taste bad and are potentially more harmful when vaporized that the original contents of the e-juice formulation.

[0009] Many commercially available electronic cigarettes use pressure sensors that are mechanically similar to electret microphones, but packaged with an ASIC (application specific integrated circuit) instead of a standard electret microphone circuit. An electret microphone is an electrostatic capacitor-based microphone that does not require a polarizing power supply. Pressure sensors of this type typically accept two power signals and have one output signal to indicate whether or not a pressure drop was recently detected. For the pressure sensor's ASIC to accommodate changes in environment conditions (humidity and temperature), slight differences in mechanical assembly from sensor to sensor, and potential shifting of parts in the mechanical assembly from vibration or drop, the ASIC's output usually depends on changes in capacitance between the sensor's conductive diaphragm (which deflects with a pressure differential across it) and a conductive static plate in the sensor instead of depending on absolute measured capacitance crossing some threshold. Given that not all measured pressure drops indicate that the user is drawing from the device, this approach is not ideal.

[0010] In all electronic cigarettes tested (some of which may not use the standard modified electret microphone with ASIC), the device can be made to start heating at the end of a blow into the device's air/vapor outlet. In devices in which direct capacitance measurements may be made by the microcontroller, the same behavior can be produced, meaning there is no software actively handling blows into the device correctly.

[0011] This failure mode may be largely unnoticed, but it is relevant based on many user practices. For example, some electronic cigarette users hold devices in their mouths, resulting in blowing into the device. Devices that don't adequately distinguish between drawing and the end of a blowing into the mouthpiece may start heating after a user has exhaled onto the device.

[0012] Described herein are apparatuses (systems and devices) and methods that may address the problem identified above.

SUMMARY OF THE DISCLOSURE

[0013] Embodiments of the present invention relate generally to apparatuses, including systems and devices, for vaporizing material to form an inhalable aerosol. Specifically, these apparatuses may include vaporizers.

According to a first aspect of the present disclosure , there is provided a vaporizer device including: a reservoir configured to hold a vaporizable material; a heater configured to heat the vaporizable material; a mouthpiece in fluid communication with the heater via a sealed air flow path, the sealed air flow path passing from an air inlet, to the heater, and to an outlet formed in the mouthpiece; a pressure sensor configured to output sensor readings, wherein a first side of the pressure sensor is exposed to the sealed air flow path and a second side of the pressure sensor is exposed to a device air path open to ambient pressure; a gasket around the pressure sensor, the gasket configured to seal the device air path from the sealed air flow path; and a microcontroller configured to perform operations comprising: tracking a baseline based on filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold respectively indicating blowing or suction is being applied to the mouthpiece; and comparing the sensor readings to the baseline and activating the heater to generate an aerosol from the vaporizable material when the sensor readings output by the pressure sensor are offset from the baseline by more than a third threshold, the third threshold indicating suction is being applied to the mouthpiece.

According to a second aspect of the present disclosure , there is provided a vaporizer device body including: a cartridge receptacle configured to insertably receive a cartridge containing a vaporizable material; a pressure sensor configured to output sensor readings, wherein a first side of the pressure sensor is exposed to a sealed air flow path and a second side of the pressure sensor is exposed to a device air path open to ambient pressure, the sealed air flow path comprising a channel formed between an interior surface of the cartridge receptacle and an exterior surface of the cartridge, the sealed air flow path passing from an air inlet, through the channel and to a heater and an outlet of a mouthpiece within the cartridge; a gasket around the pressure sensor, the gasket configured to seal the device air path from the sealed air flow path; and a microcontroller configured to perform operations comprising: tracking a baseline based on filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold respectively indicating blowing or suction is being applied to the mouthpiece; and

comparing the sensor readings to the baseline and activating the heater to generate an aerosol from the vaporizable material when the sensor readings output by the pressure sensor are offset from the baseline by more than a third threshold, the third threshold indicating suction is being applied to the mouthpiece.

According to a third aspect of the present disclosure , there is provided a vaporizer device including: a cartridge comprising a reservoir configured to hold a vaporizable material, a heater configured to heat the vaporizable material, and a mouthpiece in fluid communication with the heater; and a device body comprising: a cartridge receptacle configured to insertably receive the cartridge; a pressure sensor configured to output sensor readings, wherein a first side of the pressure sensor is exposed to a sealed air flow path and a second side of the pressure sensor is exposed to a device air path open to ambient pressure, the sealed air flow path comprising a channel formed between an interior surface of the cartridge receptacle and an exterior surface of the cartridge, the sealed air flow path passing from an air inlet, through the channel and to the heater and an outlet in the mouthpiece of the cartridge; and a gasket around the pressure sensor, the gasket configured to seal the device air path from the sealed air flow path; and

a microcontroller configured to perform operations comprising: tracking a baseline based on filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold respectively indicating blowing or suction is being applied to the mouthpiece; and comparing the sensor readings to the baseline and activating the heater to generate an aerosol from the vaporizable material when the sensor readings output by the pressure sensor are offset from the baseline by more than a third threshold, the third threshold indicating suction is being applied to the mouthpiece.

According to a fourth aspect of the present disclosure , there is provided a method of controlling a vaporizer device to prevent heating of a heater after blowing on a mouthpiece of the vaporizer device, the method including: taking sensor readings from a pressure sensor in the vaporizer device, wherein the pressure sensor comprises a differential pressure sensor, wherein a first side of the pressure sensor is exposed to a sealed air flow path and a second side of the pressure sensor is exposed to a second air path open to ambient pressure, wherein the sealed air flow path passes from an air inlet, to the heater, and to an outlet formed in the mouthpiece, and wherein the second air path is sealed

from the sealed air flow path by a gasket around the pressure sensor; tracking a baseline by filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold indicating blowing or suction is being applied to the mouthpiece; holding the baseline at a prior value of the baseline while the sensor readings are below the baseline by the second threshold; and comparing the sensor readings to the baseline and activating the heater in the vaporizer device to generate an aerosol from a vaporizable material when the sensor readings output by the pressure sensor is offset from the baseline by more than a third threshold, the third threshold indicating that suction is being applied to the mouthpiece.

According to a fifth aspect of the present disclosure , there is provided a method of controlling a vaporizer device to prevent heating after blowing on a mouthpiece of the vaporizer device, the method including: taking sensor readings from a MEMS pressure sensor in the vaporizer device; tracking a baseline by filtering the sensor readings; holding the baseline constant while the sensor readings are above the baseline; holding the baseline constant while the sensor readings are below the baseline by a threshold; comparing the sensor readings to the baseline and activating a heater in the vaporizer device to generate an aerosol from a vaporizable material when the sensor readings are below the baseline by more than the threshold, the threshold indicating that suction is being applied to the mouthpiece, wherein a first side of the MEMS pressure sensor is exposed to a first air path through the mouthpiece and a second side of the MEMS pressure sensor is exposed to a second air path open to ambient pressure, and wherein the second air path is sealed from the first air path by a gasket around the MEMS pressure sensor.

[0014] In particular, described herein are apparatuses including vaporizers that are adapted to prevent one or more failure modes that may result from blowing into the mouthpiece, which may be referred to herein as blow rejection or blow discrimination. In general, such vaporizers and methods of operating a vaporizer may include a pressure sensor that regulates the baseline pressure readings (which may be actual pressure readings or may be unconverted sensor readings, such as capacitance measurements) during a blow and/or a draw through the mouthpiece to prevent instability that may otherwise result from blowing into the mouthpiece.

[0015] For example, described herein are vaporizer devices comprising: a reservoir configured to hold a vaporizable material; a heater configured to heat the vaporizable material; a mouthpiece in

CLAIMS

1. A vaporizer device comprising:

a reservoir configured to hold a vaporizable material;

a heater configured to heat the vaporizable material;

a mouthpiece in fluid communication with the heater via a sealed air flow path, the sealed air flow path passing from an air inlet, to the heater, and to an outlet formed in the mouthpiece;

a pressure sensor configured to output sensor readings, wherein a first side of the pressure sensor is exposed to the sealed air flow path and a second side of the pressure sensor is exposed to a device air path open to ambient pressure;

a gasket around the pressure sensor, the gasket configured to seal the device air path from the sealed air flow path; and a microcontroller configured to perform operations comprising:

tracking a baseline based on filtering the sensor readings as the sensor readings are output by the pressure sensor;

holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold respectively indicating blowing or suction is being applied to the mouthpiece; and

comparing the sensor readings to the baseline and activating the heater to generate an aerosol from the vaporizable material when the sensor readings output by the pressure sensor are offset from the baseline by more than a third threshold, the third threshold indicating suction is being applied to the mouthpiece.

2. The vaporizer device of claim 1, wherein the third threshold is the same as the second threshold.

3. The vaporizer device of claim 1, wherein the third threshold is the same as the first threshold.

4. The vaporizer device of claim 1, wherein the first threshold is zero.

5. The vaporizer device of claim 1, wherein the second threshold is zero.

6. The vaporizer device of claim 1, wherein the pressure sensor comprises a capacitive membrane.

7. The vaporizer device of claim 1, wherein the pressure sensor comprises a MEMS pressure sensor.

8. The vaporizer device of claim 1, wherein the sensor readings output by the pressure sensor comprise capacitance values.

9. The vaporizer device of claim 1, wherein the sensor readings output by the pressure sensor comprise pressure values.

10. The vaporizer device of claim 1, wherein the microcontroller is further configured to perform operations comprising: tracking the baseline based on filtering the sensor readings via low pass filtering the sensor readings.

11. The vaporizer device of claim 1, wherein the microcontroller is further configured to perform operations comprising: tracking the baseline based on filtering the sensor readings via output by taking a running average of the sensor readings.

12. The vaporizer device of claim 1, wherein the microcontroller is further configured to perform operations comprising: stopping activating of the heater to generate vapor when the sensor readings are offset from the baseline by less than the third threshold.

13. The vaporizer device of claim 1, further comprising a cartridge and a device body having a cartridge receptacle configured to insertably receive the cartridge, wherein the cartridge comprises the reservoir, the heater, the mouthpiece, and an exterior surface, wherein the device body comprises the pressure sensor, the gasket, and the microcontroller, and wherein the sealed air flow path passes from the air inlet through a channel formed between the exterior surface of

the cartridge and an interior surface of the cartridge receptacle when the cartridge is insertably received within the cartridge receptacle.

14. A vaporizer device body comprising:

a cartridge receptacle configured to insertably receive a cartridge containing a vaporizable material;

a pressure sensor configured to output sensor readings, wherein a first side of the pressure sensor is exposed to a sealed air flow path and a second side of the pressure sensor is exposed to a device air path open to ambient pressure, the sealed air flow path comprising a channel formed between an interior surface of the cartridge receptacle and an exterior surface of the cartridge, the sealed air flow path passing from an air inlet, through the channel and to a heater and an outlet of a mouthpiece within the cartridge; a gasket around the pressure sensor, the gasket configured to seal the device air path from the sealed air flow path; and

a microcontroller configured to perform operations comprising: tracking a baseline based on filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold respectively indicating blowing or suction is being applied to the mouthpiece; and comparing the sensor readings to the baseline and activating the heater to generate an aerosol from the vaporizable material when the sensor readings output by the pressure sensor are offset from the baseline by more than a third threshold, the third threshold indicating suction is being applied to the mouthpiece.

15. The vaporizer device body of claim 14, wherein the pressure sensor comprises a capacitive membrane.

16. The vaporizer device body of claim 14, wherein the pressure sensor comprises a MEMS pressure sensor.

17. The vaporizer device body of claim 14, wherein the sensor readings output by the pressure sensor comprise capacitance values.

18. The vaporizer device body of claim 14, wherein the sensor readings output by the pressure sensor comprise pressure values.

19. The vaporizer device body of claim 14, wherein the third threshold is the same as the second threshold.

20. The vaporizer device body of claim 14, wherein the third threshold is the same as the first threshold.

21. The vaporizer device body of claim 14, wherein the first threshold is zero.

22. The vaporizer device body of claim 14, wherein the second threshold is zero.

23. The vaporizer device body of claim 14, wherein the microcontroller is further configured to perform operations comprising: tracking the baseline based on filtering the sensor readings via low pass filtering the sensor readings.

24. The vaporizer device body of claim 14, wherein the microcontroller is further configured to perform operations comprising: tracking the baseline based on filtering the sensor readings via output by taking a running average of the sensor readings.

25. The vaporizer device body of claim 14, wherein the microcontroller is further configured to perform operations comprising: stopping activating of the heater to generate vapor when the sensor readings are offset from the baseline by less than the third threshold.

26. A vaporizer device comprising:

a cartridge comprising a reservoir configured to hold a vaporizable material, a heater configured to heat the vaporizable material, and a mouthpiece in fluid communication with the heater; and

a device body comprising:

a cartridge receptacle configured to insertably receive the cartridge;

a pressure sensor configured to output sensor readings, wherein a first side of the pressure sensor is exposed to a sealed air flow path and a second side of the pressure sensor is exposed to a device air path open to ambient pressure, the sealed air flow path comprising a channel formed between an interior surface of the cartridge receptacle and an exterior surface of the cartridge, the sealed air flow path passing from an air inlet, through the channel and to the heater and an outlet in the mouthpiece of the cartridge;

a gasket around the pressure sensor, the gasket configured to seal the device air path from the sealed air flow path; and

a microcontroller configured to perform operations comprising: tracking a baseline based on filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold respectively indicating blowing or suction is being applied to the mouthpiece; and comparing the sensor readings to the baseline and activating the heater to generate an aerosol from the vaporizable material when the sensor readings output by the pressure sensor are offset from the baseline by more than a third threshold, the third threshold indicating suction is being applied to the mouthpiece.

27. The vaporizer device of claim 26, wherein the pressure sensor comprises a capacitive membrane.

28. The vaporizer device of claim 26, wherein the pressure sensor comprises a MEMS pressure sensor.

29. The vaporizer device of claim 26, wherein the sensor readings output by the pressure sensor comprise capacitance values.

30. The vaporizer device of claim 26, wherein the sensor readings output by the pressure sensor comprise pressure values.

31. The vaporizer device of claim 26, wherein the cartridge comprises the vaporizable material, and wherein the vaporizable material comprises a nicotine formulation.

32. The vaporizer device of claim 26, wherein the third threshold is the same as the second threshold.

33. The vaporizer device of claim 26, wherein the third threshold is the same as the first threshold.

34. The vaporizer device of claim 26, wherein the first threshold is zero.

35. The vaporizer device of claim 26, wherein the second threshold is zero.

36. The vaporizer device of claim 26, wherein the microcontroller is further configured to perform operations comprising: tracking the baseline based on filtering the sensor readings via low pass filtering the sensor readings.

37. The vaporizer device of claim 26, wherein the microcontroller is further configured to perform operations comprising: tracking the baseline based on filtering the sensor readings via output by taking a running average of the sensor readings.

38. The vaporizer device of claim 26, wherein the microcontroller is further configured to perform operations comprising: stopping activating of the heater to generate vapor when the sensor readings are offset from the baseline by less than the third threshold.

39. A method of controlling a vaporizer device to prevent heating of a heater after blowing on a mouthpiece of the vaporizer device, the method comprising: taking sensor readings from a pressure sensor in the vaporizer device, wherein the pressure sensor comprises a differential pressure sensor, wherein a first side of the pressure sensor is exposed to a sealed air flow path and a second side of the pressure sensor is exposed to a second air path open to ambient pressure, wherein the sealed air flow path passes from an air inlet, to the heater, and to an outlet formed in

the mouthpiece, and wherein the second air path is sealed from the sealed air flow path by a gasket around the pressure sensor; tracking a baseline by filtering the sensor readings as the sensor readings are output by the pressure sensor; holding the baseline constant while the sensor readings output by the pressure sensor are above the baseline by a first threshold or below the baseline by a second threshold, the first threshold and the second threshold indicating blowing or suction is being applied to the mouthpiece; holding the baseline at a prior value of the baseline while the sensor readings are below the baseline by the second threshold; and comparing the sensor readings to the baseline and activating the heater in the vaporizer device to generate an aerosol from a vaporizable material when the sensor readings output by the pressure sensor is offset from the baseline by more than a third threshold, the third threshold indicating that suction is being applied to the mouthpiece.

40. The method of claim 39, wherein the third threshold is the same as the second threshold.

41. The method of claim 39, wherein the third threshold is the same as the first threshold.

42. The method of claim 39, wherein the first threshold is zero.

43. The method of claim 39, wherein the second threshold is zero.

44. The method of claim 39, wherein the sensor readings output by the pressure sensor comprise capacitance values.

45. The method of claim 39, wherein the sensor readings output by the pressure sensor comprise pressure values.

46. The method of claim 39, wherein tracking the baseline comprises low pass filtering the sensor readings.

47. The method of claim 39, wherein tracking the baseline comprises taking a running average of the sensor readings.

48. The method of claim 39, further comprising stopping activating the heater to generate vapor when the sensor readings are offset from the baseline by less than the third threshold.

49. The method of claim 39, wherein the vaporizer device comprises a cartridge and a device body having a cartridge receptacle configured to insertably receive the cartridge, wherein the cartridge comprises a reservoir, the heater, the mouthpiece, and an exterior surface, wherein the device body comprises the pressure sensor, the gasket, and a microcontroller, and wherein the sealed air flow path passes from the air inlet through a channel formed between the exterior surface of the cartridge and an interior surface of the cartridge receptacle when the cartridge is insertably received within the cartridge receptacle.

50. A method of controlling a vaporizer device to prevent heating after blowing on a mouthpiece of the vaporizer device, the method comprising: taking sensor readings from a MEMS pressure sensor in the vaporizer device; tracking a baseline by filtering the sensor readings; holding the baseline constant while the sensor readings are above the baseline; holding the baseline constant while the sensor readings are below the baseline by a threshold; comparing the sensor readings to the baseline and activating a heater in the vaporizer device to generate an aerosol from a vaporizable material when the sensor readings are below the baseline by more than the threshold, the threshold indicating that suction is being applied to the mouthpiece, wherein a first side of the MEMS pressure sensor is exposed to a first air path through the mouthpiece and a second side of the MEMS pressure sensor is exposed to a second air path open to ambient pressure, and wherein the second air path is sealed from the first air path by a gasket around the MEMS pressure sensor.