air are expensive and use primarily UV germicidal light. These products require professional installation, are not accessible to the general public *per se*, and have not been used to kill COVID-19. Moreover, filtration in an HVAC system can be ineffective. COVID-19 measures between 0.05 to 0.2 microns, but HEPA filters can filter particulate larger than 0.3 microns so additional protection is needed against the spread of COVID-19.

[0011] For these reasons, the subject matter of the present disclosure is directed to overcoming, or at least reducing the effects of, one or more of the problems set forth above.

SUMMARY OF THE DISCLOSURE

[0012] The subject matter of the present disclosure is directed to a mobile purification device that filters air and seeks to destroy pathogens (viruses, bacteria, mold, pollens, etc.) and other elements, such as volatile organic compounds, allergens, and pollutants. The purification device is intended to be affordable, easily installed, accessible and useable in both residential and commercial settings. The purification device can be applied to real world solutions to best reduce viruses, such as COVID-19, and other pathogens in the circulating air, and the purification device can be deployed as a specialized heated filter for use in commercial, residential, mass transit, and public venues.

[0013] For example and as discussed below, the purification device includes a barrier heater or heated filter that uses targeted thermal conduction of high efficiency nickel foam/mesh raised to temperatures proven to kill pathogens, such as corona viruses (such as COVID-19). The purification device can also include an ultraviolet (UV) light sources that uses UV-C light to destroy the virus. The UV light source and the barrier heater are combined together in a flame retardant and resistant filtration system, which can then be moved and placed as desired in an environment of a facility or populated environs, such as an airport terminal, church, hospital, workshop, office space, residence, transit vehicle, school, hotel, cruise ship, recreational venue, etc. As there is no current cure for COVID-19 and many other pathogens, environmental purification strategies can help slow the spread of the virus, and the air purification provided by the disclose device can provide a primary defense against transmission.

[0013a] According to a first aspect of the present invention, there is provided an apparatus used with supplied power for treating air in an environment for a pathogen, the apparatus comprising:

a housing being mobile in the environment and having an intake and an exhaust;

at least one prime mover disposed in the housing between the intake and the exhaust and being operable to move the air in the environment through the housing from the intake to the exhaust; and

at least one heater disposed in the housing and comprising a permeable barrier having a metal material, the permeable barrier of the at least one heater being configured to allow the moved air flow therethrough up to a porosity threshold, the metal material of the permeable barrier of the at least one heater connected in electrical communication to the supplied power, the permeable barrier having an active surface area being configured to interact with the pathogen, the active surface area being heated by the supplied power to a surface temperature directed to at least damage the pathogen,

wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area comprising a latticework of tortuous channels defined through a thickness of the porous foam.

~~wherein the active surface area heated to the surface temperature and the porosity threshold of the permeable barrier are configured to produce heating that is localized and is dissipated in the air flow downstream thereof.~~

[0013b] According to a second aspect of the present invention, there is provided an apparatus used with supplied power for treating air in an environment for a pathogen, the apparatus comprising:

a housing being mobile in the environment and having an intake and an exhaust;

at least one prime mover disposed in the housing between the intake and the exhaust and being operable to move the air in the environment through the housing from the intake to the exhaust; and

at least one heated filter comprising ~~a filter media and~~ a permeable barrier disposed adjacent one another in the housing, ~~the filter media being configured to filter the air flow therethrough up to a filtration threshold and comprising a first material,~~ the permeable barrier comprising a metal material, the permeable barrier exposed to the air flow and being configured to allow the air flow therethrough up to a porosity threshold, the metal material of the permeable barrier connected in electrical communication to the supplied power, the permeable barrier having an

active surface area being configured to interact with the pathogen and being heated by the supplied power to a surface temperature directed to at least damage the pathogen,

~~wherein the active surface area heated to the surface temperature and the porosity threshold of the permeable barrier are configured to produce heating that is localized and is dissipated in the air flow downstream thereof.~~

wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area comprising a latticework of tortuous channels defined through a thickness of the porous foam.

[0013c] According to a third aspect of the present invention, there is provided a method for treating air in an environment for a pathogen, the method comprising:

moving air flow through a plenum in a mobile housing from an intake to an exhaust by powering a prime mover disposed in the plenum;

filtering the air flow up to a filtration threshold through a filter disposed across the plenum;

allowing the air flow up to a porosity threshold through a permeable barrier of a heater disposed across the plenum, the permeable barrier having a metal material and an active surface area, the active surface area being configured to interact with the pathogen; and

heating the active surface area of the permeable barrier of the heater to a surface temperature directed to at least damage the pathogen by supplying a voltage potential across the permeable barrier, ~~wherein the active surface area heated to the surface temperature and the porosity threshold of the permeable barrier are configured to produce heating that is localized and is dissipated in the air flow downstream thereof.~~

wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area comprising a latticework of tortuous channels defined through a thickness of the porous foam.

CLAIMS:

1. An apparatus used with supplied power for treating air in an environment for a pathogen, the apparatus comprising:

a housing being mobile in the environment and having an intake and an exhaust;

at least one prime mover disposed in the housing between the intake and the exhaust and being operable to move the air in the environment through the housing from the intake to the exhaust; and

at least one heater disposed in the housing and comprising a permeable barrier having a metal material, the permeable barrier of the at least one heater being configured to allow the moved air flow therethrough up to a porosity threshold, the metal material of the permeable barrier of the at least one heater connected in electrical communication to the supplied power, the permeable barrier having an active surface area being configured to interact with the pathogen, the active surface area being heated by the supplied power to a surface temperature directed to at least damage the pathogen,

wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area comprising a latticework of tortuous channels defined through a thickness of the porous foam.

~~wherein the active surface area heated to the surface temperature and the porosity threshold of the permeable barrier are configured to produce heating that is localized and is dissipated in the air flow downstream thereof.~~

2. The apparatus of claim 1, further comprising at least one filter disposed in the housing and comprising a first material, the filter configured to filter the moved air therethrough up to a filtration threshold.

3. The apparatus of claim 2, wherein the first material of the filter comprises a metal material.

4. The apparatus of claim 1, further comprising at least one cartridge being replaceable at the intake of the housing, the at least one cartridge having a plenum with an inlet and an outlet, the at least one cartridge having the at least one permeable barrier.

5. The apparatus of claim 4, wherein the at least one cartridge further comprises at least one filter disposed across the plenum and comprising a first material, the filter being configured to filter the moved air therethrough up to a filtration threshold.

6. The apparatus of claim 5, wherein the at least one cartridge comprises a receptacle being configured to hold the at least one filter.

7. The apparatus of claim 5 or 6, wherein the filter is disposed in the plenum toward the inlet, and wherein the permeable barrier is disposed in the plenum toward the outlet.

8. The apparatus of any one of claims 1 to 7, further comprising at least one ultraviolet light source disposed in the housing, the ultraviolet light source connected in electrical communication with the supplied power and being configured to generate an active field of ultraviolet radiation in at least one a portion of the housing through which the moved air passes from the intake to the exhaust.

9. The apparatus of claim 8, wherein the at least one ultraviolet light source is disposed between the filter and the barrier heater.

10. The apparatus of claim 8 or 9, wherein the ultraviolet light source comprises one or more UV-C lamps or a plurality of UV-C light emitting diodes disposed in the plenum.

11. The apparatus of claim 4, wherein the at least one cartridge comprises a plurality of sidewalls enclosing the plenum between an open side for the inlet and an opposing open side for the outlet.

12. The apparatus of claim 11, further comprising electrical insulation disposed between an edge of the permeable barrier and the sidewalls of the at least one cartridge.

13. The apparatus of any one of claims 1 to 12, wherein the prime mover comprises one or more blowers or fans.

14. The apparatus of any one of claims 1 to 13, wherein the apparatus comprises a power supply disposed on the housing and supplying the supplied power.

~~15. The apparatus of any one of claims 1 to 14, wherein the permeable barrier of the at least one heater comprises a mesh, a foam, a screen, or a tortuous media.~~

~~16~~15. The apparatus of any one of claims 1 to ~~15~~14, wherein the metal material of the permeable barrier comprises nickel, nickel-based alloy, iron-based alloy, titanium, or steel alloy.

~~17~~16. The apparatus of any one of claims 1 to ~~16~~15, wherein to allow the air flow up to the porosity threshold, the permeable barrier of the at least one heater is configured to

impede the air flow therethrough up to an impedance threshold of 20 percent, giving the permeable barrier the porosity threshold of at least 80%.

~~18~~17. The apparatus of any one of claims 1 to ~~17~~16, wherein the permeable barrier of the at least one heater is heated to the surface temperature of at least greater than about 56°C (133°F).

~~19~~18. The apparatus of any one of claims 1 to ~~18~~17, further comprising a controller disposed in electrical communication with the permeable barrier of the at least one heater and the at least one prime mover and being configured to control (i) the heating of the permeable barrier of the at least one heater by the supplied power, and (ii) the air flow through the housing from the intake to the exhaust generated by the at least one prime mover powered by the supplied power.

~~20~~19. The apparatus of claim ~~19~~18, wherein the controller is disposed in electrical communication with heater circuitry connected to the permeable barrier, the controller configured to control the heating of the permeable barrier with the heater circuitry powered by the supplied power.

~~21~~20. The apparatus of claim ~~20~~19, further comprising a temperature sensor disposed adjacent the permeable barrier and disposed in electrical communication with the controller, the temperature sensor being configured to measure a temperature associated with the heating of the permeable barrier.

~~22~~21. The apparatus of claim 8, 9, or 10, wherein a controller is disposed in electrical communication with drive circuitry connected to the at least one ultraviolet light source, the controller configured to control the ultraviolet radiation of the at least one ultraviolet light source with the drive circuitry powered by the supplied power.

~~23~~22. The apparatus of claim ~~22~~21, further comprising a light sensor disposed adjacent the at least one ultraviolet light source and disposed in electrical communication with the controller, the light sensor being configured to measure the ultraviolet radiation associated with the ultraviolet light source.

~~24~~23. The apparatus of any one of claims ~~19~~18 to ~~23~~22, wherein the controller is disposed in electrical communication with motor drive circuitry connected to the prime mover, the controller being configured to control the prime mover with the motor drive circuitry powered by the supplied power.

~~25~~24. The apparatus of claim ~~24~~23, further comprising a flow sensor disposed in the housing and disposed in electrical communication with the controller, the flow sensor

being configured to measure the air flow passing through the housing, the controller configuring the control based on the measured air flow.

~~26~~25. An apparatus used with supplied power for treating air in an environment for a pathogen, the apparatus comprising:

a housing being mobile in the environment and having an intake and an exhaust;

at least one prime mover disposed in the housing between the intake and the exhaust and being operable to move the air in the environment through the housing from the intake to the exhaust; and

at least one heated filter comprising ~~a filter media and~~ a permeable barrier disposed adjacent one another in the housing, ~~the filter media being configured to filter the air flow therethrough up to a filtration threshold and comprising a first material,~~ the permeable barrier comprising a metal material, the permeable barrier exposed to the air flow and being configured to allow the air flow therethrough up to a porosity threshold, the metal material of the permeable barrier connected in electrical communication to the supplied power, the permeable barrier having an active surface area being configured to interact with the pathogen and being heated by the supplied power to a surface temperature directed to at least damage the pathogen,

~~wherein the active surface area heated to the surface temperature and the porosity threshold of the permeable barrier are configured to produce heating that is localized and is dissipated in the air flow downstream thereof.~~

wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area comprising a latticework of tortuous channels defined through a thickness of the porous foam.

~~27~~26. The apparatus of claim ~~26~~25, further comprising at least one ultraviolet light source disposed in the housing, the ultraviolet light source connected in electrical communication with the supplied power and being configured to generate an active field of ultraviolet radiation in at least one a portion of the housing through which the moved air passes from the intake to the exhaust.

~~28~~27. The apparatus of claim ~~26~~25 or ~~27~~26, the pathogen being a virus, wherein the active surface area of the permeable barrier is heated to the surface temperature of at least up to 200°C directed to at least damage the virus.

~~29~~28. A method for treating air in an environment for a pathogen, the method comprising:

moving air flow through a plenum in a mobile housing from an intake to an exhaust by powering a prime mover disposed in the plenum;

filtering the air flow up to a filtration threshold through a filter disposed across the plenum;

allowing the air flow up to a porosity threshold through a permeable barrier of a heater disposed across the plenum, the permeable barrier having a metal material and an active surface area, the active surface area being configured to interact with the pathogen; and

heating the active surface area of the permeable barrier of the heater to a surface temperature directed to at least damage the pathogen by supplying a voltage potential across the permeable barrier~~, wherein the active surface area heated to the surface temperature and the porosity threshold of the permeable barrier are configured to produce heating that is localized and is dissipated in the air flow downstream thereof.~~,

wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area comprising a latticework of tortuous channels defined through a thickness of the porous foam.

~~30~~29. The method of claim ~~29~~28, further comprising producing an active field of ultraviolet radiation in the housing by powering an ultraviolet light source disposed in the plenum.

~~31~~30. The method of claim ~~29~~28 or ~~30~~29, wherein allowing the air flow up to the porosity threshold through the permeable barrier comprises impeding the air flow up to an impedance threshold of 20 percent, giving the permeable barrier the porosity threshold of at least 80%.

~~32. The apparatus of claim 26, 27, or 28, wherein the permeable barrier comprises one or more layers of porous foam having a thickness, the active surface area~~

~~comprising a latticework of tortuous channels defined through the thickness of the porous foam.~~

~~33. The apparatus of claim 32, wherein the one or more layers are corrugated.~~

~~34~~31. The apparatus of any one of claims ~~26~~25 to 28~~, 32, or 33~~, further comprising a controller being configured to control heating of the active surface area of the permeable barrier intermittently, when the air flow is passing through the permeable barrier, and/or when the air flow is not passing through the permeable barrier.

~~35~~32. The apparatus of any one of claims 26 to 28~~ or 32 to 34~~, wherein to allow the air flow therethrough up to the porosity threshold, the permeable barrier of the heater is configured to impede the air flow therethrough up to an impedance threshold of 20 percent, giving the permeable barrier the porosity threshold of at least 80%.

~~36. The apparatus of any one of claims 26 to 28 or 32 to 35, wherein the metal material of the permeable barrier is different than the first material of the filter media.~~