

AN AIR BARRIER DEVICE

TECHNICAL FIELD

This invention relates generally to an air barrier device.

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Background

The detrimental effects of prolonged exposure to pollution in the form of airborne particulates has been a long time public safety concern. The most common forms of airborne pollution encountered by typical individuals are automotive exhaust, smoke whether caused
10 by uncontrolled fires or from nearby manufacturing facilities, and dust and dirt which has become entrained in the air due to the passage of cars and trucks, the operation of construction equipment and not uncommonly from engaging in recreational activities which kick up dust such as mountain biking and off-road travel in popular four-wheel drive vehicles and the like.

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Further, in recent times, the general public and front line workers, for example health care personnel, have become more aware of the potential hazards associated with airborne pathogens and viruses, especially in the wake of the COVID-19 pandemic. It has been found that aerosols having airborne liquid and solid particles are generated not only by the
20 exhalation of infected patients, but also by certain procedural manipulations and processes that impart energy to microbial suspensions. A considerable number of studies have been made which are now beginning to identify the transmission of viruses through “non-accident” situations.

25 These has made wearing surgical masks or face masks as the new norm and is made compulsory in various countries when one is out in the public. As such typical masks do not protect the eyes, which are a point of virus transmissions, schools and health care institutions have mandated the use of face shields most of their staff when interacting with, for example, students and patients. Some members of the public has also voluntarily taken to wearing face
30 shields as well. However, it is noted that such face shields are only effective in preventing

exhalation of an infected person when the face shield is facing the direction of exhalation or liquid discharge from the infected person. Exhalation and liquid discharge, together with aerosols are still able to reach the face and eyes of the due to the side gaps that exist between the face shield and the face of a person wearing the face shield. Reducing the distance
5 between the face shield and the face is impractical and it will make breathing difficult and cause discomfort to the user. Aerosol-borne viruses may still enter through the greatly reduced gap between the face of the user and the face shield, while breathing. Further, the wearing of full personal protection equipment (PPE) for the general public, instead of wearing face masks and face shields, is also impractical and not a sustainable solution.
10 Therefore, there exists a need for a solution for addressing the foregoing issues.

Summary

In accordance with an aspect of the invention, there is disclosed an air barrier device adaptable for being worn by a user for producing a flow of air across a face of the user
15 comprising a support structure, an air intake, an air exhaust and a shield structure. The support structure is shaped and dimensioned for affixing to a portion of the head of the user, the air intake being coupled to the support structure for drawing ambient air thereinto and the air exhaust coupled to the support structure and being in fluid communication with the air intake for receiving the drawn air therefrom and directing a flow of air across a face of the
20 user to form an air barrier thereover. The shield structure is coupled to the support structure for extending across at least a portion of the face of the user.

In accordance with one embodiment of this disclosure, the support structure comprises at least one of a head band adapted to have an adjustable girth for fitting around the head of the
25 user and an arcuate arm being shaped and dimensioned for extending one of around the rear of the head of the user and around the back of the ear of the user.

In accordance with one embodiment of this disclosure, the shield structure is light permeable and being shaped and dimensioned for extending over at least one of the eyes, nose and
30 mouth of the user.

In accordance with one embodiment of this disclosure, the shield structure comprises a lens adaptor for receiving at least one prescription lens.

- 5 In accordance with one embodiment of this disclosure, the air exhaust is shaped to extend across the forehead of the user and comprises an exhaust air channel wherethrough air is transported and terminating at one or more nozzles wherefrom air can be discharged.

- 10 In accordance with one embodiment of this disclosure, the air intake comprises an intake air channel in fluid communication with the exhaust air channel, and an impeller disposed in the intake air channel and driven by an electrical actuator for drawing ambient air into the intake air channel.

- 15 In accordance with one embodiment of this disclosure, the air intake further comprises a filter for filtering air being drawn into the intake air channel, and an ionizer for ionizing the air being drawn into the intake air channel.

- 20 In accordance with one embodiment of this disclosure, the filter is shaped as a removable filter cartridge with the air intake being adapted to enable removable and replacement of the filter cartridge therefrom.

In accordance with one embodiment of this disclosure, the filter comprises at least one of a micro-filter and a nano-filter.

- 25 In accordance with one embodiment of this disclosure, the air barrier device further comprises a battery module for providing electrical energy for operating at least one of the electrical actuator and the ionizer.

- 30 In accordance with one embodiment of this disclosure, the air barrier device further comprises at least one of a charging adaptor in electrical communication with the battery

module and being shaped and dimensioned for removable coupling with an electrical source for charging the battery module, and a solar charge module for converting light energy into electrical energy for at least one of charging the battery module and powering the electrical actuator and the ionizer.

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In accordance with one embodiment of this disclosure, the air barrier device further comprises a controller circuitry for controlling charging of the battery via at least one of the charging adaptor and the solar charge module.

- 10 In accordance with one embodiment of this disclosure, the air barrier device further comprises at least one sensor disposed in at least one of the air intake and the air exhaust for sensing air quality of air at least one of being drawn into the air intake and being discharged from the air exhaust, and a controller circuitry in data communication with the at least one sensor for generating data from air quality being sensed thereby.

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In accordance with one embodiment of this disclosure, the air exhaust is for directing the flow of air at a mass flow rate for creating a higher than ambient pressure in a space between the face of the user and the shield structure.

- 20 In accordance with one embodiment of this disclosure, the shield structure having a curved shape.

- In accordance with one embodiment of this disclosure, the air intake and the support structure being inter-configured for disposing the air intake one of away from the face and at the back
25 of the head of the user when the support structure is worn on the head of the user.

Brief Description of the Drawings

FIG. 1 shows an exemplary partial side view of an air barrier device in accordance with an aspect of the invention;

5 FIG. 2 shows a partial rear view of the air barrier device of FIG. 1;

FIG. 3 shows a partial side sectional view of the air barrier device of FIG. 1 being worn on the head of a user with a shield structure extending of the face thereof and an air barrier generated between the face and the shield structure;

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FIG. 4 shows a side view of the air barrier device of FIG. 1 being worn on the head of a user with the shield structure extending of the face thereof and an air barrier generated between the face and the shield structure;

15 FIG. 5 shows an exemplary air flow diagram of the air barrier device of FIG. 1; and

FIG. 6 shows an exemplary data / signal flow diagram of a control circuitry of the air barrier device of FIG. 1 with other electrical components thereof.

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Detailed Description

The non-limiting exemplary embodiments will now be described more fully hereinafter with reference to the accompanying drawings. This invention may however, be embodied in many
5 different forms and shapes and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this application will be thorough and complete, and will fully convey the true scope of the invention to those skilled in the art. Like numbers refer to like elements throughout the figures.

10 An exemplary embodiment of the present invention, an air barrier device 20, is described hereinafter with reference to FIGS. 1 to 4. The air barrier device 20 is adaptable for being worn by a user 22a for producing a flow of air across a face 22b of the user 22a. The air barrier device 20 comprises a support structure 24 being shaped and dimensioned for affixing to a portion of the head 22c of the user 22a. The air barrier device 20 further comprises an
15 air intake 26 being coupled to the support structure 24 for drawing ambient air thereinto, and an air exhaust 28 coupled to the support structure 24 and being in fluid communication with the air intake 26 for receiving the drawn air therefrom and directing a flow of air across the face 22b of the user 22a to form an air barrier 30 thereover. The air barrier device 20 further comprises a shield structure 32 coupled to the support structure 24 for extending across at
20 least a portion of the face 22b of the user 22a. The support structure 24, the air intake 26 and the air exhaust 28 may further be formed and configured into a variety of shapes for being worn as a fashion accessory or sporting accessory.

The support structure 24 can comprise a head band 34 adapted to have an adjustable girth for
25 fitting around the head 22c, or adjacent the crown of the head 22c, of the user 22a. The head band 34 can be in the form of a flexible elongated strip, preferably made from plastic, with two ends forming extremities thereof that are shaped to inter-couple to form a loop. The intercoupling of the ends of the elongated strip may occur at various points therealong to enable the varying of the girth, or diameter, of the formed loop. A simple rack and pinion
30 apparatus may also be incorporated with the elongated strip to enable operation of the pinion

via an exposed thimble or knob by the user 22a so that racks, or rack gears, formed at the ends of the plastic strip may be inter-displaced to enable adjustments to the girth of the formed loop with ease. Alternatively, the elongated strip may be made from other materials such as an elastic band that enables the support structure 24 to be fitted to the head 2c of the user 22a.

Alternatively, the support structure 24 is shaped and dimensioned for extending one of around the rear of the head 22c of the user 22a and along the back of the ear of the user. When extending behind the ear of the user 22a, support structure 24 may be shaped to support the air barrier device 20 on the head and ear of the user 22a. When extending along the back of the head 22c, the support structure 24 can comprise an elongated arcuate arm that is resiliently biased to snugly the curved back of the head 22c of the user 22a. The elongated arcuate arm 34 may be held in place on the back of the head 22c of the user 22a by resilient claspings thereof to the back of the head 22c or further assisted by locating structures, shaped as a hook or a bayonet, at one or both ends of the arcuate arm for resting on and support by one or both ears of the user 22a. Further alternatively, the support structure 24 may be shaped and dimensioned as a hairband to be worn on the head 22c of the user 22a and held in place by at least one of resilient claspings of the head 22c of the user thereby and teeth structures of the hairband for nestling into the hair of the user 22a. Further alternatively, the support structure 34 may be adapted as a bridge and arms of a spectacle frame.

The air barrier device 20, and specifically the support structure 24 thereof, may be configured in a variety of designs to be worn like a pair of cycling or running shade, a sun shade, a pair of spectacle frames, a helmet, microphone headset or even a cap, which can be easily removed, cleaned and stowed when not in used. Further, the shield structure 32 can be further adapted to be detachable and re-attachable to the support structure 32 so that various shapes, design, type and function of the shield structure 32 may be swapped out and applied to the support structure 24 for forming the air barrier device 20.

Preferably, the shield structure 32 is light permeable and being shaped and dimensioned for extending over at least a portion of the face 22b, for example over at least one of the eyes, nose and mouth, of the user 22a. The shield structure 32 preferably has a curved shape and is formed from one of curved rigid plastic sheet, for example Perspex, glass and soft plastic that is shaped by a rigid structure forming the periphery thereof. The shield structure 32 may be further shaped and dimension as a long version to extend over the entire face 22b of the user, or as a short version for extending over just the eyes of the user 22a or over just the eyes and nose of the user 22a. The short version of the shield structure 32, as shown in FIG 1, FIG 2 and FIG 4, enables better communication for the user 22a due to an absence of physical material covering the mouth of the user 22a.

The shield structure 32 is preferably optically clear or translucent and may coloured by dye pigments to present a preferred colour. Additionally or alternatively, the shield structure 32 can be formed from or coated with photochromatic material to enable the automatically vary light permeability thereof under varying lighting conditions. Additionally or alternatively, the shield structure 32 can be coated with various coating to customize the optical properties thereof, for example, to polarize the shield structure or to selectively filter specific wavelength or light bands of light. The shield structure 32 can be further coated with various scratch resistant and impact resistant coatings and may comprise peripheral LED lighting along at least a portion of the periphery thereof to improve visibility of the 22a to other pedestrians and road users at night or in poor lighting conditions.

The shield structure 32 can comprise comprising a lens adaptor for receiving at least one prescription lens. The lens adaptor is coupled to one of the shield structure 32 and the support structure 24 for positioning the received at least one prescription lens of at least one of the eyes of the user 22a.

In an implementation of the air barrier device 20, The air barrier device 20 can further comprise a hinge for intercoupling the shield structure 32 and the support structure 24 to enable the shield structure 32 to be folded up to a position that is horizontal to the face 22b of

the user 22a so that it may function similar to a visor. Additionally or alternatively, the air barrier device 20 can further comprise a guide for intercoupling the shield structure 32 and the support structure 24 to enable sliding of the upwards from the face 22b of the user 22a and enabling varying of the amount of extension of shield structure 32 over the face of the user 22a.

The air exhaust 28 is shaped to extend across the forehead of the user 22a and comprises an exhaust air channel 40 where through air is transported and terminating at one or more nozzles 42 wherefrom air can be discharged for forming the air barrier 30. The air travelling through the exhaust air channel 40 may be infused with a scent via, for example, an essential oil wicking system that wicks essential oil from an essential oil container or substrate for the purpose of, for example, aromatherapy or deodorization. The air intake 26 comprises an intake air channel 44 in fluid communication with the exhaust air channel 40, and an impeller 46 disposed in the intake air channel 44 being driven by an electrical actuator 48, for example an electrical motor, for drawing ambient air into the intake air channel 44. Preferably, the air exhaust 28 will not release air streaming over the ears of the user 22a in order to prevent the latter from noise of the air flow.

The air intake 26 further comprises a filter 50 for filtering air being drawn into the intake air channel 44, and an ionizer 52 for ionizing the air being drawn into the intake air channel 44. Preferably, the filter 50 is shaped and adapted as a removable filter cartridge with the air intake 26 being adapted to enable removable and replacement of the filter cartridge therefrom. Preferably, the filter 50 comprises at least one of a micro-filter and a nano-filter, and may contain other activated carbon.

Air in the environment is drawn into the intake air channel 44 by the impeller 46 to be first channelled through the filter 50 and the ionizer 52 to be conditioned or cleaned before the clean air is channel through the exhaust air channel 40 to be discharged through the one or more nozzles 42. Preferably, the cross-sectional area of the intake air channel 44 may be

larger than the cross-sectional area of the exhaust air channel 40 to enable a higher pressure air flow to be formed at the one or more nozzles 42.

Each of the cross-sectional of the intake air channel 44 and the cross-sectional area of the exhaust air channel 40 may include a variety of shapes, for example, a round shape, an oval shape, an elliptical shape and a triangular shape. One skilled in the art may easily envisage such the air exhaust 28 having an aesthetic appearance and ergonomic shape without compromising on the functional requirements and usage comfort of the air barrier device 20.

The one or more nozzles 42 may be formed integral the air exhaust 28 or may be configured as a separate component that can be detachably coupled to the air exhaust 28. The nozzle 46 may be of an elongated shape and may include an array of apertures to air channeled to the exhaust air channel 40 to be discharged and multiple air streams or a curtain of air over the face 22b of the user 22a.

The air barrier device 20 further comprises a battery module 54 for providing electrical energy for operating at least one of the electrical actuator 48 and the ionizer 52. The air barrier device 20 further comprises a charging adaptor 56, for example a USB changing port or the like port being shaped and dimensioned for nesting, removably coupling with and nesting with an electrical energy supply, in electrical communication with the battery module 54 and being shaped and dimensioned for removable coupling with an electrical source for charging the battery module. Additionally or alternatively, the air barrier device 20 further comprises a solar charge module 58 for converting light energy into electrical energy for at least one of charging the battery module 54 and powering the electrical actuator 48 and the ionizer 53.

The air barrier device 20 further comprises a controller circuitry 60 for controlling charging of the battery module 54 via at least one of the charging adaptor 56 and the solar charger module 58. The controller circuitry 60 is preferably contained in a housing 62 that is coupled to or integrated with at least one of the support structure 24, the air intake 26, the air exhaust

28 and the shield structure 32. The controller circuitry 60 can comprise and present a user interface (UI) 63a for visually and audibly providing information to the user 22a and for receiving input therefrom. For example, the electrical actuator 48 may be controlled by the user-interaction with the UI 63a, which may present one or more of a touch display, a touch panel, buttons, knobs and switches, for varying the speed of the impeller 46 and consequently varying the flow rate of air being discharged by the air exhaust 28. The UI 63a may also enable the switching on and off of the electrical actuator 48 and the ionizer 52. The controller circuit 60 may further comprise a communication module 63b enabling wireless communication, for example by Bluetooth or WiFi, with a smart device, for example a smart phone, a laptop or a smart watch, to enable data communication therewith and remote control thereby. The battery module 54 can comprise an exemplary lithium ion battery or the like high capacity battery for sustaining, for example, two to eight hours of use, and a charge/discharge controller for controlling charge and discharge of the battery module 54 independently or in corporation with the controller circuitry 60.

The air barrier device 20 further comprises at least one sensor 64 disposed in at least one of the air intake 26 and the air exhaust 28 for sensing air quality of air at least one of being drawn into the air intake 26 and being discharged from the air exhaust 28. Preferably, the controller circuitry 60 is in data communication with the at least one sensor 64 for generating data from air quality being sensed thereby.

The air intake 26 can further comprises a heater module comprising, for example, one or more heating elements adapted for and operable to heat the conditioned or clean air that has been channelled through the filter 50 and the ionizer 52 prior to being discharged through the one or more nozzles 42. The heater module is in data communication with and for control by the controller circuitry 60. The temperature of the heated air can be further sensed by the at least one sensor 64 with the controller circuitry 60 controlling the heating at a preferred set-point temperature which may be varied or selected by the user 22a via the UI 63a.

Preferably, the air exhaust 28 is shaped and the electrical actuator 48 is adapted for directing the flow of air at a mass flow rate for creating a higher than ambient pressure in a space between the face 22b of the user 22a and the shield structure 32. This creates an air barrier or a so called “air curtain” to divert airborne particles and chemicals away from the face 22b of the user 22a and forms a positive pressure zone around the face 22b to impede travel of airborne particles and chemicals onto the face 22b of the user 22a.

The air intake 26 and the support structure 24 are inter-configured for disposing the air intake 26 one of away from the face and at the back of the head 22c of the user 22a when the support structure 24 is worn on the head 22c of the user 22a.

Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with existing face shield or face mask devices. While features, aspects, and/or advantages associated with certain embodiments have been described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by a person of ordinary skill in the art that several of the above-disclosed structures, components, or alternatives thereof, can be desirably combined into alternative structures, components, and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope of the present disclosure, which is limited only by the following claims.

Claims

1. An air barrier device adaptable for being worn by a user for producing a flow of air across a face of the user comprising:

5 a support structure being shaped and dimensioned for affixing to a portion of the head of the user;

 an air intake being coupled to the support structure for drawing ambient air thereinto;

10 an air exhaust coupled to the support structure and being in fluid communication with the air intake for receiving the drawn air therefrom and directing a flow of air across the face of the user to form an air barrier thereover; and

 a shield structure coupled to the support structure for extending across at least a portion of the face of the user.

- 15 2. The air barrier device as in claim 1, the support structure comprising at least one of a head band adapted to have an adjustable girth for fitting around the head of the user and an arcuate arm being shaped and dimensioned for extending one of around the rear of the head of the user and around the back of the ear of the user.

- 20 3. The air barrier device as in claim 1, the shield structure is light permeable and being shaped and dimensioned for extending over at least one of the eyes, nose and mouth of the user.

4. The air barrier device as in claim 1, the shield structure comprising a lens adaptor for
25 receiving at least one prescription lens.

5. The air barrier device as in claim 1, the air exhaust being shaped to extend across the forehead of the user and comprises an exhaust air channel wherethrough air is transported and terminating at one or more nozzles wherefrom air can be discharged.

6. The air barrier device as in claim 5, the air intake comprising:
an intake air channel in fluid communication with the exhaust air channel; and
an impeller disposed in the intake air channel and driven by an electrical actuator for drawing ambient air into the intake air channel.

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7. The air barrier device as in claim 6, the air intake further comprising:
a filter for filtering air being drawn into the intake air channel; and
an ionizer for ionizing the air being drawn into the intake air channel.

- 10 8. The air barrier device as in claim 7, the filter being shaped as a removable filter cartridge with the air intake being adapted to enable removable and replacement of the filter cartridge therefrom.

- 15 9. The air barrier device as in claim 7, the filter comprising at least one of a micro-filter and a nano-filter.

10. The air barrier device as in claim 7, further comprising a battery module for providing electrical energy for operating at least one of the electrical actuator and the ionizer.

- 20 11. The air barrier device as in claim 10, further comprising at least one of:
a charging adaptor in electrical communication with the battery module and being shaped and dimensioned for removable coupling with an electrical source for charging the battery module; and
a solar charge module for converting light energy into electrical energy for at
25 least one of charging the battery module and powering the electrical actuator and the ionizer.

12. The air barrier device as in claim 11, further comprising:
a controller circuitry for controlling charging of the battery via at least one of
30 the charging adaptor and the solar charge module.

13. The air barrier device as in claim 1, further comprising:
at least one sensor disposed in at least one of the air intake and the air exhaust
for sensing air quality of air at least one of being drawn into the air intake and being
5 discharged from the air exhaust; and
a controller circuitry in data communication with the at least one sensor for
generating data from air quality being sensed thereby.
14. The air barrier device as in claim 1, the air exhaust for directing the flow of air at a
10 mass flow rate for creating a higher than ambient pressure in a space between the face
of the user and the shield structure.
15. The air barrier device as in claim 1, the shield structure having a curved shape.
- 15 16. The air barrier device as in claim 1, the air intake and the support structure being
inter-configured for disposing the air intake one of away from the face and at the back
of the head of the user when the support structure is worn on the head of the user.