ARTIFICIAL LUNG TESTING APPARATUS

PHILTER LABS, Inc.

Introduction

The Artificial Lung Testing Apparatus (ALTA) device is designed for the most advanced testing of electronic cigarettes, traditional cigarettes, other combustibles, and accessory exhale filtering devices. The artificial lung invention is an apparatus that simulates a typical human inhale and exhale while using electronic cigarette devices or any combustible device.

Background – Demand for Electronic Cigarettes

Ever increasing in popularity, ENDS (Electronic Nicotine Delivery Systems) and the ECDS (Electronic Cannabis Delivery Systems), commonly referred to as electronic cigarettes (e-cigarettes) and vaporizers, use an electrical heating element to heat the substrate liquid for inhaling. The heating process produces a mist similar to smoke but without the excessive heat that causes combustion. Common components of the substrate include:

- Nicotine
- Mixture of nicotine and flavorings
- Cannabis – CBD
- Cannabis – THC
- Cannabis – mixture of CBD and THC

The US market for electronic cigarettes was $18.1billion in 2021 and is expected to grow 30% annually through 2030.[1] The number of different brands of e-cigarettes and vaporizers for nicotine and cannabis products has proliferated in the past decade. The need for testing the impact on vapers and those in the vicinity that are impacted by secondhand smoke is essential to reducing the harmful impact of vaping. The industry needs better equipment to fully understand the health issues related to e-cigarette usage.

[1] Market Analysis Report by Grand View Research, https://www.grandviewresearch.com/industry-analysis/e-cigarette-vaping-market

Medicinal cannabis use has grown in the past decade as benefits of CBD and THC become readily recognized. The total US cannabis market is forecast to grow at a 32.4% rate to reach $197.7 billion in 2028.[2] Similar to traditional cigarettes, there are harmful particulate and gaseous compounds associated with ENDS and ECDS. As a result, electronic cigarettes have been banned in commercial and social locations (restaurants, airports, bars, casinos, hotels) where secondhand smoke is harmful to anyone in the area. Despite these bans, ENDS and ECDS usage continues to grow. Hence, exhale filtering devices have evolved for harm reduction.

Issues with Existing Testing Products

Testing e-cigarette products to fully understand what is being inhaled and exhaled from the human lung has not kept pace with industry growth. Commonly used testing equipment does not adequately duplicate a human inhale and exhale. Aerosol pressure containers and air pumps are typically set for volume, pressure, and timing sequence to focus on the draw of the inhale. There is a lack of focus on the exhale, and humidity is mostly not considered. Human lungs are not all the same. Thus, to mimic the range of human lung capabilities, a testing apparatus needs the ability to adjust these parameters to fully understand the impact on humans of inhaling the substrate(s) and the subsequent exhale that will impact others and the vaper, along with the delivery product selected for testing. Additionally, testing equipment commonly used is focused on the inhale, leaving a vacuum in understanding exhale components.

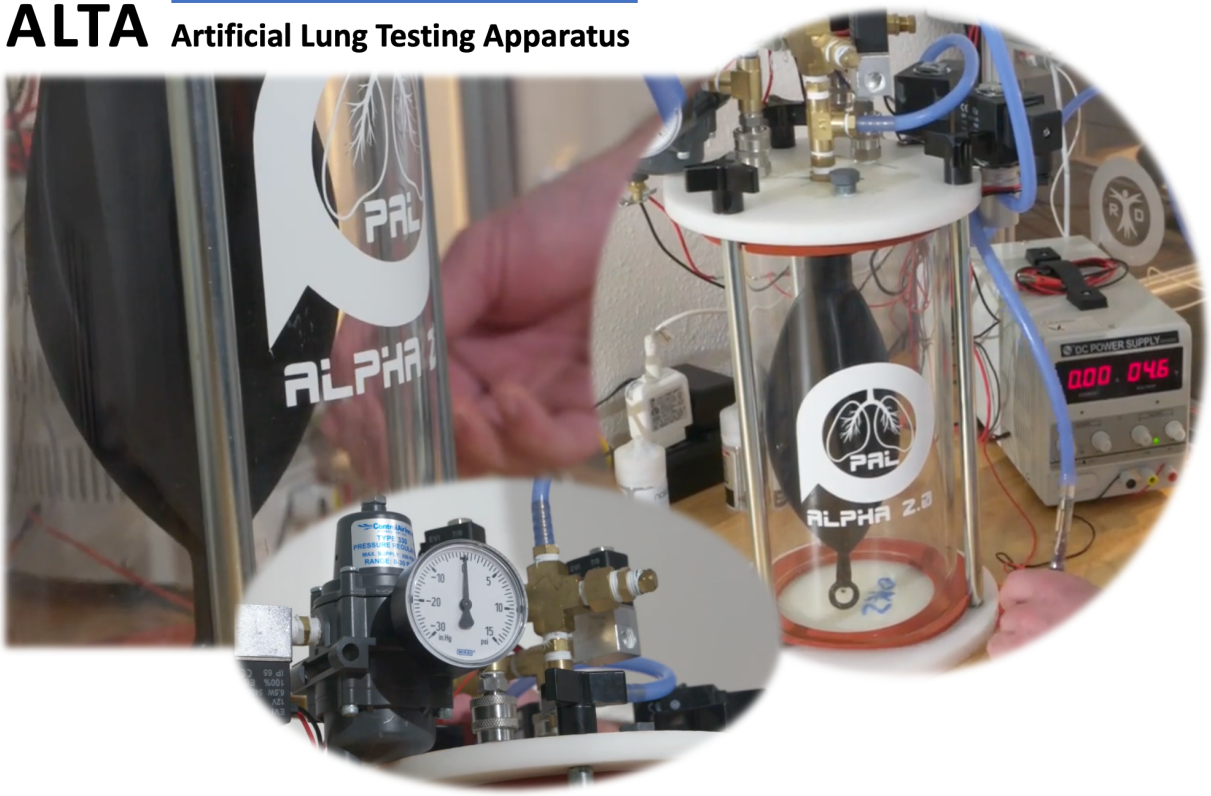
FUNCTIONAL DESCRIPTION

The Artificial Lung Testing Apparatus is designed to simulate the human lung for accurate testing on inhale of an electronic cigarette or any combustible and understanding the parameters and components of an exhale.

Multiple mechanical and control components are combined to better simulate pressure, volume and tempo of a human exhale. Changing pressure (velocity) is closely monitored simulating an actual breathing cycle. Temperature and humidity can also be adjusted and monitored. Moisture content and weight saturation simulating vapor inhale and lung exhale are monitored and recorded for data analyses.

[2] Fortune Business Insights, https://www.fortunebusinessinsights.com/industry-reports/cannabis-marijuana-market-100219

ALTA Artificial Lung Testing Apparatus



This most accurate simulation provides for optimum testing of e-cigarettes, vaporizers, and exhale filters. The ALTA is capable of testing device performance over its useful life because the testing apparatus can consistently repeat cycles for long time periods. As such, the ALTA is an essential testing apparatus to understand performance parameters of the device tested along with collecting data on the components of exhalants.

The compilation of the testing data can lead to enhancing the design of future ENDS and ENCS devices, along with enhancing design and functionality of exhale filtration devices.

The apparatus consists of a pressure chamber made of an acrylic air tight cylinder with a fill bag suspended within it. During an inhale, an inlet vapor check valve opens, air around the fill bag is displaced and the fill bag expands. The electrical solenoid valve (vacuum) can be controlled by the system to vary ramp pressure increase and temperature in the inhale half cycle. We monitor and control the moisture content in the fill bag to simulate the human lung.

During an exhale, the solenoid valve (compressor) opens and fills the cylinder with air causing the fill bag to contract while the outlet vapor check valve opens and vapor is expelled to a vacuum hood. Air pressure in the cylinder is regulated to control the inhale and exhale. A manometer coupled to a pressure transducer tracks and records pressure during cycles.

Following an inhale/exhale cycle, the solenoid air relief valve opens to allow the fill bag to return to a constant starting point. *The operation of ALTA is not limited to this description, per additional IP filings.*

Control and Monitoring

Command, control, and system monitoring is provided with customizable software instructions. The control module records data from the pressure chamber. A cycle is initiated by pressing a pushbutton. The length of testing is programmable for the system to stop at pre-determined parameters, or until STOP CYCLE or RESET is pressed. The system counts, records and logs cycles displayed to a monitor. In a preferred configuration, data can be monitored on an LCD touch panel display that identifies cycle number and half cycle stage, e.g. INHALE, EXHALE, or PAUSE.

A key aspect of the testing machine is simulating proper inhale/exhale tempo and ramp up of the exhale. For example, a three second inhale and a five second exhale can be provided via the software instructions. Results from testing are useful for determining life cycle of applicable devices such as vaporizers and filters and allows manufactures to adjust valve or nozzle technology to address optimum size and specifications.

Intellectual Property

The description in this document identifies the functionality of the Artificial Lung Testing Apparatus for which patents have been submitted. Additional advancements on the device are in the process of being filed.

ARTIFICIAL LUNG TESTING APPARATUS
ABSTRACT SUMMARY

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Description

An Artificial Lung Testing Apparatus (ALTA) is capable of simulating a human inhale and exhale also coupled to an electronic cigarette atomizer or any other combustible that a human may inhale.

Capabilities

The ALTA system is capable of multiple successive inhale and exhale cycles while carefully monitoring and recording changing air pressure and therefore flow velocity throughout a given cycle. Inhale/exhale volume, temperature and length of both the inhale and exhale are also controllable, simulating that of an average human. This testing device was designed and built to best simulate pressure, volume, moisture and tempo of a human exhale.

Current aerosol and smoke machines work primarily at a set volume, pressure, and timing sequence and typically focus on the draw or inhale. The ALTA technology enables a more accurate simulation of the velocity and air volume ramp and peak of a typical human exhale to study efficacy of removal of secondhand smoke. The common aerosol generators used to test vaporizers are not appropriate for properly and consistently testing the Philter Labs technology for elimination of secondhand smoke. The artificial lung testing apparatus allows consistent control and monitoring of an inhale and exhale sequence. With this device, we monitor volume, pressure, temperature, and humidity which enables testing and monitoring performance of filter constituents for secondhand smoke.

Exhalant data captured for analysis includes volume, back pressure, moisture content and weight saturation. The ALTA device allows for capture of the essential data to assess and improve product performance in removing harmful components of secondhand smoke. A range of devices used for inhaling nicotine and cannabis products can be tested more accurately compared to aerosol and smoking machines.