WO2017120992, CN103949017A, KR101796969B1 and CN203852759U all describe head-worn purifiers that provide an alternative to both face masks and neck-worn purifiers. Each of WO2017120992, CN103949017A and KR101796969B1 describe a headset having a pair of earphones on opposite sides of a headband and a microphone provided on the end of an arm that extends from one of the earphones.

In WO2017120992 a separate air filtering unit (5) is connected by a pipe (6) to an air outlet (1) provided on the arm that supports the microphone (2). Filtered air is generated by the air filtering unit (5) and pumped through the pipe (6) to be discharged from the air outlet (1). This head-worn purifier takes the form of a conventional head-set, and does not completely cover the user's mouth and nose, and is therefore likely to be more socially acceptable then a face mask. In addition, by providing the air delivery outlet on the end of a conventional microphone arm, this head-worn purifier should be capable of providing more accurate delivery of purified air to the user's nose and/or mouth than a neck-worn purifier. However, this head-worn purifier will still allow a not insignificant amount of unfiltered air to reach the user's mouth and nose. Furthermore, the requirement for a separate air filtering unit makes the purifier more complex and more cumbersome for the user.

In CN103949017A a fan (6) is incorporated into one of the earphones (8), with this fan (6) being used to pump air through a duct (7) to an air purifying device (5) provided on the end of the arm that supports the microphone (3). Whilst this head-worn purifier has incorporated the air purification functionality into the headset, the air purification and delivery performance will be limited due to the small space available for both filtering pollutants from the air supplied by the fan and for delivering filtered air to the user. In particular, the small space available will significantly limit both the maximum flow rate and the filtering efficiency due to the small filter area available. Furthermore, as with the head-worn purifier described in WO2017120992, this head-worn purifier will still allow a significant amount of unfiltered air to reach the user's mouth and nose.

SUMMARY ~~OF THE INVENTION~~

It is an object of the present ~~invention~~disclosure to provide a wearable air purifier that provides improved air purification and air delivery performance when compared with prior wearable air purifiers.

According to a first ~~aspect~~example there is provided a head wearable air purifier. The head wearable air purifier comprises a first speaker assembly arranged to be worn over a first ear of a user and a second speaker assembly arranged to be worn over a second ear of the user, wherein the first speaker assembly comprises a filter assembly, an impeller for creating an airflow through the

filter assembly, a motor arranged to drive the impeller, and an air outlet downstream from the filter assembly for emitting the filtered airflow from the speaker assembly. The head wearable air purifier further comprises a nozzle arranged to receive the filtered airflow from the first speaker assembly, the nozzle comprising an air outlet arranged to emit the received filtered airflow from the head wearable air purifier. The filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements. The filter elements may have the shape of a right circular conical frustum.

In one aspect, the present disclosure refers to a head wearable air purifier comprising:

a first speaker assembly arranged to be worn over a first ear of a user and a second speaker assembly arranged to be worn over a second ear of the user, wherein the first speaker assembly comprises a filter assembly, an impeller for creating an airflow through the filter assembly, a motor arranged to drive the impeller, and an air outlet downstream from the filter assembly for emitting the filtered airflow from the speaker assembly; and

a nozzle arranged to receive the filtered airflow from the first speaker assembly, the nozzle comprising an air outlet arranged to emit the received filtered airflow from the head wearable air purifier;

wherein the filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements.

Preferably, both the impeller and the motor are disposed within an impeller casing that is generally frusto-conical in shape, and the impeller casing is then at least partially disposed within a volume defined by a back of the one or more generally frusto-conical filter elements. The impeller casing may be at least partially disposed within a central opening of the one or more filter elements.

The filter assembly may comprise any of a particulate filter element and a chemical filter element. The particulate filter element may comprise a pleated particulate filter media that is arranged to be frustoconical in shape. Preferably, folds of the pleated filter media are at an acute angle relative to a central axis of the particulate filter element and both inner and outer edges of the pleated filter media are parallel to a central axis of the filter. The entirety of the inner edge of the pleated filter media may then be disposed within a seal of resilient material, and the entirety of the outer edge of the pleated filter media disposed within another seal of resilient material.

The filter assembly may further comprise a filter seat supporting the one or more filter elements. The filter seat may be provided with a plurality of apertures that allow air to pass from a front surface of the filter seat to a back surface of the filter seat, the front surface of the filter seat being arranged to support one or more filter elements over the plurality of apertures. The filter seat may comprise a generally frusto-conical portion and the plurality of apertures are provided in the frusto-conical portion.

Preferably, the first speaker assembly and the second speaker assembly are substantially the same. The second speaker assembly may comprise a filter assembly, an impeller for creating an airflow through the filter assembly, a motor arranged to drive the impeller, and an air outlet downstream from the filter assembly for emitting the filtered airflow from the speaker assembly, wherein the filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements; and wherein the nozzle is further arranged to receive the

filtered airflow from the second speaker assembly and to emit both of the received filtered airflows from the head wearable air purifier.

Preferably, the head wearable air purifier comprises headphone system, wherein the first speaker assembly is mounted on a first end of a headband and the second speaker assembly mounted on an opposite, second end of the headband, the headband being arranged to be worn on the head of a user.

According to a second ~~aspect~~example there is provided a head wearable air purifier. The head wearable air purifier comprises a headgear, an air purifier assembly supported by the headgear, the air purifier assembly comprising a filter assembly, an impeller for creating an airflow through the filter assembly, a motor arranged to drive the impeller, and a nozzle arranged to receive the airflow from the filter assembly, the nozzle comprising an air outlet arranged to emit the received airflow from the head wearable air purifier. The filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements.

The air purifier assembly may further comprise a housing having an air inlet and an air outlet, and both the filter assembly and the impeller are then disposed within the housing. The air outlet of the housing may be arranged to emit the airflow from the housing and may be connected to an air inlet of the nozzle. The air purifier assembly may further comprise a speaker or acoustic driver unit and the air purifier assembly may then be arranged to be worn over a first ear of a user.

According to a third ~~aspect~~example there is provided a filter assembly. The filter assembly comprises a particulate filter element, the particulate filter element comprising a pleated particulate filter media that is arranged to be frustoconical in shape with folds of the pleated filter media at an acute angle relative to a central axis of the particulate filter element and both inner and outer edges of the pleated filter media parallel to a central axis of the particulate filter element. The entirety of the inner edge of the pleated filter media is disposed within a seal of resilient material, and the entirety of the outer edge of the pleated filter media is disposed within another seal of resilient material. The filter assembly may further comprise a chemical filter element that is arranged to be frustoconical in shape.

According to a fourth ~~aspect~~example there is provided a head wearable air purifier. The head wearable air purifier comprises a first speaker assembly arranged to be worn over a first ear of a user and a second speaker assembly arranged to be worn over a second ear of the user, wherein the first speaker assembly comprises a filter assembly, an impeller for creating an airflow through the

CLAIMS

1. A head wearable air purifier comprising:

a first speaker assembly arranged to be worn over a first ear of a user and a second speaker assembly arranged to be worn over a second ear of the user, wherein the first speaker assembly comprises a filter assembly, an impeller for creating an airflow through the filter assembly, a motor arranged to drive the impeller, and an air outlet downstream from the filter assembly for emitting the filtered airflow from the speaker assembly; and

a nozzle arranged to receive the filtered airflow from the first speaker assembly, the nozzle comprising an air outlet arranged to emit the received filtered airflow from the head wearable air purifier;

wherein the filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements.

2. ~~The~~ A head wearable air purifier as claimed in ~~of~~ claim 1, wherein both the impeller and the motor are disposed within an impeller casing that is generally frusto-conical in shape, and wherein the impeller casing is at least partially disposed within a volume defined by a back of the one or more generally frusto-conical filter elements.

3. A~~The~~ head wearable air purifier as claimed in ~~of~~ claim 2, wherein the impeller casing is at least partially disposed within a central opening of the one or more filter elements.

4. A~~The~~ head wearable air purifier as claimed in ~~of~~ any ~~one~~ of claims 1 to 3, wherein the filter assembly comprises any of a particulate filter element and a chemical filter element.

5. A~~The~~ head wearable air purifier as claimed in ~~of~~ claim 4, wherein the particulate filter element comprises a pleated particulate filter media that is arranged to be frustoconical in shape.

6. A~~The~~ head wearable air purifier as claimed in ~~of~~ claim 5, wherein folds of the pleated filter media are at an acute angle relative to a central axis of the particulate filter element and both inner and outer edges of the pleated filter media are parallel to a central axis of the filter.

7. A~~The~~ head wearable air purifier as claimed in ~~of~~ claim 6, wherein the entirety of the inner edge of the pleated filter media is disposed within a seal of resilient material, and the entirety of the outer edge of the pleated filter media is disposed within another seal of resilient material..

8. A~~The~~ head wearable air purifier as claimed in~~of~~ any ~~one~~ of claims 1 to 7, wherein the filter assembly further comprises a filter seat supporting the one or more filter elements.

9. A~~The~~ head wearable air purifier as claimed in~~of~~ claim 8, wherein the filter seat is provided with a plurality of apertures that allow air to pass from a front surface of the filter seat to a back surface of the filter seat, the front surface of the filter seat being arranged to support one or more filter elements over the plurality of apertures.

10. A~~The~~ head wearable air purifier as claimed in~~of~~ claim 9, wherein the filter seat comprises a generally frusto-conical portion and the plurality of apertures are provided in the frusto-conical portion.

11. A~~The~~ head wearable air purifier as claimed in~~of~~ any ~~one claims 1 to 10~~preceding claim, wherein the first speaker assembly and the second speaker assembly are substantially the same.

12. A~~The~~ head wearable air purifier as claimed in~~of~~ any ~~one of claims 1 to 11~~preceding claim, wherein the second speaker assembly comprises a filter assembly, an impeller for creating an airflow through the filter assembly, a motor arranged to drive the impeller, and an air outlet downstream from the filter assembly for emitting the filtered airflow from the speaker assembly, wherein the filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements; and wherein the nozzle is further arranged to receive the filtered airflow from the second speaker assembly and to emit both of the received filtered airflows from the head wearable air purifier.

13. A~~The~~ head wearable air purifier as claimed in~~of~~ any ~~one claims 1 to 12~~preceding claim, wherein the first speaker assembly is mounted on a first end of a headband and the second speaker assembly mounted on an opposite, second end of the headband, the headband being arranged to be worn on the head of a user.

~~14. A head wearable air purifier comprising:~~

~~a headgear;~~

~~an air purifier assembly supported by the headgear, the air purifier assembly comprising a filter assembly, an impeller for creating an airflow through the filter assembly, a motor arranged to drive the impeller, and a nozzle arranged to receive the airflow from the filter assembly, the nozzle comprising an air outlet arranged to emit the received airflow from the head wearable air purifier;~~

wherein the filter assembly is provided upstream of the impeller and comprises one or more generally frusto-conical filter elements.

15. The head wearable air purifier of claim 14, wherein the air purifier assembly further comprises a housing having an air inlet and an air outlet, and both the filter assembly and the impeller are disposed within the housing

16. The head wearable air purifier of claim 15, wherein the air outlet of the housing is arranged to emit the airflow from the housing and is connected to an air inlet of the nozzle.

17. The head wearable air purifier of any one of claims 14 to 16, wherein the air purifier assembly further comprises a speaker driver unit and the air purifier assembly is arranged to be worn over a first ear of a user.

18. A filter assembly comprising:

a particulate filter element, the particulate filter element comprising a pleated particulate filter media that is arranged to be frustoconical in shape with folds of the pleated filter media at an acute angle relative to a central axis of the particulate filter element and both inner and outer edges of the pleated filter media parallel to a central axis of the particulate filter element;

wherein the entirety of the inner edge of the pleated filter media is disposed within a seal of resilient material, and the entirety of the outer edge of the pleated filter media is disposed within another seal of resilient material.

19. The filter assembly of claim 18, and further comprising a chemical filter element that is arranged to be frustoconical in shape.