products are quickly developed and brought to market.[21] First-generation e-cigarettes tend to look like traditional cigarettes and so are called "cigalikes".[19] Most cigalikes look like cigarettes but there is some variation in size.[16] Second-generation devices are larger overall and look less like traditional cigarettes.[22] Third-generation devices include mechanical mods and variable voltage devices.[19] The fourth-generation includes sub ohm tanks and temperature control devices.[23] The voltage for first-generation e-cigarettes is about 3.7[24] and second-generation e-cigarettes can be adjusted from 3 V to 6 V,[25] while more recent devices can go up to 8 V.[24] The latest generation of e-cigarettes are pod mods,[26] which provide higher levels of nicotine than regular e-cigarettes[27] through the production of aerosolized protonated nicotine.[28]

E-liquid is the mixture used in vapor products such as e-cigarettes[29] and usually contain propylene glycol, glycerin, nicotine, flavorings, additives, and differing amounts of contaminants.[30] E-liquid formulations greatly vary due to fast growth and changes in manufacturing designs of e-cigarettes.[16] The composition of the e-liquid for additives such as nicotine and flavors vary across and within brands.[31] The liquid typically consists of a combined total of 95% propylene glycol and glycerin, and the remaining 5% being flavorings, nicotine, and other additives.[32] There are e-liquids sold without propylene glycol,[33] nicotine,[34] or flavors.[35] The flavorings may be natural, artificial,[31] or organic.[36] Over 80 chemicals such as formaldehyde and metallic nanoparticles have been found in the e-liquid.[37] There are many e-liquids manufacturers in the US and worldwide,[38] and more than 15,500 flavors existed in 2018.[39] Under the US Food and Drug Administration (FDA) rules, e-liquid manufacturers are required to comply with a number of manufacturing standards.[40] The revision to the EU Tobacco Products Directive has some standards for e-liquids.[41] Industry standards have been created and published by the American E-liquid Manufacturing Standards Association (AEMSA).[42]

Contents

Use[edit]

Function[edit]

A later-generation box mod e-cigarette.

An e-cigarette is a handheld battery-powered vaporizer that simulates smoking, but without tobacco combustion.[1] Once the user inhales, the airflow activates the flow sensor, and then the heating element atomizes the liquid solution.[6] The different kinds of trigger sensor or sensors used are acoustic, pressure, touch, capacitive, optical, Hall Effect or electromagnetic field.[43] Most devices have a manual push-button switch to turn them on or off.[7] E-cigarettes do not turn on by trying to "light" the device with a flame.[1] The e-

liquid reaches a temperature of roughly 100-250 °C within a chamber to create an aerosolized vapor.[8] However, variable voltage devices can raise the temperature.[31] A glycerin-only liquid vaporizes at a higher temperature than a propylene glycol-glycerin liquid.[31] Rather than cigarette smoke, the user inhales an aerosol, commonly but inaccurately called vapor.[9] E-cigarettes do not create vapor between puffs.[44]

Perception[edit]

Vaping is different from tobacco smoking, but there are some similarities with their behavioral habits, including the hand-to-mouth action and a vapor that looks like cigarette smoke.[1] E-cigarettes provide a flavor and feel similar to smoking.[1] A noticeable difference between the traditional cigarette and the e-cigarette is sense of touch.[1] A traditional cigarette is smooth and light but an e-cigarette is rigid, cold and slightly heavier.[1] Since e-cigarettes are more complex than traditional cigarettes, a learning curve is needed to use them correctly.[10]

Compared to traditional cigarettes, the general e-cigarette puff time is much longer, and requires a more forceful suction than a regular cigarette.[45] The volume of vapor created by e-cigarette devices in 2012 declined with vaping.[1] Thus, to create the same volume of vapor increasing puff force is needed.[1] Later-generation e-cigarettes with concentrated nicotine liquids may deliver nicotine at levels similar to traditional cigarettes.[46] Many e-cigarette versions include a power[*disambiguation needed*] control to adjust the volume of vapor created.[12] The amount of vapor produced is controlled by the power from the battery, which has led some users to adjust their devices to increase battery power.[8] Larger percentages of glycerin in e-liquid also increase vapor production.[47]

Construction[edit]

An ordinary cigarette compared to a "cigalike" e-cigarette.

E-cigarettes come in many variations,[12] such as cigarette-shaped, pen-shaped, and tank-shaped styles.[11] Some e-cigarettes look like traditional cigarettes, but others do not.[10] There are three main types of e-cigarettes: cigalikes, looking like cigarettes; eGos, bigger than cigalikes with refillable liquid tanks; and mods, assembled from basic parts or by altering existing products.[14]

E-cigarette components include a mouthpiece, a cartridge (liquid storage area), a heating element/atomizer, a microprocessor, a battery, and some have a LED light on the end.[3] An exception to this are mechanical e-cigarettes (mods) which contain no electronics and the circuit is closed by using a mechanical action switch.[4] E-cigarettes are sold in disposable or reusable variants.[14] Most versions are reusable, though some are disposable.[48] They range in cost from under $10 to over $200.[49] An entry-level reusable e-cigarette costs around $25.[50] Disposable e-cigarettes are discarded once the liquid in the cartridge is used up, while rechargeable e-cigarettes may be used indefinitely.[51] Even with rechargeable cigarettes (pod-based systems) however, there is a risk of littering.[52][53] However, there are some thoughts on how to prevent pods from ending up in the environment (i.e. a deposit-system for e-cigarette pods) and we should remember that cigarette butts currently also pollute the environment.[54] One piece devices are normally disposable.[55] E-cigarettes are typically designed as one, two, three or multiple pieces.[55] A disposable e-cigarette lasts to around 400 puffs.[56] Reusable e-cigarettes are refilled by hand or exchanged for pre-filled cartridges, and general cleaning is required.[12] A wide range of disposable and reusable e-cigarettes exist.[43] Disposable e-cigarettes are offered for a few dollars, and higher-priced reusable e-cigarettes involve an up-front investment for a starter kit.[10] Some e-cigarettes have a LED at the tip to resemble the glow of burning tobacco.[46] The LED may also indicate the battery status.[1] The LED is not generally used in personal vaporizers or mods.[3]

First-generation e-cigarettes usually simulated smoking implements, such as cigarettes or cigars, in their use and appearance.[19] Later-generation e-cigarettes often called mods, PVs (personal vaporizer) or APVs (advanced personal vaporizer) have an increased nicotine-dispersal performance,[19] house higher capacity batteries, and come in various shapes such as metal tubes and boxes.[57] They contain silver, steel, metals, ceramics, plastics, fibers, aluminum, rubber and spume, and lithium batteries.[58] A growing subclass of vapers called cloud-chasers configure their atomizers to produce large amounts of vapor by using low-resistance heating coils.[59] This practice is known as cloud-chasing.[60] Many e-cigarettes are made of standardized replaceable parts that are interchangeable between brands.[61] A wide array of component combinations exists.[62] Many e-cigarettes are sold with a USB charger.[63] E-cigarettes that resemble pens or USB memory sticks are also sold for those who may want to use the device unobtrusively.[13]

The increasing numbers of new vaping products combined with unrelated functions attest to a clear trend toward customization of e-cigarettes.[64] It seems that experienced users like to adopt the e-cigarette to their (inhalation) needs, leading to e-cigarettes with adjusted airflow inlet using atomizer heads with different sized air holes.[64] This is applied in the most recently introduced models, which are activated by a pressure difference when the user inhales from the e-cigarette, avoiding pressing a button to heat the device.[64] Other interesting new e-cigarette-like devices provide a combined function with other electronic products such as a Bluetooth e-cigarette,

which combines vaping with listening to music or calling friends and another device can be used both as e-cigarette and mobile phone.[64]

Moreover, smartphone applications were introduced that track the number of e-cigarette puffs taken, calculate cost savings and increased life expectancy, and have features such as auto-shut down and password protection safety.[64] In line with this, Philip Morris International has filed a patent for an e-cigarette that is Wi-Fi connected, and thus would be able to connect to other devices.[64] This device could potentially synchronize to a smartphone application that is intended to help people quit smoking, and carefully track their progress.[64] A similar product is the Vaporcade Jupiter, a "cellular vaporizer," combining a smartphone with an e-cigarette.[64] This allows the user to monitor the e-cigarette use, the e-liquid remaining, and the flavor used.[64]

Device generations[edit]

As the e-cigarette industry continues to evolve, new products are quickly developed and brought to market.[21] The early devices looked like a traditional cigarette, often including a small light on the tip that lit when the user puffed.[65] These early systems were generally inefficient at delivering nicotine, in part because the particle sizes of the aerosol were too large to penetrate deep into the lungs.[65] Newer versions feature replaceable or refillable reservoirs and rechargeable batteries that generate smaller particles and more efficient nicotine delivery.[65] Since e-cigarettes are not regulated in many countries, the device designs can change often.[66] There is wide differences in the quality of e-cigarettes, such as the airflow rate, aerosol production, and leaking of e-liquid cartridges.[67]

First-generation[edit]

Various types of e-cigarettes, including an e-cigarette designed to look like a tobacco cigarette, an e-cigar, and an e-pipe.

First-generation e-cigarettes tend to look like tobacco cigarettes and so are called "cigalikes".[19] The three parts of a cigalike e-cigarette initially were a cartridge, an atomizer, and a battery.[16] A cigalike e-cigarette currently contains a cartomizer (cartridge atomizer), which is connected to a battery.[16] Most cigalikes look like cigarettes but there is some variation in size.[16]

They may be a single unit comprising a battery, coil and filling saturated with e-liquid in a single tube to be used and discarded after the battery or e-liquid is depleted.[19] They may also be a reusable device with a battery and cartridge called a cartomizer.[22] The cartomizer cartridge can be separated from the battery so the battery can be charged and the empty cartomizer replaced when the e-liquid runs out.[19]

The battery section may contain an electronic airflow sensor triggered by drawing breath through the device.[22] Other models use a power button that must be held during operation.[22] An LED in the power button or on the end of the device may also show when the device is vaporizing.[68]

Charging is commonly accomplished with a USB charger that attaches to the battery.[69] Some manufacturers also have a cigarette pack-shaped portable charging case (PCC), which contains a larger battery capable of recharging the individual e-cigarette batteries.[70] Reusable devices can come in a kit that contains a battery, a charger, and at least one cartridge.[70] Varying nicotine concentrations are available and nicotine delivery to the user also varies based on different cartomizers, e-liquid mixtures, and power supplied by the battery.[11]

These manufacturing differences affect the way e-cigarettes convert the liquid solution to an aerosol, and thus the levels of ingredients, that are delivered to the user and the surrounding air for any given liquid.[11] First-generation e-cigarettes use lower voltages, around 3.7 V.[24]

Second-generation[edit]

Second-generation PV.

Second generation devices tend to be used by people with more experience.[22] They are larger overall and look less like tobacco cigarettes.[22] They usually consist of two sections, basically a tank and a separate battery. Their batteries have higher capacity, and are not removable.[19] Being rechargeable, they use a USB charger that attaches to the battery with a threaded connector. Certain batteries have a "passthrough" feature so they can be used even while they are charging.[5][71]

Second-generation e-cigarettes commonly use a tank or a "clearomizer".[22] Clearomizer tanks are meant to be refilled with e-liquid, while cartomizers are not.[19] Because they're refillable and the battery is rechargeable, their cost of operation is lower.[19] However, they can also use cartomizers, which are pre-filled only.[19]

Some cheaper battery sections use a microphone that detects the turbulence of the air passing through to activate the device when the user inhales. Other batteries like the eGo style can use an integrated circuit, as well as a button for manual activation. The LED shows battery status. The power button can also switch off the battery so it is not activated accidentally.[72] Second generation e-cigarettes may have lower voltages, around 3.7 V.[24] However, adjustable-voltage devices can be set between 3 V and 6 V.[25]

Third-generation[edit]

Third-generation PV.

The third-generation includes mechanical mods and variable voltage devices.[73][74] Battery sections are commonly called "mods," referencing their past when user modification was common.[19] Mechanical mods do not contain integrated circuits.[74] They are commonly cylindrical or box-shaped, and typical housing materials are wood, aluminium, stainless steel, or brass.[75] A larger "box mod" can hold bigger and sometimes multiple batteries.[75]

Mechanical mods and variable devices use larger batteries than those found in previous generations.[76] Common battery sizes used are 18350, 18490, 18500 and 18650.[77] The battery is often removable,[74] so it can be changed when depleted. The battery must be removed and charged externally.[74]

Variable devices permit setting wattage, voltage, or both.[5][74] These often have a USB connector for recharging; some can be used while charging, called a "passthrough" feature.[5][78]

The power section may include additional options such as screen readout, support for a wide range of internal batteries, and compatibility with different types of atomizers.[22] Third-generation devices can have rebuildable atomizers with different wicking materials.[19][22] These rebuildables use handmade coils that can be installed in the atomizer to increase vapor production.[76] Hardware in this generation is sometimes modified to increase power or flavor.[79]

The larger battery sections used also allow larger tanks to be attached that can hold more e-liquid.[75] Recent devices can go up to 8 V, which can heat the e-liquid significantly more than earlier generations.[24]

Fourth-generation[edit]

Fourth-generation PV.

A fourth-generation e-cigarette became available in the United States in 2014.[46] Fourth-generation e-cigarettes can be made from stainless steel and pyrex glass, and contain very little plastics.[23] Included in the fourth-generation are sub ohm tanks and temperature control devices.[23] The e-cigarette user can breathe in large puff volumes, which results in a significant usage of e-liquid per puff.[80] Usually used by experienced e-cigarettes users.[81]

Atomizer and tank[edit]

Inside view of an e-cigarette atomizer with the coil (heating element).

An atomizer consists of a small heating element that vaporizes e-liquid and a wicking material that draws liquid onto the coil. Along with a battery and e-liquid the atomizer is the main component of every personal vaporizer.[22] When activated, the resistance wire coil heats up and vaporizes the liquid, which is then inhaled by the user.[82]

The electrical resistance of the coil, the voltage output of the device, the airflow of the atomizer and the efficiency of the wick all affect the vapor coming from the atomizer.[83] They also affect the vapor quantity or volume yielded.[83]

Atomizer coils made of kanthal usually have resistances that vary from 0.4Ω (ohms) to 2.8Ω.[83] Coils of lower ohms have increased vapor production but could risk fire and dangerous battery failures if the user is not knowledgeable enough about electrical principles and how they relate to battery safety.[84]

Wicking materials vary from one atomizer to another.[85] "Rebuildable" or "do it yourself" atomizers can use silica, cotton, rayon, porous ceramic, hemp, bamboo yarn, oxidized stainless steel mesh and even wire rope cables as wicking materials.[85]

Cartomizers[edit]

A 45mm length, extra-long cartomizer.

A "cartomizer" (a portmanteau of cartridge and atomizer.[17]) or "carto" consists of an atomizer surrounded by a liquid-soaked poly-foam that acts as an e-liquid holder.[5] They can have up to 3 coils and each coil will increase vapor production.[5] The cartomizer is usually discarded when the e-liquid starts to taste burnt, which usually happens when the e-cigarette is activated with a dry coil or when the cartomizer gets consistently flooded (gurgling) because of sedimentation of the wick.[5] Most cartomizers are refillable even if not advertised as such.[5]

Cartomizers can be used on their own or in conjunction with a tank that allows more e-liquid capacity.[5] The portmanteau word "cartotank" has been coined for this.[86] When used in a tank, the cartomizer is inserted in a plastic, glass or metal tube and holes or slots have to be punched on the sides of the cartomizer so liquid can reach the coil.[5]

Clearomizers[edit]

eGo style e-cigarette with a top-coil clearomizer. Silica fibers are hanging down freely inside of the tank, drawing e-liquid by capillary action to the coil that is located directly under the mouthpiece.

Box mod e-cigarette fitted with a rebuildable dripping atomizer (RDA).

The clearomizer was invented in 2009 that originated from the cartomizer design.[87] It contained the wicking material, an e-liquid chamber, and an atomizer coil within a single clear component.[87] This allows the user to monitor the liquid level in the device.[87] Clearomizers or "clearos", are like cartotanks, in that an atomizer is inserted into the tank.[18] There are different wicking systems used inside clearomizers.[5] Some rely on gravity to bring the e-liquid to the wick and coil assembly (bottom coil clearomizers for example) and others rely on capillary action or to some degree the user agitating the e-liquid while handling the clearomizer (top coil clearomizers).[5] The coil and wicks are typically inside a prefabricated assembly or "head" that is replaceable by the user.[88]

Clearomizers are made with adjustable air flow control.[89] Tanks can be plastic or borosilicate glass.[90] Some flavors of e-liquid have been known to damage plastic clearomizer tanks.[90]

Rebuildable atomizers[edit]

A view of the RDA deck showing the wicks and coils, e-liquid is dripped into a hopper where the wicks rest as well as atop the coil assembly.

A rebuildable atomizer (RBA) is an atomizer that allows the user to assemble or "build" the wick and coil themselves instead of replacing them with off-the-shelf atomizer "heads".[19] They are generally considered advanced devices.[91] They also allow the user to build atomizers at any desired electrical resistance.[19]

These atomizers are divided into two main categories; rebuildable tank atomizers (RTAs) and rebuildable dripping atomizers (RDAs).[92]

Rebuildable tank atomizers[edit]

RTAs have a tank to hold liquid that is absorbed by the wick.[93] They can hold up to 4 ml of e-liquid.[94] The tank can be either plastic, glass, or metal.[90] One form of tank atomizers was the Genesis style atomizers.[93] They can use ceramic wicks, stainless steel mesh or rope for wicking material.[93] The steel wick must be oxidized to prevent arcing of the coil.[93] Another type is the Sub ohm tank.[94] These tanks have rebuildable or RBA kits.[94] They can also use coil heads of 0.2 ohm, 0.4 ohm, and 0.5 ohm.[94] These coil heads can have stainless steel coils.[95]

Rebuildable dripping atomizers[edit]

RDAs are atomizers where the e-liquid is dripped directly onto the coil and wick.[96] The common nicotine strength of e-liquids used in RDA's is 3 mg and 6 mg.[96] Liquids used in RDA's tend to have more vegetable glycerin.[96] A fully saturated wick can give you as many as 10-20 puffs.[97] They typically consist only of an atomizer "building deck", commonly with three posts with holes drilled in them, which can accept one or more coils.[79] The user needs to manually keep the atomizer wet by dripping liquid on the bare wick and coil assembly, hence their name.[96]

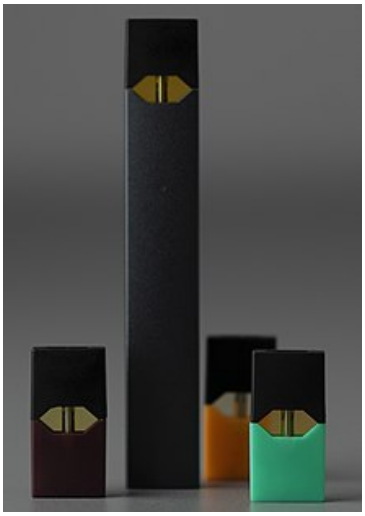
Resistance elements[edit]

Kanthal wire is used in RDA's, RBA's, RTA's, in addition to clearomizers, tanks, and cartomizers.[5] Nickel wire or titanium wire can be used for temperature control.[96]

Squonk mods[edit]

The origins of a squonk mod bottom-feeding system go as far back as 2009.[98] A member of the E-Cigarette Forum (ECF) named "Carlos49" was largely credited with developing the first squonker available in the marketplace.[98] Squonk mods differ from other mod boxes with their construction.[98] Squonk mods have a 510 connection that have been modified with the use of an e-liquid bottle placed inside the mod.[5] The user squeezes an e-liquid bottle through an opening in the device to send e-liquid through a tube into the attached atomizer.[98] Extra liquid goes back into the bottle when it is unsqueezed.[98]

Pod mods[edit]



Juul e-cigarette with pods.

Bravo nicotine salt e-liquids.

Pod mods heat up a liquid containing nicotine, flavors, and other ingredients that creates an aerosol.[28] Pod mods are lightweight, portable,[99] small, and reusable.[28] Pod mods do not require pushing a button.[100] A pod mod does not require much of a learning curve.[100] With the majority of pod mods, users can just open their new package, put a pod into the device, and begin vaping.[28] They are charged using a USB port.[100] There are numerous pod mods in the marketplace[101] and there are many kinds of pod mods.[102] The three categories for the different kinds of pod mods are an open system, a closed system, or those that use both.[102] Pod mods come in varying colors and flavors.[103] Many devices rely on replaceable liquid pods that may contain propylene glycol, glycerin, benzoic acid, nicotine, and artificial flavors.[104] Some pod mods can be refillable, with flavors such as cotton candy, donut cream, and gummy bear.[101] Pod mods that contain tetrahydrocannabinol (THC), the primary psychoactive chemical of cannabis, are being sold.[101] Pod mods can look like USB flash drives, cell phones, credit card holders, and highlighters.[105] Because pod mods are small and generate less aerosol, it makes it easy to hide them.[106] There are pod mods that can be concealed in the palm of a person's hand.[106] Later-generation pod mods are small like a Sharpie pen.[100] Pod mods cost about half as much as larger e-cigarettes.[100]

The latest generation of e-cigarettes, "pod products", such as Juul, have the highest nicotine content (59 mg/mL), in protonated salt, rather than the free-base nicotine form found in earlier generations, which makes it easier for less experienced users to inhale.[26] Pod mods deliver higher levels of nicotine than regular e-cigarettes.[27] One nicotine pod, in terms of nicotine, is roughly equivalent to one pack of regular cigarettes.[107] The labels on products state pods contain 59 mg/mL of nicotine, but the levels can be considerably greater such as 75 mg/mL of nicotine.[101] Some pod mods contained greater levels of nicotine than Juul which were as high as 6.5%.[108] In June 2015, Juul introduced a pod mod device.[109] British American Tobacco told to *The Verge* in 2018 that "They've been incorporated in our Vuse e-liquid in the US since 2012."[110]

Research on nicotine salts is limited.[99] Tests show that the pod mods Juul, Bo, Phix, and Sourin contain nicotine salts in a solution with propylene glycol and glycerin.[99] A nicotine base and a weak acid such as benzoic acid or levulinic acid is used to form a nicotine salt.[111] Benzoic acid is the most used acid to create a nicotine salt.[108] A free-base nicotine solution with an acid reduces the pH, which makes it possible to provide higher levels of nicotine without irritating the throat.[112] Nicotine salts are thought to amplify the level and rate of nicotine delivery to the user.[99] The speed of nicotine salts uptake into the body is close to the speed of nicotine uptake from traditional cigarettes.[113] Nicotine salts are less harsh and less bitter, and as a consequence e-liquids that contain nicotine salts are more tolerable even with high nicotine concentrations.[108] Traditional cigarettes provide high levels of nicotine, but with the bad taste of smoking.[28] Pod mods, however, can provide high levels of nicotine without the negative smoking experience.[28]

Power[edit]

Variable power and voltage devices[edit]

Variable devices are variable wattage, variable voltage or both.[5][74] Variable power and/or variable voltage have an electronic chip allowing the user to adjust the power applied to the heating element.[22][74] The amount of power applied to the coil affects the heat produced, thus changing the vapor output.[22][62] Greater heat from the coil increases vapor production.[62] Variable power devices monitor the coil's resistance and automatically adjust the voltage to apply the user-specified level of power to the coil.[114] Recent devices can go up to 8 V.[24]

They are often rectangular but can also be cylindrical.[75] They usually have a screen to show information such as voltage, power, and resistance of the coil.[115] To adjust the settings, the user presses buttons or rotates a dial to turn the power up or down.[62] Some of these devices include additional settings through their menu system such as: atomizer resistance meter, remaining battery voltage, puff counter, and power-off or lock.[116] The power source is the biggest component of an e-cigarette,[20] which is frequently a rechargeable lithium-ion battery.[12] Smaller devices contain smaller batteries and are easier to carry but typically require more repeated recharging.[12] Some e-cigarettes use a long lasting rechargeable battery, a non-rechargeable battery or a replaceable battery that is either rechargeable or non-rechargeable for power.[43] Some companies offer portable chargeable cases to recharge e-cigarettes.[43] Nickel-cadmium (NiCad), nickel metal-hydride (NiMh), lithium ion (Li-ion), alkaline and lithium polymer (Li-poly), and lithium manganese (LiMn) batteries have been used for the e-cigarettes power source.[43]

PV with variable and regulated power offering battery protection.

Temperature control devices[edit]

Temperature control devices allow the user to set the temperature.[96] There is a predictable change to the resistance of a coil when it is heated.[117] The resistance changes are different for different types of wires, and must have a high temperature coefficient of resistance.[117] Temperature control is done by detecting that resistance change to estimate the temperature and adjusting the voltage to the coil to match that estimate.[118]

Nickel, titanium, NiFe alloys, and certain grades of stainless steel are common materials used for wire in temperature control.[96] The most common wire used, kanthal, cannot be used because it has a stable resistance regardless of the coil temperature.[117] Nickel was the first wire used because it has the highest coefficient of the common metals.[117]

Mechanical PV with a rebuildable atomizer.

The temperature can be adjusted in Celsius or Fahrenheit.[119] The Evolv's DNA40 and YiHi's SX350J are control boards used in temperature control devices.[120] Temperature control can stop dry wicks from burning, or e-liquid overheating.[120]

Mechanical devices[edit]

Mechanical PVs or mechanical "mods", often called "mechs", are devices without integrated circuits, electronic battery protection, or voltage regulation.[74] They are activated by a switch.[96] They rely on the natural voltage output of the battery and the metal that the mod is made of often is used as part of the circuit itself.[121]

The term "mod" was originally used instead of "modification".[19] Users would modify existing hardwares to get better performance, and as an alternative to the e-cigarettes that looked like traditional cigarettes.[62] Users would also modify other unrelated items like flashlights as battery compartments to power atomizers.[62][75] The word mod is often used to describe most personal vaporizers.[5]

Mechanical PVs have no power regulation and are unprotected.[96] Because of this ensuring that the battery does not over-discharge and that the resistance of the atomizer requires electric current within the safety limits of the battery is the responsibility of the user.[121]

E-cigarette liquid[edit]

Composition[edit]

Various bottles of e-liquid.

An e-liquid containing a mixture of cannabinoid concentrates.[122]

E-cigarette liquid,[123] E-Cig liquid,[8] e-liquid, juice, vapor juice, smoke juice,[12] vaping fluid,[124] vaping juice,[125] e-juice,[126] e-fluid,[14] or vape oil[127] is the mixture used in vapor products including e-cigarettes.[29] Since e-cigarettes are not regulated in many countries, the composition of the liquid can change often.[66] There is a great amount of variability in e-liquid formulations due to fast growth and changes in the manufacturing designs of e-cigarettes.[notes 1][16] The composition of the e-liquid for additives such as nicotine and flavors vary across and within brands.[31] E-liquids come in many variations, including different nicotine strengths and many different flavors.[129] The main ingredients are propylene glycol, glycerin, and flavorings; and most often, nicotine in liquid form.[130] The liquid typically consists of a combined total of 95% propylene glycol and glycerin, and the remaining 5% being flavorings, nicotine, and other additives.[32] The most frequently used e-liquid solvents are propylene glycol and glycerin.[131] Flavorings may contain menthol, sugars, esters, and pyrazines.[131] Flavor components include eucalyptol, camphor, methyl salicylate, pulegone, ethyl salicylate, cinnamaldehyde, eugenol, diphenyl ether, coumarin,[131] diacetyl, acetoin, 2,3-pentanedione, cyclohexanone, benzaldehyde, cresol, butyraldehyde, and isoamyl acetate.[81] Sugars are frequently used in e-liquids to provide a sweet flavor.[132] Diacetyl, acetoin, and 2,3-pentanedione are used for buttery flavoring.[81] Camphor and cyclohexanone are used for minty flavoring.[81] Benzaldehyde is used for cherry or almond flavoring.[81] Cinnamaldehyde is used for cinnamon flavoring.[81] Cresol is used for leathery or medicinal flavoring.[81] Butyraldehyde is used for chocolate flavoring.[81] Isoamyl acetate is used for banana flavoring.[81] E-liquids named coffee, tea, chocolate, or energy drinks, typically contain caffeine at levels considerably less than in comparison with dietary products.[133] E-liquids are also available with vitamins or cannabis flavors.[64][134] In addition, specific e-cigarettes (mods) are available that allow for not only liquids but also herbs, oils, or fruits to be vaped.[64] Moreover, dual-function devices handle both concentrates and e-liquids using multiple cartridges.[64]

E-liquid can be made with or without nicotine, with more than 90% of e-liquids containing some level of nicotine.[135] The most regularly used base carrier chemical is propylene glycol with or without glycerin.[11] E-liquid containing glycerin and water made without propylene glycol are also sold.[33] There are e-liquids sold without propylene glycol,[33] nicotine,[34] or flavors.[35] E-liquids containing THC or other cannabinoids is also sold.[122][136] Specific kinds of e-liquids contain a tiny amount of alcohol.[137] The amount of alcohol in e-liquids vary, and there are cases where it has not been disclosed as an ingredient.[138] It is uncertain whether the nicotine used in e-liquid is manufactured using a US Pharmacopeia grade nicotine, a tobacco plant or tobacco dust extract, or a synthetic nicotine.[139] Most e-cigarette liquids contain nicotine, but the level of nicotine varies depending on user-preference and manufacturers.[140] Although some e-liquid is nicotine-free, surveys demonstrate that 97% of respondents use products that contain nicotine.[141] About 3.5% of users use liquid without nicotine.[142] An e-cigarette user used approximately three flavors.[137] A 2016 study showed that measurable amounts of arsenic, nickel and other metals were in e-liquids.[143]

Over 80 chemicals such as formaldehyde and metallic nanoparticles have been found in the e-liquid.[37] E-liquids typically contain nicotine, propylene glycol, glycerin, 1,3-butanediol, 1,3-propanediol, ethylene glycol, menthol, safrole, ethyl vanillin, camphor, α-thujone, coumarin, and diethylene glycol, according to a 2017 review.[144] E-liquid can contain a range of toxicants and can contain impurities.[145] A 2013 study found the e-liquids tested had as high as five times the upper threshold permitted levels of impurities.[145] E-liquids have been found to contain low levels of some of the toxicants found in tobacco smoke, as well as small concentrations of carcinogens.[146] The FDA in 2009 analyzed e-liquid cartridge samples which were found to contain tobacco-specific nitrosamines (TSNAs), diethylene glycol (detected one e-cigarette cartridge), cotinine, anabasine, myosmine, and beta-nicotyrine.[147] The TSNAs *N*-nitrosonornicotine (NNN), 4-(methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK), N-nitrosoanabasine, and nitrosoanatabine have been detected in five e-liquid cartridge samples from two companies in levels comparable to nicotine replacement products, according to the results of the FDA's analysis.[147] TSNAs were found in a broad range of levels.[148] TSNAs present in tobacco smoke, were found in

in e-liquids, at different levels, in trace amounts.[149] Studies in 2013 of other e-liquids had not detected diethylene glycol.[146] The majority of the e-liquids analyzed contained NNN from 0.34 to 60.08 µg/L and contained NNK from 0.22 to 9.84 µg/L.[150] The FDA issued warnings to several e-cigarette companies for selling e-cartridges and refill solutions containing active pharmaceutical ingredients such as rimonabant (Zimulti) for the purpose of losing weight and reducing smoking addiction, and tadalafil (the active ingredient in Cialis) for the purpose of increasing sexual capacity.[151] FDA analyses of these e-cartridges and solutions showed the presence of amino-tadalafil and not tadalafil, and the presence of an oxidative product of rimonabant, as well as rimonabant.[151]

The e-liquid often contain other substances unknown and/or undisclosed to the user.[152] The specific origin of the e-liquid ingredients is often unclear.[153] When content information is given on the packaging, it is usually incomplete.[31] Contamination with various compounds in e-liquids is a result of poor quality control.[31] Some nicotine and TSNAs have been found in e-liquids labelled as 'no nicotine'.[31] Nicotine content information on labels for some e-liquid companies may be vague, inaccurate or absent.[146] E-liquid were found to contain low levels of anthracene, phenanthrene, 1-methyl phenanthrene and pyren.[154] Diethylene glycol, ethylene glycol, hydrocarbons, ethanol, terpenic compounds and aldehydes, particularly formaldehyde and acrolein were found in the e-liquid.[155] Diethylene glycol is a potential byproduct of propylene glycol.[16] A 2014 study showed that e-liquids from a specific manufacturer contained greater amounts of ethylene glycol than glycerin or propylene glycol, which was likely a result of improper manufacturing methods.[156] Some liquids contained residual solvents such as 1,3-butadiene, cyclohexane, and acetone.[155] Some e-liquids contain tobacco alkaloids such as nornicotine, anabasine, or anatabine, and TSNAs, such as *N*-nitrosonornicotine (NNN), 4-(methylnitrosamine)-1-(3-pyridyl)-1-butanone (NNK),[16] nitrates, and phenol.[156] Tobacco alkaloids that were identified in some e-liquids were not found on the ingredient list.[156] Small quantities of volatile organic compounds (VOCs) such as benzene, toluene, xylene, and styrene have been found in the e-liquid.[41] Diethyl phthalate and diethylhexyl phthalate have been found in e-liquids.[157] Some e-liquids contain tin "whiskers," microscopic crystals that originate from tin in the solder joints.[16]

Levels of aldehydes in e-liquid[edit]

Aldehydes (in µg/g) in bottles of e-liquids∗[158]

Company	Code	Formaldehyde	Acetaldehyde	Propionaldehyde	Crotonaldehyde	Butyraldehyde	Benzaldehyde	Hexaldehyde
LOD		0.060	0.030	0.043	0.053	0.077	0.035	0.036
Janty	H60339	0.497	0.728	0.043	<0.053	<0.077	<0.035	<0.036
Ecigexpress	H60346	0.161	1.74	<0.043	<0.053	0.186	0.160	<0.036
Vapor4Life	H60349	0.776	0.507	0.089	<0.053	0.217	40.0	<0.036
Totally Wicked	H60352	0.532	0.129	<0.043	<0.053	<0.077	0.821	<0.036
Sedansa	H60355	0.813	1.25	0.167	<0.053	0.164	<0.035	<0.036
Johnson Creek	H60360	0.356	2.58	0.122	<0.053	<0.077	0.291	<0.036
TECC	H60364	0.467	0.235	<0.043	<0.053	<0.077	0.078	<0.036
Intellicig	H60369	0.114	4.05	0.083	<0.053	<0.077	0.581	<0.036
e-cigarettes.fr	H60370	0.257	0.413	<0.043	<0.053	<0.077	0.104	0.068
CigLib	H60373	0.274	0.421	<0.043	<0.053	<0.077	0.035	0.089
V2 Cigs	H60374	0.411	0.332	0.045	<0.053	<0.077	0.146	0.115
e-liquide.com	H60375	9.00	3.14	<0.043	<0.053	<0.077	0.145	0.100
Tasty Vapor	H60376	3.52	2.37	<0.043	<0.053	<0.077	305	0.532
e-cig.com	H60379	0.226	0.393	0.047	<0.053	<0.077	0.062	0.132

∗A 2013 analysis tested a total of 42 bottles of e-liquids.[158]

Contents[edit]

The e-liquid is sold in bottles or pre-filled disposable cartridges, or as a kit for consumers to make their own e-liquids.[159] Some vendors of e-liquids offer options to change the amounts of flavorings or nicotine strengths and build each bottle customized for the purchaser.[159] E-liquids are made with various tobacco, fruit, and other flavors,[11] as well as variable nicotine concentrations (including nicotine-free versions).[130] The standard notation "mg/ml" is often used on labels to denote nicotine concentration, and is sometimes shortened to "mg".[160] Some flavors are created to resemble the flavors used in traditional cigarettes such as tobacco and menthol-tobacco.[138] Adults in general also preferred sweet flavors (though smokers like tobacco flavor the most) and disliked flavors that elicit bitterness or harshness.[161] Young adults overall preferred sweet, menthol, and cherry flavors, while non-smokers in particular preferred coffee and menthol flavors.[161] In surveys of regular e-cigarette users, the most popular e-liquids had a nicotine content of 18 mg/ml, and the preferred flavors were largely tobacco, mint and fruit.[146] Men tend to favor flavors with tobacco, while women tend to favor chocolate or sweet flavors.[153] The most favorite flavors among regular e-cigarette users reported in a 2017 UK survey were fruit, tobacco, and menthol/mint.[162] The survey also found 2.6% regular e-cigarette users used no flavors.[162] A 2013 study examined 33 countries and found that only 1% of the adult smokers exclusively used non-nicotine e-cigarettes.[161] A cartridge may contain 0 to 20 mg of nicotine.[163] Refill liquids are often sold in the size range from 15 to 30 ml.[164] E-liquids are frequently sold in dropper

bottles.[165] One cartridge may typically last as long as one pack of cigarettes.[166] A refill bottle can contain up to 100 mg/ml of nicotine,[163] which is meant to be diluted before use.[167] Some users, probably due to financial reasons and the willingness to experiment, are opting to make homemade e-liquids.[29] A small percentage of liquids without flavoring is also sold.[168] The flavorings may be natural or artificial.[31] Certified organic e-liquid is also sold.[36] About 8,000 flavors existed in 2014.[169] More than 15,500 flavors existed in 2018.[39] A user does not normally consume a whole cartridge in a single session.[170] Most e-liquids are produced by a few manufacturers in China, the US, and Europe.[146] An e-cigarette user will usually obtain 300 to 500 puffs per ml of e-liquid.[164] A 2017 survey found that 62.2% of everyday e-cigarette users stated using lower than 4 ml daily and 1.5% used higher than 10 ml daily.[171] 18.1% of everyday e-cigarette users were not aware of the amount of e-liquid they use.[171]

Manufacturing[edit]

E-liquids are manufactured by many producers, both in the US and across the world.[38] First tier manufacturers use lab suits, gloves, hair covers, inside of certified clean rooms with air filtration similar to pharmaceutical-grade production areas.[38]

Standards[edit]

E-liquid manufacturing requirements under the US Food and Drug Administration (FDA) rules include report user fee information, pay user fees, register their establishment and submit list of products, including labeling and advertisements, submit health documents, submit ingredient listing, include required warning statements on packages and advertisements, submit quantities of harmful and potentially harmful constituents, and submit a modified risk tobacco product application.[40] The revision to the EU Tobacco Products Directive has some standards for e-liquids.[41]

Standards for e-liquid manufacturing have been created by American E-liquid Manufacturing Standards Association (AEMSA), which is trade association dedicated to creating responsible and sustainable standards for the safe manufacturing of e-liquids used in vapor products.[172] AEMSA has published a comprehensive list standards and best known methods, which are openly available for use by any manufacturer of e-Liquids.[42] The AEMSA standards cover nicotine, ingredients, sanitary manufacturing rooms, safety packaging, age restrictions, and labeling.[42] AEMSA guidelines recommend that the nicotine levels in e-liquids be within the amount of ±10% from the levels stated on the label.[150]

Regulation[edit]

Effective August 8, 2016, under the FDA rules, a company that mixes or prepares e-liquids is regulated as a tobacco product manufacturer.[173] Under the same regulation, a company that sells e-liquids is regulated as a tobacco retailer.[173] Companies who import or try to sell for import into the US must conform to the Federal Food, Drug, and Cosmetic Act.[174] The 2016 FDA ruling did not incorporate regulation concerning flavoring of e-cigarettes.[175] Industry standards have been created and published by the American E-liquid Manufacturing Standards Association (AEMSA).[42] The FDA authority to regulate e-liquids was announced in May 2016.[176][177] The FDA has sought to regulate e-liquid in 2014[178] through use of the Family Smoking Prevention and Tobacco Control Act,[179] passed into law in June 2009.[180] In April 2014, the FDA issued its "Deeming" proposals for public comment, which would cover e-liquids manufacturing.[181]

Manufacturers of e-liquid in the UK are required to inform the Government regarding the content in each liquid.[182] The EU Tobacco Products Directive requires e-liquids to be tested 6 months before they are sold.[183]

The Tobacco Products Directive in the EU limits the sale of e-liquid.[184] It can only be sold in 10 ml bottles, which need to have a child-proof closure.[184] They have to be pre-registered to the Medicines and Healthcare products Regulatory Agency before sale.[184] There is also a limit on the nicotine content, meaning the nicotine strength of any e-liquid cannot exceed 20 mg/ml (2.0%).[184] Refill liquids in the EU with more than 20 mg/ml of nicotine may be sold with prior authorization from the pharmaceutical regulation.[41]

As of January 2020, the Food and Drug Administration put new regulations on the flavor of e-liquids. They ban companies from manufacturing any juices or pre-filled pods that contained fruity or minty flavors. This restriction also banned stores from selling any flavors of e-liquid that are fruity or minty that could have been imported from a different country. [185]

Nicotine yield[edit]

Smoking a traditional cigarette yields between 0.5 and 1.5 mg of nicotine,[186] but the nicotine content of the cigarette is only weakly correlated with the levels of nicotine in the smoker's bloodstream.[187] The amount of nicotine in the e-cigarette aerosol varies widely either from puff-to-puff or among devices of the same company.[9] In practice e-cigarette users tend to reach lower blood nicotine concentrations than smokers, particularly when the users are inexperienced[186] or using first-generation devices.[19] Nicotine in cigarette smoke is absorbed into the bloodstream rapidly, and e-cigarette aerosol is relatively slow in this regard.[19] Vaping typically gives a lower amount of nicotine per puff than smoking cigarettes.[188] E-liquids contain nicotine in a variety of different strengths.[189] From no nicotine[190] to 36 mg/ml.[191] On average a regular cigarette contains 6-28 mg of nicotine or the user will inhale about 1.1 to 1.8 mg of nicotine if just a portion is used.[192] On average an e-cigarette contains 0.5-15.4 mg of nicotine per 15 puffs.[192] In practice the nicotine concentration in an e-liquid is not a reliable guide to the amount of nicotine that reaches the bloodstream.[193] [194]

Notes[edit]

1. ^ The liquid composition of each brand of e-cigarettes may differ, making it difficult to generalize about the potential toxic properties of these devices.[128]

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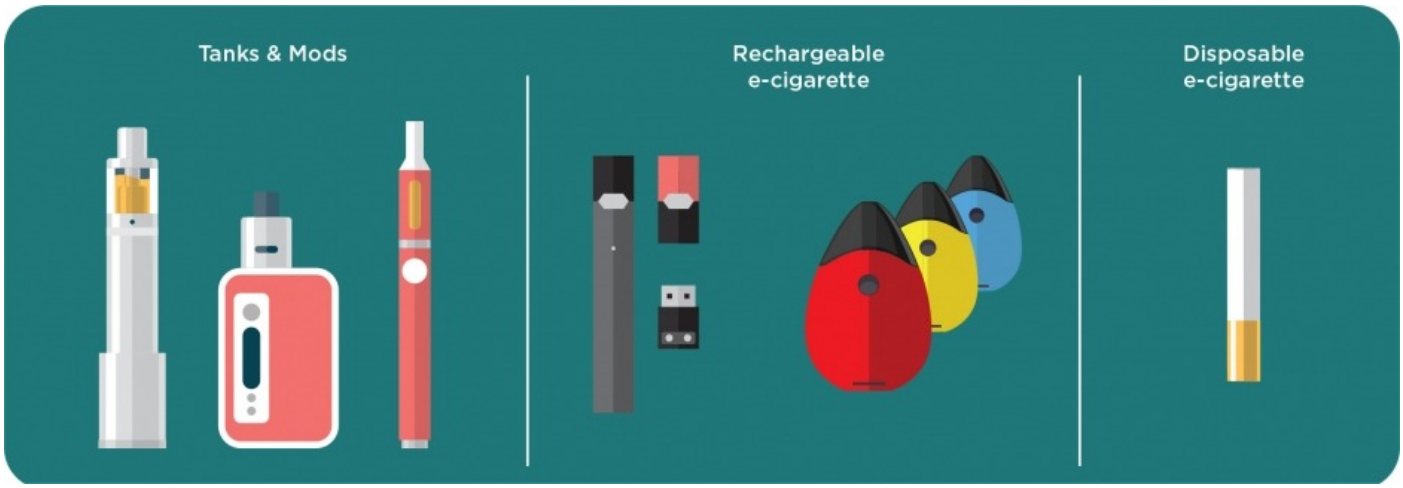
Vaping Devices (Electronic Cigarettes) DrugFacts

What are vaping devices?

Vaping devices are battery-operated devices that people use to inhale an aerosol, which typically contains nicotine (though not always), flavorings, and other chemicals. They can resemble traditional tobacco cigarettes *(cig-a-likes)*, cigars, or pipes, or even everyday items like pens or USB memory sticks. Other devices, such as those with fillable tanks, may look different. Regardless of their design and appearance, these devices generally operate in a similar manner and are made of similar components. More than 460 different e-cigarette brands are currently on the market.[1]



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Some e-cigarettes are made to look like regular cigarettes, cigars, or pipes. Some resemble pens, USB sticks, and other everyday items.

How do vaping devices work?

Most e-cigarettes consist of four different components, including:

- a cartridge or reservoir or pod, which holds a liquid solution (*e-liquid* or *e-juice*) containing varying amounts of nicotine, flavorings, and other chemicals
- a heating element (atomizer)
- a power source (usually a battery)
- a mouthpiece that the person uses to inhale

In many e-cigarettes, puffing activates the battery-powered heating device, which vaporizes the liquid in the cartridge. The person then inhales the resulting aerosol or vapor (called *vaping*).

Vaping Among Teens

Vaping devices are popular among teens and are now the most commonly used form of nicotine among youth in the United States. Some research shows that many teens do not even realize that vaping cartridges contain nicotine, and assume the pods contain only flavoring. The easy availability of these devices, alluring advertisements, various e-liquid flavors, and the belief that they're safer than cigarettes have helped make them appealing to this age group. In addition, they are easy to hide from teachers and parents because they do not leave behind the stench of tobacco cigarettes, and are often disguised as flash drives. Further, a study of high school students found that one in four teens reported using e-cigarettes for dripping, a practice in which people produce and inhale vapors by placing e-liquid drops directly onto heated atomizer coils. Teens reported the following reasons for dripping: to create thicker vapor (63.5 percent), to improve flavors (38.7 percent), and to produce a stronger throat hit—a pleasurable feeling that the vapor creates when it causes the throat to contract (27.7 percent).[2] More research is needed on the risks of this practice.

In addition to the unknown health effects, early evidence suggests that vaping might serve as an introductory product for preteens and teens who then go on to use other nicotine products, including cigarettes, which are known to cause disease and premature death. A study showed that students who had used e-cigarettes by the time they started 9th grade were more likely than others to start smoking cigarettes and other smokable tobacco products within the next year.[3] Another study supports these findings, showing that high school students who used e-cigarettes in the last month were about 7 times more likely to report that they smoked cigarettes when asked approximately 6 months later, as compared to students who said they didn't use e-cigarettes. Notably, the reverse was not true—students who said they smoked cigarettes were no more likely to report use of e-cigarettes when asked approximately 6 months later. Like the previous study, these results suggest that teens using e-cigarettes are at a greater risk for smoking cigarettes in the future.[4] Another study has shown an association between e-cigarette smoking and progression

to smoking actual cigarettes.[5] This study suggests that vaping nicotine might actually encourage cigarette smoking in adolescents.

Additionally, a study of adult smokers in Europe found those who vaped nicotine were less like to have stopped smoking than those who did not. Those who used e-cigarettes also smoked more cigarettes than those who didn't.[6] In another study of more than 800 people who said they vaped to help them quit traditional cigarette smoking, only nine percent reported having quit when asked a year later.[7] However, more research is still needed to understand if experimenting with e-cigarettes leads to regular use of smokable tobacco.

Under U.S. Food and Drug Administration (FDA) regulations designed to protect the health of young Americans, minors can no longer buy e-cigarettes in stores or online (see "Government Regulation of E-cigarettes"). The FDA now regulates the manufacture, import, packaging, labeling, advertising, promotion, sale, and distribution of e-cigarettes. This includes components and parts of e-cigarettes but excludes accessories.[8]

Government Regulation of E-cigarettes

In 2016, the FDA established a rule for e-cigarettes and their liquid solutions. Because e-cigarettes contain nicotine derived from tobacco, they are now subject to government regulation as tobacco products. In December 2019, the federal government raised the legal minimum age of sale of tobacco products from 18 to 21 years, and in January 2020, the FDA issued a policy on the sale of flavored vaping cartridges.

How does vaping affect the brain?

The nicotine in e-liquids is readily absorbed from the lungs into the bloodstream when a person vapes an e-cigarette. Upon entering the blood, nicotine stimulates the adrenal glands to release the hormone epinephrine (adrenaline). Epinephrine stimulates the central nervous system and increases blood pressure, breathing, and heart rate. As with most addictive substances, nicotine activates the brain's reward circuits and also increases levels of a chemical messenger in the brain called *dopamine*, which reinforces rewarding behaviors. Pleasure caused by nicotine's interaction with the reward circuit motivates some people to use nicotine again and again, despite risks to their health and well-being.

What are the health effects of vaping? Is it safer than smoking tobacco cigarettes?

Research so far suggests that vaping devices might be less harmful than combustible cigarettes when people who regularly smoke switch to them as a complete replacement. But nicotine in any form is a highly addictive drug. Research suggests it can even prime the brain's reward system, putting vapers at risk for addiction to other drugs.[9]

Also, e-cigarette use exposes the lungs to a variety of chemicals, including those added to e-liquids, and other chemicals produced during the heating/vaporizing process.[10] A study of some e-cigarette products found the vapor contains known carcinogens and toxic chemicals, as well as potentially toxic metal nanoparticles from the device itself. The study showed that the e-liquids of certain cig-a-like brands contain high levels of nickel and chromium, which may come from the nichrome heating coils of the vaporizing device. Cig-a-likes may also contain low levels of cadmium, a toxic metal also found in cigarette smoke that can cause breathing problems and disease.[11] More research is needed on the health consequences of repeated exposure to these chemicals. There are also reports of lung illnesses and deaths related to inhalation of certain vaping oils into the lungs, which have no way to filter out toxic ingredients.

Reports of Deaths Related to Vaping

The Food and Drug Administration has alerted the public to thousands of reports of serious lung illnesses associated with vaping, including dozens of deaths. They are working with the Centers for Disease Control and Prevention (CDC) to investigate the cause of these illnesses. Many of the suspect products tested by the states or federal health officials have been identified as vaping products containing THC, the main psychotropic ingredient in marijuana. Some of the patients reported a mixture of THC and nicotine; and some reported vaping nicotine alone. While the CDC and FDA continue to investigate possible other contributing substances, CDC has identified a thickening agent—Vitamin E acetate—as a chemical of concern among people with e-cigarette or vaping associated lung injuries. They recommend that people should not use any product containing Vitamin E acetate, or any vaping products containing THC; particularly from informal sources like friends, family, or in-person and online dealers. They also warn against modifying any products purchased in stores, or using any vaping products bought on the street. People, including health professionals, should report any adverse effects of vaping products. The CDC has posted an information page for consumers.

Health Effects for Teens

The teen years are critical for brain development, which continues into young adulthood. Young people who use nicotine products in any form, including e-cigarettes, are uniquely at risk for long-lasting effects. Because nicotine affects the development of the brain's reward system, continued nicotine vaping can not only lead to nicotine addiction, but it also can make other drugs such as cocaine and methamphetamine more pleasurable to a teen's developing brain.[12]

Nicotine also affects the development of brain circuits that control attention and learning. Other risks include mood disorders and permanent problems with impulse control—failure to fight an urge or impulse that may harm oneself or others.[12]

Can vaping help a person quit smoking?

Some people believe e-cigarettes may help lower nicotine cravings in those who are trying to quit smoking. However, e-cigarettes are not an FDA-approved quit aid, and there is no conclusive scientific evidence on the effectiveness of vaping for long-term smoking cessation. It should be noted that there are seven FDA-approved quit aids that are proven safe and can be effective when used as directed.

Vaping nicotine has not been thoroughly evaluated in scientific studies. For now, not enough data exists on the safety of e-cigarettes, how the health effects compare to traditional cigarettes, and if they are helpful for people trying to quit smoking.

Points to Remember

- People vape with battery-operated devices used to inhale an aerosol, which can contain nicotine, marijuana, flavorings, and other chemicals. In many e-cigarettes, puffing activates the battery-powered heating device, which vaporizes the liquid in the cartridge or reservoir. The person then inhales the resulting aerosol or vapor (called *vaping*).
- Vaping is popular among teens. Under U.S. Food and Drug Administration (FDA) regulations designed to protect the health of young Americans, minors can no longer buy e-cigarettes in stores or online.
- Nicotine stimulates the adrenal glands to release the hormone epinephrine (adrenaline) and increases the levels of a chemical messenger in the brain called *dopamine*. Pleasure caused by nicotine's interaction with the brain's reward

system motivates some people to use nicotine again and again, despite possible risks to their health and well-being.

- Research so far suggests that vaping is less harmful than combustible cigarettes when people who regularly smoke switch to them as a complete replacement. But e-cigarettes can still damage a person's health.
- Vaping can lead to nicotine addiction and increased risk for addiction to other drugs.
- Vaping also exposes the lungs to a variety of chemicals, including those added to e-liquids, and other chemicals produced during the heating/vaporizing process.
- More research is needed to determine if vaping nicotine can be as effective as smoking cessation aids already approved by the FDA.

Learn More

For more information about e-cigarettes, visit:

- NIH-funded study finds teens prefer mint and mango vaping flavors (Science Spotlight, November 2019)
- NIDA Live: The Science of Vaping (30:19) (September 2019)
- NIDA TV Spotlight on Electronic Cigarettes
- A NIDA *Science Spotlight* on the association between e-cigarette use and future tobacco cigarette use
- the FDA's webpage, Vaporizers, E-Cigarettes, and other Electronic Nicotine Delivery Systems (ENDS)
- the website, Know the Risks: E-cigarettes & Young People, based on the U.S. Surgeon General's Report on e-cigarette use among youth and young adults; includes various resources such as a parent tip sheet, healthcare provider conversation card, and FAQs
- Notes from the Field: Use of Electronic Cigarettes and Any Tobacco Product Among Middle and High School Students — United States, 2011–2018 (MMRW) (CDC, November 2018)
- E-Cigarette, or Vaping, Products Visual Dictionary (CDC)

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1 **:** to give knowledge to **:** teach, train
2 **:** to provide with authoritative information or advice the judge instructed the jury
3 **:** to give an order or command to **:** direct

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command, order, bid, enjoin, direct, instruct, charge mean to issue orders. command and order imply authority and usually some degree of formality and impersonality. command stresses official exercise of authority. a general *commanding* troops order may suggest peremptory or arbitrary exercise. *ordered* his employees about bid suggests giving orders peremptorily (as to children or servants). she *bade* him be seated enjoin implies giving an order or direction authoritatively and urgently and often with admonition or solicitude. a sign *enjoining* patrons to be quiet direct and instruct both connote expectation of obedience and usually concern specific points of procedure or method, instruct sometimes implying greater explicitness or formality. *directed* her assistant to hold all calls the judge *instructed* the jury to ignore the remark charge adds to enjoin an implication of imposing as a duty or responsibility. *charged* by the President with a secret mission

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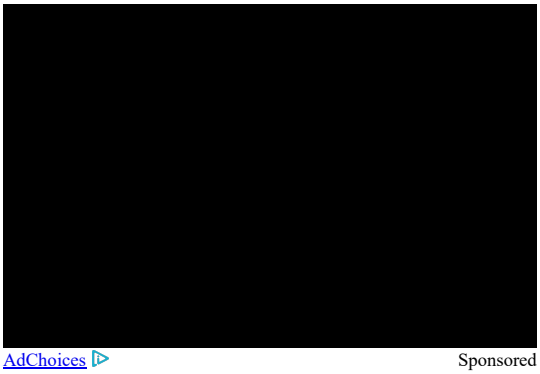

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2 **:** to give information to I *instructed* him that school was closed.
3 **:** to give directions or commands to She *instructed* us to stay seated.

instruct

transitive verb
in·struct

Legal Definition of *instruct*

: to provide (a jury) with explanation and directions regarding the law applicable to a case the judge instructed the jury that the plaintiff bears the burden of proof the jury was instructed to ignore the attorney's comments

intransitive verb

: to give instructions to a jury the trial judge refused to instruct on manslaughter— W. R. LaFave and A. W. Scott, Jr.

More from Merriam-Webster on *instruct*

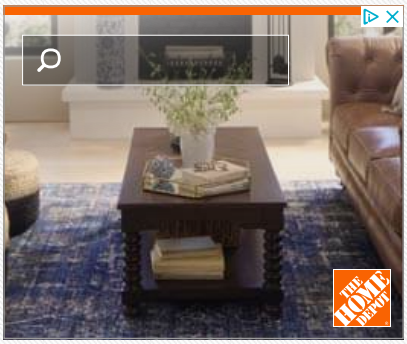
Nglish: Translation of *instruct* for Spanish Speakers

Britannica English: Translation of *instruct* for Arabic Speakers

- What does 'poke' refer to in the expression 'pig in a poke'?

state of difficulty | stable

mud pit | bag



“In Vino Veritas” and Other Latin Phrases to Live By

- Top 10 Latin Phrases

Hypercorrections: Are you making these 6 common mistakes?

- When your 'correction' is incorrect

The Many Plurals of 'Octopus'

- But which is correct?

8 Significant Words for 'Insignificant'

- A list that is anything but trivial

ASK THE EDITORS

'Everyday' vs. 'Every Day'

- A simple trick to keep them separate

What Is 'Semantic Bleaching'?

- How 'literally' can mean "figuratively"

Literally

- How to use a word that (literally) drives some pe...

Is Singular 'They' a Better Choice?

- The awkward case of 'his or her'

WORD GAMES

Name Those Herbs and Spices

How many do you know?

- TAKE THE QUIZ >

Name That Emotion

It's a whole mood

- TAKE THE QUIZ >

Name That Thing

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Time period - definition of time period by The Free Dictionary

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time period

Also found in: **Thesaurus**, **Acronyms**, **Wikipedia**.

Thesaurus

Legend: 〓 Synonyms ↔ Related Words ≠ Antonyms

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Noun 1. time period - an amount of time; "a time period of 30 years"; "hastened the period of time of his recovery"; "Picasso's blue period"

〓 **period**, **period of time**

↔ **fundamental measure**, **fundamental quantity** - one of the four quantities that are the basis of systems of measurement

↔ **test period**, **trial period** - a period of time during which someone or something is tested

↔ **time frame** - a time period during which something occurs or is expected to occur; "an agreement can be reached in a reasonably short time frame"

↔ **hours** - an indefinite period of time; "they talked for hours"

↔ **downtime** - a period of time when something (as a machine or factory) is not operating (especially as a result of malfunctions)

↔ **uptime** - a period of time when something (as a machine or factory) is functioning and available for use

↔ **work time** - a time period when you are required to work

↔ **time off** - a time period when you are not required to work; "he requested time off to attend his grandmother's funeral"

↔ **bout** - a period of illness; "a bout of fever"; "a bout of depression"

↔ **hospitalization** - a period of time when you are confined to a hospital; "now they try to shorten the patient's hospitalization"

↔ **travel time** - a period of time spent traveling; "workers were not paid for their travel time between home and factory"

↔ **times** - a more or less definite period of time now or previously present; "it was a sign of the times"

↔ **time** - an indefinite period (usually marked by specific attributes or activities); "he waited a long time"; "the time of year for planting"; "he was a great actor in his time"

↔ **elapsed time** - the time that elapses while some event is occurring

↔ **duration**, **continuance** - the period of time during which something continues

↔ **calendar week**, **week** - a period of seven consecutive days starting on Sunday

↔ **midweek** - the middle of a week

↔ **field day** - a time of unusual pleasure and success

↔ **lifespan**, **lifetime**, **life-time**, **life** - the period during which something is functional (as between birth and death); "the battery had a short life"; "he lived a long and happy life"

↔ **life** - the period between birth and the present time; "I have known him all his life"

↔ **life** - the period from the present until death; "he appointed himself emperor for life"

↔ **millennium**, **millenary** - a span of 1000 years

↔ **bimillenary**, **bimillennium** - a span of 2000 years

↔ **occupation** - the period of time during which a place or position or nation is occupied; "during the German occupation of Paris"

↔ **past** - a earlier period in someone's life (especially one that they have reason to keep secret); "reporters dug into the candidate's past"

↔ **shelf life** - the length of time a packaged food or drug will last without deteriorating

↔ **puerperium** - time period following childbirth when the mother's uterus shrinks and the other functional and anatomic changes of pregnancy are resolved; "a perinatologist cared for her during the puerperium"

↔ **lactation** - the period following birth during which milk is secreted; "lactation normally continues until weaning"

↔ **time of life** - a period of time during which a person is normally in a particular life state

↔ **calendar day**, **civil day** - a day reckoned from midnight to midnight

↔ **festival** - a day or period of time set aside for feasting and celebration

↔ **daylight**, **daytime**, **day** - the time after sunrise and before sunset while it is light outside; "the dawn turned night into day"; "it is easier to make the repairs in the daytime"

↔ **forenoon**, **morn**, **morning**, **morning time** - the time period between dawn and noon; "I spent the morning running errands"

↔ **night**, **nighttime**, **dark** - the time after sunset and before sunrise while it is dark outside

↔ **night** - the time between sunset and midnight; "he watched television every night"

↔ **night** - the period spent sleeping; "I had a restless night"

↔ **night** - a period of ignorance or backwardness or gloom

↔ **eve** - the period immediately before something; "on the eve of the French Revolution"

↔ **evening** - the early part of night (from dinner until bedtime) spent in a special way; "an evening at the opera"

↔ **hebdomad**, **week** - any period of seven consecutive days; "it rained for a week"

↔ **fortnight**, **two weeks** - a period of fourteen consecutive days; "most major tennis tournaments last a fortnight"

↔ **weekend** - a time period usually extending from Friday night through Sunday; more loosely defined as any period of successive days including one and only one Sunday

↔ **Indian summer**, **Saint Martin's summer** - a period of unusually warm weather in the autumn

↔ **year** - the period of time that it takes for a planet (as, e.g., Earth or Mars) to make a complete revolution around the sun; "a Martian year takes 687 of our days"

↔ **schooltime**, **school day**, **school** - the period of instruction in a school; the time period when school is in session; "stay after school"; "he didn't miss a single day of school"; "when the school day was done we would walk home together"

EXHIBIT H

URL	https://www.quora.com/What-is-the-magnitude-of-current
Date captured	November 22th 2021, 2:51:46PM
Last updated	November 22th 2021, 2:51:46PM
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What is the magnitude of current?

8 Answers

RaviVarma

Answered Jul 18, 2021

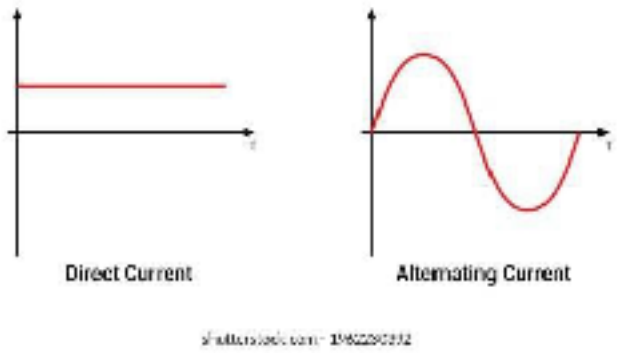
First of all we know that current is nothing but flow of electric charge carriers (electrons) .

Magnitude of current is the amount of charge flowing at a particular point.

This simplifies the concept of Alternating and Direct currents (A.C and D.C)

As we know the graph of Alternating current will be pulsating so its magnitude changes from time to time that means charge flowing keeps changing.

But in Direct Current graph it is shown as linear so its the magnitude of D.Current remains constant.



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How do you determine the magnitude of the current drawn by the load from two currents (10A and 15A) that are 30° out of phase?

What is the magnitude of the current in an electrolyte?

What is the magnitude of current through voltage and power?

Gavin Monson, BEng Hons Mechanical Engineering & Energy Engineering, Heriot-Watt University (2011)

Answered 3 years ago

Current is just the measure of how many electrons are flowing at a given time.

So an ampere will represent a certain number of electrons per second.

I had to look this up as its not an easy number to remember.

So 1 amp means there are 6.242×10^18 electrons flowing past per second. This unit of charge is called a Coulomb after its inventor.

Related Questions

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What is the magnitude of current through voltage and power?

How do you calculate magnitude?

slowly.

Continue Reading

Although the electric field travels at the speed of light the electrons themselve

7

Sulimon Sattari, Specially Appointed Assistant Professor at Hokkaido University

Answered 4 years ago · Author has **570** answers and **1.3M** answer views

When you say “magnitude” of current it seems like you must be talking about current as a vector. This is possible since current can have a direction. So the magnitude is the square root of the sum of the squares of the components of the current. Or, if the current is just a number and not a vector, the magnitude is the absolute value of the number.

12.8K views · View upvotes

8

Ruhul Amin, Optometry BSc

Answered 5 years ago

Current, measured in Amperes (A), has the symbol "I" ('eye') and is equal to the charge (Coulombs, C) per unit time (Seconds, s). In other words, it is the number of electrons passing a point per second.

$I = Q/t$

Where Q is charge and t is time

Current is also equal to the potential difference (voltage, V) across a component over the resistance (ohms) of the component

$I = V/R$

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8 1 2

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How do you calculate magnitude?

What is magnitude of magnitude?

A current has both a magnitude and a direction. Why is a current not a vector quantity?

What is the formula for magnitude?

What is the magnitude of the current in the loop?

Michael Kenyon, I am an Engineer and inventor. Airliner safety inventions

Answered 4 years ago · Author has **784** answers and **1.1M** answer views

Yes I = Q/t

V=I x R

I squared = Q squared / time squared

Power = R x Q squared / time squared

Voltage = Q x R/ time

The negative electrons are attracted to the positive point in the circuit, the anode.

5.8K views · View upvotes

2

Willy Roentgen, Registered Professional Engineer, BSAeroE, MSME, MBA, Pilot,

Answered 4 years ago · Author has **11.9K** answers and **7.3M** answer views

The units of (electrical) current is the Ampere (or milliampere, etc). Its magnitude can be measured or calculated buy measuring the voltage of a resistor in the circuit. Then the calculation:

A = E/R, where A is the current, E is the voltage drop across the resistor and R is the value of the resistor in Ohms.

7.8K views · View upvotes

2

Vikas Singh, Ceo at Life and Living (1999-present)

Answered 3 years ago

I think literally you are confused that current is scalar or vector. If so, then

If we will talk about current in wire it is considered as scalar (literally tensor) but if we talk about a conducter at microscopic level then some electron have same other have different direction (e.g. eddy current) so here current is vector. Thatswhy you listened somewhere magnitude of current.

4.4K views · View upvotes

1

Shashvata Ghosh, Student at Techno India NJR Institute of Technology (2018-present)

Answered 1 year ago

Originally Answered: What is the magnitude of a current?

A(Ampere) is unit of current. Actually current is a scalar quantity since it follows scalar addition. When current coming from two opposite directions are added irrespective of their direction

1.4K views · Answer requested by Swati Shukla

Related Answers

Related Answer

Marty Frolick, Physics Teacher

Answered 4 years ago · Author has **1.9K** answers and **1.3M** answer views

What is the definition of magnitude in physics?

Originally Answered: What is meant by magnitude in physics?

Magnitude simply means “how much”. In physics, we use many kinds of numbers, two of which are scalars and vectors. A scalar is a number that only has a magnitude or an amount. For example:

6 bananas

23.5 kilograms

A vector is a number that has a magnitude and a direction. For example:

18 meters/second West

67 kilometers Up

12 miles at an angle of 35 degrees

Some scalars can be made into vectors by adding a direction, but only certain things can be vectors since it would make no sense to say 6 bananas down (unless you were using a banana as a ruler - weird!)

Related Answer

Avtar Singh, Process Engineer (2017-present)

Answered 3 years ago · Author has **84** answers and **119.4K** answer views

What is magnitude & direction?

So you want to understand Vector quantities which have both magnitude and direction:

Magnitude is the result of measurement in numerical value like 2Kg, 3 m/s 4 cm2 etc.

And the direction is any specific way straight, forward, backward, east, west, upward, downward etc.

In vector quantities magnitude and direction both are given but in scalar quantity it is not given that in which way or in which direction it is measured so vector quantity tells us result in numerical value in a specified direction which is very helpful like speed and velocity

Speed is scalar whereas velocity is vector because spe

Related Answer

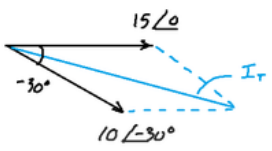
Jim Phipps, Power Systems Engineer

Answered 2 years ago · Author has **1.6K** answers and **3M** answer views

How do you determine the magnitude of the current drawn by the load from two currents (10A and 15A) that are 30° out of phase?

You use Kirchhoff's current law and sum the two phasor currents together to get the total current.

Say we take the 15 A current as the reference and assume the 10 A current lags by 30°:



$$I_T = 15\angle 0° + 10\angle -30°$$
$$= 15 + j0 + 8.66 - j5$$
$$= 23.66 - j5$$
$$= 24.18\angle -11.9°$$

If the 10 A current leads by 30°,

gn on the angle to +11.9°. In

Related Questions

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What is the magnitude of the current in an electrolyte?

What is the magnitude of current through voltage and power?

How do you calculate magnitude?

What is magnitude of magnitude?

A current has both a magnitude and a direction. Why is a current not a vector quantity?

What is the formula for magnitude?

What is the magnitude of the current in the loop?

Does DC current have a varying magnitude?

What is magnitude?

How do I find magnitude of force?

What is the difference between magnitude and direction?

What is the magnitude of charges?

EXHIBIT I

URL	https://en.wikipedia.org/wiki/Electrical_connector
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Last updated	November 22th 2021, 2:49:10PM
Hash	0dcde7c4a2f09337ce5d6305fef7c0c569f0c239c788b63386805f668a30fdc0

Electrical connector

From Wikipedia, the free encyclopedia
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Schematic symbols for male and female connectors *(see Gender of connectors and fasteners)*

This rear panel of an integrated amplifier features a variety of electrical connectors

Connectors on the back of a 2018 computer

An **electrical connector** is an electromechanical device used to join electrical conductors and create an electrical circuit.[1] Most electrical connectors have a gender – i.e. the male component, called a *plug*, connects to the female component, or *socket*. The connection may be removable (as for portable equipment), require a tool for assembly and removal, or serve as a permanent electrical joint between two points.[2] An adapter can be used to join dissimilar connectors.

Thousands of configurations of connectors are manufactured for power, data, and audiovisual applications.[3] Electrical connectors can be divided into four basic categories, differentiated by their function:[4]

- *inline* or *cable* connectors permanently attached to a cable, so it can be plugged into another terminal (either a stationary instrument or another cable)[5]
- *Chassis* or *panel* connectors permanently attached to a piece of equipment so users can connect a cable to a stationary device

- *PCB mount* connectors soldered to a printed circuit board, providing a point for cable or wire attachment.[6]:56 (e.g. pin headers, screw terminals, board-to-board connectors)
- *Splice* or *butt* connectors (primarily insulation displacement connectors) that permanently join two lengths of wire or cable

In computing, electrical connectors are considered a physical interface and constitute part of the physical layer in the OSI model of networking.

Contents

Physical construction[edit]

In addition to the classes mentioned above, connectors are characterised by their pinout, method of connection, materials, size, contact resistance, insulation, mechanical durability, ingress protection, lifetime (number of cycles), and ease of use.

It is usually desirable for a connector to be easy to identify visually, rapid to assemble, inexpensive, and require only simple tooling. In some cases an equipment manufacturer might choose a connector specifically because it is *not* compatible with those from other sources, allowing control of what may be connected. No single connector has all the ideal properties for every application; the proliferation of types is a result of the diverse yet specific requirements of manufacturers.[7]:6

Materials[edit]

Electrical connectors essentially consist of two classes of materials: conductors and insulators. Properties important to conductor materials are contact resistance, conductivity, mechanical strength, formability, and

resilience.[8] Insulators must have a high electrical resistance, withstand high temperatures, and be easy to manufacture for a precise fit.

Electrodes in connectors are usually made of copper alloys, due to their good conductivity and malleability.[7]:15 Alternatives include brass, phosphor bronze, and beryllium copper. The base electrode metal is often coated with another inert metal such as gold, nickel, or tin.[8] The use of a coating material with good conductivity, mechanical robustness and corrosion resistance helps to reduce the influence of passivating oxide layers and surface adsorbates, which limit metal-to-metal contact patches and contribute to contact resistance. For example, copper alloys have favorable mechanical properties for electrodes, but are hard to solder and prone to corrosion. Thus, copper pins are usually coated with gold to alleviate these pitfalls, especially for analog signals and high reliability applications.[9][10]

Contact *carriers* that hold the parts of a connector together are usually made of plastic, due to its insulating properties. *Housings* or *backshells* can be made of molded plastic or metal.[7]:15

Failure modes[edit]

The majority of connector failures result in intermittent connections or open contacts:[11][12]

Failure mode	Relative probability
Open circuit	61%
Poor contact	23%
Short circuit	16%

Connectors are purely passive components – that is, they do not enhance the function of a circuit – so connectors should affect the function of a circuit as little as possible. Insecure mounting of connectors (primarily chassis-mounted) can contribute significantly to the risk of failure, especially when subjected to extreme shock or vibration.[11] Other causes of failure are connectors inadequately rated for the applied current and voltage, connectors with inadequate ingress protection, and threaded backshells that are worn or damaged.

High temperatures can also cause failure in connectors, resulting in an "avalanche" of failures – ambient temperature increases, leading to a decrease in insulation resistance and increase in conductor resistance; this increase generates more heat, and the cycle repeats.[11]

Fretting (so-called *dynamic corrosion*) is a common failure mode in electrical connectors that have not been specifically designed to prevent it, especially in those that are frequently mated and de-mated.[13] Surface corrosion is a risk for many metal parts in connectors, and can cause contacts to form a thin surface layer that increases resistance, thus contributing to heat buildup and intermittent connections.[14] However, remating or reseating a connector can alleviate the issue of surface corrosion, since each cycle scrapes a microscopic layer off the surface of the contact(s), exposing a fresh, unoxidised surface.

Circular connectors[edit]

Many connectors used for industrial and high-reliability applications are circular in cross section, with a cylindrical housing and circular contact interface geometries. This is in contrast to the rectangular design of some connectors, e.g. USB or blade connectors. They are commonly used for easier engagement and disengagement, tight environmental sealing, and rugged mechanical performance.[15] They are widely used in military, aerospace, industrial machinery, and rail, where MIL-DTL-5015 and MIL-DTL-38999 are commonly specified. Fields such as sound engineering and radio communication also use circular connectors, such as XLR and BNC. AC power plugs are also commonly circular, for example, Schuko plugs and IEC 60309.

NMEA 2000 cabling using M12 connectors

The M12 connector, specified in IEC 61076-2-101, is a circular electrical plug/receptacle pair with 12mm OD mating threads, used in NMEA 2000, DeviceNet, IO-Link, some kinds of Industrial Ethernet, etc.[16][17]

A disadvantage of the circular design is its inefficient use of panel space when used in arrays, when compared to rectangular connectors.

Circular connectors commonly use backshells, which provide physical and electromagnetic protection, whilst sometimes also providing a method for locking the connector into a receptacle.[18] In some cases, this backshell provides a hermetic seal, or some degree of ingress protection, through the use of grommets, O-rings, or potting.[15]

Hybrid connectors[edit]

Hybrid connectors allow the intermixing of many connector types, usually by way of a housing with inserts.[19] These housings may also allow intermixing of electrical and non-electrical interfaces, examples of the latter being pneumatic line connectors, and optical fiber connectors. Because hybrid connectors are modular in nature, they tend to simplify assembly, repair, and future modifications. They also allow the creation of composite cable assemblies that can reduce equipment installation time by reducing the number of individual cable and connector assemblies.

Mechanical features[edit]

Pin sequence[edit]

Some connectors are designed such that certain pins make contact before others when inserted, and break first on disconnection.[1] This is often used in power connectors to protect equipment, e.g. connecting safety ground first. It is also employed for digital signals, as a method to sequence connections properly in hot swapping.

Keying[edit]

Examples of keyed connectors

XLR connector, showing the notch for alignment

A 4-pin Mini-DIN S-Video cable, with notches and a rectangular alignment pin

Many connectors are **keyed** with some mechanical component (sometimes called a *keyway*), which prevents mating in an incorrect orientation.[20] This can be used to prevent mechanical damage to connectors, from being jammed in at the wrong angle or into the wrong connector, or to prevent incompatible or dangerous electrical connections, such as plugging an audio cable into a power outlet.[1] Keying also prevents otherwise symmetrical connectors from being connected in the wrong orientation or *polarity*. Keying is particularly important for situations where there are many similar connectors, such as in signal electronics.[7]:26 For instance, XLR connectors have a notch to ensure proper orientation, while Mini-DIN plugs have a plastic projection that fits into a corresponding hole in the socket (they also have a notched metal skirt to provide secondary keying).[21]

Locking mechanisms[edit]

Some connector housings are designed with locking mechanisms to prevent inadvertent disconnection or poor environmental sealing.[1] Locking mechanism designs include locking levers of various sorts, jackscrews, screw-in shells, push-pull connector, and toggle or bayonet systems. Some connectors, particularly those with large numbers of contacts, require high forces to connect and disconnect. Locking levers and jackscrews and screw-in shells for such connectors frequently serve both to retain the connector when connected and to provide the force needed for connection and disconnection. Depending on application requirements, housings with locking mechanisms may be tested under various environmental simulations that include physical shock and vibration, water spray, dust, etc. to ensure the integrity of the electrical connection and housing seals.

Backshells[edit]

Backshells are a common accessory for industrial and high-reliability connectors, especially circular connectors.[18] Backshells typically protect the connector and/or cable from environmental or mechanical stress, or shield it from electromagnetic interference.[22] Many types of backshells are available for different purposes, including various sizes, shapes, materials, and levels of protection. Backshells usually lock onto the cable with a clamp or moulded boot, and may be threaded for attachment to a mating receptacle.[23] Backshells for military and aerospace use are regulated by SAE AS85049 within the USA.[24]

Hyperboloid contacts[edit]

To deliver ensured signal stability in extreme environments, traditional pin and socket design may become inadequate. Hyperboloid contacts are designed to withstand more extreme physical demands, such as vibration and shock.[20] They also require around 40% less insertion force[25] – as low as 0.3 newtons (1 oz_f) per contact,[26] – which extends the lifespan, and in some cases offers an alternative to zero insertion force connectors.[27][25]

In a connector with hyperboloid contacts, each female contact has several equally spaced longitudinal wires twisted into a hyperbolic shape. These wires are highly resilient to strain, but still somewhat elastic, hence they essentially function as linear springs.[28][29] As the male pin is inserted, axial wires in the socket half are deflected, wrapping themselves around the pin to provide a number of contact points. The internal wires that

form the hyperboloid structure are usually anchored at each end by bending the tip into a groove or notch in the housing.[30]

Whilst hyperboloid contacts may be the only option to make a reliable connection in some circumstances, they have the disadvantage of taking up greater volume in a connector, which can cause problems for high-density connectors.[25] They are also significantly more expensive than traditional pin and socket contacts, which has limited their uptake since their invention in the 1920s by Wilhelm Harold Frederick.[31] In the 1950s, Francois Bonhomme popularised hyperboloid contacts with his "Hypertac" connector, which was later acquired by Smiths Group. During the following decades, the connectors steadily gained popularity, and are still used for medical, industrial, military, aerospace, and rail applications (particularly trains in Europe).[28]

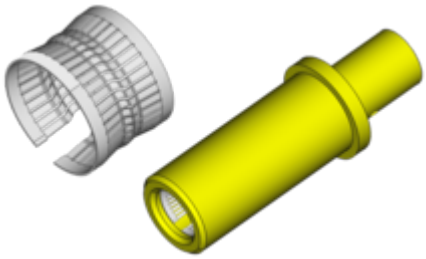
Pogo pins[edit]

Main article: Pogo pin

Pogo pin connectors

Pogo pin or *spring loaded* connectors are commonly used in consumer and industrial products, where mechanical resilience and ease of use are priorities.[32] The connector consists of a barrel, a spring, and a plunger. They are in applications such as the MagSafe connector where a quick disconnect is desired for safety. Because they rely on spring pressure, not friction, they can be more durable and less damaging than traditional pin and socket design, leading to their use in in-circuit testing.[33]

Crown spring connectors[edit]



Typical crown spring plug and its female socket

Crown spring connectors are commonly used for higher current flows and industrial applications. They have a high number of contact points, which provides a more electrically reliable connection than traditional pin and socket connectors.[34]

Methods of connection[edit]

Plug and socket connectors

Male MIL-DTL-5015 plug

Female VGA connector

Male serial port connector

Mating surfaces of a hermaphroditic connector

Whilst technically inaccurate, electrical connectors can be viewed as a type of adapter to convert between two connection methods, which are permanently connected at one end and (usually) detachable at the other end.[7]:40 By definition, each end of this "adapter" has a different connection method – e.g. the solder tabs on a male phone connector, and the male phone connector itself.[3] In this example, the solder tabs connected to the cable represent the permanent connection, whilst the male connector portion interfaces with a female socket forming a detachable connection.

There are many ways of applying a connector to a cable or device. Some of these methods can be accomplished without specialized tools. Other methods, while requiring a special tool, can assemble connectors much faster and more reliably, and make repairs easier.

The number of times a connector can connect and disconnect with its counterpart while meeting all its specifications is termed as *mating cycles* and is an indirect measure of connector lifespan. The material used for connector contact, plating type and thickness is a major factor that determines the mating cycles.[35]

Plug and socket connectors[edit]

See also: Gender of connectors and fasteners and Pinout

Plug and socket connectors are usually made up of a male **plug** (typically pin contacts) and a female **socket** (typically receptacle contacts). Often, but not always, sockets are permanently fixed to a device as in a chassis connector *(see above)*, and plugs are attached to a cable.

Plugs generally have one or more pins or prongs that are inserted into openings in the mating socket. The connection between the mating metal parts must be sufficiently tight to make a good electrical connection and complete the circuit. An alternative type of plug and socket connection uses hyperboloid contacts, which makes

a more reliable electrical connection. When working with multi-pin connectors, it is helpful to have a pinout diagram to identify the wire or circuit node connected to each pin.

Some connector styles may combine pin and socket connection types in a single unit, referred to as a hermaphroditic connector.[6]:56 These connectors includes mating with both male and female aspects, involving complementary paired identical parts each containing both protrusions and indentations. These mating surfaces are mounted into identical fittings that freely mate with any other, without regard for gender (provided that the size and type match).

Sometimes both ends of a cable are terminated with the same gender of connector, as in many Ethernet patch cables. In other applications the two ends are terminated differently, either with male and female of the same connector (as in an extension cord), or with incompatible connectors, which is sometimes called an *adapter cable*.

Plugs and sockets are widely used in various connector systems including blade connectors, breadboards, XLR connectors, car power outlets, banana connectors, and phone connectors.

Jacks and plugs[edit]

Male phone plug

A **jack** is a connector that installs on the surface of a bulkhead or enclosure, and mates with its reciprocal, the **plug**.[36] According to the American Society of Mechanical Engineers,[37] the stationary (more fixed) connector of a pair is classified as a *jack* (denoted J), usually attached to a piece of equipment as in a chassis-mount or panel-mount connector. The movable (less fixed) connector is classified as a *plug* (denoted P),[37] designed to attach to a wire, cable or removable electrical assembly.[38] This convention is currently defined in ASME Y14.44-2008, which supersedes IEEE 200-1975, which in turn derives from the long-withdrawn MIL-STD-16 (from the 1950s), highlighting the heritage of this connector naming convention.[36] IEEE 315-1975 works alongside ASME Y14.44-2008 to define jacks and plugs.

The term *jack* occurs in several related terms:

- The **registered jack** or **modular jack** in RJ11, RJ45 and other similar connectors used for telecommunication and computer networking
- The **telephone jack** of manual telephone switchboards, which is the socket fitting the original $^{1}/_{4}$ inch (6.35 mm) telephone plug
- The $^{1}/_{4}$ inch (6.35 mm) **phone jack** common to many electronic applications in various configurations, sometimes referred to as a *headphone jack*
- The **RCA jack**, also known as a *phono jack*, common to consumer audiovisual electronics
- The **EIAJ jack** for consumer appliances requiring a power supply of less than 18.0 volts

Crimp-on connectors[edit]

A wire and connector being crimped together with a crimping tool

Main article: Crimp (electrical)

Crimped connectors are a type of solderless connection, using mechanical friction and uniform deformation to secure a connector to a pre-stripped wire (usually stranded).[1] Crimping is used in splice connectors, crimped multipin plugs and sockets, and crimped coaxial connectors. Crimping usually requires a specialised crimping tool, but the connectors are quick and easy to install and are a common alternative to solder connections or insulation displacement connectors. Effective crimp connections deform the metal of the connector past its yield point so that the compressed wire causes tension in the surrounding connector, and these forces counter each other to create a high degree of static friction. Due to the elastic element in crimped connections, they are highly resistant to vibration and thermal shock.[39]

Crimped contacts are permanent (i.e. the connectors and wire ends cannot be reused).[40]

Crimped plug-and-socket connectors can be classified as *rear release* or *front release*. This relates to the side of the connector where the pins are anchored:[20]

- **Front release contacts** are released from the front (contact side) of the connector, and removed from the rear. The removal tool engages with the front portion of the contact and pushes it through to the back of the connector.
- **Rear release contacts** are released and removed from the rear (wire side) of the connector. The removal tool releases the contacts from the rear and pulls the contact out of the retainer.

Soldered connectors[edit]

See also: Soldering

Many plug and socket connectors are attached to a wire or cable by **soldering** conductors to electrodes on the back of the connector. Soldered joints in connectors are robust and reliable if executed correctly, but are usually slower to make than crimped connections.[1] When wires are to be soldered to the back of a connector, a backshell is often used to protect the connection and add strain relief. Metal *solder buckets* or *solder cups* are provided, which consist of a cylindrical cavity that an installer fills with solder before inserting the wire.[41]

When creating soldered connections, it is possible to melt the dielectric between pins or wires. This can cause problems because the thermal conductivity of metals causes heat to quickly distribute through the cable and connector, and when this heat melts plastic dielectric, it can cause short circuits or "flared" (conical) insulation.[40] Solder joints are also more prone to mechanical failure than crimped joints when subjected to vibration and compression.[42]

Insulation-displacement connectors[edit]

Main article: Insulation-displacement connector

Since stripping insulation from wires is time-consuming, many connectors intended for rapid assembly use **insulation-displacement connectors** which cut the insulation as the wire is inserted.[1] These generally take

the form of a fork-shaped opening in the terminal, into which the insulated wire is pressed, which cut through the insulation to contact the conductor. To make these connections reliably on a production line, special tools accurately control the forces applied during assembly. On small scales, these tools tend to cost more than tools for crimped connections.

Insulation displacement connectors are usually used with small conductors for signal purposes and at low voltage. Power conductors carrying more than a few amperes are more reliably terminated with other means, though "hot tap" press-on connectors find some use in automotive applications for additions to existing wiring.

A common example is the multi-conductor flat ribbon cable used in computer disk drives; to terminate each of the many (approximately 40) wires individually would be slow and error-prone, but an insulation displacement connector can terminate all the wires in a single action. Another very common use is so-called punch-down blocks used for terminating unshielded twisted pair wiring.

Binding posts on a bi-amplified loudspeaker

Binding posts[edit]

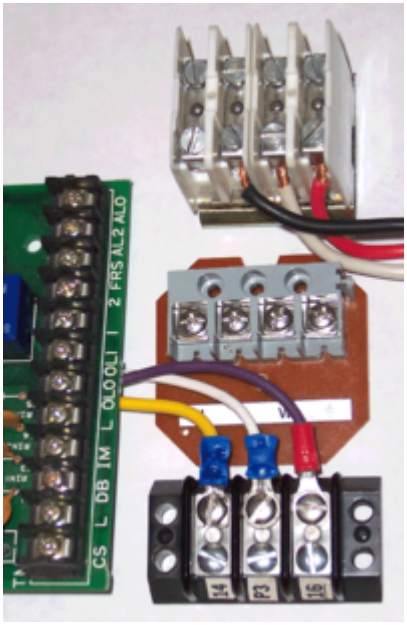
Main article: Binding post

Binding posts are a single-wire connection method, where stripped wire is screwed or clamped to a metal electrode. Such connectors are frequently used in electronic test equipment and audio. Many binding posts also accept a banana plug.

Screw terminals[edit]

Main article: Screw terminal

Screw connections are frequently used for semi-permanent wiring and connections inside devices, due to their simple but reliable construction. The basic principle of all screw terminals involves the tip of a bolt clamping onto a stripped conductor. They can be used to join multiple conductors,[43] to connect wires to a printed circuit board, or to terminate a cable into a plug or socket.[7]:50 The clamping screw may act in the longitudinal axis (parallel to the wire) or the transverse axis (perpendicular to the wire), or both. Some disadvantages are that connecting wires is more difficult than simply plugging in a cable, and screw terminals are generally not very well protected from contact with persons or foreign conducting materials.



Terminal blocks of various types

Terminal blocks (also called terminal *boards* or *strips*) provide a convenient means of connecting individual electrical wires without a splice or physically joining the ends. Since terminal blocks are readily available for a wide range of wire sizes and terminal quantity, they are one of the most flexible types of electrical connector available. One type of terminal block accepts wires that are prepared only by stripping a short length of insulation from the end. Another type, often called *barrier strips*, accepts wires that have ring or spade terminal *lugs* crimped onto the wires.

Printed circuit board (PCB) mounted **screw terminals** let individual wires connect to a PCB through leads soldered to the board.

Ring and spade connectors[edit]

Ring style wire-end crimp connectors

The connectors in the top row of the image are known as **ring terminals** and **spade terminals** (sometimes called fork or split ring terminals). Electrical contact is made by the flat surface of the ring or spade, while mechanically they are attached by passing a screw or bolt through them. The spade terminal form factor facilitates connections since the screw or bolt can be left partially screwed in as the spade terminal is removed or attached. Their sizes can be determined by the gauge of the conducting wire, and the interior and exterior diameters.

Blade connectors[edit]

Blade connectors (lower half of photo). Ring and spade terminals (upper half). Bullet terminals, male and female (right-center, with blue wires)

A **blade connector** is a type of single wire, plug-and-socket connection device using a flat conductive blade (plug) that is inserted into a receptacle. Wires are typically attached to male or female blade connector terminals by either crimping or soldering. Insulated and uninsulated varieties are available. In some cases the blade is an integral manufactured part of a component (such as a switch or a speaker unit), and the reciprocal connector terminal is pushed onto the device's connector terminal.

Other connection methods[edit]

- Crocodile (alligator) clips – conductive clamps used for temporary connections, e.g. jumper cables
- Board to board connectors – e.g. card-edge connectors or FPGA mezzanine connectors
- Twist-on wire connectors (e.g. wire nuts) – used in low-voltage power circuits for wires up to about 10 AWG
- Wire wrapping – used in older circuit boards

See also[edit]

- Adapter
- Bent pin analysis
- Cable gland
- Electrical contacts
- Electrical network
- Electrical splice
- Electrical termination
- Gender of connectors and fasteners
- Lightbulb socket
- Pothead for a termination on a high voltage electric power cable
- Tee connector
- Tube socket
- Wire nut

Connectors[edit]

- AC power plugs and sockets
- Audio and video connector
- Banana connector
- Battery holder
- Battery terminals
- Coaxial power connector

- Computer port (hardware)
- Crocodile clip
- DC connector
- DIN connector
- Dock connector
- D-sub connectors
- Edge connector
- Elastomeric connector
- JST connector
- Mini-DIN connector
- Optical fiber connector
- Phone connector (audio)
- Pin header
- RCA connector
- RJ-XX connector

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- 粵語
- 中文

EXHIBIT
J

URL	https://www.dictionary.com/browse/support
Date captured	November 22th 2021, 2:48:37PM
Last updated	November 22th 2021, 2:48:37PM
Hash	d5a91aaffd81aff32f9972f058023bd5d932b94625381fb96ce94be5118cb172

Elementary Level

support

[*suh*-**pawrt**, -**pohrt**] SHOW IPA

See synonyms for: support / supported / supporting / supports on Thesaurus.com

verb (used with object)

1 to bear or hold up (a load, mass, structure, part, etc.); serve as a foundation for.

2 to sustain or withstand (weight, pressure, strain, etc.) without giving way; serve as a prop for.

3 to undergo or endure, especially with patience or submission; tolerate.

SEE MORE

noun

10 the act or an instance of supporting.

11 the state of being supported.

SEE MORE

adjective

19 (of hosiery) made with elasticized fibers so as to fit snugly on the legs, thereby aiding circulation, relieving fatigue, etc.

OTHER WORDS FOR SUPPORT

3 suffer, bear, stand, stomach.

13 sustenance, subsistence, keep.

See synonyms for *support* on Thesaurus.com

QUIZ

ARE YOU A TRUE BLUE CHAMPION OF THESE "BLUE" SYNONYMS?

We could talk until we're blue in the face about this quiz on words for the color "blue," but we think you should take the quiz and find out if you're a whiz at these colorful terms.

QUESTION 1 OF 8

Which of the following words describes “sky blue”?

navy

beryl

azure

TAKE THE QUIZ TO FIND OUT

ORIGIN OF SUPPORT

First recorded in 1350–1400; (verb) Middle English *supporten,* from Middle French *supporter,* from Medieval Latin *supportāre* “to endure” (Latin: “to convey”), equivalent to *sup-* sup- + *portāre* “to carry” (see port[5]); (noun) Middle English, derivative of the verb

HISTORICAL USAGE OF SUPPORT

The English noun SUPPORT derives from the verb SUPPORT. The verb comes from Middle English *supporten, soport, supporte,* from Anglo-French and Middle French *subporter, supporter,* originally “to suffer patiently, endure,” then “to come to the help of,” and later “to be in favor of, encourage.” The Middle French *subporter* clearly shows its Latin original, *supportāre* (also *subportāre*), which in Latin means only “to transport or carry (supplies) to a place.” The other senses of *supportāre* arose in Medieval Latin. *Supportāre* is a compound verb made up of the preposition and prefix *sub, sub-* (here in the sense “movement or position up close to”) and the simple verb *portāre* “to carry, convey, transport.”

OTHER WORDS FROM SUPPORT

sup·port·ing·ly, adverb
non·sup·port·ing, adjective
pre·sup·port, noun, verb (used with object)
pro·sup·port, adjective

SEE MORE RELATED FORMS

WORDS NEARBY SUPPORT

supply chain, supply-side, supply-side economics, supply-sider, supply teacher, support, supportable, support area, supporter, support group, supporting

WHEN TO USE

What are other ways to say *support*?

To *support* something, as a structure or heavy load, is to bear it or hold it up. To *support* a person is to supply them with things necessary to existence, or to keep their spirits or courage up under trial or affliction. How is *support* different from *maintain*, *sustain*, and *uphold*? Find out on Thesaurus.com.

FEEDBACK

WORDS RELATED TO SUPPORT

backing, aid, assistance, encouragement, loyalty, protection, relief, care, payment, responsibility, subsidy, bolster, hold, reinforce, uphold, encourage, finance, fund, maintain, raise

HOW TO USE SUPPORT IN A SENTENCE

A few of the 3DS variation that were, until recently, *support*ed by Nintendo.
THE END OF THE 3DS MARKS AN INFLECTION POINT FOR PORTABLE GAMING | KYLE ORLAND | SEPTEMBER 17, 2020 | ARS TECHNICA

In the playoffs, calls have been more likely to get the "*support*" ruling than "stands," indicating slightly more confident review decisions.
DON'T BLAME THE REFS FOR ALL OF THESE REPLAY REVIEWS | JARED DUBIN | SEPTEMBER 17, 2020 | FIVETHIRTYEIGHT

It may, Cloudflare has a blog post that shares how you can check your site *support*.
GOOGLEBOT TO SOON CRAWL OVER HTTP/2 | BARRY SCHWARTZ | SEPTEMBER 17, 2020 | SEARCH ENGINE LAND

That's 4 percentage points higher than the 68 percent who *support*ed Hillary Clinton in 2016.
MORE AND MORE AMERICANS AREN'T RELIGIOUS. WHY ARE DEMOCRATS IGNORING THESE VOTERS? | DANIEL

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“Have” vs. “Has”: When To Use Each One


10 Types Of Pronouns And How To Use Them


Understanding Native American Heritage: The Tribes, Languages, And Culture

FEEDBACK

BRITISH DICTIONARY DEFINITIONS FOR SUPPORT

support

/ (səˈpɔːt) /

verb (tr)

1 to carry the weight of

2 to bear or withstand (pressure, weight, etc)

3 to provide the necessities of life for (a family, person, etc)

4 to tend to establish (a theory, statement, etc) by providing new facts; substantiate

SEE MORE

noun

13 the act of supporting or the condition of being supported

14 a thing that bears the weight or part of the weight of a construction

SEE MORE

DERIVED FORMS OF SUPPORT

supportless, adjective

WORD ORIGIN FOR SUPPORT

C14: from Old French *supporter,* from Latin *supportāre* to bring, from *sub-* up + *portāre* to carry

MEDICAL DEFINITIONS FOR SUPPORT

support

[sə-pôrt′]

v.

To bear the weight of, especially from below.

To hold in position so as to keep from falling, sinking, or slipping.

To be capable of bearing; withstand.

To keep from weakening or failing; strengthen.

SEE MORE

n.

The act of supporting.

The state of being supported.

SEE MORE

WORD OF THE DAY

persnickety

adjective | [per-**snik**-i-tee]

SEE DEFINITION

FEEDBACK

OTHERS ARE READING


10 New Dating Slang Words To Know In 2021


The Most Surprisingly Serendipitous Words Of The Day


7 Meaningful Ways To Express Your Gratitude


Wrap Your Head Around These 26 Hard Words To Pronounce

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Attorneys for Plaintiff VPR Brands, LP

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF ARIZONA

VPR Brands, LP, Plaintiff, v. Jupiter Research, LLC, Defendant.	No. CV-20-02185-PHX-DJH **DECLARATION OF ELIEZER LEKHT**

I, Eliezer Lekht, declare and say:

1. I am an attorney of record on the above captioned case.

2. Attached herewith as Exhibit A, is a true and correct copy of U.S. Patent No. 8,205,622 ("'622"), the patent at issue in the above captioned action.

3. Attached herewith as Exhibit B, is a true and correct copy the English translation of the Chinse Patent Application No. 2009100801475 to which the '622 patent claims priority and is incorporated by reference in its entirety.

I declare under perjury under the laws of the United States of America that the

foregoing is true and correct.

Executed on November 22, 2021 at New York, NY.

Dated: November 22, 2021

Respectfully submitted,

/s/ Eliezer Lekht
ELIEZER LEKHT

Exhibit

A

US008205622B2

(12) **United States Patent**
Pan

(10) **Patent No.: US 8,205,622 B2**
(45) **Date of Patent: Jun. 26, 2012**

(54) **ELECTRONIC CIGARETTE**

(76) Inventor: **Guocheng Pan**, Cupertino, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 435 days.

(21) Appl. No.: **12/437,511**

(22) Filed: **May 7, 2009**

(65) **Prior Publication Data**

US 2010/0242974 A1 Sep. 30, 2010

(30) **Foreign Application Priority Data**

Mar. 24, 2009 (CN) 2009 1 0080147

(51) **Int. Cl.**
A24F 47/00 (2006.01)

(52) **U.S. Cl.** **131/273**

(58) **Field of Classification Search** 131/273
See application file for complete search history.

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EP	845220	A1 *	6/1998
WO	WO 2009/152651	A1	12/2009

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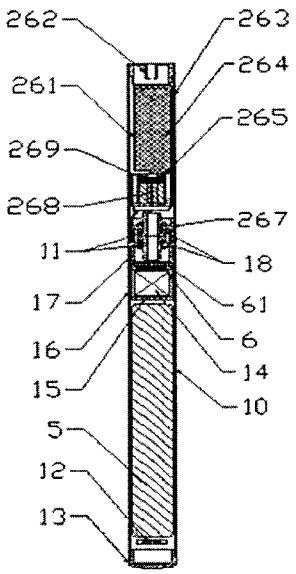
* cited by examiner

Primary Examiner — Matthew Daniels
Assistant Examiner — Cynthia Szewczyk
(74) *Attorney, Agent, or Firm* — Squire Sanders (US) LLP

(57) **ABSTRACT**

An electronic cigarette has two tubes that resemble a cigarette: an electronic inhaler and an electronic atomizer. The two tubes are connected through one or more electric connectors to form an electronic cigarette. Inside the inhaler is a rechargeable or non-rechargeable power source such as a battery, which supplies electric power to the electronic inhaler and atomizer and ensures that both work together like a cigarette. In addition to the power source, the inhaler also includes other major components: an electric airflow sensor to detect air movement generated by a user's inhaling or puffing act and a Single Chip Micyoco which controls the atomization process. The sensor's role is to collect an airflow signal that triggers the Single Chip Micyoco, which in turn instructs the electronic cigarette to supply electric power to the inhaler and atomizer connected through an electric connector. Inside the electronic atomizer are an electric connector, electric heating wire, liquid container, and atomizer cap with an air-puffing hole. The user inhales through the air-puffing hole at an end of the electronic cigarette to create an air inflow, which triggers the atomization process. The Single Chip Micyoco driven by a software program controls the electronic cigarette in an on/off manner according to the signal detected by the electric sensor on the airflow and completes a cycle of atomization, which converts a solution of a liquid form inside the liquid container to a gas form. This entire process achieves the emulated smoking process of a user, who is satisfied with scent taste that mimics cigarette smoking.

18 Claims, 7 Drawing Sheets



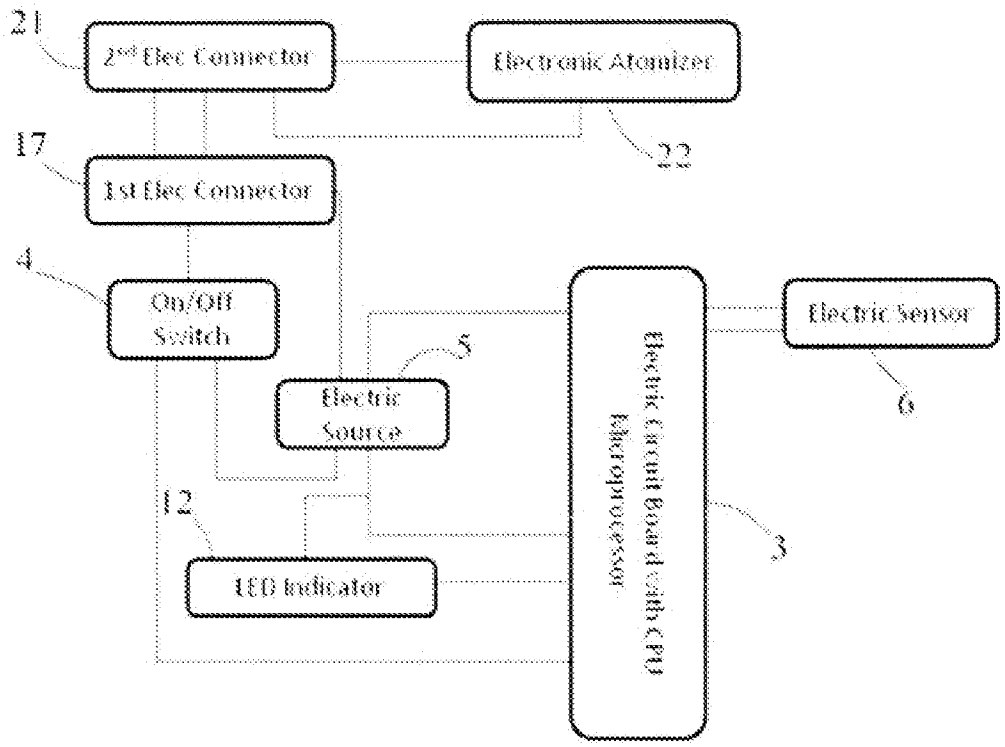

21
2nd Elec Connector
Electronic Atomizer
22
17
1st Elec Connector
4
On/Off Switch
5
Electric Source
12
LED Indicator
Electric Circuit Board with CPU Microprocessor
3
Electric Sensor
6

Figure 1

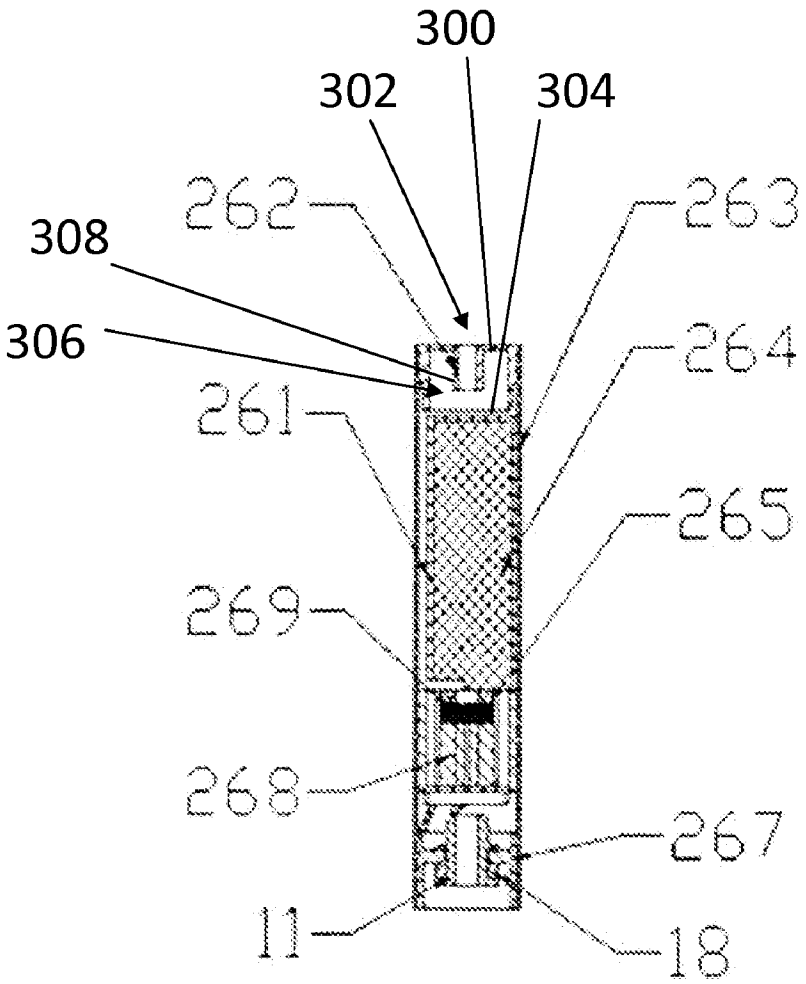


Figure 2

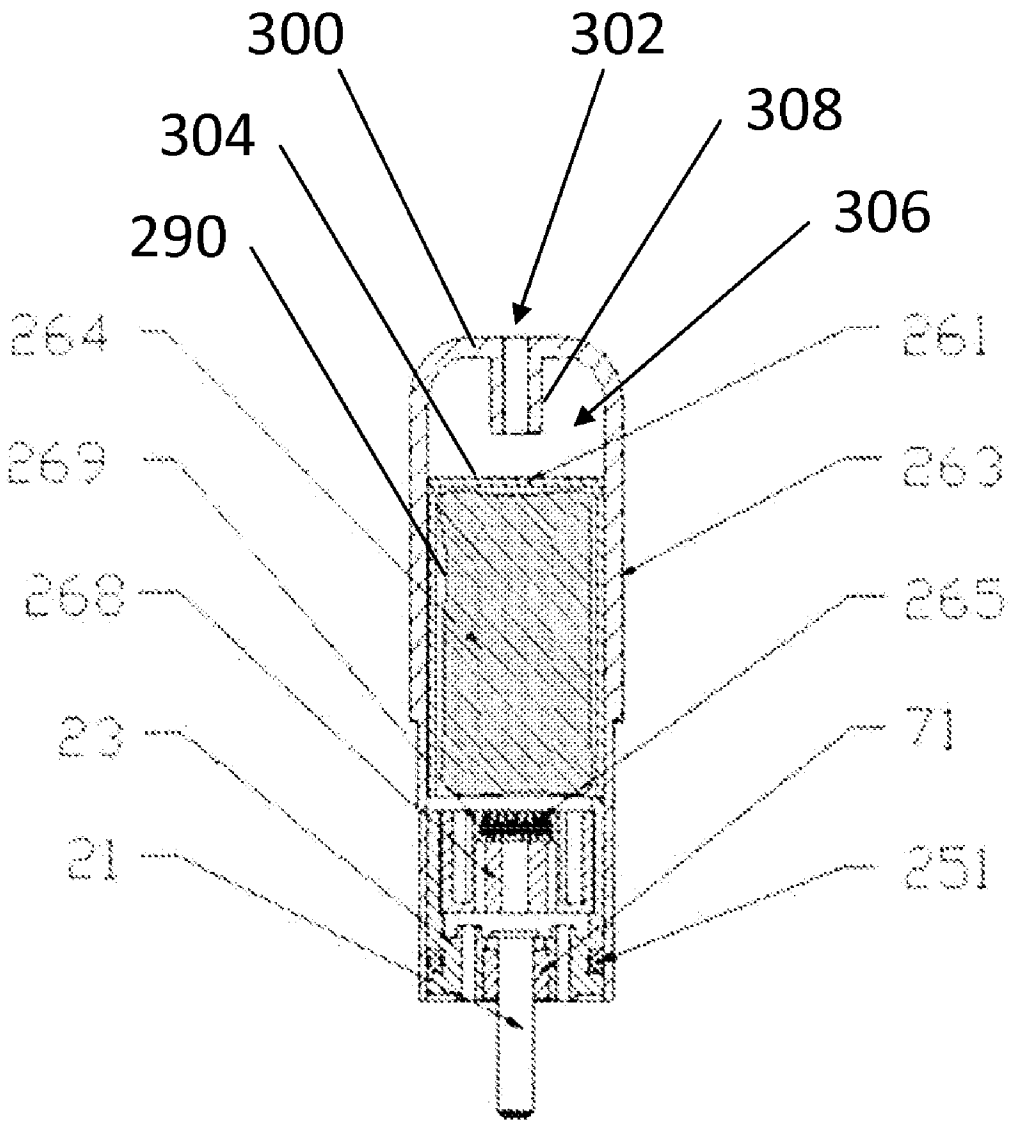


Figure 3

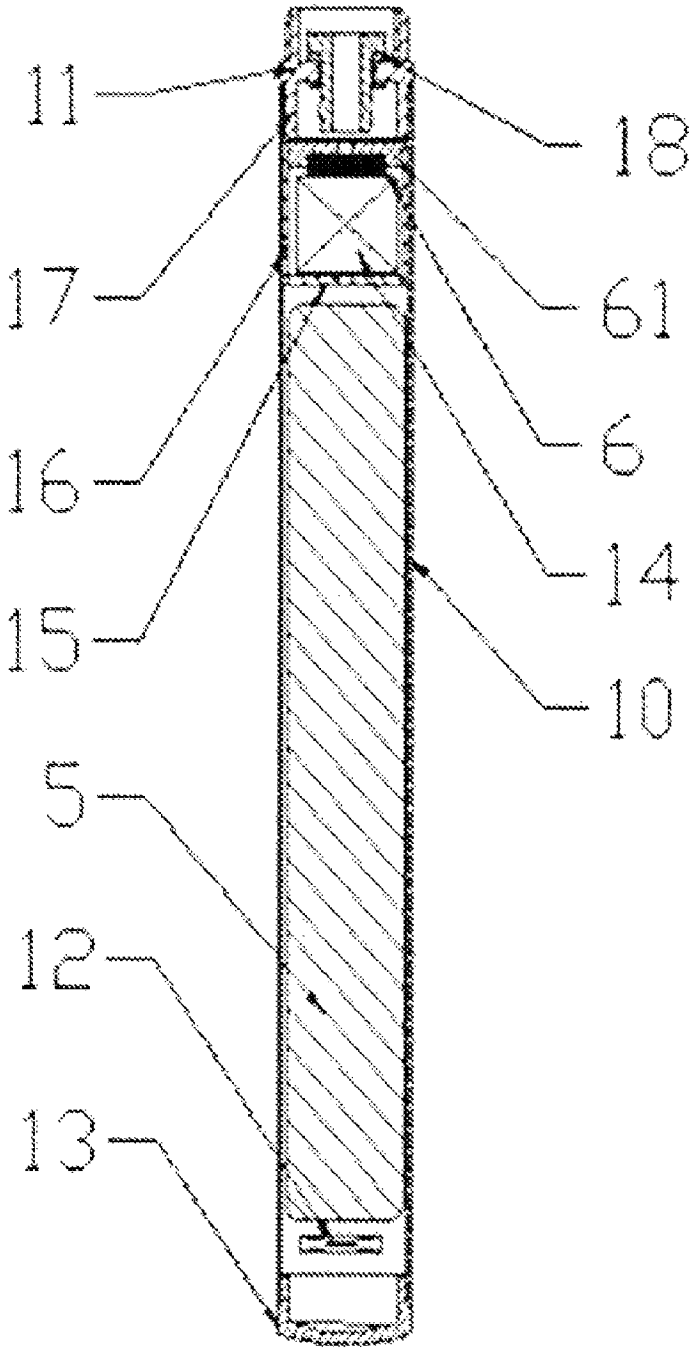


Figure 4

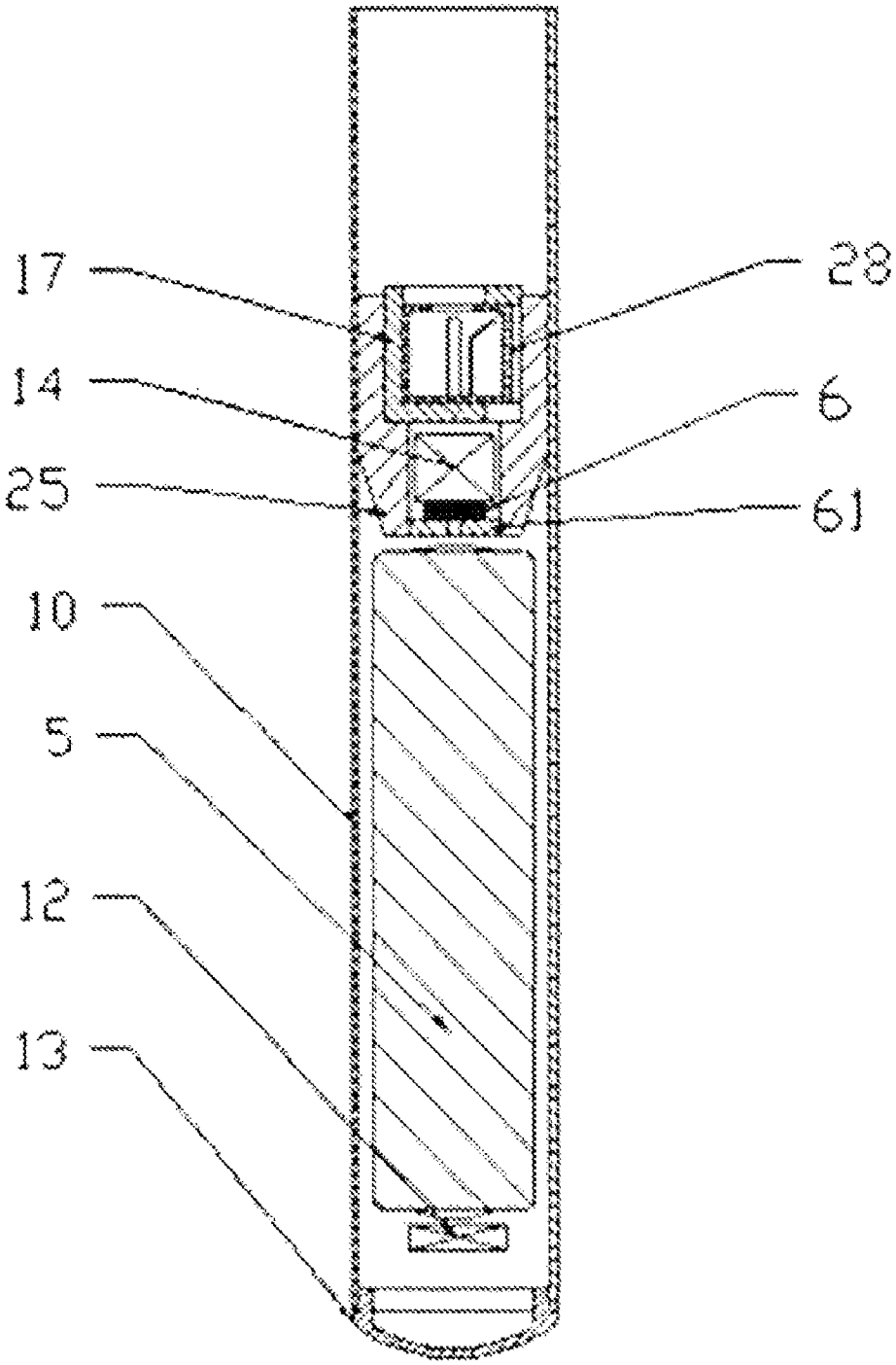


Figure 5

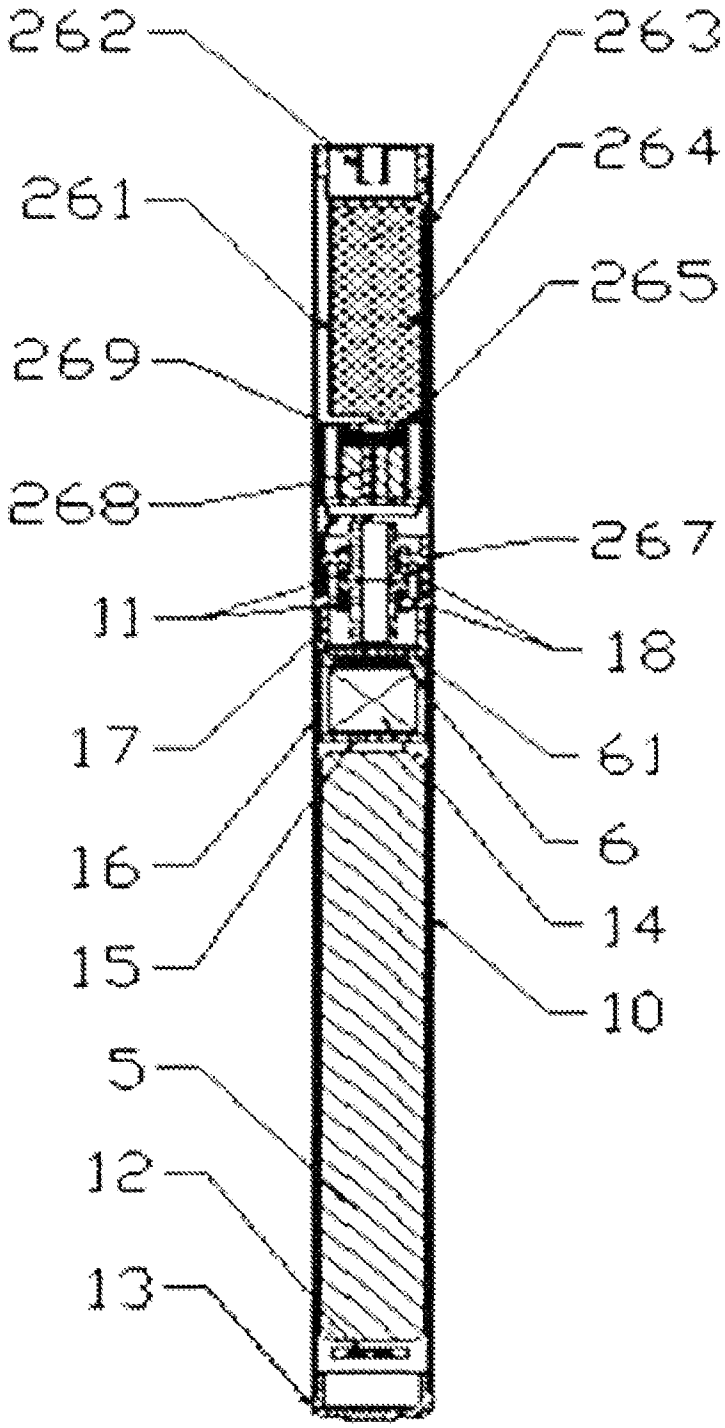


Figure 6

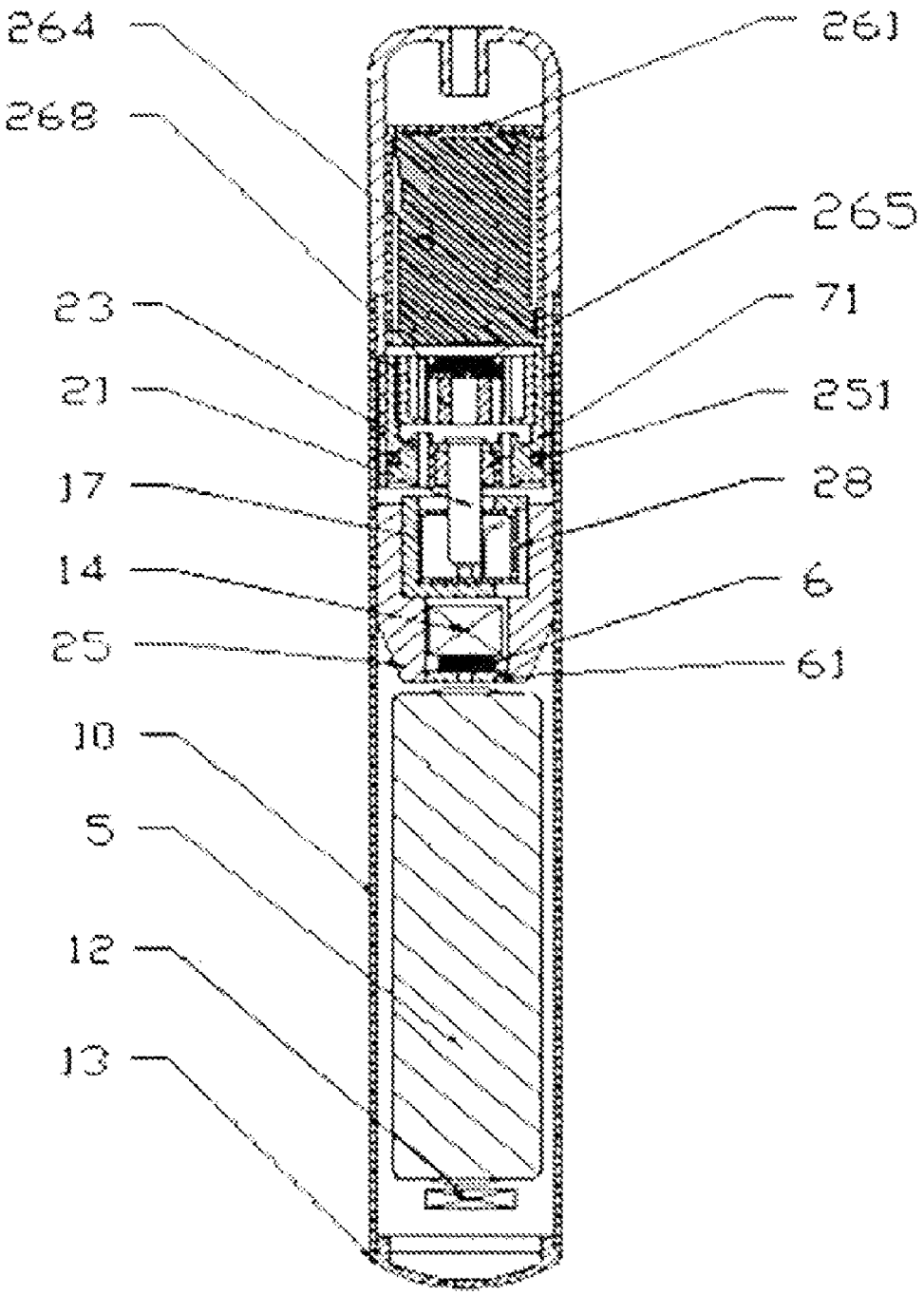


Figure 7

ELECTRONIC CIGARETTE

This application claims the priority of Chinese Patent Application No. 200910080147.5, filed Mar. 24, 2009, the entire disclosure of which is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to an electronic cigarette.

BACKGROUND OF THE INVENTION

Tobacco smoking creates one of the most serious health threats to the mankind. Although people have used tobacco for centuries, cigarettes did not appear in the mass-manufactured form until the 19th century. Today, the number of smokers has grown to over 1.3 billion worldwide. In the high-income countries, smoking has been in overall decline for decades, although it continues to rise in some groups. In low- and middle-income countries, by contrast, cigarette consumption has been increasing. Death directly related to the use of tobacco is estimated to be at least 5 million people annually. If every tobacco user smoked one pack a day, there would be a total of 1.3 billion packs of cigarettes smoked each day, emitting a large amount of harmful tar, CO and other more than 400 gas contents to homes and offices, causing significant second-hand smoking damages to human health.

Nicotine is highly addictive. Tar in cigarettes increases smoker's risk of lung cancer, emphysema, and bronchial disorders. The carbon monoxide in smoke increases the chance of cardiovascular diseases. Secondhand smoke causes lung cancer in adults and greatly increases the risk of respiratory illnesses in children. It is hard to quit smoking. In order to overcome these problems, people have invented many new technologies and products, such as nicotine patches, nicotine gum, etc. Recently, several new inventions have been made, including a Japanese patent (#3-232481), which proposes a simulated cigarette device with an insulated tube, inside which a heated generator and solid scent media are stored. Through an electric power source, the heat generator supplies heat to the scent media to generate an odor which is then absorbed to ease smokers' need for cigarette smoking. However, this simulated cigarette device requires a long time to reach a temperature high enough to generate the scent odor for users. Hence, this tool does not meet smokers' need.

A Chinese patent (#03111582.9) proposes a non-flammable atomizing electronic cigarette, which is intended to be a smoking cessation device and a replacement for conventional cigarettes. This product includes a shell, battery, high-frequency generator, nicotine-fluid chamber, controlling circuit, display screen, electronic inductor, body-contact transducer, piezoelectricity supersonic atomizer, and high-temperature air emitter. It also includes an electrically-controlled pump, metering valve, unidirectional injection valve, etc. Due to its extreme complexity in structure and very high manufacturing cost, this kind of electronic cigarettes is difficult to commercialize.

Another Chinese patent (#ZL200410048792.6) proposes an electronic cigarette, which has a stick-like shell, air-puffing hole, emitting device, pressure-modifying driver, control device, detection device, and smoke generator. This invention uses the control device to drive the emitting device to eject liquid drops generated from scent media outside of the shell. This invention also contains an atomizing device inside the shell, which vaporizes the liquid drops into vapor mists to be inhaled by the user by puffing through the smoke-flow hole at an end of the shell. This inhaling allows the user to absorb the scent-media in a vapor form together with the airflow inside the shell. In this way, the user is satisfied with a scent taste that mimics cigarette smoking.

In sum, the existing electronic cigarette devices have several major drawbacks: (1) too complex to be implemented as an ordinary consuming product and too costly for manufacturing and maintenance; (2) all having problems such as fluid leaking, reversal, nicotine-liquid exposing, discontinuous vaporizing, hard inhaling, and sub-standard sanitation; (3) all using mechanical devices as an airflow detector, which has a short life and is too sensitive to outside temperature and humidity changes.

SUMMARY OF THE INVENTION

An electronic cigarette described and claimed in this patent application overcomes at least some of the above-described problems associated with the prior art.

An object of this invention is to provide a green alternative to harmful, polluting conventional cigarettes and to overcome at least some of the above-described problems associated with prior electronic cigarettes.

This invention adopts a brand new technical solution to create a device that highly resembles a conventional cigarette and the cigarette smoking process. An electronic cigarette of the present invention preferably is comprised of two parts, one being an electronic inhaler and the other being an integrated electronic atomizer. Each part may have a metal or plastic tube, and the two tubes may have an identical or similar diameter. The inhaler preferably includes one or more of an electric power source, electric sensor, single chip micyoco, and LED indicator. The electric power source, which can be a rechargeable or non-rechargeable battery, supplies electricity to the atomizer to vaporize a liquid inside an atomizer chamber. On the first end of the inhaler tube may be a cigarette cap with a small hole for airflow. On the second end of the tube may be an electric connector with either outskirt screw thread or a DC socket.

The electronic atomizer may include a liquid-container or a chamber inside the atomizer tube, which preferably also includes a heat equalizer that has an electric heat wire, a supporting piece which holds up the heat equalizer, and an electric connector. On the first end of the atomizer tube may be a cap with an air-puffing hole for the user to draw an airflow and for the emission of vapor mist. On the second of the atomizer tube may be an electric connector with either internal screw thread or a DC plug.

In a preferred embodiment, the connection between the electronic inhaler and electronic atomizer through the connectors on both parts forms an entire electronic cigarette. When the user puffs on the electronic cigarette through the air-puffing hole on the first end of the atomizer, the electronic sensor detects an airflow and converts it to a signal, which then wakes up the single chip micyoco to record the signal. The single chip micyoco guided by its embedded software instructions may turn on the electric power source to supply an electricity current with a predefined time length. This electric current preferably flows through the electric heat wire inside the atomizer tube, which then heats up the heat equalizer with absorbed liquid from the liquid-container. The heated equalizer converts the liquid into a form of vapor mist, which is finally drawn into the month of the user. This completes an entire cycle of vaporizing process from which the user gets satisfaction of "smoking."

One of the unique technical advances in this invention is the integrated atomizer technology. Previous atomizing units are directly embedded into the inhaler tubes, while the liquid

chamber is made as a separate piece, which must be inserted into the atomizing chamber before the electronic cigarette can be used. This old technology has several major drawbacks: (1) inconvenient in using the electronic cigarette, (2) insanitary and even unsafe to users due to the direct exposure of liquids, and (3) a short life for the atomizing unit. The integrated atomizer of the present invention is an integrated and disposable part, which overcomes some or all of the problems stated above. In addition, the integrated atomizer technology has also minimized the likelihood of a liquid leak, liquid reversal to the month when the user puffs on the electronic cigarette, and discontinuous vaporizing problems.

Another technical advance of the integrated atomizer is the material of the heat equalizer, which plays the key role in ensuring of large vapor volumes and the elimination of the disconnected vaporization problem. This material of the heat equalizer, which may be made of a non-toxic inorganic material, is required to withstand a high temperature up to 2000 degrees centigrade.

The electronic inhaler of the present invention represents the state-of-the-art electronic cigarette technology in both structural design and microelectronic devices. One of the new technologies that may be used with an electronic cigarette of the present invention is the use of an electric airflow sensor instead of a mechanical device in detecting an airflow generated by the user's puffing and creating a signal for the microprocessor to activate the electric circuit. Once the circuit is activated, the electric power source sends an electric current to the system and the connected integrated atomizer, and the vaporizing process begins. When the puffing stops, the microprocessor instructs the electric power source to stop supplying the electricity current, and the vaporizing process stops.

This new technology provides a solution to the problems of the current inhaling technology by eliminating aging and short-life drawbacks of the current mechanical device technology. Moreover, the new technology also makes the puffing of users on the cigarette much easier and smoother. It is more sensitive in turning on and off the vaporizing process than the conventional mechanical system. The life of an electric sensor can last for five years, many times longer than the mechanical device.

The new electronic inhaler may also adopt a new technology of a protection board, which protects the inhaler from damage of a short-circuit event. Since use of electric connectors between the inhaler and atomizing units, there is always a likelihood of a short-circuit, which usually destroys some of the electric components on the circuit board, and sometime even destroys the electric power source—the battery. Incorporation of the protection unit completely eliminates short-circuit problems, and extends the life of the electronic inhaler.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an electric circuit structure of an embodiment of the present invention.

FIG. **2** is a section view of an integrated electronic atomizer of the present invention.

FIG. **3** is a section view of another integrated electronic atomizer of the present invention.

FIG. **4** is a section view of an electronic inhaler of the present invention.

FIG. **5** is a section view of another electronic inhaler of the present invention.

FIG. **6** is a section view of an electronic cigarette of the present invention.

FIG. **7** is a section view of another electronic cigarette of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. **1**, the electric power source **5** supplies an electric current to the electronic atomizer **22** and other electric units to heat up the heat equalizer through the connected electronic inhaler and atomizer **22** through the first electric connector **17** of the inhaler and the second electric connector **21** of atomizer **22**. The electric sensor **6** plays the role of detecting the airflow resulted from the puffing action of a user, and wakes up the single chip micyoco **3** to turn on the electricity on/off switch **4** and generate an electric current form the electric power source **5** to the electronic atomizer **22** for vaporizing of a liquid inside the liquid chamber inside the atomizer **22**. The single chip micyoco **3** instructs the electric power source **5** to supply electricity to the system by its embedded computer programs when a signal is generated through the airflow detected by the electric sensor **6** from the user's puffing action.

The LED indicator **12**, which is connected to both the CPU processor **3** and electric power source **5**, lights up when the electric current flows and it is turned off when the electric current stops flowing. The magnitude of the electric current supplied from the electric power source **5** depends on the magnitude of signal detected from the airflow proportional to the strength of user's puffing action. This, in turn, controls the temperature and heat generated through the electric heating wire and heat equalizer. This process closely mimics the process of cigarette smoking.

FIG. **2** shows a section view of one integrated electronic atomizer of the present invention with the second electric connector being of the screw thread type. The electronic atomizer includes an atomizer tube **263** and, inside the atomizer tube **263**, a second electric connector **267** with an internal screw thread with a rush pith **11** surrounded by a silica-gel insulator **18**, supporting piece **268**, heat equalizer **269** twined with electric heating wire **265**, liquid container **261** inside which liquid-storing media **264** being filled with liquids is inserted, and an atomizer cap **262** with an air-puffing hole in the center. Between the liquid container **261** and the liquid media **264** there preferably is a side-space **290** (FIG. **3**) for airflow. The second electric connector **267** may be inserted inside the atomizer tube **264**.

The atomizer tube **263** is preferably made of a metallic or plastic material. The liquid-storing media **264** is preferably made of specially-designed cotton, while the supporting piece **268** is preferably made of a ceramic or plastic material in the shape of a cylinder or another configuration, which may be able to sustain a high temperature up to 1000 degrees centigrade. The heat equalizer **269** is preferably made of a special fiber which can withstand temperature as high as 2000 degrees centigrade. The electric heating wire **265** twined on the heat equalizer **269** can be made from tungsten or another electric heating material, which produces heat when the electric current flows therethrough. The two ends of the electric heating wire **265** are going through the small holes of the supporting piece **268** and connected to the second electric connector **267** to supply heat for atomization or vaporization of the liquid inside the liquid-storing media **264**.

FIG. **3** is a section view of another integrated electronic atomizer with the second electric connector **21** being of a DC plug-socket type. The electronic atomizer includes an atomizer tube **263** and, inside the atomizer tube **263**, a second electric connector comprised of a DC plug **21** located on a

plug seat **71**, leak-proof piece **23**, seal washer **251**, supporting piece **268**, heat equalizer **269** twined with an electric heating wire **265**, liquid container **261** inside which liquid-storing media **264** being filled with liquids is inserted, and an air-puffing hole in the center of one end of the atomizer tube **263**. In FIG. **3**, the air-puffing hole is placed atop the atomizer tube **263**.

FIG. **4** is a section view of one electronic inhaler having a first electric connector of a screw thread type. The electronic inhaler includes an inhaler tube **10**, cigarette cap **13** with small holes for air inflow, LED indicator **12**, electric power source **5**, annular tube **16** with its cap **15**, integrated circuit board with a CPU processor **14**, electric airflow sensor **6**, sensor supporter **61**, and first electric connector **17** with an inserted rush pith **11** surrounded by a silica-gel insulator **18**.

The electric power source **5** connects to the circuit board **14**, which connects to the first electric connector **17** and the electric airflow sensor **6**. The LED **12** is connected to both electric power source **5** and the circuit board **14**. The electric airflow sensor **6** is assembled onto the sensor supporter **61**. The first electric connector **17** with an outskirt screw thread is partially embedded in the inhaler tube **10**, which can be connected to the second electric connector of the electric atomizer to form an electronic cigarette.

The inhaler tube **10** is made of either a metal or a plastic. The electric power source **5** may be a battery of rechargeable or non-rechargeable type. The first electric connector is generally made of copper or another metal conductor.

FIG. **5** is a section view of another electronic inhaler having a first electric connector **17** of a DC plug-socket type. The electronic inhaler includes an inhaler tube **10**, cigarette cap **13** with small holes for air inflow, LED indicator **12**, electric power source **5**, seal piece **25**, sensor supporter **61**, electric airflow sensor **6**, integrated circuit board with a CPU processor **14**, and the first electric connector **17** located on the DC socket seat **28**.

The electric power source **5** connects to the circuit board **14**, which connects to the first electric connector **17** and the electric airflow sensor **6**. The LED **12** is connected to both electric power source **5** and the circuit board **14**. The electric airflow sensor **6** is assembled onto the sensor supporter **61**. The first electric connector **17** with the socket seat **28** is completely embedded in the inhaler tube **10**, which can be connected to the second electric connector of the electric atomizer to form an electronic cigarette.

The inhaler tube **10** is made of either a metal or a plastic. The electric power source **5** may be a battery of rechargeable or non-rechargeable type. The first electric connector is generally made of copper or another metal conductor.

FIG. **6** is a section view of one electronic cigarette when the electronic inhaler and electronic atomizer are connected via their respective electric connectors of the screw thread type. The electronic inhaler and the integrated electronic atomizer are fit together through their connectors of the same type to form the electronic cigarette. The connection is done via the first electric connector **17** of the electronic inhaler and the second electric connector **267** of the integrated electronic atomizer. The connection achieves the electric combination of the inhaler tube and the atomizer tube, each of which has a circular cross section in this embodiment, wherein the diameter is the inhaler is the same as or similar to that of the atomize. The user puffs on the end of the electronic cigarette with the air-puffing hole to activate the CPU processor through detection of an airflow signal and generate an electric current flowing through the electric heating wire, which achieves vaporization of the solution inside the liquid container.

FIG. **7** is a section view of another electronic cigarette when the electronic inhaler and electronic atomizer are connected via the electric connectors of the DC plug-socket type. The electronic inhaler and the integrated electronic atomizer are fit together through their connectors of the same type to form the electronic cigarette. The connection is done through the first electric connector socket **28** of the electronic inhaler and the second electric connector plug **21** of the integrated electronic atomizer. The connection achieves the electric combination of the inhaler tube and the atomizer tube, each of which has a circular cross section in this embodiment, wherein the diameter is the inhaler is the same as or similar to that of the atomizer. The user puffs on the end of the electronic cigarette with the air-puffing hole to activate the CPU processor through detection of an airflow signal and generate an electric current flowing through the electric heating wire, which achieves vaporization of the solution inside the liquid container.

Referring to FIGS. **2** and **3**, the tubular electronic atomizer includes exterior wall **300** having air-puffing hole **302** formed therethrough. Liquid container **261** includes a container wall **304**. Chamber **306** is disposed between exterior wall **300** and container wall **304**. Tube **308** extends from air-puffing hole **302** and into chamber **306**.

The invention claimed is:

1. An electronic cigarette comprising a tubular electronic inhaler and a tubular electronic atomizer that is detachably attached to the electronic inhaler, wherein the electronic inhaler includes an electric power source that provides an electric current to the electronic atomizer, and wherein the tubular electronic atomizer includes a container and media within the container, the media is soaked with a solution to be atomized, and between the container and the media there is a side-space for airflow tubular electronic, and wherein the tubular electronic inhaler includes an electric airflow sensor configured to turn on and off the electric power source by way of detecting an airflow, and the airflow sensor is a diaphragm microphone.

2. The electronic cigarette of claim **1**, wherein the electronic inhaler includes a first electric connector disposed at a second end of the electronic inhaler, wherein the electronic atomizer includes a second electric connector disposed at a first end of the electronic atomizer, and wherein the first electric connector is connected to the second electric connector so that the electronic inhaler and the electronic atomizer form the electronic cigarette.

3. The electronic cigarette of claim **1**, wherein the liquid container prevents or reduces liquid leak and reverse flow.

4. The electronic cigarette of claim **3**, wherein the electronic atomizer includes an electric heating wire which generates heat for atomization of the solution soaked in the media inside the liquid container, a heat equalizer onto which the electric heating wire is wired and is made of fibers that can withstand a temperature up to 2000 degrees centigrade, wherein the heat equalizer ensures that the heat generated by the electric wire is uniform, and a supporting piece that is disposed next to the heat equalizer and is made of a plastic or ceramic material that can withstand a temperature up to 2000 degrees centigrade.

5. The electronic cigarette of claim **4**, wherein the electronic atomizer includes a leak-proof member, wherein the leak-proof member and a second electric connector are closer to the first end of the electronic atomizer than the heat equalizer.

6. The electronic cigarette of claim **5**, where the first electric connector is a DC socket and the second electric connector is a DC plug, wherein the DC plug is embedded onto the

leak-proof piece through a plug seat, which is connected to the electric heating wire, and wherein the first end of the electronic atomizer is connected to the second of the electronic inhaler by placing the DC plug to the DC socket.

7. The electronic cigarette of claim **6**, wherein the first electric connector is a cylinder terminal, and its outskirt is tightly embedded into the second end of the electric inhaler tube and its exposed portion has a screw thread, wherein the second electric connector is a cylinder terminal, which is tightly embedded into the first end of the electronic atomizer and has a screw thread inside the inhaler tube, and wherein the first electric connector and second electric connector are connected through the screw threads.

8. The electronic cigarette of claim **1**, wherein the electronic atomizer includes, in sequence, a second electric connector, a leak-proof piece, a supporting piece, a heat equalizer coupled with an electric heating wire, the container filled with the media, and an atomizer cap with an air-puffing hole.

9. The electronic cigarette of claim **1**, wherein the electric power source is inside the electronic inhaler.

10. The electronic cigarette of claim **1**, wherein the tubular electronic atomizer includes an exterior wall having an air-puffing hole formed therethrough, wherein the liquid container includes a container wall, there being a chamber disposed between the exterior wall and the container wall, and wherein the tubular electronic atomizer includes a tube extending from the air-puffing hole and into the chamber.

11. The electronic cigarette of claim **1**, wherein the media comprises cotton.

12. An electronic cigarette comprising a tubular electronic inhaler and a tubular electronic atomizer, wherein the electronic inhaler includes an electric power source that provides an electric current to the electronic atomizer, the electronic cigarette further comprising an integrated circuit board that has a Single Chip Micyoco that controls atomization of a liquid solution.

13. An electronic cigarette comprising a tubular electronic inhaler and a tubular electronic atomizer, wherein the electronic inhaler includes an electric power source that provides an electric current to the electronic atomizer, the electronic cigarette further comprising an electric airflow sensor that is used to turn on and off the electric power source by way of detecting an airflow and sending a signal to a Single Chip Micyoco, wherein the Single Chip Micyoco receives the signal from the electric airflow sensor, instructs the electric power source to send an electric current to the electronic atomizer, and a time period and a magnitude of the electric current.

14. The electronic cigarette of claim **13**, wherein the electric airflow sensor is a diaphragm microphone.

15. The electronic cigarette of claim **13**, further comprising an LED indicator inside the electronic inhaler, wherein the LED indicator is connected to the Single Chip Micyoco and the electric power source, and wherein the on time of the LED indicator is controlled by the Single Chip Micyoco.

16. An electronic cigarette comprising a tubular electronic inhaler and a tubular electronic atomizer, wherein the electronic inhaler includes an electric power source that provides an electric current to the electronic atomizer, wherein the electronic inhaler includes, sequentially from a first end of the electronic inhaler to the second end, a cigarette cap, an LED indicator, the electric power source, an electric airflow sensor, a circuit board for a Single Chip Micyoco, and a first electric connector.

17. An electronic cigarette comprising:

a tubular electronic inhaler; and

a tubular electronic atomizer that is detachably attached to the electronic inhaler,

wherein the electronic inhaler includes an electric power source that provides an electric current to the electronic atomizer,

wherein the tubular electronic atomizer includes a container and media within the container, the media is soaked with a solution to be atomized,

wherein the tubular electronic atomizer includes an exterior wall having an air-puffing hole formed therethrough, wherein the liquid container includes a container wall, there being a chamber disposed between the exterior wall and the container wall,

wherein the tubular electronic atomizer includes a tube extending from the air-puffing hole and into the chamber, and

wherein the tubular electronic inhaler includes an electric airflow sensor configured to turn on and off the electric power source by way of detecting an airflow, and the airflow sensor is a diaphragm microphone.

18. The electronic cigarette of claim **17**, wherein the tubular electronic atomizer includes, in sequence, an electric connector, a leak-proof piece, a supporting piece, a heat equalizer coupled with an electric heating wire, the container filled with the media, and the air-puffing hole.

* * * * *

EXHIBIT B

State Intellectual Property Office of the People's Republic of China

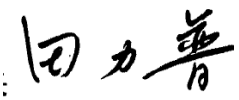
Certificate

Attached to this certificate is a copy of the following patent application submitted to the Office.

Application date:	March 24, 2009
Application number:	200910080147.5
Type:	Patent for Invention
Title:	A Highly Simulated Electronic Cigarette
Applicant:	Beijing GreenWorld Technologies Co., Ltd.
Inventor or designer:	Pan Guocheng

The People's Republic of China

Director of State Intellectual Property Office:


(Tian Lipu)

May 08, 2009

Claims

1. A highly simulated electronic cigarette comprising: a housing shaped like a cigarette and a power unit, an electronic vaporizer and an electronic inhaler in the housing, wherein the power unit supplies electrical current to the electronic vaporizer for vaporizing; and characterized by comprising further: an electronic sensor that is sensitive to a suction action of a user and can generate a triggering signal corresponding to the speed of a suction air flow for triggering a central processing unit (CPU);

wherein the CPU, after receiving the triggering signal from the electronic sensor, regulates the power supplied to the electronic vaporizer by modulating the output electrical current with an electronic switch, which is controlled by an intelligent program stored in the CPU based on the strength of the triggering signal.

2. The highly simulated electronic cigarette of claim 1 characterized by the housing, as in it a LED indicator is also equipped and the LED indicator is connected to the CPU and power unit respectively in a way that brightness of the LED indicator matches the strength of the triggering signal.

3. The highly simulated electronic cigarette of claim 2 characterized by the housing, as it has two parts, of which the front end houses the electronic vaporizer and the rear end houses the electronic inhaler, in which a cigarette cap, the LED indicator, the power unit, the circuit board on which the electronic sensor and CPU are installed and a first electrical connector are arranged one by one from the rear end to the front end and the power unit is connected to the first electrical connector through an electronic switch.

4. The highly simulated electronic cigarette of claim 3 characterized by the front end housing of the electronic vaporizer, as in it a second electrical connector and the electronic vaporizer are equipped and the first electrical connector and the second electrical connector are connected electrically and the second electrical connector and the electronic vaporizer are connected electrically.

5. The highly simulated electronic cigarette of claim 4 characterized by the electronic vaporizer comprising:

a housing for the vaporizer;

an embedded part of the vaporizer equipped in the housing for the vaporizer with liquid storage element in it for absorbing or storing nicotine solution to be vaporized;

a liquid vaporizing element connected electrically to the second electrical connector and in the liquid vaporizing element a venting hole is equipped for generating vapor after electrical heating;

an upper cap of the electronic vaporizer embedded to the upper end of the housing for the vaporizer and a venting hole is equipped on the upper cap for sealing as well as preventing back flow of the nicotine solution.

6. The highly simulated electronic cigarette of claim 5 characterized by the liquid

vaporizing element comprising:

a heating device made of tungsten filament for generating heat;

a heat spreader for evenly distributing heat from the heating device, which is located in the heat spreader, which is made of heat resistant material capable of enduring a temperature from 100 ℃ to 3000 ℃ and is fitted in the housing for the vaporizer;

a bracket for the heating device sleeves the heating device and is made of heat resistant organic or inorganic material capable of enduring a temperature from 100 ℃ to 3000 ℃.

7. The highly simulated electronic cigarette of claim 5 or 6 characterized by comprising further: a leakproof device, in which the liquid vaporizing element is equipped, and the leakproof device is tightly fitted to the housing for the vaporizer.

8. The highly simulated electronic cigarette of claim 7 characterized by the first electrical connector, which is a socket, and the second electrical connector, which is a plug, and the plug is embedded into the leakproof device with a plug base, which is connected electrically to the heating device; the socket and plug are connected by inserting and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

9. The highly simulated electronic cigarette of claim 4, 5 and 6 characterized by the first electrical connector as a lower terminal, which is a cylindrical terminal, part of which is embedded from the outer edge into the rear end housing of the electronic inhaler to fit tightly and the exposed outer edge is equipped with external threads;

the second electrical connector as a upper terminal, which is a cylindrical terminal, is tightly fitted to inner wall of the upper end of the electronic vaporizer, and is equipped with inner threads;

the lower terminal and upper terminal are connected by threads and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

10. The highly simulated electronic cigarette of claim 7 characterized by the first electrical connector, which is a plug, and the second electrical connector, which is a socket, and the socket is embedded into the leakproof device and is connected electrically to the heating device; the socket and plug are connected by inserting and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

11. The highly simulated electronic cigarette of claim 4, 5 and 6 characterized by the first electrical connector as a lower terminal, which is a cylindrical terminal, which is tightly fitted to inner wall of the lower end of the upper housing of the electronic vaporizer and has inner threads;

the second electrical connector as an upper terminal, which is a cylindrical terminal, part of which is embedded from the outer edge into the rear end housing of the

electronic inhaler to fit tightly and the exposed outer edge is equipped with external threads;

the lower terminal and upper terminal are connected by threads and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

Description

A highly simulated electronic cigarette

Technical Field

The invention relates to an electronic cigarette, particularly, a highly simulated electronic cigarette with health benefits.

Background Art

Nicotine, which is an active ingredient in a cigarette, can be absorbed rapidly by the human body after it enters pulmonary alveoli together with a lot of tar aerosol droplets produced in the burning cigarette during smoking. By acting on the receptors of the smoker's central nervous system, it can make him/her relax and enjoy an inebriety similar to that produced by an exhilarant. Nicotine is a kind of alkaloid with low molecular weight. A small dose of nicotine is essentially harmless to human body considering its quite short half-life in blood. The major harmful substance in tobacco is tar, and the tar in tobacco is composed of thousands of ingredients, tens of which are cancerogenic substances. It is believed that passive smoking can be more harmful. In efforts to deal with smoking's harmful effects on human health and the environment, many cigarette substitutes have been proposed with the aims of mitigating these damages with the help of technologies.

For example, Japanese Patent Disclosure (Kokai) No. 3-232481 discloses a concept of a simulated smoking article formed by paper packaging a heating element and a solid flavor material equipped in a heat insulation pipe as well as a power unit for the heating element. In this type of simulated smoking articles, people addicted to flavor of cigarettes can be satisfied with air inhaled into the article mixed with the flavor ingredients, which is generated by heating the flavor material by applying power to it.

However, for this type of simulated smoking articles, as it takes some time to heat the flavor material, a smoker needs to wait a while before enough amount of flavor ingredients can be generated. Therefore, in the initial period of time, the smoker cannot be fully satisfied. In addition, as the amount of flavor ingredients cannot be controlled precisely, it is not possible to adjust the amount of the flavor ingredients based on the amount of air inhaled and therefore the smoker cannot get a feeling similar to that from smoking genuine cigarettes.

Also, as the article does not produce smoke and light similar to those from genuine cigarettes, smokers cannot get the feeling of smoking.

Chinese patent application 03111582.9 with the title "A Non-combustible Cigarette with Electronic Vaporization" discloses a non-combustible cigarette with electronic vaporization that can be used for quitting and substituting smoking. This type of cigarettes comprises a housing, a battery, a high frequency generator, stored nicotine solution and a container, a controlling circuit board, a displaying panel, an electronic sensor, a touch sensor, a piezoelectric ultrasonic vaporizer, a high temperature vaporizing nozzle, as well as electrically controlled pump or valve with metering cavity and one way injecting valve. They are difficult to be promoted considering

their complex design and high cost.

Chinese patent ZL200410048792.6 with the title “Electronic Cigarette” discloses an electronic cigarette comprising: a stick-like shell and an air-puffing hole; an emitting device, which is equipped in the shell, at least one pressure modifying driver for changing pressure in a cavity with liquid media for generating flavor and for emitting the liquid media as droplets from a nozzle connected with the cavity; a controller, equipped in the shell, for controlling the driving force of the emitting device; a metering device for measuring air flow in the shell; and a vaporizing device for generating simulated smoke from the front end of the shell; and the driving of the vaporizing device is controlled by the controller based on results from the metering device.

Therefore, the flavor media droplets are emitted into the shell under the drive of the controller. The shell also comprises: a vaporizing device equipped in the shell for vaporizing droplets of flavor media emitted from the emitting device.

Therefore, the flavor media emitted into the shell by the emitting device is vaporized (atomized) by the vaporizing device. Then, as a smoker inhales from the air-puffing hole of the shell under the condition, the mixture of air and vaporized flavor ingredients in the shell enters into the smoker’s mouth and the flavor ingredients dispersed in the mouth can satisfy the smoker’s addiction to flavor from cigarettes.

However, there are several disadvantages with the invention.

This prior art has the disadvantages such as leakage of nicotine solution, back flow, exposure of nicotine solution, interrupted vaporization, hard to suck, the ease of sucking and amount of smoke are much poorer than those for genuine cigarettes. In case the nicotine solution is exhausted, the exposed solution in replacing is not safe and healthy. The process of replacing is also cumbersome and complex.

The electronic cigarettes as proposed by prior arts have very complex vaporizing devices, which may degrade quickly after certain working cycles, resulting in substantially reduced amount of smoke, interrupted smoke, and failed vaporization, directly due to which the life cycle of electronic cigarettes may be shortened.

The switches for working power supply of electronic cigarettes proposed by prior arts are critical, but may cause serious issues such as interrupted smoke, hard to inhale and short life cycle due to their unstable performance and functions under variation of external environment such as temperature and moisture.

In charging the battery of electronic cigarettes proposed by prior arts, users have to take the battery out or find a suitable cable. This can be cumbersome.

The present invention is the result of long term efforts in research and experiments aimed at overcoming these disadvantages.

Summary

An object of the present invention is to provide a highly simulated electronic cigarette

which can overcome these disadvantages.

The technical solution presented in the invention provides a highly simulated electronic cigarette comprising: a housing shaped like a cigarette and a power unit, an electronic vaporizer and an electronic inhaler equipped in the housing, in which the power unit supplies electrical current to the electronic vaporizer for vaporizing; and comprising further: an electronic sensor that is sensitive to a suction action of a user and can generate a triggering signal corresponding to the speed of the suction air flow;

a CPU, after receiving the triggering signal from the electronic sensor, regulates the power supplied to the electronic vaporizer by modulating the output electrical current with an electronic switch, which is controlled by an intelligent program stored in the CPU based on the strength of the triggering signal.

Preferably, a LED indicator is also equipped in the housing and the LED indicator is connected to the CPU and power unit respectively in a way that brightness of the LED indicator matches the strength of the triggering signal,

wherein the housing has two parts, of which the front end houses the electronic vaporizer and the rear end houses the electronic inhaler, in which a cigarette cap, the LED indicator, the power unit, the circuit board on which the electronic sensor and CPU are installed and a first electrical connector are arranged one by one from the rear end to the front end and the power unit is connected to the first electrical connector through an electronic switch;

wherein the front end housing of the electronic vaporizer has in it a second electrical connector and the electronic vaporizer are equipped and the first electrical connector and the second electrical connector are connected electrically and the second electrical connector and the electronic vaporizer are connected electrically;

wherein the electronic vaporizer comprises:

a housing for the vaporizer;

an embedded part of the vaporizer equipped in the housing for the vaporizer with liquid storage element in it for absorbing or storing nicotine solution to be vaporized;

a liquid vaporizing element connected electrically to the second electrical connector and in the liquid vaporizing element a venting hole is equipped for generating vapor after electrical heating;

an upper cap of the electronic vaporizer embedded to the upper end of the housing for the vaporizer and a venting hole is equipped on the upper cap for sealing as well as preventing back flow of the nicotine solution.

Preferably, the liquid vaporizing element comprises: a heating device made of tungsten filament for generating heat;

a heat spreader for evenly distributing heat from the heating device, which is located in the heat spreader, which is made of heat resistant material capable of enduring a

temperature from 100 ℃ to 3000 ℃ and is fitted in the housing for the vaporizer;

a bracket for the heating device sleeves the heating device and is made of heat resistant organic or inorganic material capable of enduring a temperature from 100 ℃ to 3000 ℃.

Preferably, it comprises further: a leakproof device, in which the liquid vaporizing element is equipped, and the leakproof device is tightly fitted to the housing for the vaporizer.

In terms of two ways in which the first electrical connector is connected to the second electrical connector, for the first one, the first electrical connector is a socket and the second electrical connector is a plug, and the plug is embedded into the leakproof device with a plug base, and the socket is embedded in a sealing piece, which is tightly fitted to the rear end of the housing for electronic inhaler. The plug base and the heating device are connected electrically. The socket and plug are connected by inserting and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

In the second way, the first electrical connector is a lower terminal, which is a cylindrical terminal, part of which is embedded from the outer edge into the rear end housing of the electronic inhaler to fit tightly and the exposed outer edge is equipped with external threads;

the second electrical connector is an upper terminal, which is a cylindrical terminal, and is tightly fitted to inner wall of the front end of the electronic vaporizer, and is equipped with inner threads;

the lower terminal and upper terminal are connected by threads and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

Objects in the connection can be interchanged, that is, the first electrical connector is a plug, and the second electrical connector is a socket, and the socket is embedded into the leakproof device and is connected electrically to the heating device; The socket and plug are connected by inserting and the front end housing of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body. Or, the first electronic inhaler and the second electronic vaporizer can be connected directly with conductors, which connect the electronic vaporizer and the electronic inhaler together in the same rod.

Advantages of the present invention in comparison with prior arts include stable functions and performance, great consistency, easy to inhale, no interrupted vaporization, longer life cycle and assured quality. It also prevents issues such as leakage of nicotine solution, back flow, exposure of nicotine solution to ensure safety, hygiene and convenience, therefore preventing the issue of degradation of the vaporizer.

Description of the Drawings

Fig. 1 is a structural diagram of the circuit for critical parts for the highly simulated electronic cigarette in accordance with the present invention.

Fig. 2 is a schematic sectional view of the front end of the electronic vaporizer in example 1 of a highly simulated electronic cigarette in accordance with the present invention.

Fig. 3 is a sectional view of the electronic vaporizer in example 1 of a highly simulated electronic cigarette in accordance with the present invention.

Fig. 4 is a schematic sectional view of an assembled device in example 1 of a highly simulated electronic cigarette in accordance with the present invention.

Fig. 5 is a schematic sectional view of the rear end of the electronic inhaler in example 2 of a highly simulated electronic cigarette in accordance with the present invention.

Fig. 6 is a schematic sectional view of the leakproof device and the bracket for heating device fitted together for a highly simulated electronic cigarette in accordance with the present invention.

Fig. 7 is a schematic sectional view of an assembled device in example 2 of a highly simulated electronic cigarette in accordance with the present invention.

Detailed Description of the Examples

Technical features and advantages of the present invention are described in more details below by referring to the drawings.

A highly simulated electronic cigarette of the present invention comprises: a housing in the shape of a cigarette, and the housing has a power unit, an electronic vaporizer and an electronic inhaler in it and the housing comprises two parts, which are the front end for the electronic vaporizer and the rear end for the electronic inhaler.

Referring to Fig. 1, a structural diagram of the circuit for critical parts for a highly simulated electronic cigarette in accordance with the present invention, the power unit 5 supplies electrical current to the electronic vaporizer 22 for heating as well as powers other electrical devices, wherein the power unit 5 is connected to the electronic vaporizer 22 through a first electrical connector 11 and a second electrical connector 21; an electronic sensor 6 that is sensitive to a suction action of a user can generate a triggering signal corresponding to the speed of a suction air flow for triggering a CPU 3;

the CPU 3, after receiving the triggering signal from the electronic sensor 6, with the intelligent program stored in it, controls the amount of power supplied by the power unit 5 to the electronic vaporizer 22 through an electronic switch 4, wherein the strength of output current from power unit 5 is modulated based on the strength of the triggering signal. The housing also has a LED indicator 12 in it and the indicator is connected to the CPU 3 and power unit 5 respectively. Brightness of the LED indicator 12 matches the strength of the triggering signal. This is a critical process of

the present invention. As a user inhales with greater force, the triggering signal generated by the electronic sensor 6 is more powerful. Controlled by the CPU 3, the electronic switch 6 modulates output current from power unit 5 so that it matches the speed of inhaled air flow. Therefore, a realistic smoking experience can be simulated as the heating of the electronic vaporizer 22 and brightness of the LED indicator 12 are modulated.

Referring to Fig. 2, a schematic sectional view of the front end of the electronic vaporizer in example 1 of a highly simulated electronic cigarette in accordance with the present invention, wherein in the front end housing of the electronic vaporizer a cigarette cap 13, the LED indicator 12, the power unit 5, the circuit board 14 on which the electronic sensor 6 and CPU 3 are installed and a first electrical connector 11 are arranged one by one from the front end to the rear end, wherein the electronic sensor 6 is installed on a sensor bracket 61, wherein the first electrical connector is a lower terminal 11, which is a cylindrical terminal, part of which is embedded from the outer edge into the front end housing 10 of the electronic vaporizer to fit tightly and the exposed outer edge is equipped with external threads 17 to connect with another structure with inner threads together.

Referring to Fig. 3, a sectional view of the electronic vaporizer in example 1 of a highly simulated electronic cigarette in accordance with the present invention,

wherein the electronic vaporizer comprises: a housing for the vaporizer 263; in which it houses: an embedded part 261 of the vaporizer equipped in the housing for the vaporizer 263 with liquid storage element 264 in it for absorbing or storing nicotine solution to be vaporized; the liquid storage element 264, made of material such as glass fiber or other mixtures capable of enduring a temperature from 100 ℃ to 3000 ℃ so that it will not be damaged by heat from the electronic vaporizer under working conditions;

a liquid vaporizing element that generates heat after energized as heating source for vaporization and that connected electrically through a conductor 266 to the second electrical connector 267, and the liquid vaporizing element comprises: a heating device 265 for generating heat and made of materials that could endure high temperature, such as tungsten filament; and a heat spreader 268 for evenly distributing heat from the heating device 265, which is located in the heat spreader 268, which is made of heat resistant material capable of enduring a temperature from 100 ℃ to 3000 ℃ and can be in the shape of a can, cylinder or others and a can is used in the example; and comprises further: a bracket 269 for the heating device that sleeves on the tungsten filament for supporting purposes and for anchoring the heat spreader 268, wherein the bracket 269 is made of organic or inorganic heat resistant material capable of enduring a temperature from 100 ℃ to 3000 ℃, and wherein high temperature filament is used in the example and venting hole is equipped in the middle of the bracket in the shape of a can;

an upper cap 262 of the electronic vaporizer embedded to the upper end of the housing for the vaporizer 263 and a venting hole is equipped on the upper cap 262 for

sealing as well as preventing back flow of the nicotine solution;

the second electrical connector is an upper terminal 267, which is a cylindrical terminal, and is tightly fitted to inner wall of the rear end housing of the electronic inhaler, and is equipped with inner threads;

the lower terminal 267 and the upper terminal 11 are connected by threads and the front end of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

It should be noted that with threaded connection, objects in the connection can be interchanged, that is, the first electrical connector located at the front end of the electronic vaporizer can be an upper terminal, which is to be tightly fitted to inner wall of the lower end of the front end housing of the electronic vaporizer and the upper terminal has inner threads in it;

the second electrical connector located at the rear end of the electronic inhaler can be a lower terminal, part of which is embedded from the outer edge into the rear end housing of the electronic inhaler to fit tightly and the exposed outer edge is equipped with external threads;

the lower terminal and upper terminal are connected by threads and the front end of the electronic vaporizer is connected to the rear end of the electronic inhaler to form a whole body.

Referring to Fig. 4, a schematic sectional view of an assembled device in example 1 of a highly simulated electronic cigarette in accordance with the present invention, wherein the inner threads in the upper terminal 11 are fitted with the outer threads equipped on the lower terminal 267 to join the front end housing for the electronic vaporizer and the rear end housing for the electronic inhaler to form a whole body while connection in them is made electrically.

Referring to Fig. 5, a schematic sectional view of the rear end of the electronic inhaler in example 2 of a highly simulated electronic cigarette in accordance with the present invention, wherein in the rear end housing of the electronic inhaler, the leakproof device 23 and liquid vaporizing element are equipped one by one, wherein the leakproof device 23 is made of electrically conductive material, wherein a cigarette mouthpiece is equipped at the far end of the rear end housing of the electronic inhaler, wherein a DC plug 21 is connected to the leakproof device 23 through a plug base 24 to realize electrical connection to heating device 265 in the liquid vaporizing element.

Referring to Fig. 6, a schematic sectional view of the leakproof device and the bracket for heating device fitted together for a highly simulated electronic cigarette in accordance with the present invention, wherein the leakproof device 23 is a can-like structure with different diameters at the ends and has a bearing seat at the middle, wherein the heat spreader 268 of the liquid vaporizing element is equipped in the leakproof device 23 and in touch with the bearing seat, wherein the leakproof device 23 connects to the DC plug base with its hollow part at the front end; the sealing for

the devices in the housing and the housing itself is obvious for skilled person in the art and therefore is not described in details here.

Referring to Fig. 7, a schematic sectional view of an assembled device in example 2 of a highly simulated electronic cigarette in accordance with the present invention, wherein in the front end housing of the electronic vaporizer a cigarette cap 13, the power unit 10, circuit board 14 and a DC plug 21 are equipped one by one, wherein the plug base 24 is embedded into the leakproof device 23 and the plug base 24 is connected electrically to the heating device 265; the socket 28 and the DC plug are connected by inserting and the front end housing of the electronic vaporizer is connected to the rear end housing of the electronic inhaler to form a whole body.

It should be noted that objects in the connection can be interchanged, that is, the first electrical connector in the front end of the electronic vaporizer can be a DC plug 21, and the second electrical connector in the rear end of the electronic inhaler can be a socket 28, and wherein the socket 28 is embedded into the leakproof device 23 and is connected electrically to the heating device 265; the socket 28 and the DC plug 21 are connected by inserting and the front end housing of the electronic vaporizer is connected to the rear end housing of the electronic inhaler to form a whole body.

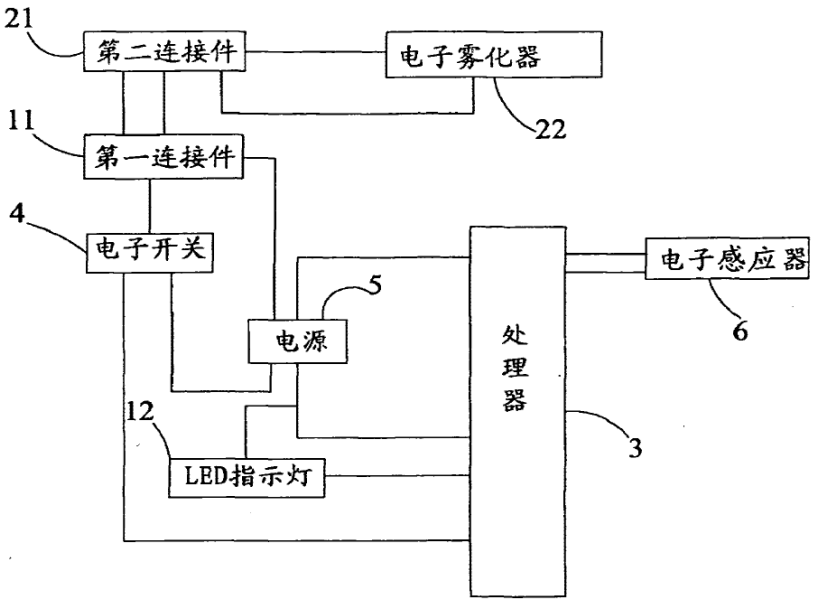
An electronic cigarette in accordance with the present invention controls core processes and switch of the circuit with electronic sensor and CPU program, simplifying complex mechanical mechanisms and cumbersome assembling of electronic cigarettes in accordance with prior arts. Its suction easiness and amount of smoke are similar to those of genuine cigarettes. Such design also ensures stable performance and functions as well as long life cycle.

In addition, the vaporizer and control circuit of the electronic inhaler are designed into separate parts. The design that seals the nicotine solution container, the vaporizing device and the circuit in the electronic vaporizer can prevent leakage of nicotine solution and its back flow and exposure. The core issue of degrading vaporizing device can be fixed for good as the electronic vaporizer can be disposed all together after the nicotine solution is depleted, so that the life cycle of the electronic cigarette can be extended.

Also, with standard DC plug that can be plugged into a socket for charging directly or the threaded rear end rod of the electronic vaporizer that can be screwed into an adapter, charging can be simplified.

The above only describes preferred examples of the present invention and is illustrative rather than restrictive. Many other alternations, revisions, and even alternatives within the spirit and scope as defined by the claims of the present invention understandable to skilled person in the art should also be included in the scope of protection for the present invention.

Drawings



21 The second connector

22 Electronic vaporizer

11 The first connector

4 Electronic switch

5 Power unit

6 Electronic sensor

12 LED indicator

3 CPU

Fig. 1

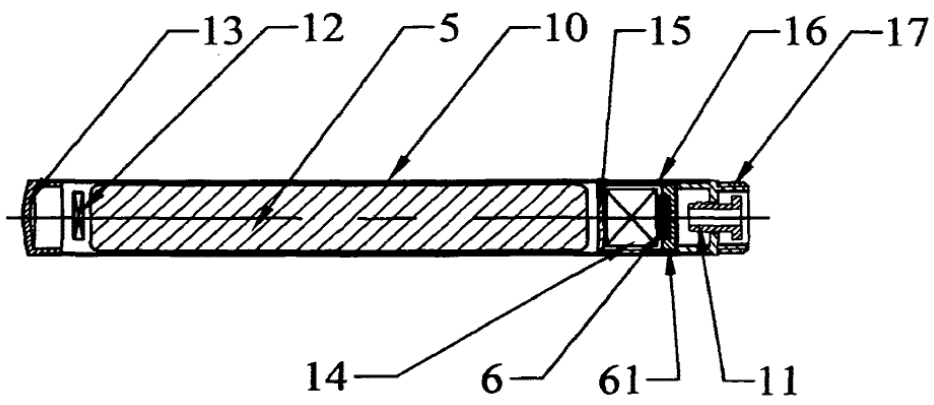


Fig. 2

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IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF ARIZONA

VPR Brands, LP, Plaintiff, v. Jupiter Research, LLC, Defendant.	No. CV-20-02185-PHX-DJH **[proposed] ORDER GRANTING PLAINTIFF VPR BRANDS's PROPOSED CLAIM CONSTRUCTION REGARDING PATENT NUMBER 8,205,622**

Before the Court is Plaintiff VPR Brands, LP's proposed claim construction regarding patent number 8,205,622, supporting exhibits, and the declaration of George Yanulis ("Yanulis DEC."). The court, having considered the proposal, exhibits, and Yanulis DEC., having found good cause, therefore hereby **ORDERS** that the proposal is **ACCEPTED** and that the terms outlined in Plaintiff's proposed claim construction be entered and construed accordingly.

The disputed terms are as follows:

Claim Term	VPR's Proposed Construction
diaphragm microphone	A device for converting pressure waves into electrical energy using a thin sheet of material that is capable of vibrating
electronic inhaler	A tubular housing comprising one or more electrical components and one or more holes to allow airflow.
instructs	The Single Chip Micyoco provides a signal to control the time period & magnitude of the electric current
time period and magnitude of the electric current	The duration of time and the strength of the current is provided to the heating element.

The parties submit the following undisputed terms:

Claim term	Proposed construction
electronic cigarette	A device operating with the aid of electricity containing a substance that is vaporized/atomized and inhaled
tubular	A hollow length of material having substantially parallel sides defining an open space
power source	A rechargeable or non-rechargeable battery
Single Chip Micyoco	A microcontroller including a processor, software instructions to be executed by the processor, memory, and I/O processed by the processor.
LED indicator	A light emitting diode that lights up when the electric current flows and it is turned off when the electric current stops flowing
electronic atomizer	A device that converts a solution of a liquid form through vaporization or atomization to a gas form, using electric current
electric airflow sensor	An electric sensor to detect air movement generated by a user's inhaling or puffing act

that is detecting an airflow	detecting air movement generated by a user's inhaling or puffing act
cigarette cap	A cap with holes attached to the device.
circuit board	A board on which electronic components are mounted
electric connector	A conductive contact
detachably attached	Able to be connected and then separated.
air puffing hole	Hole through which air can be drawn by a user.
detecting an airflow	Determining that a user is inducing airflow into or out of the device.
supporting piece	A piece made of material able to withstand high temperatures that supports one or more electrical components
heat equalizer	A thermally conductive material capable of withstanding high temperatures that distributes the heat from a heat source

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UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF ARIZONA

VPR Brands, LP Plaintiff, v. Jupiter Research, LLC, Defendants.	Case No. 2:20-cv-02185-DJH **DEFENDANT JUPITER RESEARCH, LLC'S RESPONSIVE CLAIM CONSTRUCTION BRIEF**

Defendant Jupiter Research, LLC ("Jupiter"), by and through its undersigned counsel, respectfully submits its responsive claim construction brief pursuant to the Scheduling Order in this case entered February 26, 2021 (ECF 19).

In this litigation, VPR has asserted claims 13-18 of U.S. Patent No. 8,205,622 titled "Electronic Cigarette" (the "'622 Patent" or "patent-in-suit").

On November 22, 2021, Plaintiff VPR filed its opening claim construction brief. The brief indicated that only three terms were remaining in dispute at the time of the filing of that brief. Counsel for Jupiter has reviewed VPR's opening claim construction brief. At this time, Jupiter is prepared to accept VPR's constructions for the three identified terms in dispute. Consequently, no terms that the parties identified as requiring

construction remain in dispute, and Jupiter proposes that an order be entered listing the terms identified by the parties and undisputed constructions. The table below identifies the terms to be construed and proposed constructions that are not in dispute by the parties.

The parties agree on the following constructions of the following terms:

Claim Term	**Appears in Claims**	**Proposed Construction**
time period and a magnitude of the electric current	13,14,15	The duration of time and the strength of the current that is provided to the heating element.
Electronic inhaler	13,14,15,16,17,18	A tubular housing comprising one or more electrical components and one or more holes to allow airflow.
Diaphragm microphone	14, 17, 18	A device for converting pressure waves into electrical energy using a thin sheet of material that is capable of vibrating.
Single Chip Micyoco	13,14,15,16	A microcontroller including a processor, software instructions to be executed by the processor, memory, and I/O processed by the processor.
electronic cigarette	13,14,15,16,17,18	A device operating with the aid of electricity containing a substance that is vaporized/atomized and inhaled
Tubular	13,14,15,16,17,18	A hollow length of material having substantially parallel sides defining an open space
Electronic atomizer	13,14,15,16,17,18	A device that converts a solution of a liquid form through vaporization or atomization to a gas form, using electric current.
Power Source	13,14,15,16,17,18	A rechargeable or non-rechargeable battery
LED indicator	15,16	A light emitting diode that lights up when the electric current flows and it is turned off when the electric current stops flowing
Electric airflow sensor	13,14,15,16,17,18	An electric sensor to detect air movement generated by a user's inhaling or puffing act.
That is detecting air flow	13, 14, 15, 17, 18	detecting air movement generated by a user's inhaling or puffing act

(sending a) signal	13, 14, 15	Any signal provided by the airflow sensor responsive to airflow.
instructs	13, 14, 15	Provides a signal that tells the power supply to provide or not provide electricity to the inhaler and atomizer.
Cigarette Cap	16	A cap with holes attached to the device.
Circuit Board	16	A board on which electronic components are mounted.
detachably attached	17	Able to be connected and then separated.
Electric connector	16, 18	A conductive contact
air puffing hole	17, 18	Hole through which air can be drawn by a user.
detecting an airflow	13, 14, 15, 17, 18	Determining that a user is inducing airflow into orout of the device.
heat equalizer	18	A thermally conductive material capable of withstanding high temperatures that distributes theheat from a heat source.
supporting piece	18	A piece made of material able to withstand high temperatures that supports one or more electrical components.

In light of the above, this Court should adopt the agreed upon proposed construction for the agreed claim terms. An order to that effect is attached.

DATED this 6th day of December, 2021.

Respectfully submitted,

SCHMEISER, OLSEN & WATTS LLP

By:

/s/ Anthony L. Meola

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CERTIFICATE OF SERVICE

I hereby certify that on December 6, 2021 I electronically transmitted the attached document to the below listed attorneys for Plaintiff:

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