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(54) Title: WINDOW AIR FILTER

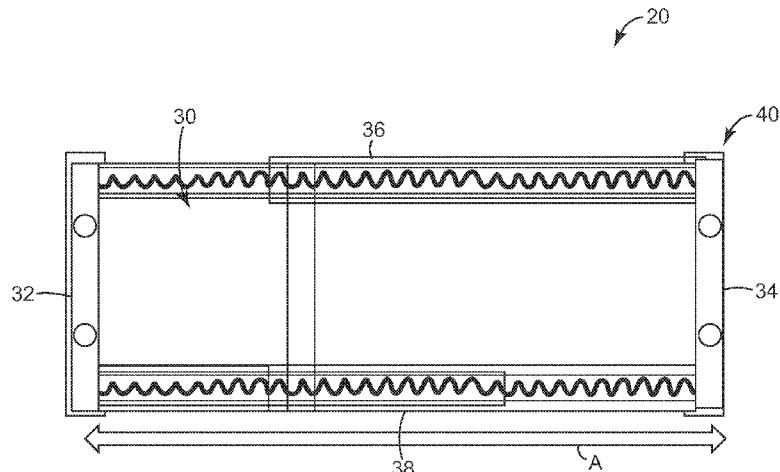


FIG. 1

(57) Abstract: The present disclosure generally relates to adjustably sized air filter systems capable of use in a window opening. The present disclosure also related to methods of making and using these adjustably sized air filter systems.



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## WINDOW AIR FILTER

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### Technical Field

The present disclosure relates to air filters. In some embodiments, it relates to adjustably sized air filter systems capable of use in a window opening.

### Background

10 Windows exist 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 15 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<sub>2.5</sub>, bacteria, and viruses. Gaseous outdoor pollutants such as odors, NO<sub>x</sub>, SO<sub>2</sub>, ozone, and others may also be of concern in some locations.

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### Summary

25 The inventors of the present disclosure recognized 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/or 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.

30 Some embodiments of the present disclosure relate to a window filter assembly, comprising: (1) a frame assembly comprising: first and second end frame members; and first and second side frame members; wherein the first and second side frame members are configured to couple with the first and second end frame members; and (2) a filter media assembly that is attachable to at least one of the side frame members and the end frame members; wherein the window filter assembly is expandable from a collapsed state to an expanded state.

35 In some embodiments, at least one of the first and second side frame members are expandable. In some embodiments, at least one of the side frame members include at least one of a spring-loaded mechanism permitting lengthwise adjustment, a telescoping mechanism permitting lengthwise adjustment, a ratcheting mechanism permitting lengthwise adjustment, a friction fit permitting lengthwise adjustment, two or more components that are slidable relative to one another permitting lengthwise

adjustment, a portion that nests within another portion permitting lengthwise adjustment, and/or threads to permit screw-like lengthwise adjustment.

In some embodiments, each of the first and second side frame members include multiple pieces or portions and a length of each of the pieces or portions is less than the total length of the side frame member in an expanded state. In some embodiments, the side frame members are tubular. In some embodiments, the first and second side frame members are configured to removably couple with the first and second end frame members.

In some embodiments, either the first and second end frame members or the first and second side frame members include apertures sized and shaped to receive the other of the first and second end frame members or the first and second side frame members.

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

In some embodiments, at least one of the end frame members and the side frame members include filter media receivers configured to receive connectors mounted on the filter media assembly. In some embodiments, the connectors are at least one of pegs, teeth, hooks, or other mechanical connections mechanism. In some embodiments, either the end frame members or the side frame members include a female attachment geometry and the other of the end frame members or the side frame members include a male attachment geometry. 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.

In some embodiments, the filter media is at least one of an extended surface area media, pleated, corrugated, scrunched, ruffled, crinkled, 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, at least one of the first and second end frame members has lengthwise adjustability. In some embodiments, at least one of the first and second end frame members includes a spring-loaded feature.

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.

Some embodiments relate to a method of replacing filter media in the window filter assembly of any of the preceding claims, comprising: (1) removing one of the first and second end frame members from the frame assembly; (2) removing used filter media; (3) sliding unused filter media along the first and second side frame members; (4) attaching the unused filter media to one of the first and second end

frame members; (5) attaching the unused filter media to the other of the first and second end frame members; and (6) securing the previously removed one of the first and second end frame members to form the complete frame assembly.

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### Brief Description of the Drawings

FIG. 1 is a cross-sectional view of a window air filter in accordance with principles of the present disclosure;

10 FIG. 2A is a cross-sectional view of a filter frame useful with the window air filter of FIG. 1 in accordance with principles of the present disclosure and partially unassembled

FIG. 2B is a cross-sectional view of a filter frame useful with a window air filter in accordance with principles of the present disclosure including a spring loaded end frame;

15 FIG. 3A is a side view of a partially assembled window air filter in accordance with principles of the present disclosure;

FIG. 3B is a side view of the window air filter of FIG. 3A fully assembled in accordance with principles of the present disclosure;

FIG. 3C is a cross-sectional view of a filter media useful with the window air filter of FIG. 3B in accordance with principles of the present disclosure;

20 FIG. 4A is a perspective view a pleated filter media assembly useful with window 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;

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

FIG. 5A is a perspective view of a window air filter in horizontally opening window transitioning from a collapsed state to an expanded state in accordance with principles of the present disclosure;

FIG. 5B is a perspective view of the window air filter of FIG. 5A in an expanded state;

30 FIG. 6A is a perspective view of a window air filter in vertically opening window transitioning from a collapsed state to an expanded state in accordance with principles of the present disclosure; and

FIG. 6B is a perspective view of the window air filter of FIG. 6A in an expanded state.

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 present invention.

### 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 5 embodiments set forth or shown herein.

One embodiment of a window air filter 20 in accordance with principles of the present disclosure is shown in FIG. 1. The window air filter 20 is generally configured to be expandable by a user from a collapsed, initial state (see, e.g., FIGS. 5A and 6A) to an expanded, end-use state (see, e.g., FIGS. 5B and 10 6B), and to self-retain the expanded state for installation and use in a window opening. The window air filter 20 includes a filter media assembly 30 and a frame assembly 40. The frame assembly 40 includes 15 opposing first and second end frame members 32, 34 and first and second side frame members 36, 38. Details on the various components are provided below. In general terms, the filter media assembly 30 is configured to readily transition between the collapsed and expanded states by directing the end frame members 32, 34 toward or away from each other as indicated by arrows "A". Upon transitioning the filter 15 media assembly 30 to a desired size or length in the expanded state, the side frame members 36, 38 are manipulated to secure the filter media assembly 30 in the selected expanded state. The window air filter 20 does not require a fully rigid frame permanently surrounding the filter media assembly 30 and can be 20 adjusted to fit window openings of various sizes.

The window air filter 20 is typically removably installed in a partially opened window. The 20 window air filter 20 includes a pair of expandable side frame members 36, 38 that are configured to couple with the end frame members 30, 32, as shown in FIGS. 2A-2B, which further allows the filter to fit a wide variety of window sizes. The side frame members 36, 38 can be spring-loaded rods or members to provide dimensional adjustability and further provide an outward "holding" force to maintain the filter media assembly 30 placement within an open window. The filter media assembly 30 is attachable to and 25 slidable over the side frame members 36, 38 and is adjustable as the window filter 20 is adjusted for length by a user. The filter media assembly 30 includes a high surface area filter media, for example, a filter media that is pleated, crinkled, or ruffled to provide for expansion and contraction of the filter media assembly 30 to correspond with the desired length of the window air filter 20.

The expandable side frame members 36, 38 provide dimensional adjustability to the window filter 30 20, which may be achieved by spring-loading (as shown in FIG. 1), ratcheting mechanisms, or friction fit, for example. The spring-loaded feature can improve ease of use by helping hold the filter in place during use. The side frame members 36, 38 can include or incorporate a wide variety of other structures, components and/or mechanisms that allow a user to adjust and select a length of the side frame members 36, 38. The side frame members 36, 38 can include two or more components or portions that are slidable 35 relative to one another in a telescoping-like fashion. Each of the side frame members 36, 38 can include a first portion 36a can be at least partially nested within a second portion 36b (identified for the first side frame 36 in FIGS. 2A-2B). The first portion 36a and the second portion 36b can be adjustable with

respect to one another along a longitudinal axis. In one embodiment, the portions 36a, 36b are spring-loaded to be biased to extend away from each other. Alternatively, the portions 36a, 36b can be frictionally adjustable or threaded for screw-like adjustment. Regardless, the length of each of the portions 36a, 36b is less than the total length of the side frame member 36 in an extended state. The first 5 and second portions 36a, 36b thus can be readily manipulated by a user (manually) from a first arrangement in the collapsed state to a second arrangement in the expanded state and any state in between.

The side frame members 36, 38 can assume a variety of forms, and in some embodiments are substantially identical. In one embodiment, the side frame members 36, 38 are tubular and have a round 10 in cross-section. Each of the side frame members 36, 38 define opposing, leading and trailing ends 42, 44 (identified for the first side frame 36 in the view of FIG. 2A), with the trailing end 44 optionally being permanently connected to a corresponding one of the end frame members 32. Alternatively, both the leading and trailing ends 42, 44 are removably coupled to the end frame members 32, 34, respectively. In some embodiments, the end frame members 32, 34 include side member receivers 46 for selective 15 connection of the side frame members 36, 38 to the end frame members 32, 34. For example, the side member receivers 46 can form apertures sized and shaped to receive (e.g., frictionally receive one of the ends 42, 44 of the side frame members 36, 38. The end frame members 32, 34 and the side frame members 36, 38 can incorporate a wide variety of other complementary structures, components, and/or 20 mechanisms that promote mounted engagement. The frame assembly 40 can be constructed of a relatively light weight yet structurally rigid material such as, for example, plastic, metal, paper, wood, and/or cardboard. The frame members 32-38 can be completely disconnected and disassembled for storage or packing and shipping.

In some embodiments, the end frame members 32, 34 are identical. Optionally, as illustrated in FIG. 2B, one or more end frame members 32, 34 can include a spring-loaded end cap 50 or similar 25 structure which provides a slight dimensional adjustability for improving the ease of installation and removal of the product, and for further providing an outward pushing force to help hold the product in place during use. The optional spring-loaded or adjustable end cap 50 also allows for easier installation if the side frame members 36, 38 are locked in position after initial sizing to the user's window. In one embodiment, the end frame members 32, 34 are also slidably adjustable so that the window filter 20 is 30 extendable in a second direction perpendicular from the first extendable direction formed by the side frame members 36, 38.

At least one of the end frame members 32, 34 is removable to allow for user-replacement of the filter media assembly 30. The removable end frame member(s) 32, 34 allow for simple and quick filter media assembly 30 change/replacement. As illustrated in FIG. 3A, the filter media assembly 30 can be 35 slid along the side members 36, 38 and attached to both end members 32, 34. The end members 32, 34 can include filter receivers 48. The filter media assembly 30 may include connectors 52 that facilitate the attachment and removal of the filter media assembly 30 to the end frame members 32, 34. For example,

the end frame members 32, 34 may have filter receivers 48 configured to receive connectors 52 (e.g., pegs) which are mounted on the filter media assembly 30. The connectors 52 can include teeth, hooks, or other mechanism to provide or promote attachment to filter receivers 48 of the end frame members 32, 34. Regardless, the filter media assembly 30 can include connectors 52 suitable to be coupled with filter receivers 48. In other embodiments, the end frame members 32, 34 may include a “female” attachment geometry and the filter media assembly 30 may include “male” attachment components.

As illustrated in FIG. 3A, the filter media assembly 30 attaches to the adjustable side frame members 32, 34. The filter media assembly 30 is further depicted without the frame assembly 40 in FIGS. 3B and 3C. The filter media assembly 30 may include attachments 54 such as open tubes, pockets, partial loops, or other features that go entirely around the perimeter of the rods, or they may include mechanical and/or adhesive features, such as adhesive strips, hook & loop, loop-engaging material, etc., that are attachable to portions of the side frame members 32, 34 and may not require the filter media assembly 30 to wrap around the entire side frame members 32, 34. As used herein, the term “loop-engaging” as used herein relates to the ability of a hook element to be mechanically attached to a loop material. For example, the hook element may be in the shape of a mushroom (e.g., with a circular or oval head enlarged with respect to the stem), a hook, a palm-tree, a nail, a T, or a J. The loop-engageability of hook elements may be determined and defined by using standard woven, nonwoven, or knit materials. One exemplary commercially available loop-engaging material is 3M™ Dual-Lock™ fastener.

The attachments 54 are illustrated as circular attachments in the cross-sectional view of FIG. 3C, sized and shaped to accommodate circular side frame members 36, 38. As shown in FIGS. 3A-3C, the filter media assembly 30 can, in the presence of loop-like side attachment structures 54, slide onto the side frame members 36, 38 and attach to the end frame members 32, 34 of the frame assembly 40. The side attachment structures 54 can be the same or different material as the filter media 56. The combined filter media assembly 30 and frame assembly 40 has the ability to adjust in the length dimension to accommodate a variety of window sizes.

The filter media assembly 30 can assume a wide variety of forms useful for air filtration presently known, or in the future developed. The filter media assembly 30 is preferably an extended surface area filter, meaning that it has greater surface area than a flat sheet which occupies the same two-dimensional area. The extended surface area may be achieved by performing a defined pleating operation, by corrugating the media, or by performing a “scrunching” operation similar to how ruffled curtains are constructed. For example, the filter media can be pleated, crinkled, or ruffled, or otherwise include a suitable expanding and contracting surface area. Regardless, the media is expandable to accommodate a variety of window sizes.

By “ruffled” is meant at least a portion gathered along at least one edge to form a configuration comprising undulations. For example, and as shown in FIGS. 3A and 3B, the ruffled filter media assembly 30 includes a plurality of ruffles, or undulations, extending generally parallel to one another with each ruffle extending between opposing side frame members 36, 38. Materials and construction of

the ruffled filter media assembly 30 are such that the ruffled filter media assembly 30 can, in some embodiments, be repeatedly transitioned between an expanded condition as in FIG. 3B and a collapsed condition, with a spacing distance between and the depth of successive ruffles in the expanded condition being greater than that of the collapsed condition. The filter media assembly 30 can have the rectangular shape (that is specifically inclusive of a square shape) shown, defining opposing ends 58a, 58b and opposing sides 59a, 59b.

In another example, and as shown in FIGS. 4A through 4C, filter media assembly 130 is pleated and includes a plurality of pleats 60 each including a fold line 62 defining a pleat tip 64 and a pair of adjacent panels 66. By “pleated” is meant at least a portion of which has been folded to form a configuration comprising rows of generally parallel, oppositely oriented folds. Aspects of the materials and construction of the pleated filter media assembly 130 are akin to filter media assembly 30 and are such that the filter media assemblies 30, 130 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 64 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 130 as an individual component generally corresponds with the “expanded state” of the window air filter 120, 220 (e.g., FIGS. 5B 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 130 in the particular size and shape of the expanded state. In other words, while the pleated filter media assembly 130 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. The pleated filter media assembly 130 can have the rectangular shape (that is specifically inclusive of a square shape) shown, defining opposing ends 68a, 68b and opposing sides 70a, 70b.

Pleats can be formed in the filter media 72 (or in the pleated filter media assembly 130) using various methods and components as are well known in the art, e.g., to form a pleated filter for use in applications such as air filtration., for example those described in U.S. Patent No. 6,740,137 to Kubokawa et al. and U.S. Patent No. 7,622,063 to Sundet et al., the entire teachings of both of which are incorporated herein by reference.

The pleated filter media assembly 130, and similarly the filter media assembly 30, can consist of a filter media or web 72 alone (as in the illustrated embodiment), or can include one or more additional components or structures applied or assembled to the filter media 72 so long as the resultant filter media assembly 130 can at least be transitioned from the collapsed condition to the expanded condition without damaging a structural integrity of the filter media assembly 30, 130, and optionally can be repeatedly transitioned between the collapsed and expanded conditions without damaging a structural integrity of the filter media assembly 30, 130. The filter media 72 of the assembly 30, 130 can be self-supporting or non-self-supporting. For example, where the pleated filter media assembly 130 consists of the pleated filter

media 72 alone, the filter media or web 72 can be self-supporting or non-self-supporting. Where the pleated filter media assembly 130 consists of the pleated filter media or web 72 and a support structure, the pleated filter media 72 can be non-self-supporting with the addition supporting structure rendering the pleated filter media assembly 130, as a whole, to be self-supporting. For example, the filter media 72 can be wire-backed. A “self-supporting pleated filter media or web” can describe a filter media or web that is deformation resistant without requiring stiffening layers, adhesive or other reinforcement in the filter media web. Alternatively, “self-supporting” means that the pleated 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. Alternatively, the term “self-supporting” refers to a web or media having sufficient coherency and strength so as to be drapable and handleable without substantial tearing or rupture, and when used with respect to a pleated filter refers to a filter whose pleats have sufficient stiffness so that they do not collapse or bow excessively when subjected to the air pressure typically encountered in force air ventilation systems. 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.

The particular filter media 72 selected for the filter media assemblies 30, 130 can be particularly suited have particular desired characteristics described herein. In some embodiments, an electrostatic charge is optionally imparted into or on to material(s) of the filter media 72. An electrostatically charged media 72 may be used, of which many grades are available, and many of which offer high efficiency with low pressure drop. Thus, the filter media 72 can be an electret nonwoven web. Electric charge can be imparted to the filter media 72 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 72 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. The filter media 72 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 72 comprises a filter media that attracts and captures dust, allergens such as pollen and mold spores, and fine particle pollution from the outdoor air.

In another embodiment, the filter assembly 30 can include both ruffled and pleated portions. The central portion of the filter media 56 may include self-supporting or wire-backed pleats which are connected to the side attachment structures 54, and the side attachment structures 54 may form a ruffled structure when installed over the side frame members 36, 38. In a further embodiment, a single continuous piece of filter media 56 may be used to form both ruffled edge attachment structures 54 and the central pleated filter media 56 portion.

Other nonwoven webs useful with the filter media 72 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 72 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 72 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.

Figure 5 then illustrates the expandable filter fitted into both a horizontal sliding window and a vertical sliding window. The filter is installed by expanding it to the non-motion dimension of the window and then partially closing one sash onto the filter assembly. It is noted that 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 to gain entry to the indoors. This bypass may be avoided by the use of a piece of foam, weather-stripping, etc.

Embodiments include window filters suitable for sliding-type windows, such as horizontal sliding windows and vertical sliding windows (e.g. single and double hung). These sliding window types appear to be the predominant types in both North America and the China region, for example. FIGS. 5A and 5B illustrate a window air filter 120 installed in a horizontally opening window 180 (i.e., having a horizontally operable sash 182). FIGS. 6A and 6B illustrate a window air filter 220 installed in a window 280 having a vertically operable sash 282. The window air filters 120, 220 are sized for a wide variety of window dimensions in the dimension of sliding window sash 182, 282 travels. The dimensional adjustability of the window air filter 120, 220 in the longitudinal dimension of the filter (indicated by the arrow) further allows adjustability to fit a variety of window widths (the cross-direction of window travel). The window air filter 120, 220 is sized for a partially open window 180, 280. In some embodiments, only 10-30% of the window area is blocked, leaving a large percentage of the window area still open for light passage and visibility.

In accordance with principles of the present disclosure, window air filters 120, 220 protect users from outside air quality contaminants while allowing fresh air get into the home or building structure through the windows 180, 280. In one example, by incorporating an extendable surface area of filter media assembly 130 and by covering a moderate portion of the window 180, 280, in combination with using a low pressure drop web 72 enabled by the electrostatic charging, a reasonably low pressure drop can be achieved for the window air filter 120, 220, and a moderate airflow is provided through the window air filter 120, 220. The adjustable frame assembly 140, 240 allows users to easily adjust the length of the window air filter 120, 220 to fit their specific window size 180, 280. In one embodiment, the window air filter 120, 220 optionally includes a restraining strap or component to prevent it from falling out the window (not shown).

With additional reference to FIGS. 1 through 3C, when the user is ready to install the window air filter 120, 220 in the window 180, 280, the user simply pull on the two end frame members 32, 34 to stretch the filter media assembly 130 to a desired size corresponding with the window opening. The window air filter 120, 220 can be adjusted to the width of the window opening and the operable sash 182, 282 of the window 180, 280 snugly pressed against one of the side frame members 36, 38 so that the window air filter 120, 220 fully occupies the opening space created by the window sash 182, 282. The side members 36, 38 maintain their strength in the expanded state to ensure the integrity of the window filter 120, 220, combining with the end frame members 32, 34 to collectively define a frame that secures the filter media assembly 130. When the user desires to change the filter media assembly 130, for example, when the filter media becomes at least partially clogged or blocked by contaminants collected on the filter media, the user can adjust the window sash to increase the window opening size and push the end frame members 32, 34 towards each other to at least partially collapse the window air filter 120, 220. The window air filter 120, 220 can be removed from the window opening and one of the end frame members 32, 34 disengaged, or uncoupled, from the side frame members 36, 38 and the filter media assembly 30. For example, as discussed above, the side frame members 36, 38 can be disengaged from the frame receivers 46 of at least one of the end frame 32, 34 and the filter media assembly 30 can be disengaged from the filter receivers of both the end frames 32, 34. The filter media assembly 30 can then be slidably or otherwise removed from the side frame members 36, 38. Another filter media assembly 30 can be assembled to the frame members and the side frame members 36, 38 inserted or otherwise connected frame receivers 46 of the end frame member 32, 34.

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 assembly or media of U.S. Patent No. 62/206,928 can be used in the air filters of the present disclosure.

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 by reference 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).

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.

5

What is claimed is:

1. A window filter assembly, comprising  
a frame assembly comprising:
  - 5 first and second end frame members; and
  - first and second side frame members;  
wherein the first and second side frame members are configured to couple with the first and second end frame members; and
  - 10 a filter media assembly that is attachable to at least one of the side frame members and the end frame members;  
wherein the window filter assembly is expandable from a collapsed state to an expanded state.
2. The window filter assembly of claim 1, wherein at least one of the first and second side frame members are expandable.  
15
3. The window filter assembly of any of the preceding claims, wherein at least one of the side frame members include at least one of a spring-loaded mechanism permitting lengthwise adjustment, a telescoping mechanism permitting lengthwise adjustment, a ratcheting mechanism permitting lengthwise adjustment, a friction fit permitting lengthwise adjustment, two or more components that are slidable relative to one another permitting lengthwise adjustment, a portion that nests within another portion permitting lengthwise adjustment, and/or threads to permit screw-like lengthwise adjustment.  
20
4. The window filter assembly of any of the preceding claims, wherein each of the first and second side frame members include multiple pieces or portions and a length of each of the pieces or portions is less than the total length of the side frame member in an expanded state.  
25
5. The window filter assembly of any of the preceding claims, wherein the side frame members are tubular.  
30
6. The window filter assembly of any of the preceding claims, wherein the first and second side frame members are configured to removably couple with the first and second end frame members.  
35
7. The window filter assembly of any of the preceding claims, wherein either the first

and second end frame members or the first and second side frame members include apertures sized and shaped to receive the other of the first and second end frame members or the first and second side frame members.

5        8. The window 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.

10        9. The window filter assembly of any of the preceding claims, wherein at least one of the end frame members and the side frame members include filter media receivers configured to receive connectors mounted on the filter media assembly.

15        10. The window filter assembly of claim 9, wherein the connectors are at least one of pegs, teeth, hooks, or other mechanical connections mechanism.

20        11. The window filter assembly of any of the preceding claims, wherein either the end frame members or the side frame members include a female attachment geometry and the other of the end frame members or the side frame members include a male attachment geometry.

25        12. The window 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.

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

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

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

45        16. The window 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.

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

18. The window filter assembly of any of the preceding claims, wherein at least one of the first and second end frame members has lengthwise adjustability.

5 19. The window filter assembly of any of the preceding claims, wherein at least one of the first and second end frame members includes a spring-loaded feature.

20. The window 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.

10

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

15 22. The window 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.

23. A method of replacing filter media in the window filter assembly of any of the preceding claims, comprising:

20 removing one of the first and second end frame members from the frame assembly;  
removing used filter media;  
sliding unused filter media along the first and second side frame members;  
attaching the unused filter media to one of the first and second end frame members;  
attaching the unused filter media to the other of the first and second end frame members; and  
securing the previously removed one of the first and second end frame members to form the  
25 complete frame assembly.

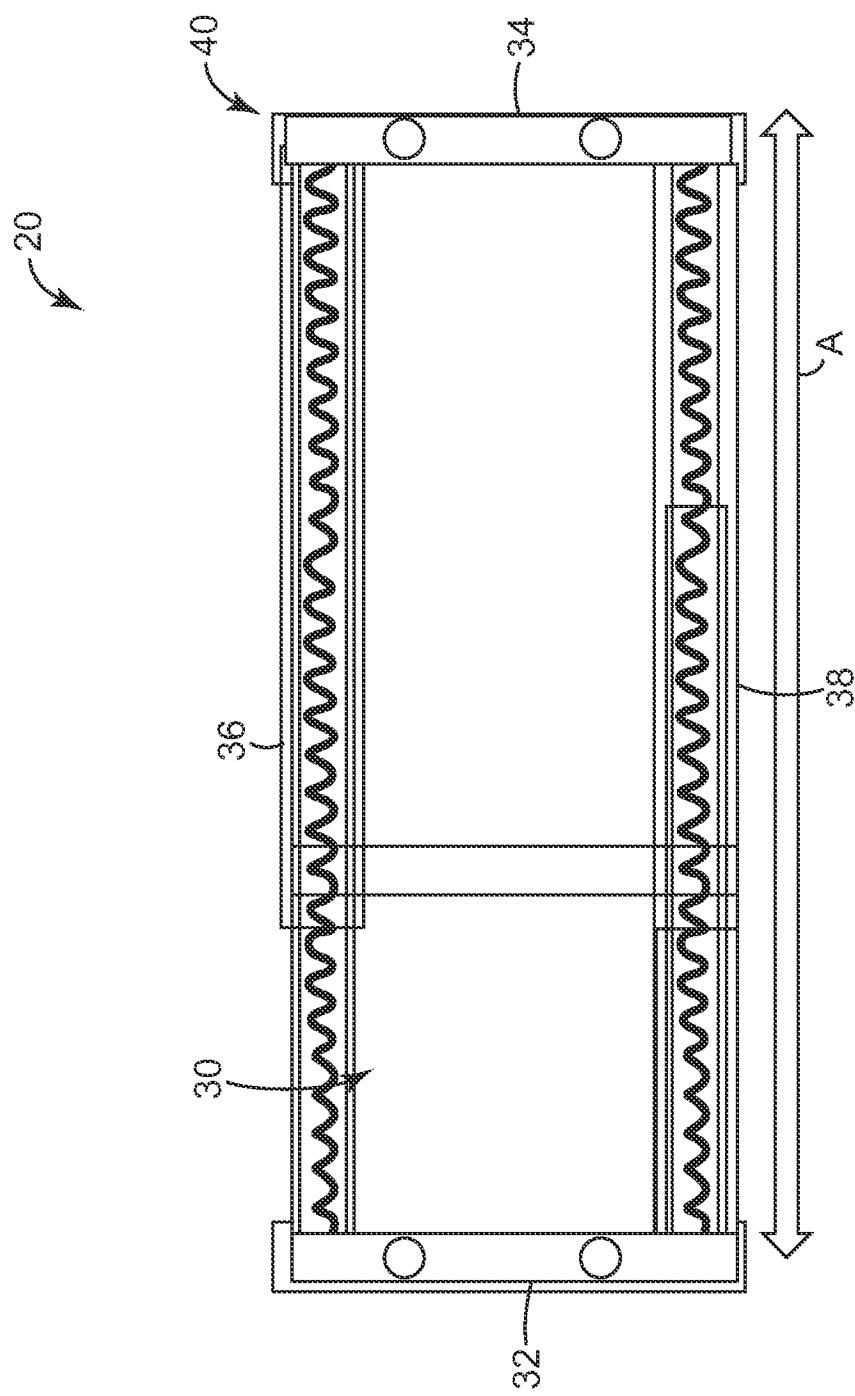


FIG. 1

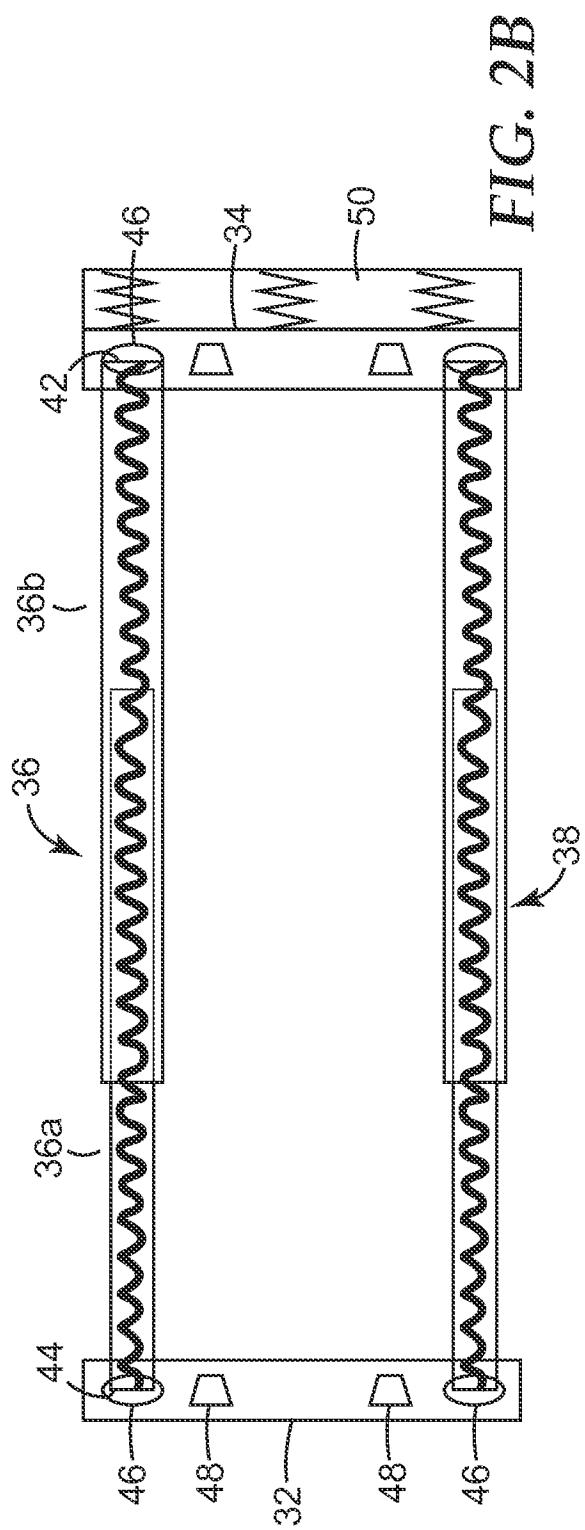
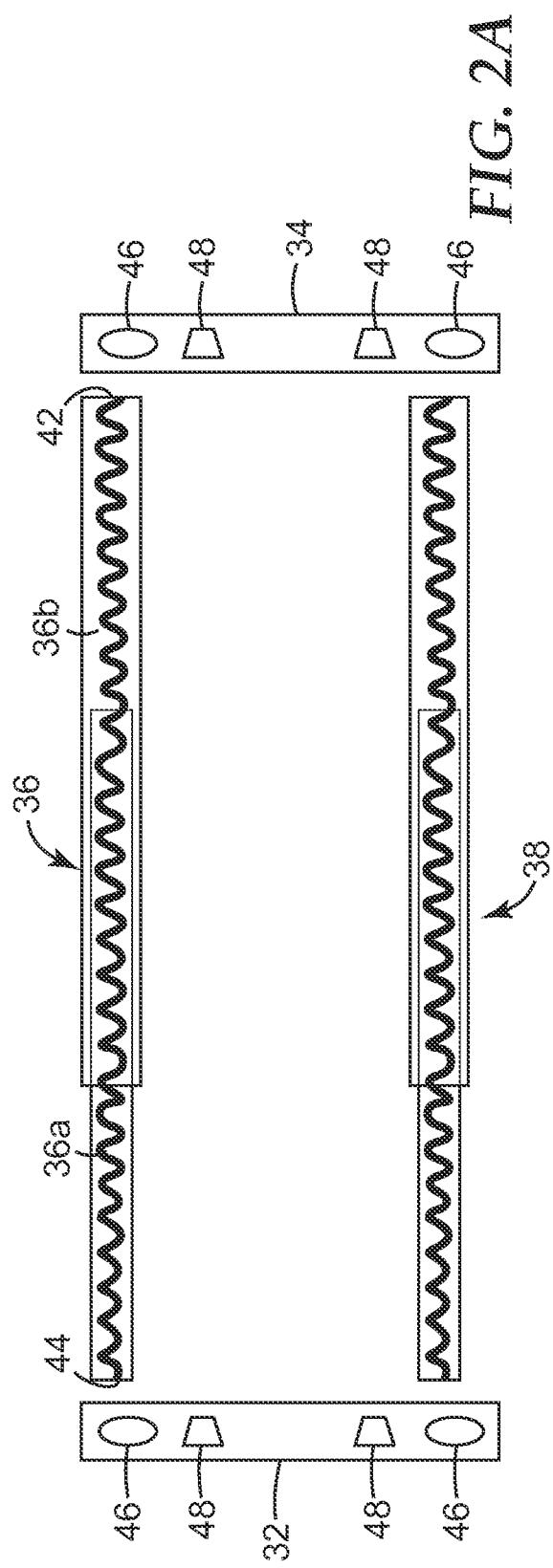


FIG. 3A

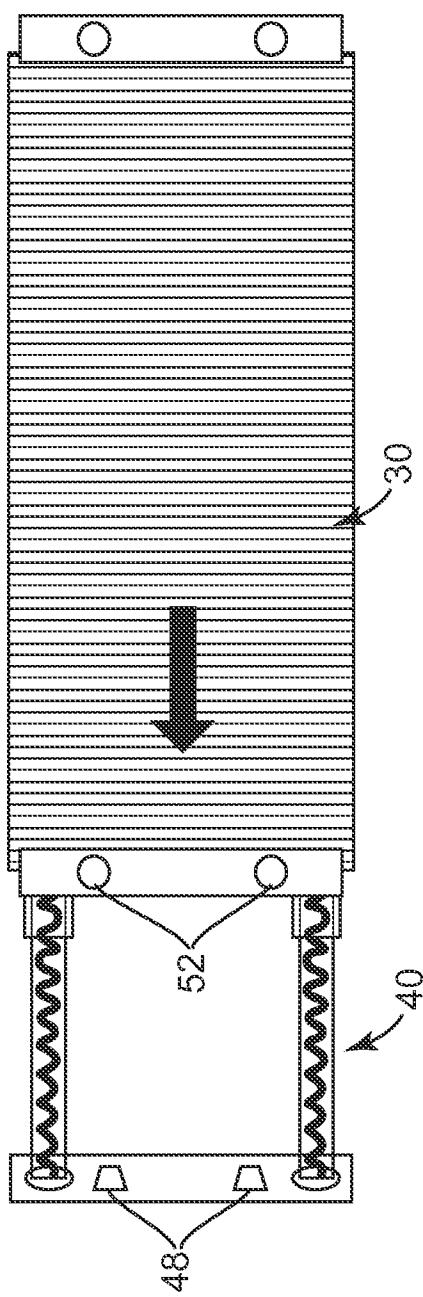
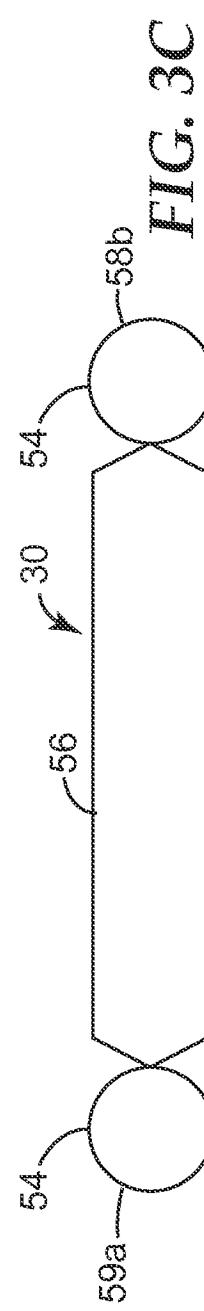
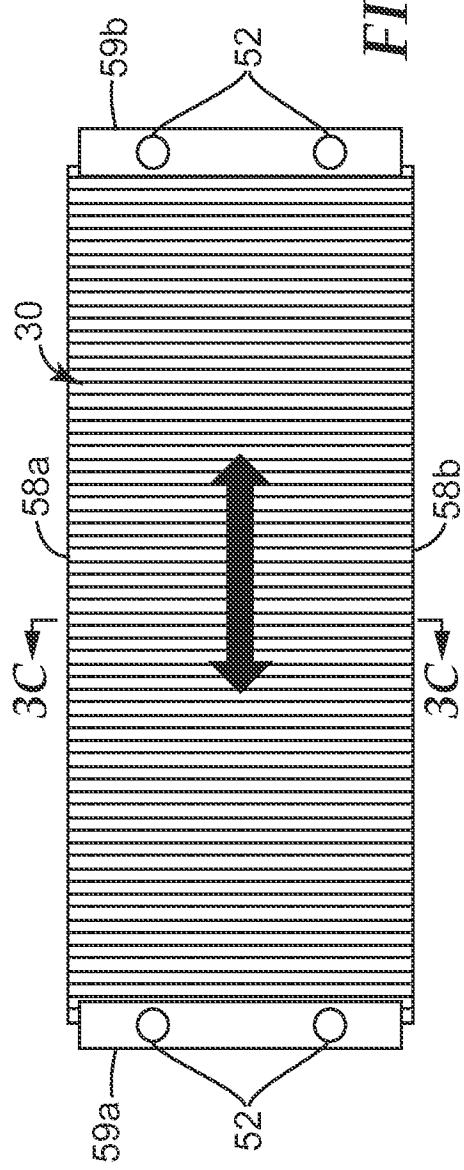


FIG. 3B



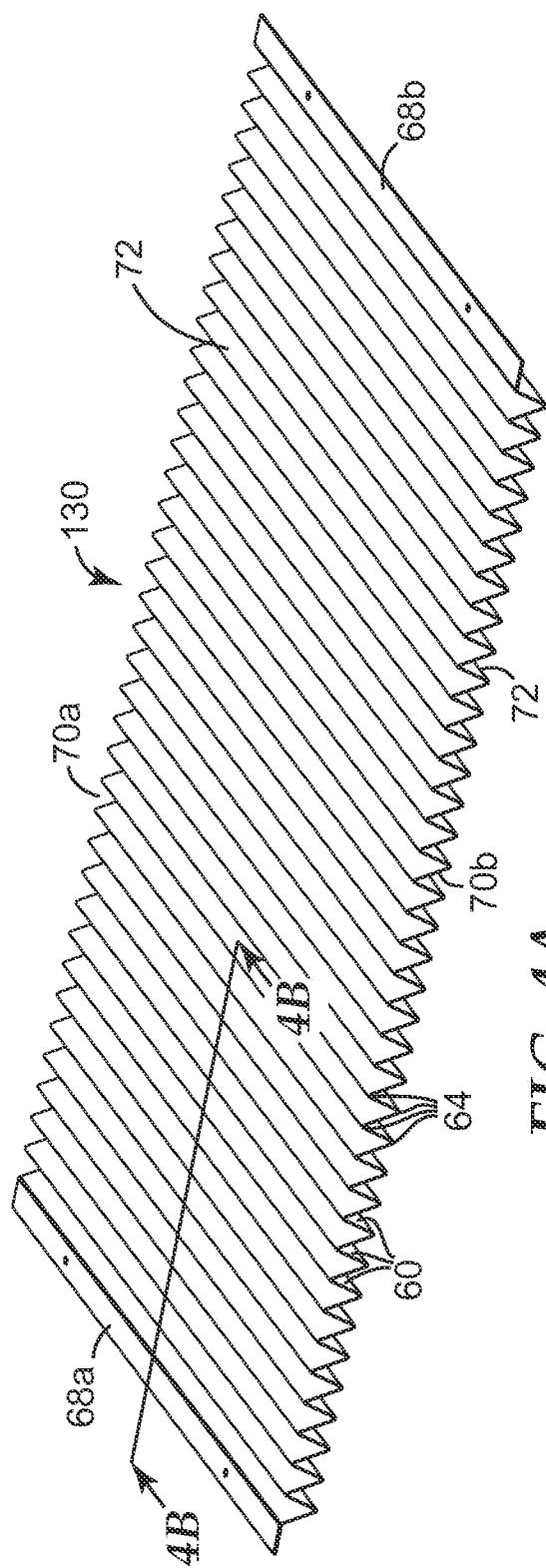


FIG. 4A

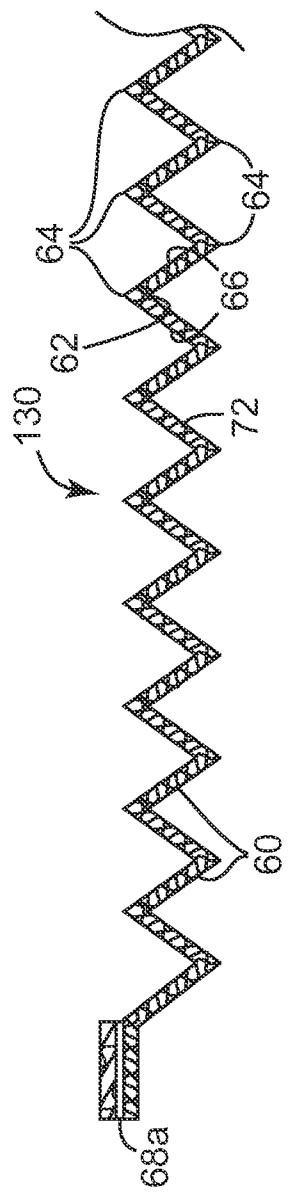


FIG. 4B

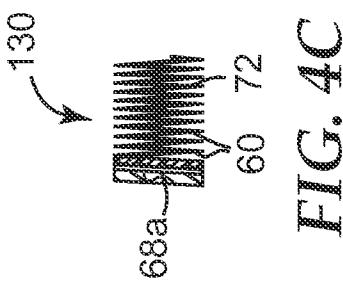


FIG. 4C

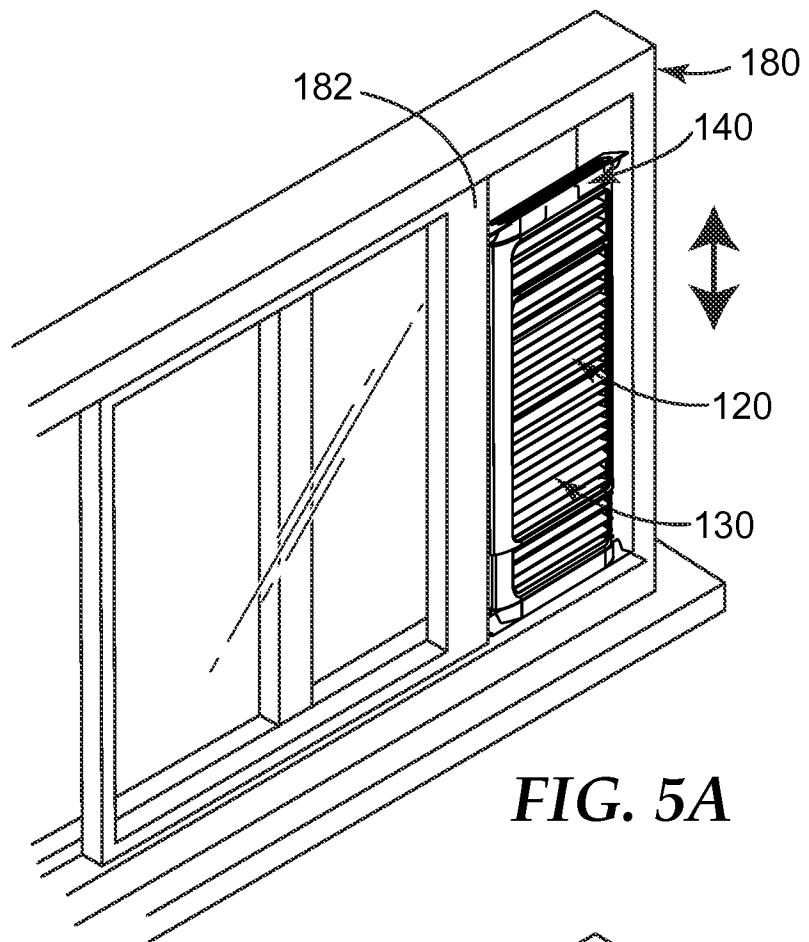


FIG. 5A

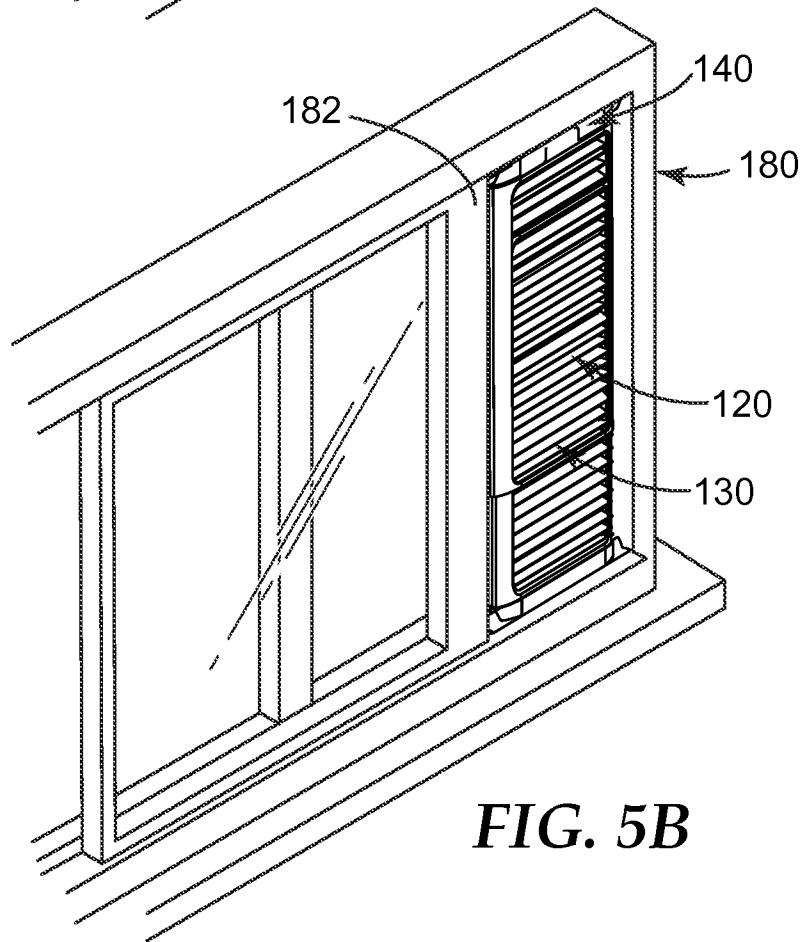
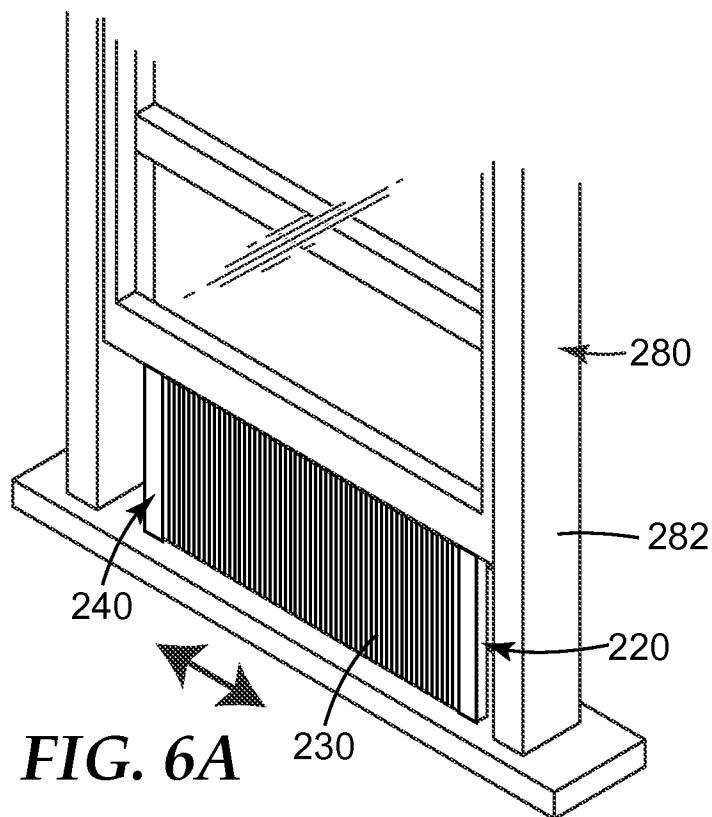
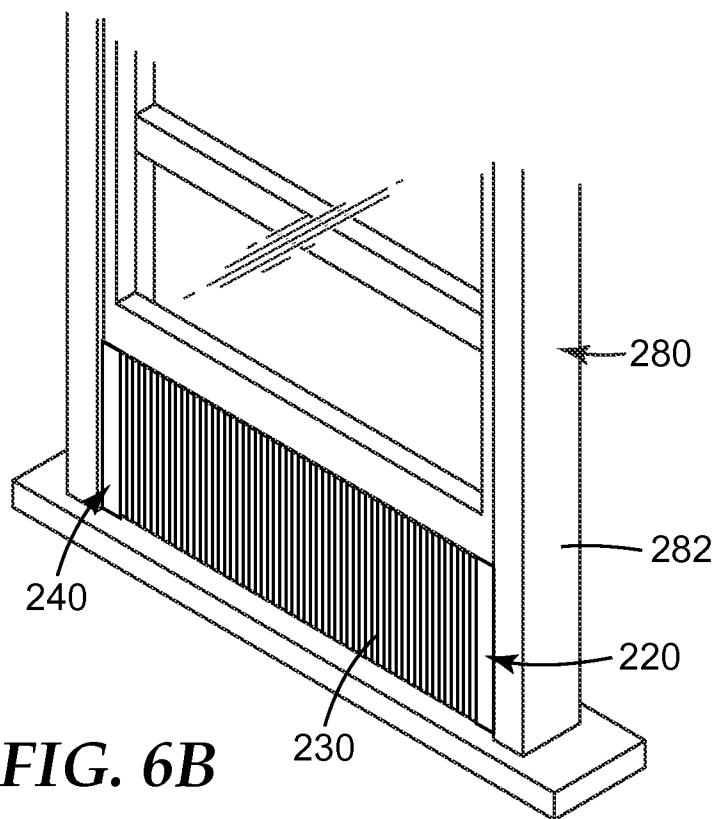


FIG. 5B

**FIG. 6A****FIG. 6B**

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US15/46483

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01D 39/14, 46/10; E06B 7/03; F24F 3/16 (2015.01)

CPC - B01D 39/14, 46/0002, 46/10; E06B 7/03; F24F 3/1603

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): B01D 39/14, 46/00, 46/10, 46/52; E06B 7/03, 9/52; F24F 3/16 (2015.01)

CPC: B01D 39/14, 46/0002, 46/0016, 46/10, 46/521; E06B 7/03; F24F 3/1603

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, Other Countries (INPADOC), RU, AT, CH, TH, BR, PH), ProQuest, Google/Google Scholar Window, filter, cleaner, Frame, Casing, Mount\*, Expand\*, Collaps\*, Adjust\*, Spring\_load, Telescop, Ratchet, slidabl\*, sliding

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,492,551 A (WOLFE M) 20 February 1996 figures 1 and 2; column 4, lines 1-10	1, 2, 3/1, 3/2
A	US 3,675,402A (WEED JH) July 1972 entire document	1, 2, 3/1, 3/2
A	US 6,044,892 A (EPSTEIN MI) 04 April 2000 entire document	1, 2, 3/1, 3/2

 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

09 October 2015 (09.10.2015)

Date of mailing of the international search report

12 NOV 2015

Name and mailing address of the ISA/

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Authorized officer

Shane Thomas

PCT Helpdesk: 571-272-4300  
PCT OSP: 571-272-7774

**INTERNATIONAL SEARCH REPORT**

International application No.

PCT/US15/46483

**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.: 4-23 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.