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(71) Applicant: **3M INNOVATIVE PROPERTIES COMPANY** [US/US]; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(72) Inventors: **FOX, Andrew R.**; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US). **JIANG, Weilai**; 8 Xing Yi Road, Maxdo Centre 38/F, Shanghai 200336 (CN). **GERHARDT, Bryan L.**; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US). **ECHEVERRI, Nicolas A.**; 3M Center, Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

(74) Agents: **NOWAK, Sandra K.** et al.; 3M Center Office of Intellectual Property Counsel Post Office Box 33427, Saint Paul, Minnesota 55133-3427 (US).

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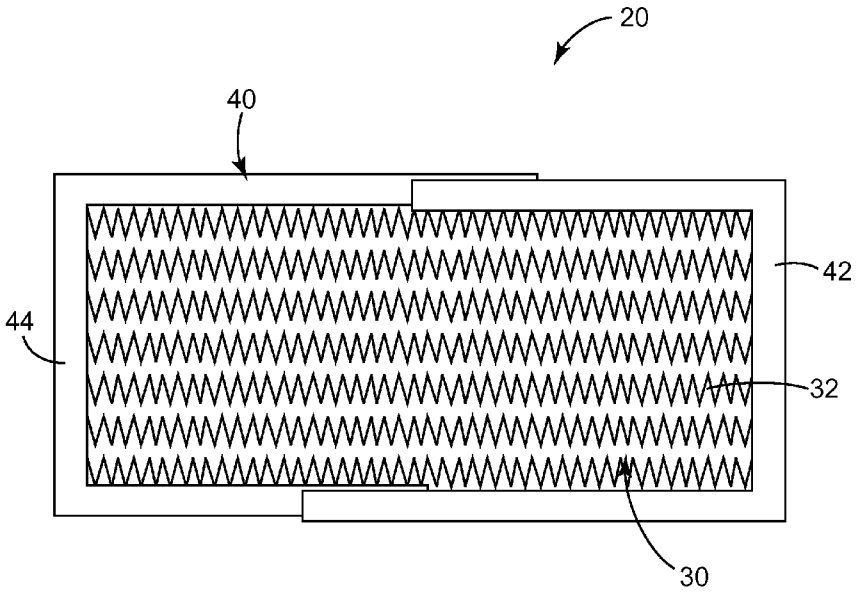

FIG. 1

(57) Abstract: The present disclosure relates to air filters. More particularly, it relates to adjustably sized air filter systems useable in a window opening. Some exemplary window air filter assemblies include two u-shaped frame members that can be coupled to form an adjustable frame assembly; and a filter media assembly that is attachable to the frame assembly and that includes an adjustable length media. The window filter assemblies are capable of moving between a collapsed state to an expanded state.

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ADJUSTABLE AIR FILTER

Technical Field

The present disclosure relates to air filters. More particularly, it relates to adjustably sized air filter systems useable in a window opening.

Background

Windows are available in a large variety of sizes and can include vertically or horizontally operable sashes to provide air flow between an exterior and an interior of a building structure. Occupants of a building structure often desire opening windows to let fresh air into an interior of a home, business, or otherwise enclosed space. However, in many locations, such as highly populated areas of China, the outside air is more contaminated than the indoor air. Novel filtering solutions are needed to let the fresh aspects of the outdoor air in without letting in the pollution or contaminants. Outdoor contaminants may include larger particles such as pollen, dust, and mold spores and smaller particles such as those forming $PM_{2.5}$, bacteria, and viruses. Gaseous outdoor pollutants such as odors, NO_x, SO_2, ozone, and others may also be of concern in some locations.

Summary

The inventors of the present disclosure realized that a need exists for a window filter that protects users from outside air quality contaminants, allows fresh air get into the home through windows, can be easily installed and used by consumers, is versatile to fit most window sizes, and has minimal impact on lighting and visibility. The inventors of the present disclosure invented and discovered apparatuses and methods that address at least some of these goals.

Some embodiments of the present disclosure relate to a window air filter assembly, comprising: first and second u-shaped frame members that can be coupled to form an adjustable frame assembly; and a filter media assembly that is attachable to the frame assembly and that includes an adjustable length filter media; wherein the window filter assembly is expandable from a collapsed state to an expanded state.

In some embodiments, the first and second u-shaped frame members are telescopically coupled.

In some embodiments, the first and second u-shaped frame members are in a spring-loaded engagement with one another.

In some embodiments, the first and second u-shaped frame members include at least one of a detent, notch, or other mechanism to selectively lock the adjustable window air filter assembly in a desired length or orientation.

In some embodiments, the first and second u-shaped frame members are frictionally secured to one another.

In some embodiments, the first and second u-shaped frame members are identical but asymmetric.

In some embodiments, the frame assembly is made of at least one of plastic, metal, paper, wood, and/or cardboard.

Some embodiments further include an adjustable element that assists in retaining the adjustable air filter within a window.

In some embodiments, the adjustable element is at least one of a spring-loaded end member, rubber materials, or a gripping structure.

In some embodiments, the filter media is held in place in or on the frame assembly by at least one of open tubes, pockets, partial loops, adhesive strips, hook and loop connection means, and/or a loop-engaging fastener material.

Some embodiments further include a spring-loaded engagement with one another to provide continuous dimensional adjustability.

In some embodiments, the filter media is at least one of an extended surface area media, pleated, corrugated, and/or a high surface area media.

In some embodiments, the filter media is self-supporting.

In some embodiments, the filter media has an electrostatic charge.

In some embodiments, the filter media includes at least one of porous foam, a nonwoven, paper, and/or fiberglass.

In some embodiments, the filter media is wire-backed. In some embodiments, the window filter assembly can self-retain the shape of the selected expanded and/or collapsed state.

In some embodiments, the window filter assembly can be adjusted to fit windows of various sizes.

In some embodiments, the window filter assembly has a size that can be adjusted to fit in a partially open window.

In some embodiments, the air filter media is replaceable and/or removable.

In some embodiments, the air filter media can be replaced by at least one of (a) through an open length along one side of the first or second u-shaped frame members; (b) by insertion from one of the major faces of the adjustable air filter; and /or (c) through one of the major ends.

In some embodiments, the filter media is pleated.

In some embodiments, the filter media has an elastic or elongating structure.

In some embodiments, the filter media includes at least one of elastic filaments, extruded elastic filaments, and/or elastic netting.

In some embodiments, the assembly further includes elongated pleat tip supports.

In some embodiments, the filter media is corrugated.

In some embodiments, the assembly further includes a restraining strap or component.

Brief Description of the Drawings

FIG. 1 is a side view of an exemplary adjustable air filter in accordance with principles of the present disclosure;

FIG. 2A is a side view of an exemplary filter frame useful with the adjustable air filter of FIG. 1 in accordance with principles of the present disclosure and partially unassembled;

FIG. 2B is a side view of the filter frame of FIG.2A in an assembled state;

FIG. 2C is a side view of an exemplary filter frame useful with an adjustable air filter in accordance with principles of the present disclosure including a spring loaded end frame;

FIGS. 3A-3D are cross-sectional views of exemplary adjustable air filters in accordance with principles of the present disclosure;

FIG. 4A is a perspective view an exemplary pleated filter media assembly useful with adjustable air filters of the present disclosure and in an expanded condition;

FIG. 4B is a cross-sectional view of the pleated filter media assembly of FIG. 4A, taken along the line 4B-4B;

FIG. 4C is a side view of a portion of the pleated filter media assembly of FIG. 4A in a collapsed condition;

FIGS. 5A-5C are cross-sectional views of filter media as useful with the adjustable air filters of the present disclosure;

FIGS. 6A-6B are perspective views of an adjustable air filter for use in a vertically opening window in accordance with principles of the present disclosure; and

FIGS. 7A-7B are perspective views of an adjustable air filter installed in a horizontally opening window in accordance with principles of the present disclosure.

The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the inventions described herein.

Detailed Description

The present disclosure will be described more fully hereinafter with reference to the accompanying drawings, in which exemplary embodiments are shown. The scope of this disclosure, however, may be embodied in many different forms and should not be construed as limited to the embodiments set forth or shown herein.

One embodiment of an adjustable window air filter assembly 20, in accordance with principles of the present disclosure, is shown in FIG. 1. The adjustable air filter 20 is generally configured to be expandable and, optionally, retractable and to self-retain in a desired state for installation and use in a window opening. The adjustable air filter 20 includes a filter media assembly 30 and a frame assembly 40. The filter media assembly 30 includes an adjustable length filter media 32. The frame assembly 40 includes opposing first and second frame members 42, 44. Details on the various components are provided below. In general terms, the adjustable air filter 20 does not require a fully rigid frame permanently surrounding the filter media assembly 30 and can be adjusted to fit window openings of various sizes.

With additional reference to FIGS. 2A-2C, the frame assembly 40 of the adjustable window filter 20 has an adjustable length along a major, or longitudinal, axis. The adjustable air filter 20 is intended to require a simple length adjustment by a user to set the major dimension of the frame assembly 40. The frame assembly 40 can include the at least two frame members 42, 44 to provide expansion and contraction of along the major axis. In some embodiments, the frame members 42, 44 are identical but asymmetric. As illustrated in FIG. 1, when assembled, the frame assembly 40 contains the filter media assembly 30. The filter media assembly 30 is adjustable to correspond to the adjusted length of the frame assembly 40 as discussed in more detail below. The adjustable air filter 20 is configured to be readily adjustable along the longitudinal axis and contracted or expanded by directing the frame members 42, 44 toward or away from each other.

FIG. 1 illustrates one embodiment of a telescopic engagement of the two frame members 42, 44. Various interlocking geometries may be used to secure the telescoping frame members 42, 44 to one another. Upon transitioning the frame assembly 40 to a desired size or length by manipulating the frame members 42, 44, the frame assembly 40 and the filter media assembly 30 can be secured in the selected state. In some embodiments, the frame members 42, 44 include a detent, notch, or other mechanism to selectively lock the adjustable air filter 20 in a preferred or desired length or orientation once set (not shown). In other embodiments, the frame members 42, 44 are frictionally secured at the preferred length.

With particular reference to FIG. 2A, the frame members 42, 44 are generally U-shaped in profile and each includes a first section 50(a, b), a second section 52(a, b), and a third section 54(a, b) extending between the first section 50(a, b) and the second section 52(a, b), respectively. The first and second sections 50, 52 extend parallel to one another and the third section 54 is perpendicular to both the first and second sections 50, 52. In one embodiment, the first section 50 has a length greater than the second section 52. Asymmetric features may be used to allow easier motion in the longitudinal direction of travel. The frame members 40, 42 are constructed of a rigid and lightweight material such as plastic, metal, paper, wood, and/or cardboard for example.

As illustrated in FIG. 2B, when assembled, the first section 50a of the first frame member 42 is diametrically opposed to the first section 50b of the second frame member 44. In other words, the first

section 50a of the first frame member 42 mates with the second section 52b of the second frame member 44. The first section 50 terminates in a first end portion 56 opposite the third section 54 and the second section 52 terminates in a second end portion 58 opposite the third section 54. The end portions 56, 58 can be slidably matable and end portions 56, 58 at least partially overlapping. In some embodiments, either the first or second end portion 56, 58 is larger in at least one direction (*i.e.*, has a larger cross-section) than the other. In one embodiment, the end portions 56, 58 are frictionally fit together. In some embodiments, the entire length of the first sections 50a, 50b have a larger cross-sectional width than the second sections 52a, 52b.

As illustrated in FIG. 2C, an adjustable element 60 can be included on one or more of the third section 54 of the frame members 42, 44. The adjustable element 60 can be a spring-loaded end member, for example. The spring-loaded end member 60 can be included to allow easier installation of the adjustable air filter 20, for example, if the frame members 42, 44 are locked in position after initial sizing to the user's window. The adjustable element 60 may be employed, particularly of the entire frame 40 is not spring-loaded. An adjustable element 60 can improve installation and removal of the product by providing a small amount of adjustability (*e.g.* 2-50 mm of travel) on the adjustable air filter 20 that is intended to fit snugly into a window opening. Additionally, the adjustable element 60 can assist in retaining the adjustable air filter 20 within the open window cavity. The spring-loaded end member 60 can be included on one or both ends to provide an outward pushing force to hold the adjustable air filter 20 into the window frame during use. The adjustable element 60 can also provide the benefit of a continuous outward pushing force that would help hold the filter in place during use. The adjustable element 60 can include rubber materials, a micro-replicated gripping surface, or other structures. The adjustable air filter can also otherwise employ rubber materials or other gripping structures to improve the frictional fit in the window opening.

FIGS. 3A-3D illustrate cross-sectional views of adjustable air filters according to embodiments of the present disclosure. As illustrated, the frame members 142, 144, 242, 244 can be U-shaped channels in cross-section. The filter media assembly 30 is captured on an interior of the U-shaped channel of the frame members 142, 144, 242, 244. Other shapes suitable to capture edges 34 of the pleated filter media assembly 30 are also acceptable, for example, C-shaped channels or channels which can "pinch" onto a filter media. In some embodiments, the air filter media is held in the frame assembly by at least one of at least one of open tubes, pockets, partial loops, adhesive strips, hook and loop connection means, and/or a loop-engaging fastener material.

In some embodiments, the filter frame 240 is spring-loaded for both adjustability and ease of installation and removal. FIGS. 3C-3D illustrate cross-sectional embodiments of a spring 62 included for spring-loading of the filter frame 240. The spring 62 may be separated from the filter 30 by a wall 64 extending along a length of frame members 242, 244. In some embodiments, the spring 62 does not travel the entire length of the filter frame 240 and the first and second sections 250, 252 are in a spring-

loaded engagement with one another to provide continuous dimensional adjustability and a continuous outward force once installed in the window.

The pleated filter media assembly 30 is optionally replaceable. With additional reference to FIGS. 1-2C, the filter media assembly 30 may be refilled by having one or more frame members 40, 42 including a hinge or other mechanism (not shown) for opening to allow removal of the spent filter media assembly 30 and insertion of a new filter media assembly 30. Any or some of the frame sections 50, 52, 54 can include hinged connections (not shown) to allow for simple filter media assembly 30 replacement. Alternatively, the filter media assembly 30 is replaceable through an open length along one side of the third section 54, for example. Alternatively, the replaceable filter media assembly 30 may be inserted from one of the major faces of the adjustable air filter 20, and may or may not require moveable components on the frame members 42, 44; for example, insertion and replacement of the filter media assembly can be achieved by a front or back face-loading replacement of filter media assembly 30.

One embodiment of a filter media assembly 30 is shown in FIGS. 4A through 4C. The filter media 32 of the filter media assembly 30 is pleated and includes a plurality of pleats 70 each including a fold line 72 defining a pleat tip 74 and a pair of adjacent panels 76. As used herein, the term "pleated" refers to filter media at least a portion of which has been folded to form a configuration comprising rows of generally parallel, oppositely oriented folds. Each fold is referred to as a pleat. Pleats can be formed in the filter media 32 (or in the pleated filter media assembly 30) using various methods and components as are well known in the art (*e.g.*, those described in U.S. Patent No. 6,740,137 to Kubokawa et al., U.S. Patent No. 7,622,063 to Sundet et al., and U.S. Patent Application No. 62/073067, the entire teachings of each of which are incorporated herein by reference). The pleated filter media assembly 30 can have any desired shape, including, for example, the quadrilateral or rectangular shape (the term "rectangular" being specifically inclusive of a square shape) shown, defining opposing sides 34a, 34b and opposing ends 35a, 35b.

As discussed more specifically below, the pleated filter media assemblies can consist of the filter media or web 32 alone or can include one or more additional components or structures applied or assembled to the filter media 32 so long as the resultant filter media assembly 30 can at least be transitioned from the collapsed condition to the expanded condition without damaging a structural integrity of the filter media assembly 30, and optionally can be repeatedly transitioned between the collapsed and expanded conditions without damaging a structural integrity of the filter media assembly 30.

The filter media 32 of the assembly 30 can be self-supporting or non-self-supporting. As used herein, the term "self-supporting filter media or web" can describe at least one of the following conditions: (1) a filter media or web that is deformation resistant without requiring stiffening layers, adhesive or other reinforcement in the filter media web; or (2) the filter media generally maintains its shape when subjected to an airstream as described, for example, in U.S. Patent No. 7,169,202 to

Kubokawa, the entire teachings of which are incorporated herein by reference; or (3) a web or media having sufficient coherency and strength so as to be drapable and handleable without substantial tearing or rupture. As used herein, the term "non-self-supporting" can denote an air filter media that is not capable, in the absence of a support frame and/or a support grill, of withstanding the forces encountered due to typical air flow.

For example, where the pleated filter media assembly 30 consists of the pleated filter media 32 alone, the filter media or web 32 can be self-supporting or non-self-supporting. Where the pleated filter media assembly 30 consists of the pleated filter media or web 32 and a support structure, the pleated filter media 32 can be non-self-supporting with the addition supporting structure rendering the pleated filter media assembly 30, as a whole, to be self-supporting. For example, the filter media 32 can be wire-backed.

FIGS. 5A-5C illustrate various examples of pleated filter media that can be employed with the adjustable air filter 20. The pleated filter media are expandable in at least one direction corresponding to the major axis. FIG. 5A illustrates a coarse pleated filter assembly 130 useful in the adjustable air filter 20. The coarse pleated filter assembly 130 contains filter media 132 continuously bonded to an expanded metal mesh 136 and then co-pleated, has adjustability controlled by the bending properties of the expanded metal mesh 136 and the length provided by the pleated structure. FIG. 5B illustrates a filter media assembly 230 having a mini-pleat filter media 232 construction that can be dimensionally adjustable by having an elastic structure 236, such as elastic filaments (e.g. Spandex), extruded elastic filaments, or an elastic netting (such as is available from Conwed) instead of the typically non-elongating pleat support structures (such as expanded metal mesh, plastic netting, etc.). The elongating pleat tip supports, or elastic structure, 236 may attach to one or both of the pleated element top and bottom pleat tips 238. FIG. 5C illustrates a filter media assembly 330 having a corrugated filter media 332 construction, as described in U.S. Patent Application No. 13/968,609, filed August 16, 2013, entitled "Nestable Framed Pleated Air Filter and Method of Making" and U.S. Patent Application No. 13/968,626, filed on August 16, 2013, entitled "Framed Pleated Air Filter with Upstream Bridging Filaments" may also be used, in which the pleat support members 336 are elastic filaments (e.g. Spandex), extruded elastic filaments, or an elastic netting (such as is available from Conwed, for example).

The particular filter media 132, 232, 332 selected for the filter media assemblies 130, 230, 330 can be any desired filter media. Some exemplary filter media may be particularly suited to have particular desired characteristics. In some embodiments, the filter media assembly 30 (and, accordingly, filter media assemblies 130, 230, 330) is constructed from moisture-resistant materials. In some embodiments, the filter media may optionally include additional layers or features to specifically block or repel water, such as rain. In some embodiments, an electrostatic charge is optionally imparted into or on to material(s) of the filter media 32. An electrostatically charged media 32 may be used, of which many

grades are available, and many of which offer high efficiency with low pressure drop. Thus, in some embodiments, the filter media 32 can be an electret nonwoven web. Electric charge can be imparted to the filter media 32 in a variety of ways as is well known in the art, for example by hydrocharging, corona charging, etc. (*e.g.*, as described in U.S. Patent No. 7,947,142 (mentioned above)). In other embodiments, the filter media 32 is not electrostatically charged. Additional multi-functional media grades, which incorporate activated carbon or other materials for purifying gas-phase pollutants, may also be incorporated into the filter structure. In some embodiments, the filter media 32 can be constructed, for example, from nonwoven fibrous media formed of thermoplastics or thermosetting materials such as polypropylene, linear polyethylene and polyvinyl chloride. Other suitable, non-limiting materials for the filter media include porous foams, nonwovens, papers, fiberglass, or the like. In some embodiments, the filter media 32 comprises a filter media that attracts and captures dust, allergens such as pollen and mold spores, and fine particle pollution from the outdoor air.

Other nonwoven webs useful with the filter media 32 can be a high loft spunbond web, such as described, for example, in U.S. Patent No. 8,162,153 to Fox et al., the entire teachings of which are incorporated herein by reference. In other embodiments, the filter media 32 can be a low loft spunbond web, such as those described in U.S. Patent No. 7,947,142 to Fox et al., the entire teachings of which are incorporated herein by reference. In yet other embodiments, nonwoven webs useful with the filter media 32 are generated by other techniques and/or have other characteristics, such as the meltblown nonwoven webs disclosed in U.S. Patent No. 6,858,297 to Shah et al. (mentioned above). Other non-limiting example of useful nonwoven web formats include bi-modal fiber diameter meltblown media such as that described in U.S. Patent No. 7,858,163, the entire teaching of which are incorporated herein by reference.

The present adjustable air filters 20 are useful in protecting users from outside air quality contaminants. An electrostatically charged media 32 may be used, of which many grades are available, and many of which offer high efficiency with low pressure drop. Additional multi-functional media grades, which incorporate activated carbon or other materials for purifying gas-phase pollutants, may also be incorporated into the filter media assembly 30. By incorporating an extended surface area and by covering moderate portion of the window, in combination with using a low pressure drop web enabled by the electrostatic charging, a reasonably low pressure drop can be achieved for the filter, which should help provide moderate airflow through the filter. A pleated structure can provide a significantly lower airflow resistance than a flat sheet for the same filter perimeter dimensions and allow fresh air get into the home or building structure through at least partially open windows.

Aspects of the materials and construction of the pleated filter media assembly 130, 230, 330 are akin to filter media assembly 30 and are such that the filter media assemblies 130, 230, 330 can, in some embodiments, be repeatedly transitioned between an expanded condition as in FIG. 4B and a collapsed condition as in FIG. 4C, with a spacing distance between successive pleat tips 74 in the expanded condition being greater than that of the collapsed condition. As a point of reference, the "expanded

condition" of the pleated filter media assembly 30 as an individual component generally corresponds with the "expanded state" of the window air filter 120, 220 (e.g., FIGS. 6A and 6B) as a whole, except that the window air filter 120, 220 includes additional components (described above) that retain the pleated filter media assembly 30 in the particular size and shape of the expanded state. In other words, while the pleated filter media assembly 30 can be transitioned (e.g., stretched or compacted) to any of a number of different "expanded conditions" and "collapsed conditions". The window air filter 120, 220, as a whole, can self-retain the shape of the selected expanded state and collapsed state.

FIGS. 6A-6B illustrate an adjustable air filter 120 installed in vertically sliding-type windows 180 either single or double hung. FIGS. 7A-7B illustrate an adjustable air filter 280 installed in a horizontally sliding-type window. These sliding window types appear to be the predominant types in both North America and the China region. The dimensional adjustability in the major dimension of the adjustable air filter 120, 220 provides adjustability to fit a variety of window 180, 280 widths (the cross-direction of window travel). The frame assembly 140, 240 can be captured on one side by the window sash and by three sides by the window frame. The adjustable air filter 120, 220 is expanded to the cross-direction dimension of the window, and the window is partially closed on the filter to provide adjustability in the window-motion direction. A small gap may be created between the two window segments, allowing air to flow from the outside between the two window segments and bypassing the filter 120, 220 to gain entry to the indoors. This bypass may be avoided by the use of a piece of foam, weather-stripping, etc. (not shown). The adjustable air filter 120, 220 can be employed in a partially open window, where only 10-30% of the window area is blocked, for example, leaving a large percentage of the window area still open for light passage and visibility. In some embodiments, the adjustable air filter 20 further has a restraining strap or component to prevent it from falling out the window (not shown). As discussed above, the length of the adjustable air filter 120, 220 is adjustable to fit a variety of window sizes, and the filter frame 140, 240 optionally has a locking mechanism to fix the size once expanded to fit the window.

The air filter assembly of the present disclosure can be used in a powered air filtration system such as, for example, that described in U.S. Patent Application No. 62/041501, incorporated herein in its entirety. The air filter media can come in roll form, such as, for example, that described in US Patent Application No. 62/041500, the entirety of which is incorporated herein. The air filter media or assembly can include expandable elements as is described in U.S. Patent Application No. 62/206,928, incorporated herein in its entirety.

The terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

All references mentioned herein are incorporated in their entirety.

Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other orientations than described or illustrated herein.

The recitation of all numerical ranges by endpoint is meant to include all numbers subsumed within the range (*i.e.*, the range 1 to 10 includes, for example, 1, 1.5, 3.33, and 10).

All references mentioned herein are incorporated herein in their entirety.

Those having skill in the art will appreciate that many changes may be made to the details of the above-described embodiments and implementations without departing from the underlying principles thereof. Further, various modifications and alterations of the present invention will become apparent to those skilled in the art without departing from the spirit and scope of the invention. The scope of the present application should, therefore, be determined only by the following claims and equivalents thereof.

What is claimed is:

1. A window air filter assembly, comprising:

first and second u-shaped frame members that can be coupled to form an adjustable frame assembly; and

a filter media assembly that is attachable to the frame assembly and that includes an adjustable length filter media;

wherein the window filter assembly is expandable from a collapsed state to an expanded state.

2. The window air filter assembly of claim 1, wherein the first and second u-shaped frame members are telescopically coupled.

3. The window air filter assembly of claim 1, wherein the first and second u-shaped frame members are in a spring-loaded engagement with one another.

4. The window air filter assembly of any of the preceding claims, wherein the first and second u-shaped frame members include at least one of a detent, notch, or other mechanism to selectively lock the adjustable window air filter assembly in a desired length or orientation.

5. The window air filter assembly of any of the preceding claims, wherein the first and second u-shaped frame members are frictionally secured to one another.

6. The window air filter assembly of any of the preceding claims, wherein the first and second u-shaped frame members are identical but asymmetric.

7. The window air filter assembly of any of the preceding claims, wherein the frame assembly is made of at least one of plastic, metal, paper, wood, and/or cardboard.

8. The window air filter assembly of any of the preceding claims, further including an adjustable element that assists in retaining the adjustable air filter within a window.

9. The window air filter assembly of claim 8, wherein the adjustable element is at least one of a spring-loaded end member, rubber materials, or a gripping structure.

10. The window air filter assembly of any of the preceding claims, wherein the filter

media is held in place in or on the frame assembly by at least one of open tubes, pockets, partial loops, adhesive strips, hook and loop connection means, and/or a loop-engaging fastener material.

11. The window air filter assembly of any of the preceding claims, further including a spring-loaded engagement with one another to provide continuous dimensional adjustability

12. The window air filter assembly of any of the preceding claims, wherein the filter media is at least one of an extended surface area media, pleated, corrugated, and/or a high surface area media.

13. The window air filter assembly of any of the preceding claims, wherein the filter media is self-supporting.

14. The window air filter assembly of any of the preceding claims, wherein the filter media has an electrostatic charge.

15. The window air filter assembly of any of the preceding claims, wherein the filter media includes at least one of porous foam, a nonwoven, paper, and/or fiberglass.

16. The window air filter assembly of any of the preceding claims, wherein the filter media is wire-backed.

17. The window air filter assembly of any of the preceding claims, wherein the window filter assembly can self-retain the shape of the selected expanded and/or collapsed state.

18. The window air filter assembly of any of the preceding claims, wherein the window filter assembly can be adjusted to fit windows of various sizes.

19. The window air filter assembly of any of the preceding claims, wherein the window filter assembly has a size that can be adjusted to fit in a partially open window.

20. The window air filter assembly of any of the preceding claims, wherein the air filter media is replaceable and/or removable.

21. The window air filter assembly of claim 20, wherein the air filter media can be

replaced by at least one of (a) through an open length along one side of the first or second u-shaped frame members; (b) by insertion from one of the major faces of the adjustable air filter; and /or (c) through one of the major ends.

22. The window air filter assembly of any of the preceding claims, wherein the filter media is pleated.

23. The window air filter assembly of any of the preceding claims, wherein the filter media has an elastic or elongating structure.

24. The window air filter assembly of any of the preceding claims, wherein the filter media includes at least one of elastic filaments, extruded elastic filaments, and/or elastic netting.

25. The window air filter assembly of any of the preceding claims, further including elongated pleat tip supports.

26. The window air filter assembly of any of the preceding claims, wherein the filter media is corrugated.

27. The window air filter assembly of any of the preceding claims, further including a restraining strap or component.

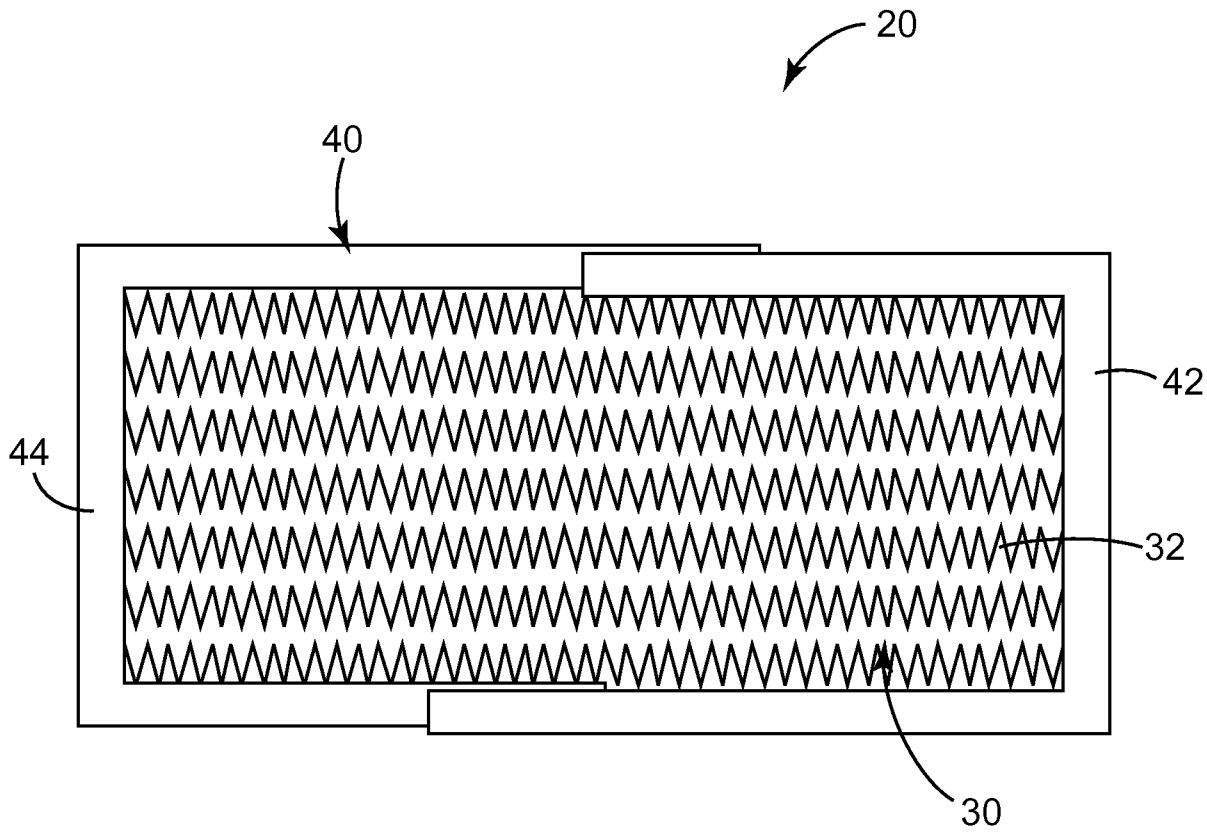

FIG. 1

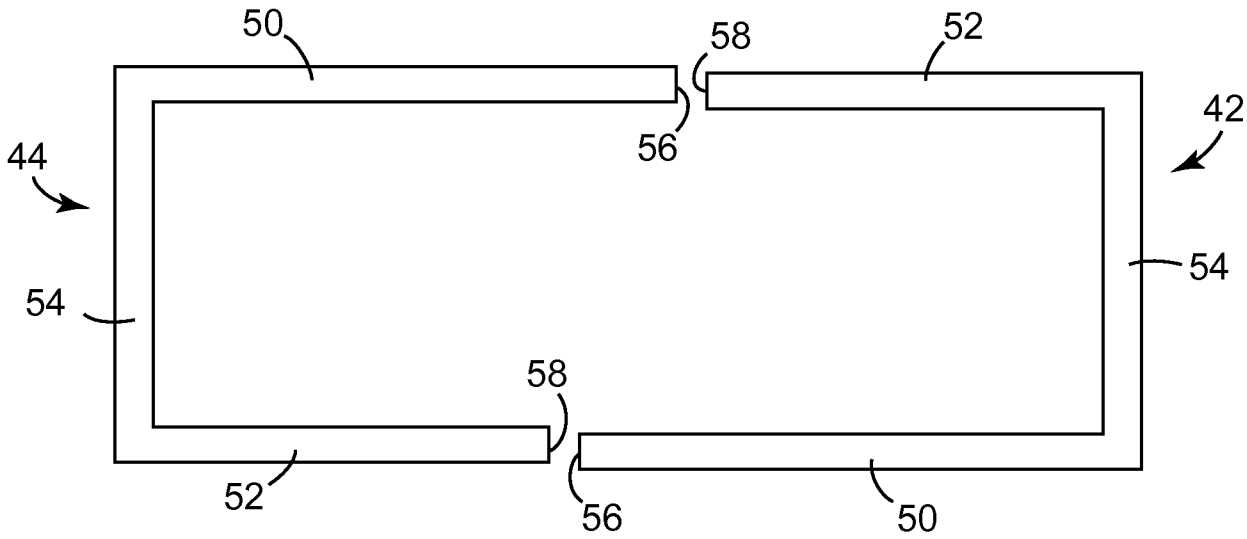

FIG. 2A

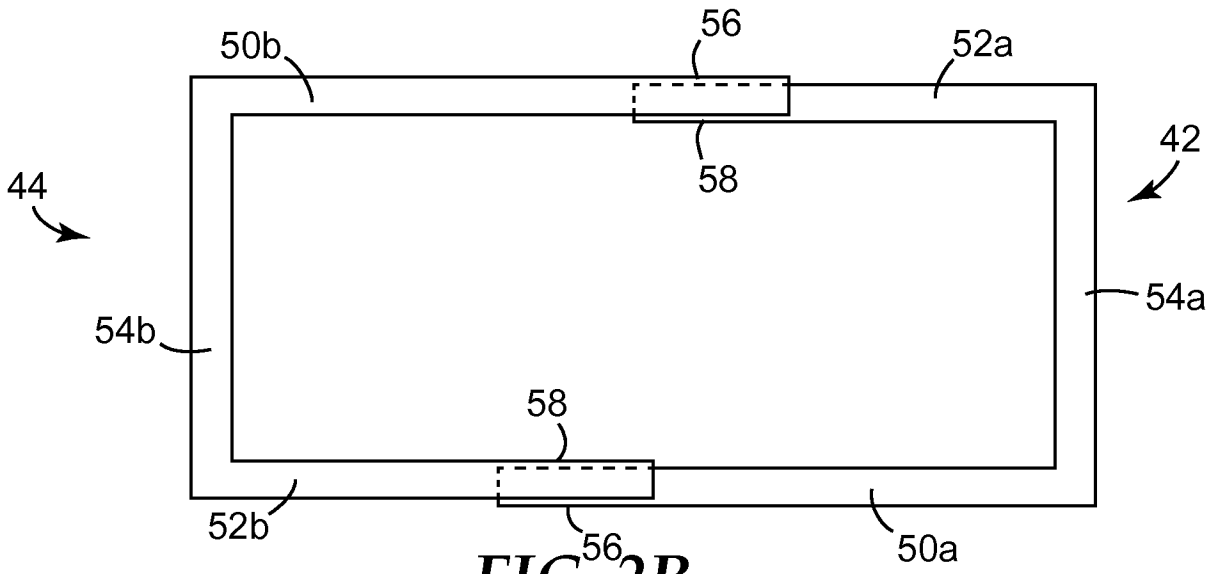

FIG. 2B

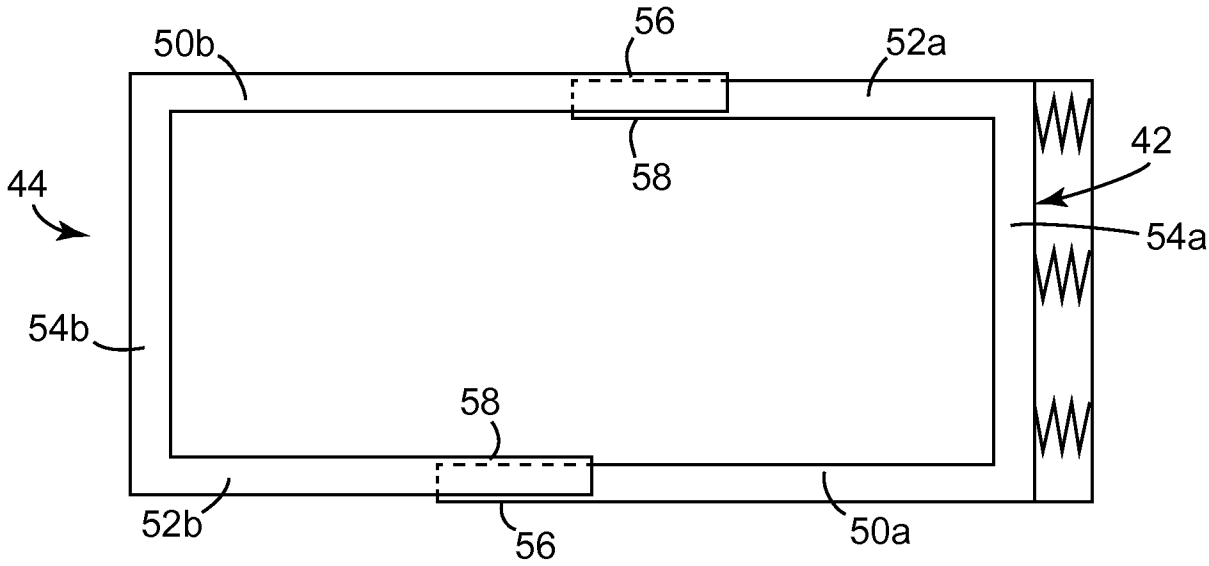

FIG. 2C

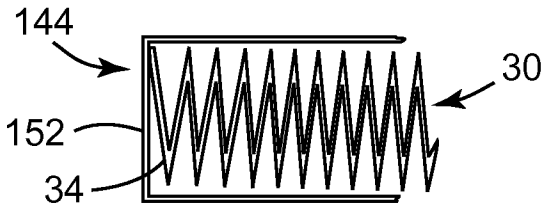

FIG. 3A

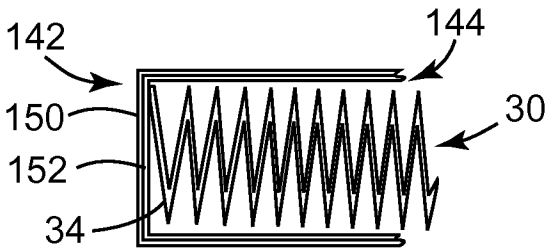

FIG. 3B

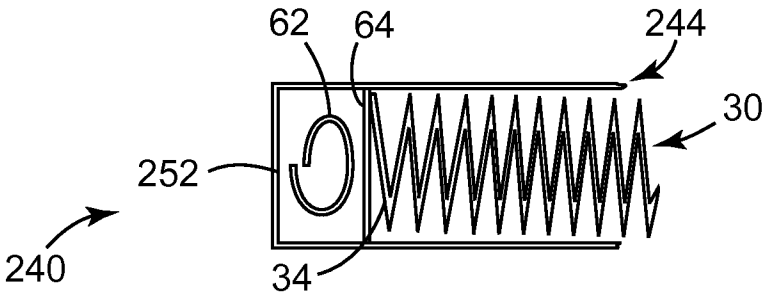

FIG. 3C

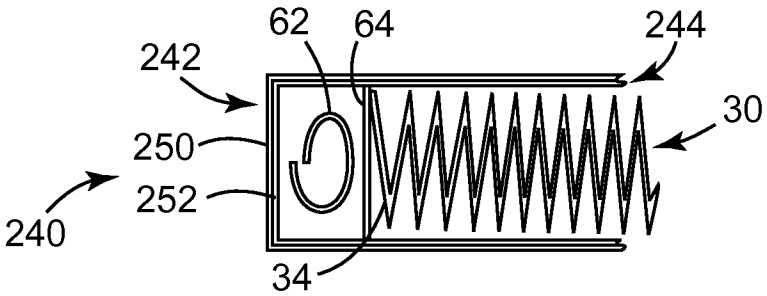

FIG. 3D

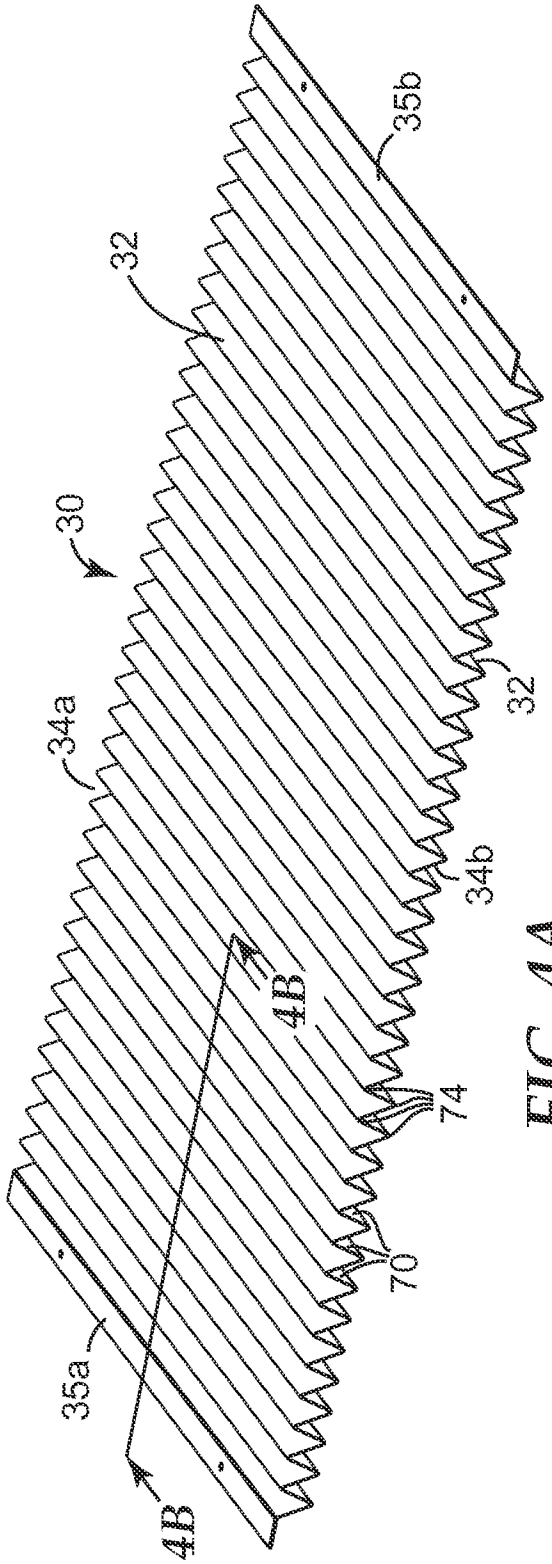

FIG. 4A

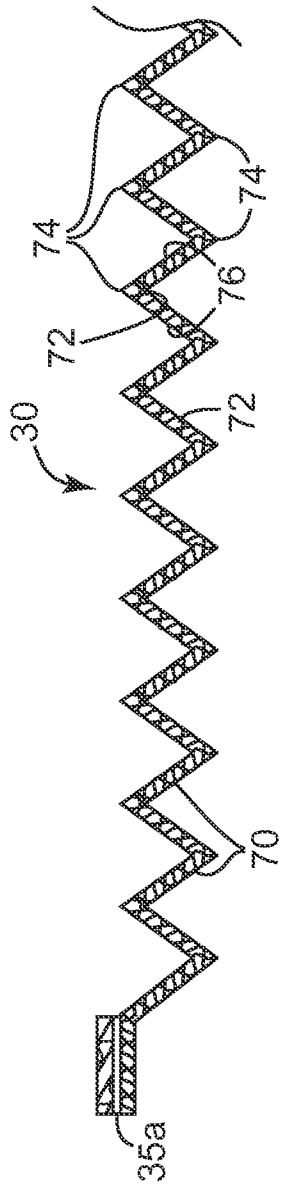

FIG. 4B

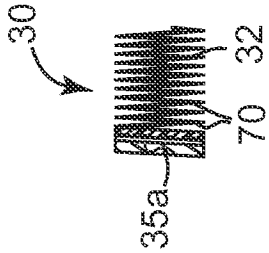

FIG. 4C

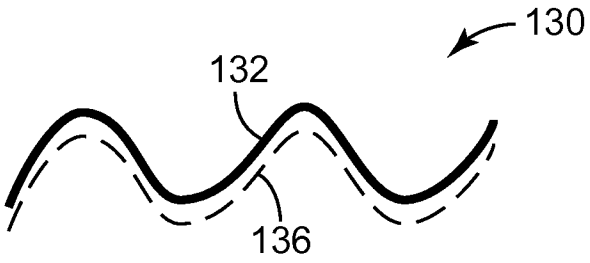

FIG. 5A

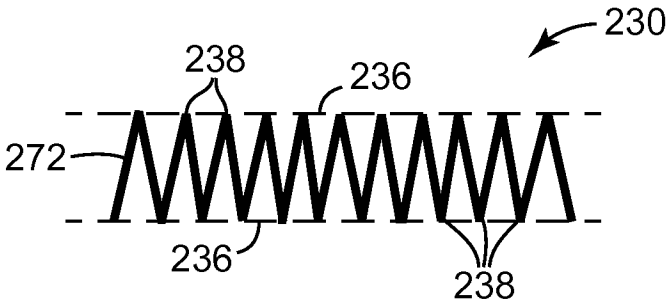

FIG. 5B

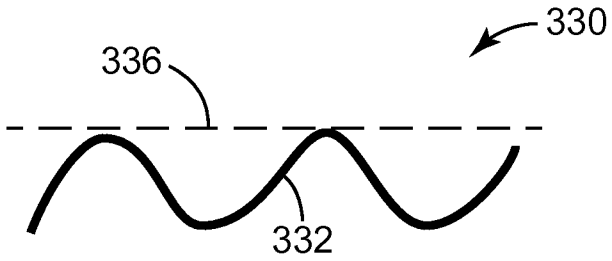

FIG. 5C

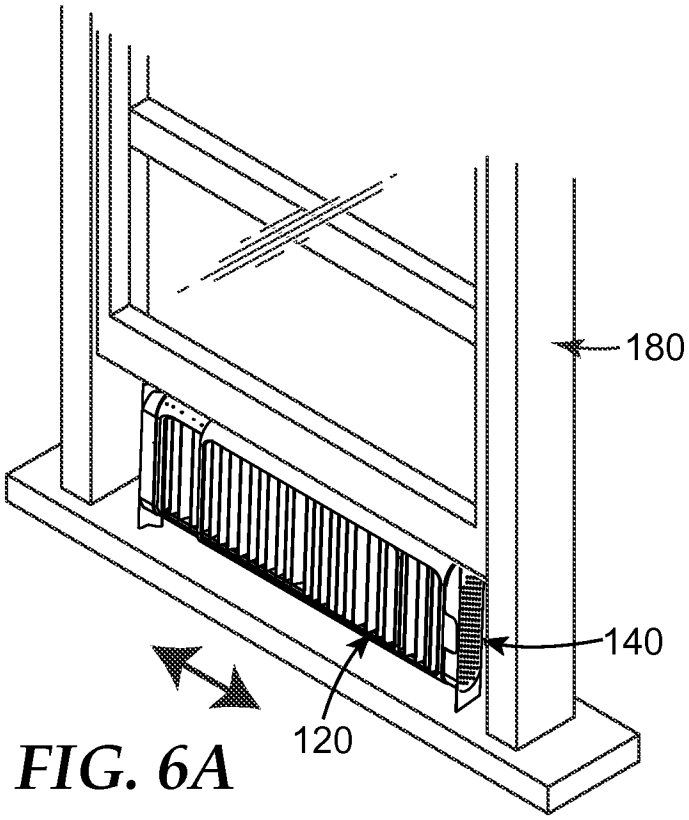

FIG. 6A

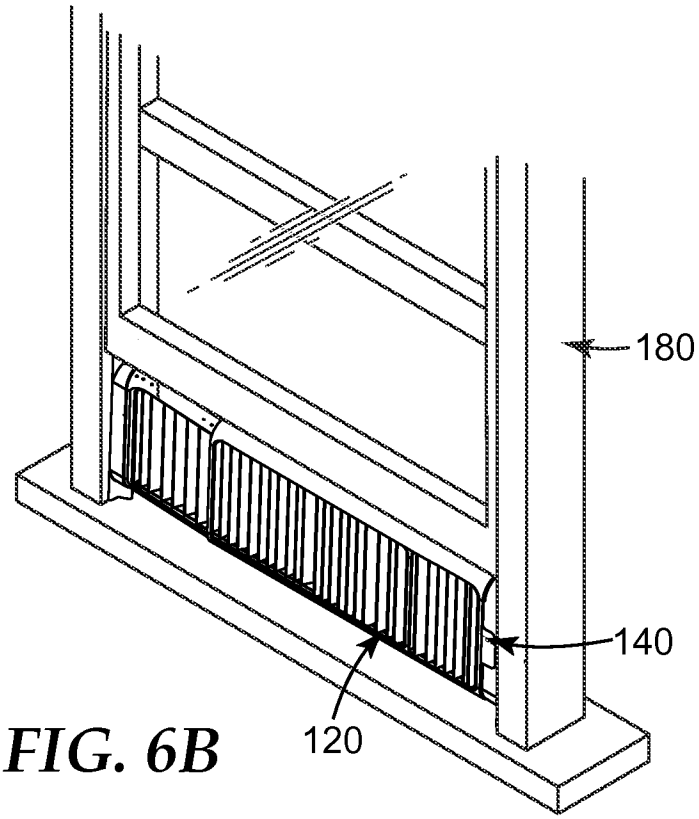

FIG. 6B

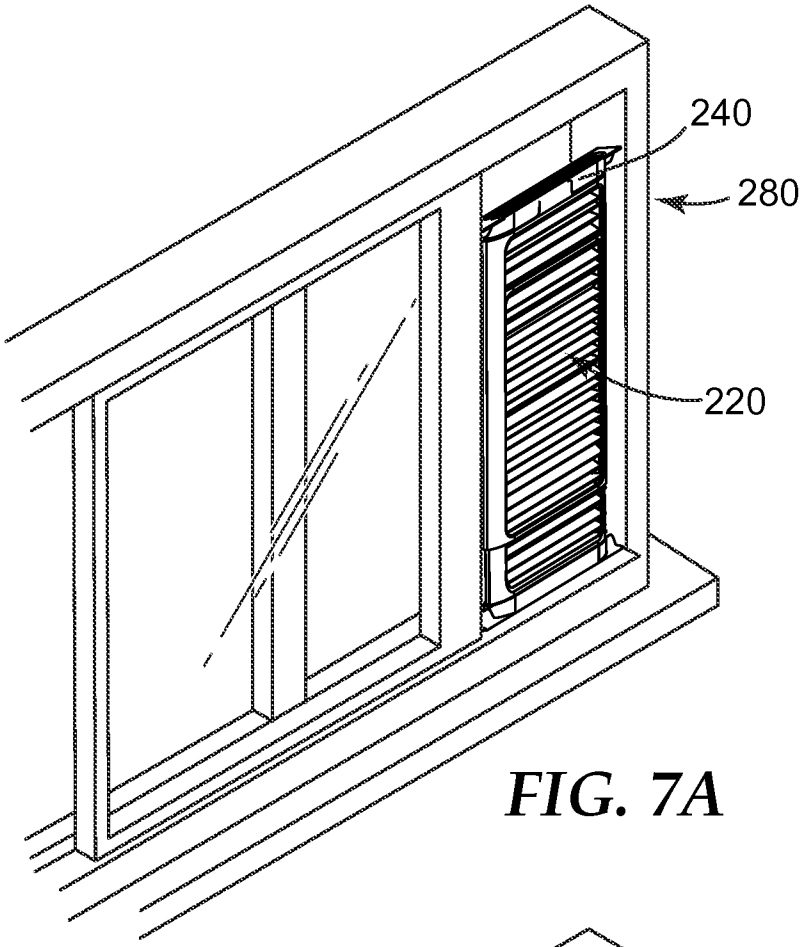

FIG. 7A

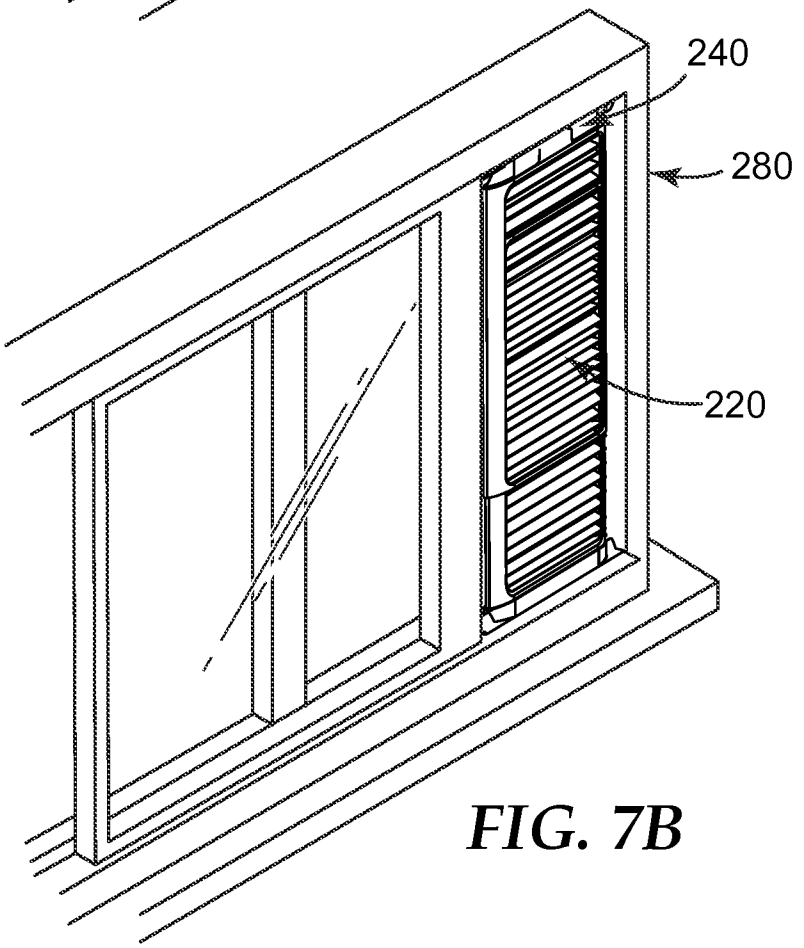

FIG. 7B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US15/46488

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 5-27
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US15/46488

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B01D 46/00, 46/10 (2015.01)
CPC - B01D 46/0002, 46/0005, 46/0006
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classification(s): B01D 46/00, 46/10 (2015.01)
CPC Classification(s): B01D 46/0002, 46/0005, 46/0006; F24F 13/085, 13/28: USPC Classification(s): 55/491, 496, 511, 524

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data): air, filter, filtration, sliding, telescoping, length, size, height, adjust, change, modify, select, spring, lock, window

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7,452,396 B2 (TERLSON B. A. et al.) November 18, 2008; figures 3, 16; column 6, lines 1-5, column 9, lines 35-45	1, 3, 4/1, 4/3
X --- Y	US 5,312,467 A (WOLFE M.) May 17, 1994; figure 1; column 2, lines 60-65, column 3, lines 30-35	1, 2 --- 4/2
Y	US 5,837,022 A (CHAPMAN R. L.) November 17, 1998; figures 1, 1A; column 2, lines 60-67	4/2
A	US 6,007,596 A (ROSEN R. M.) December 28, 1999; entire document	1-3, 4/1-4/3
A	US 6,716,267 B2 (LAWLOR T. J. SR.) April 06, 2004; entire document	1-3, 4/1-4/3
A	US 3,768,235 A (MEYER C. P. et al.) October 30, 1973; entire document	1-3, 4/1-4/3
A	US 5,476,526 A (ATTERMEYER D. G.) December 19, 1995; entire document	1-3, 4/1-4/3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 October 2015 (18.10.2015)	27 NOV 2015
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)