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(19) **United States**(12) **Patent Application Publication**
Grimm et al.(10) **Pub. No.: US 2021/0052003 A1**(43) **Pub. Date: Feb. 25, 2021**(54) **SMART PERSONAL AIR FILTER****Publication Classification**(71) Applicants: **John Grimm**, Santee, CA (US); **Yuval Shenkal**, Cardiff by the Sea, CA (US)(51) **Int. Cl.***A24F 40/40* (2006.01)*A24F 40/53* (2006.01)*A24F 40/65* (2006.01)(72) Inventors: **John Grimm**, Santee, CA (US); **Yuval Shenkal**, Cardiff by the Sea, CA (US)(52) **U.S. Cl.**CPC *A24F 40/40* (2020.01); *A24F 40/65* (2020.01); *A24F 40/53* (2020.01)(21) Appl. No.: **16/998,459**

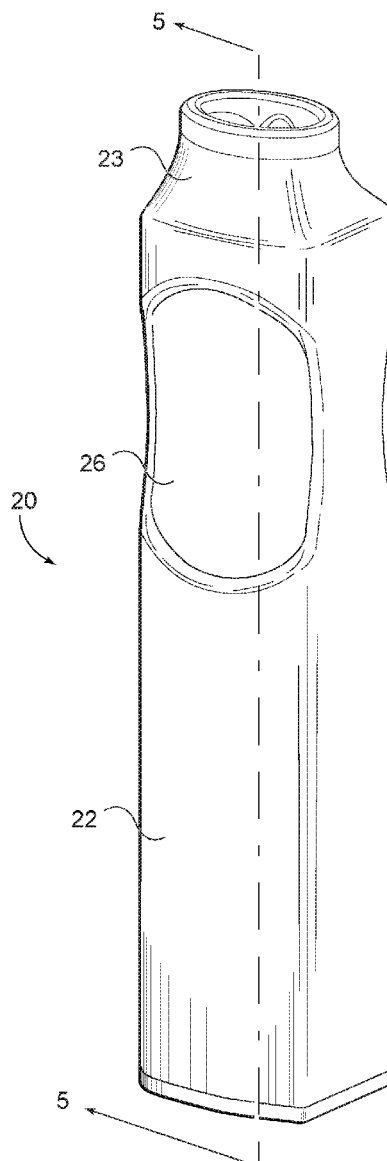
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ABSTRACT(22) Filed: **Aug. 20, 2020**

A personal air filter with a PCB, with or without a micro-processor, and wireless transmission to a mobile ad hoc network is presented herein. In a preferred embodiment, the device is an accessory e-cigarette, (CBD, tobacco, etc.) filter assembly that is essentially configured with one or more sensors and transmission capability. The apparatus is further part of a wider system of the present invention for the purpose of performance monitoring and tracking, making the filter reusable and further extension of its life cycle.

Related U.S. Application Data

(60) Provisional application No. 62/889,814, filed on Aug. 21, 2019.



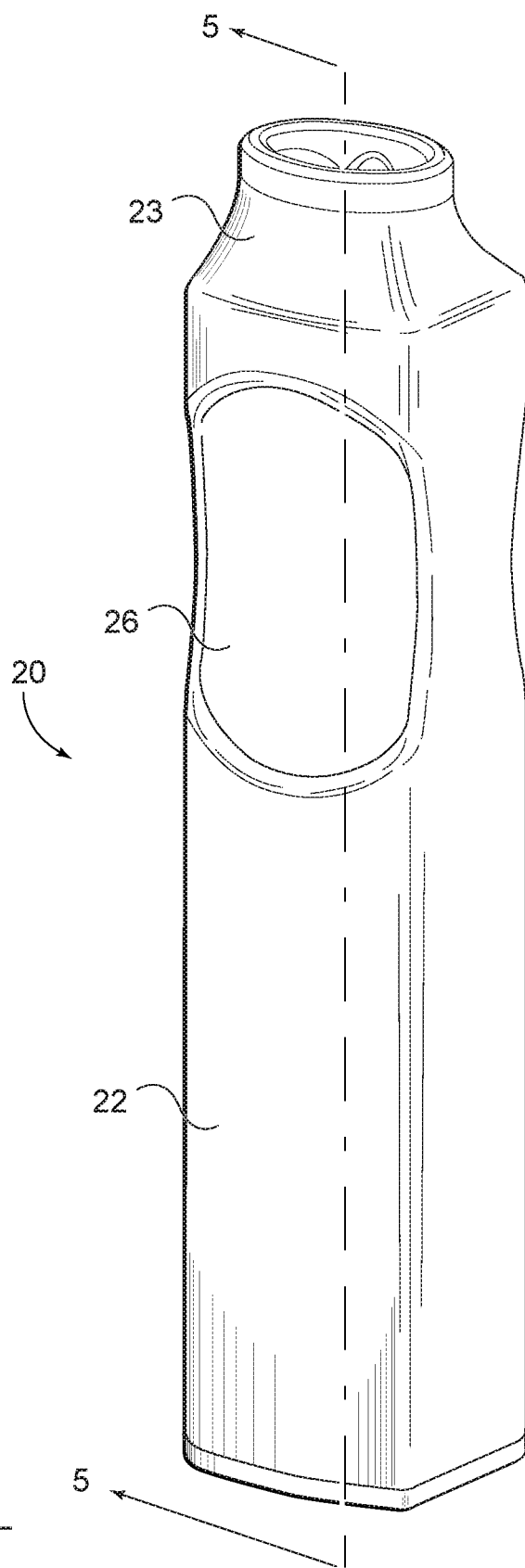
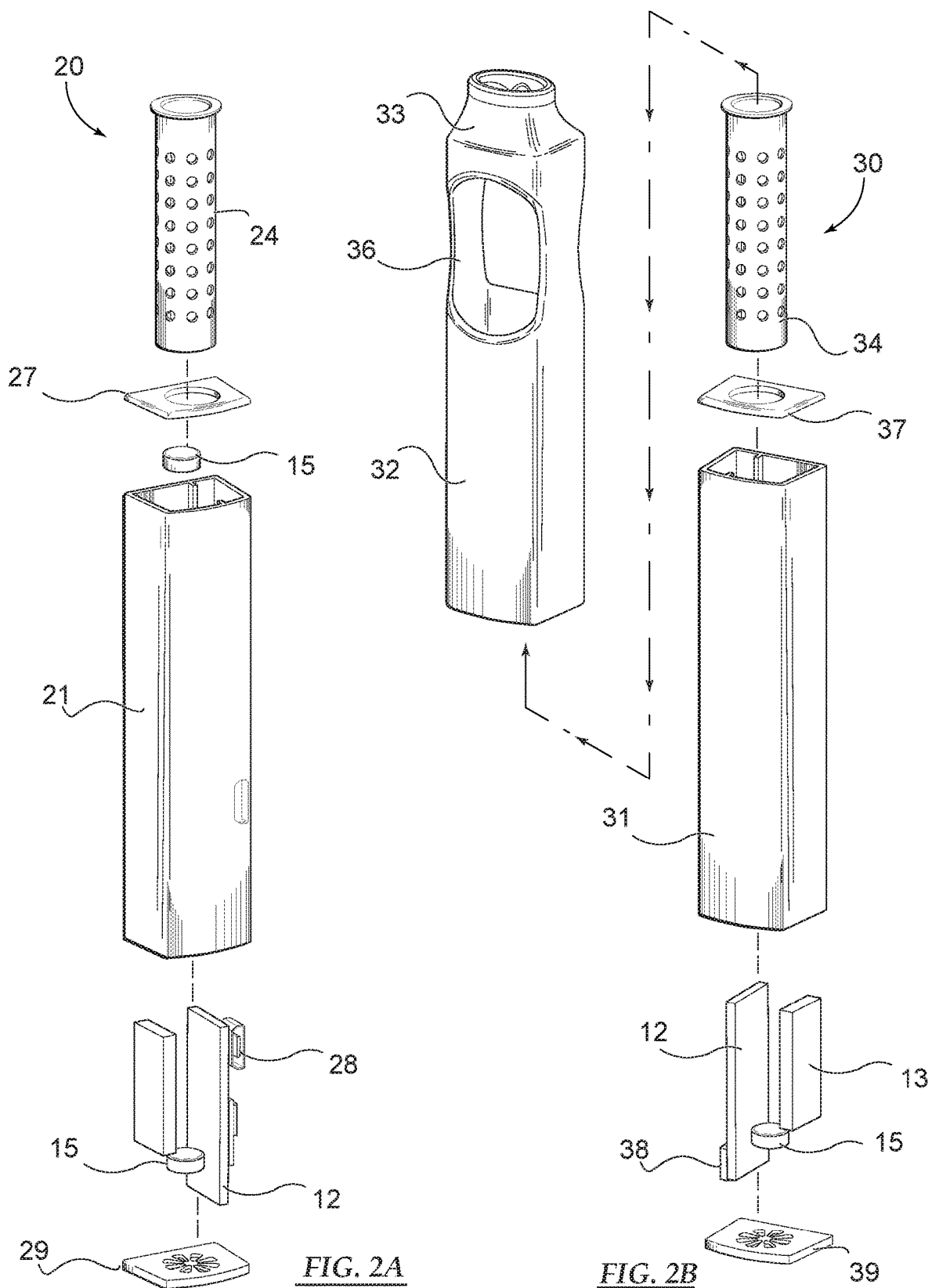
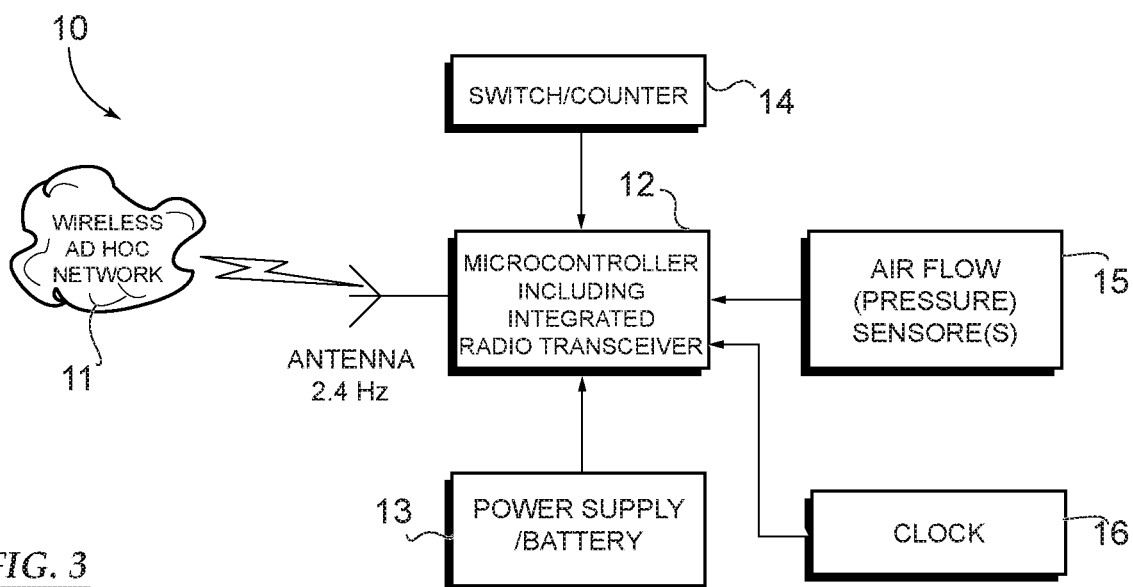


FIG. 1





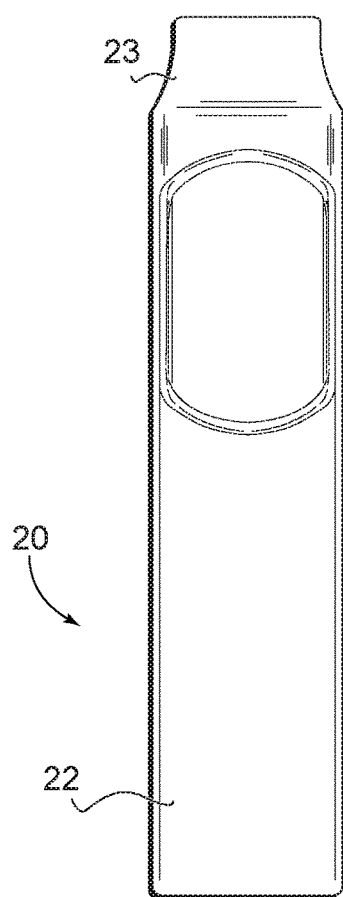


FIG. 4

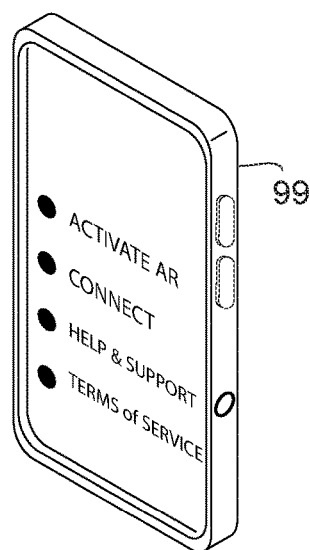
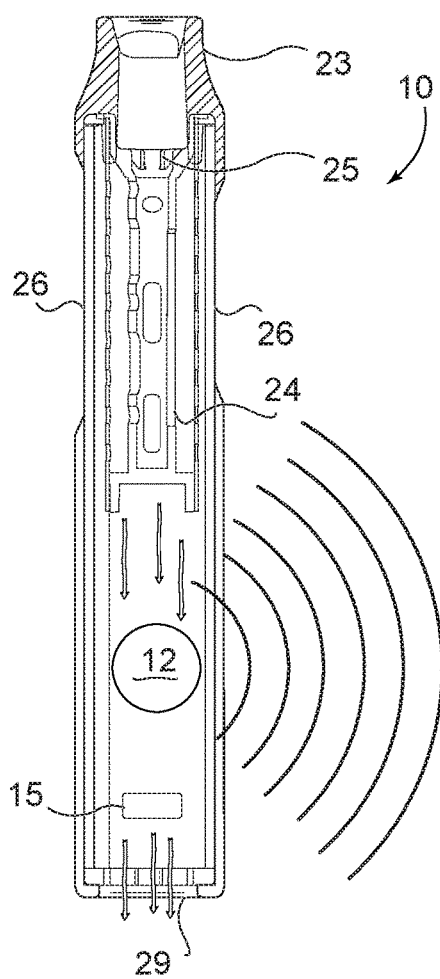


FIG. 5

SMART PERSONAL AIR FILTER**PRIORITY CLAIM**

[0001] This patent application claims benefit of the priority date of U.S. Prov. Pat. App. Ser. No. 62/889,814 filed on Aug. 21, 2019 entitled “Smart Filter.” Accordingly, the entire content of this U.S. provisional patent submission is hereby expressly incorporated by reference.

BACKGROUND OF THE INVENTION**Field of the Invention**

[0002] The present invention pertains generally to accessories for electronic smoking devices. More specifically, the present invention relates to a smart electronic (or traditional) cigarette exhale filter capable of recording and transmitting data and providing information, alerts and data to users and manufacturers regarding filter performance.

Description of the Prior Art

[0003] Ever increasing in popularity, “electronic cigarettes/e-cigarettes” and vaporizers typically use an electrical heating element to heat a liquid usually containing a mixture of nicotine and flavorings/extract that produces a mist similar to smoke but without the excessive heat that causes combustion. A useful exemplary apparatus was proposed by Counts et al., U.S. Pat. No. 5,666,978, entitled “Electrical Smoking System for Delivering Flavors and Methods of Making Same,” and was awarded patent protection in 1997. This particular prior art device has a receptacle for receiving tobacco or “tobacco flavored material” and electrical heating elements configured to the device for heating the material in order to emit vapors or aerosol for delivery to a smoker.

[0004] Over the intervening years, e-cigarettes have evolved to pen-types, wafer or stick-types, or larger units fitting into a user’s hand with a mouthpiece coupled thereto.

[0005] Further, as e-cigarette use has evolved and gained momentum, either as an alternative to typical cigarettes or smoked flower material, so have accessory items to accompany them. One such accessory currently on the market has been branded the Smoke Buddy®. This device is specifically an external filter for receiving exhaled mist; and it could be applicable to vaping, traditional cigarette smokers, or medical *cannabis* smokers that wish to filter emissions and eliminate odors produced by using the smoking devices. The Smoke Buddy® however has its drawbacks; for example, it’s bulky, awkward and irregular in shape. Also, Accordingly, the present invention herein is an improvement of the device adding technology aimed at making the filter reusable and extending its life. Another object of the present invention is to provide sensing and data collection for users and 3rd parties. In this way, the filter may be referred to as a smart device.

[0006] It is still further an object of the present invention to provide an advanced, scalable and cost-effective device incorporating advancements in electronic/wireless transmission and 3D printing technology. More specifically, control microprocessors have become less expensive and there has been an emergence of wireless initiatives, such as the Bluetooth or ZigBee standard using small, low power, short range transmission. Such wireless system performance monitoring has become easier and cheaper, lessening the initial cost of implementation.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention specifically addresses and alleviates the above-mentioned deficiencies, more specifically, the present invention, in a first aspect is a personal air filter for filtering exhale comprising: a first tubular housing for receiving and containing a plurality of filter components; a mouth piece configured to a proximal end of the first tubular housing, the mouthpiece for introducing the exhale; an air instrument for sensing air flow (or air pressure) within the first tubular housing; and an electronic transmitter (or transceiver) for sending data to a wireless network provided by the air instrument, the data to be for the purpose of monitoring filter performance (e.g. the data to be received by a receiver and processor in a smart cellular telephone or a wireless ad hoc network); and a power supply for powering said personal air filter.

[0008] The invention in this first aspect is additionally characterized in that it comprises a second tubular housing about an outer surface of the first tubular housing wherein the first tubular housing comprises extruded aluminum and wherein the second tubular housing comprises PLA material being substantially biodegradable defined as having approximately a five (5) year environmental presence.

[0009] The invention in this first aspect is additionally characterized in that it comprises a second tubular housing about an outer surface of the first tubular housing wherein the first tubular housing comprises extruded aluminum and wherein the second tubular housing comprises PLA material being substantially biodegradable defined as having approximately a five (5) year environmental presence. The plurality of filter components further comprises a replaceable filter cartridge at an interior to the first housing and a filter medium at an interior to the filter cartridge.

[0010] Still further according to the invention in the first aspect, the sending data to a wireless network further comprises a clock for measuring a duration of exhale and time of use, and a counter circuit for recording number of exhalations. It should be appreciated that the counter could be accomplished any number of ways. Still further, the instrument for sensing air flow can be a first air instrument at an outlet plenum to the plurality of filter components. In this embodiment, the personal air filter further has a second air instrument positioned at an inlet check valve (either adjacent to the inlet or exit to the inlet check valve), wherein the electronic transmitter is configured to a printed circuit board (PCB), wherein further a microprocessor and a mini-universal serial bus (USB) charging port are both configured to the PCB.

[0011] The personal air filter for filtering exhale is additionally characterized in that it comprises: a top end wall at the proximal end of the tubular housing; a check valve approximately at the proximal end of the tubular housing; and an exit vent at a distal end of the tubular housing. In addition the outer housing further comprises a relief including an aperture exposing and providing access to the first tubular (inner) housing, the relief carveout for assisting allowing a user to disassemble the personal air filter.

[0012] The invention is still a second aspect is characterized as smart personal air filter comprising: a filter cartridge comprising a filter medium; a mouthpiece for introducing air to be filtered to the filter cartridge; a first (inner) housing for containing and receiving the filter cartridge; a printed circuit board (PCB) having a power source coupled thereto; a

transmitter coupled to the PCB for transmitting filter informational data to a wireless network.

[0013] The smart personal air filter in this aspect of the invention is additionally characterized in that an outer jacket is provided covering the first inner housing including a relief carveout in the outer jacket for assisting removal thereof wherein the mouthpiece is permanently affixed to the outer jacket.

[0014] In still a third aspect, the invention may be characterized as a system for measuring filter performance comprising: a personal air filter having a mouthpiece for introducing air thereto; an air sensor for sensing air flow or air pressure; a low power transmitter for transmitting sensor data; and a receiver and processor for receiving and processing sensor data. The system further comprises a clock for recording data comprising: a duration of exhale; a number of exhales per day; and count days of useful life of a filter cartridge, the useful life being determined by the air sensor.

[0015] While the apparatus and method has or will be described for the sake of grammatical fluidity with functional explanations, it is to be expressly understood that the claims, unless expressly formulated under 35 USC § 112, or similar applicable law, are not to be construed as necessarily limited in any way by the construction of “means” or “steps” limitations, but are to be accorded the full scope of the meaning and equivalents of the definition provided by the claims under the judicial doctrine of equivalents, and in the case where the claims are expressly formulated under 35 USC § 112 are to be accorded full statutory equivalents under 35 USC § 112, or similar applicable law. The invention can be better visualized by turning now to the following drawings wherein like elements are referenced by like numerals.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The novel features of this invention, as well as the invention itself, both as to its structure and its operation, will be best understood from the accompanying drawings, taken in conjunction with the accompanying description, in which similar reference characters refer to similar parts, and in which:

[0017] FIG. 1 is an isometric view of the present invention in a position of use;

[0018] FIG. 2A is an exploded view of a first preferred embodiment of the present invention;

[0019] FIG. 2B is an additional exploded view of an alternative embodiment;

[0020] FIG. 3 is a functional block diagram of the present invention including data transmitted to a mobile ad hoc network;

[0021] FIG. 4 is a front elevational view of a filter of the present invention; and

[0022] FIG. 5 is a cross sectional view of a device taken along line 5-5 in FIG. 1 included with a schematic to show the Bluetooth module of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] Referring initially to FIG. 1, an isometric view of the outside structure of a smart personal filtering apparatus 20 is shown in an isometric view. The device 20 has an inner and outer housing, the outer housing 20 being a removable

jacket designed to allow easy disassembly of the device 20, for example, when a filter cartridge 24 should be replaced. Relief 26 in the outer jacket 20 is a carveout aperture that assist a user removal thereof. The isometric view of a filter is shown with a mouthpiece at a top thereof; the mouthpiece 23 may be its own removable component; or the mouthpiece could be configured permanently affixed to the outer jacket. As stated, the relief carveout aperture 26 is provided to the second outside housing that surrounds a first housing. As detailed herein, an upper area of the device 20 houses a replaceable filter cartridge 24.

[0024] With regard to FIGS. 2A and 2B, closely related first and second embodiments of a smart filter apparatus 20, 30 are shown in separate exploded views. The difference between the two 20, 30 are the locations of the mini-USB (Universal Serial Bus) charging port and whether the invention 10 employs one or two air flow instruments 15, the later to be explained in more detail herein.

[0025] Importantly in a preferred embodiment the replaceable filter cartridge 24, 34 (and/or the second or outer housing 22, 32) is comprised of polyester material derived from biomass, commonly referred to as PLA (polylactic acid) that is similar to plastic however biodegradable, hence referred to as a bioplastic. PLA is distinguishable from ABS (acrylonitrile butadiene styrene) thermoplastic polymer material that is used in injection molding and 3-D printing that is not biodegradable. The present invention has selected a bioplastic material having an environmental presence of approximately five (5) years.

[0026] Also referring to FIG. 2A and FIG. 2B, at an exit to the replaceable filter cartridge 24, 34 the device has an outlet plenum that comprises an air flow sensor measuring filter performance (either by volumetric/mass air flow or air pressure). As an example, the invention 10 measures an exit pressure at the beginning of life. As the filter is put to successive uses, the air pressure at the exit 15 shall drop to a predetermined delta at which point, it's time to replace the filter cartridge 24, 34. The sensor further can determine an entire life cycle for a filter cartridge from its initial performance to when it is time for a replacement. This could similarly be accomplished with two sensors 15, at an inlet and outlet to the filter cartridge 34, respectfully.

[0027] Additionally, with regard to FIG. 2A and FIG. 2B exploded views, the first inner housing is provided with extruded Aluminum material so that electronic components, PCBA (printed circuit board assembly) 12, Bluetooth module, air flow sensor 15, battery 13 and micro USB charging port 28, 38 are easily connected or components can easily slide into place. Also, the first 21, 31 and second 22 32 housing provide excellent insulation to the device as well as a good barrier from ambient conditions.

[0028] Now turning to FIG. 3, the invention 10 may be characterized as a system for measuring filter 24, 34 performance comprising: a filter 20, 24, 30, 34; an air sensor 15 for sensing air flow or air pressure; a low power transmitter 12 for transmitting sensor 15 data; and a receiver and processor 11, 99 for receiving and processing sensor data. If should be understood that a receiver and processor that records and stores historical data is a part of a greater wireless ad hoc network and could be a computer device or a smart phone 99 application. And this data could be shared with tobacco and *cannabis* distillate manufactures and to e-cigarette and vaporizer OEM manufactures, and interested

members of the public, etc. FIG. 4 illustrates an elevational view of the filter device 20 having a relief carveout 26 in the outer jacket 22.

[0029] With regard to FIG. 3 and FIG. 5 together, a functional block diagram and schematic illustration provide an over view of the invention 10. System PCB 12 has a Bluetooth module and a counting circuit 14. It 10 also has a clock 16 and input from the air pressure sensor(s) 15. Data goes to the network server 11 or I-phone/Android app 99 and can record the following: air flow pressure over time and after each exhale, and a number of exhales. The counting circuit will have a reset either manually 99 or automatically when a filter cartridge 24, 34 is replaced. A length of exhale is also recorded with the clock as is a time of use. Alerts are provided to the smart phone 99 app or elsewhere in the wireless/mobile ad hoc network 11. For example, time to replace the filter cartridge 24, 34, or time to reorder based on order history and cartridges expended up to that point in time. All data may be maintained for accurate history of filter 20, 30 life cycle for subsequent examination and review.

[0030] Stated differently regarding FIG. 3 and FIG. 5, the system 10 herein for measuring filter 20, 24, 30, 34 performance is additionally characterized as further comprising a clock 16 for recording data, wherein the data comprises: a duration of exhale; a number of exhales per day; and days of useful life of a filter cartridge 24, 34, said useful life being determined by the air sensor(s) 15. Further with regard to FIG. 5, it is contemplated that data processing can be realized with a smart phone 99 application and be provided to e-cigarette and vaporizer manufactures, as well as tobacco and *cannabis* distillate/oil manufactures, and of course, to the manufactures of the filter cartridges. It is expected that *cannabis* oil users will use less times per day but have a longer exhale as compared to tobacco users. Additionally further, the smart personal exhale filter herein could be applicable to traditional smoker applications and e-cigarette user, alike. The system 10 herein further includes an interactive component that allows users to check, retrieve data as well as receive data from third parties.

[0031] Regarding FIG. 2A together with FIG. 5 cross-sectional view, the invention is a smart personal air filter 20, 30 for filtering exhale comprising: a first inner tubular housing 31 for receiving and containing a plurality of filter components, such as a filter cartridge 24, 34 containing carbon or HEPA (high efficiency particulate air) filter, for example; a mouth piece 23 configured to a proximal end of the first tubular housing, the mouthpiece for introducing the exhale. Additionally the air filter 20, 30 comprises an air instrument 15, or two, for sensing air flow (or air pressure) within the first tubular housing 31; and an electronic transmitter 12 (or transceiver) for sending data to a wireless network provided by the air instrument 15, the data to be for the purpose of monitoring filter performance (e.g. the data to be received by a receiver in a cellular telephone 99); and a power supply 13 for powering said personal air filter.

[0032] Also regarding FIG. 5, arrows show the movement of air through the device downward. At a proximal end of the inner housing 21, 31 is top end wall 27, 37 providing support at an interface between the mouthpiece 23, 33 and the inner housing 21, 31. Check valve 12 allows air flow in a downward only direction during a user exhale. It should be appreciated that inlet sensor 15 (if employed FIG. 2A) can be configured immediately before the check valve 25 or

after. Similarly, check valve 25 can be incorporated to top end wall 27 or sit down in the hole provided by top end wall 27. Exit vent 29, 39 is provided opposite to top end wall 27, 37.

[0033] Many alterations and modifications may be made by those having ordinary skill in the art without departing from the spirit and scope of the invention. Therefore, it must be understood that the illustrated embodiments have been set forth only for the purposes of example and that it should not be taken as limiting the invention as defined by the following claims. For example, notwithstanding the fact that the elements of a claim are set forth below in a certain combination, it must be expressly understood that the invention includes other combinations of fewer, more or different elements, which are disclosed above even when not initially claimed in such combinations.

[0034] While the particular Smart Personal Air Filter herein shown and disclosed in detail is fully capable of obtaining the objects and providing the advantages herein before stated, it is to be understood that it is merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as described in the appended claims.

[0035] Insubstantial changes from the claimed subject matter as viewed by a person with ordinary skill in the art, now known or later devised, are expressly contemplated as being equivalently within the scope of the claims. Therefore, obvious substitutions now or later known to one with ordinary skill in the art are defined to be within the scope of the defined elements.

What is claimed is:

1. A personal air filter for filtering exhale comprising:
 - a first tubular housing for receiving and containing a plurality of filter components;
 - a mouth piece configured to a proximal end of the first tubular housing, the mouthpiece for introducing the exhale;
 - an air instrument for sensing air flow within the first tubular housing; and
 - an electronic transmitter for sending data to a wireless network provided by the air instrument, the data to be for the purpose of monitoring filter performance; and
 - a power supply for powering said personal air filter.
2. The personal air filter for filtering exhale of claim 1 further comprising a second tubular housing about an outer portion of the first tubular housing wherein the first tubular housing comprises extruded aluminum and wherein the second tubular housing comprises PLA material being substantially biodegradable defined as having approximately a five (5) year environmental presence.
3. The personal air filter for filtering exhale of claim 1, the plurality of filter components further comprising a replaceable filter cartridge at an interior to the first housing, wherein the replaceable filter cartridge is made from a PLA material being substantially biodegradable defined as having approximately a five (5) year environmental presence.
4. The personal air filter for filtering exhale of claim 1, the sending data to a wireless network further comprising:
 - a clock for measuring a duration of exhale and time of use; and
 - a counter circuit for recording number of exhales.
5. The personal air filter for filtering exhale of claim 1, wherein the air instrument for sensing air flow is a first air

instrument at an outlet plenum to the plurality of filter components, the personal air filter further comprising a second air instrument positioned at an inlet check valve, wherein the electronic transmitter is configured to a printed circuit board (PCB), wherein further a microprocessor and a mini-universal serial bus (USB) charging port are both configured to the PCB.

6. The personal air filter for filtering exhale of claim 1, further comprising:

a top end wall at the proximal end of the tubular housing;
a check valve approximately at the proximal end of the tubular housing; and

an exit vent at a distal end of the tubular housing

7. The personal air filter for filtering exhale of claim 2, the outer housing further comprising a carveout relief including an aperture exposing and providing access to the first tubular housing, the relief for allowing a user to disassemble the personal air filter.

8. A personal air filter comprising:

a filter cartridge comprising a filter medium;

a mouthpiece for introducing air to be filtered to the filter cartridge;

a first inner housing for containing and receiving the filter cartridge;

a printed circuit board (PCB) having a power source coupled thereto;

a transmitter coupled to the PCB for transmitting filter informational data to a wireless network.

9. The personal air filter of claim 8 further comprising an outer jacket covering the first inner housing including a relief carveout in the outer jacket for assisting removal thereof wherein the mouthpiece is permanently affixed to the outer jacket.

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