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(54) **WINDOW AIR FILTER**

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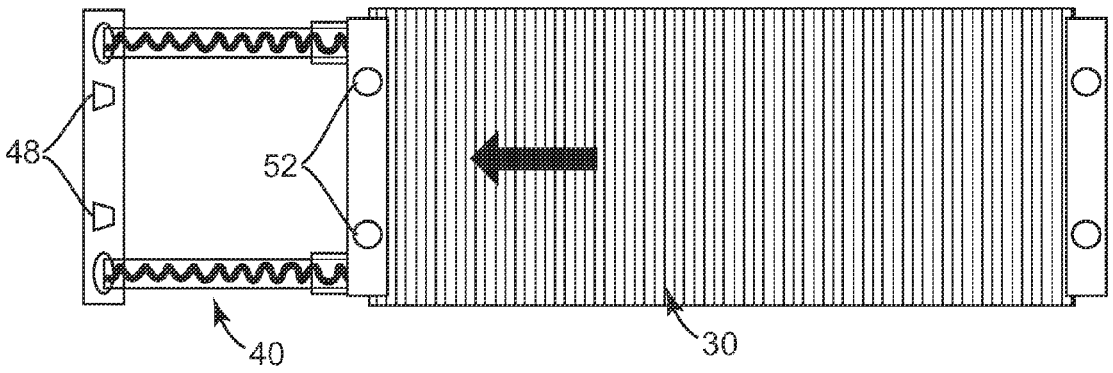
(57) **ABSTRACT**

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.



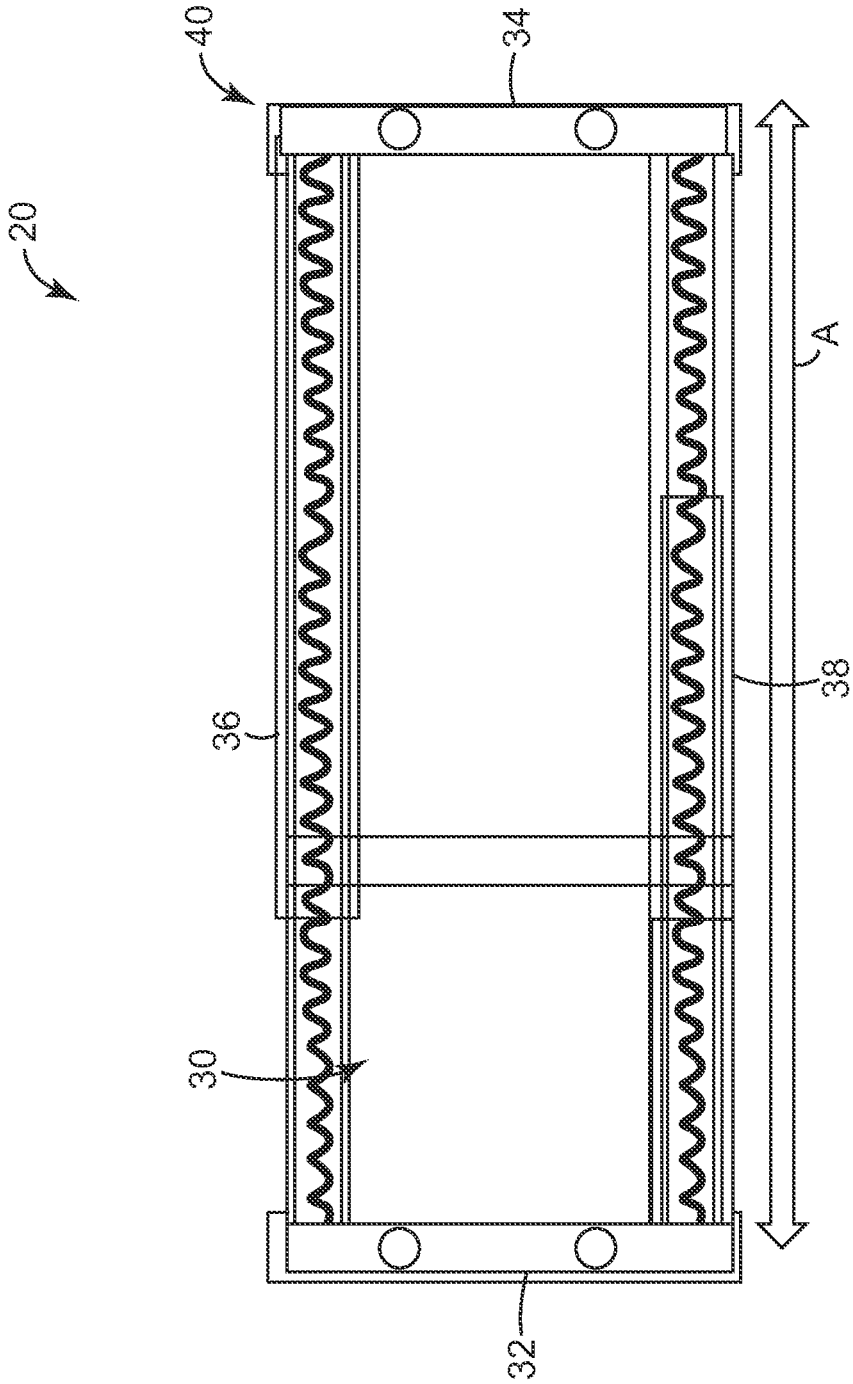


FIG. 1

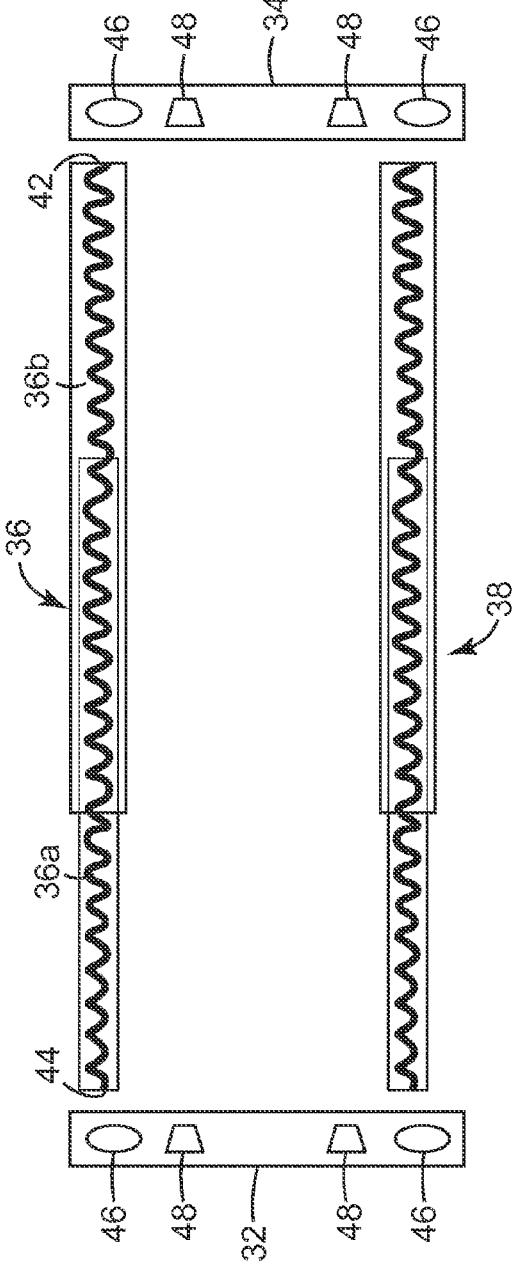

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FIG. 2A

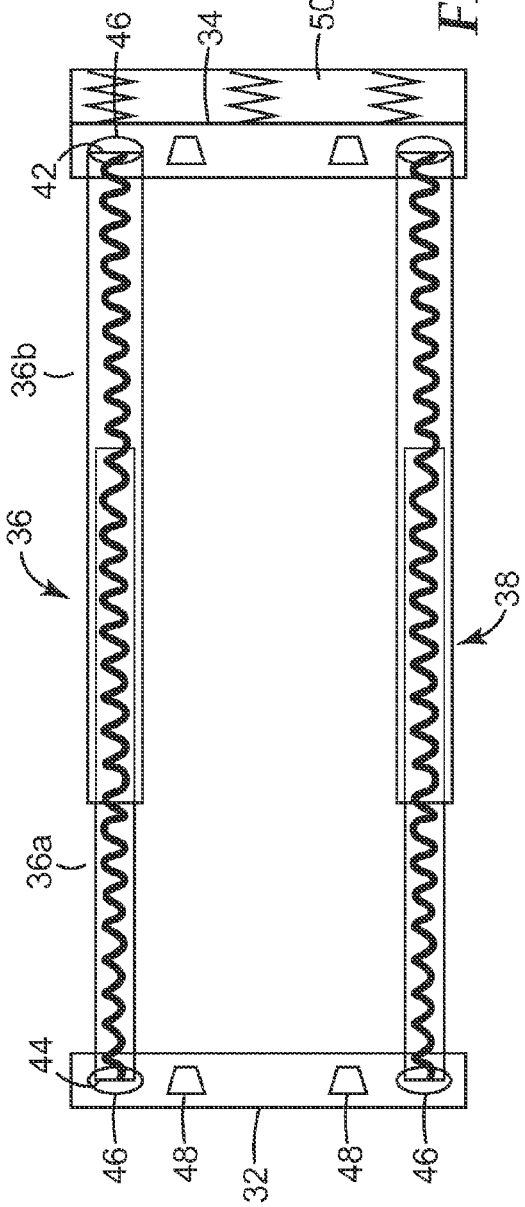
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FIG. 2B

FIG. 3A

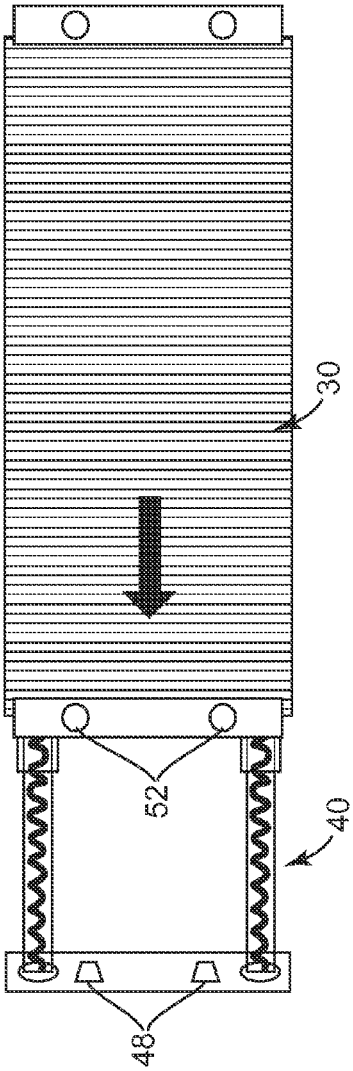


FIG. 3B

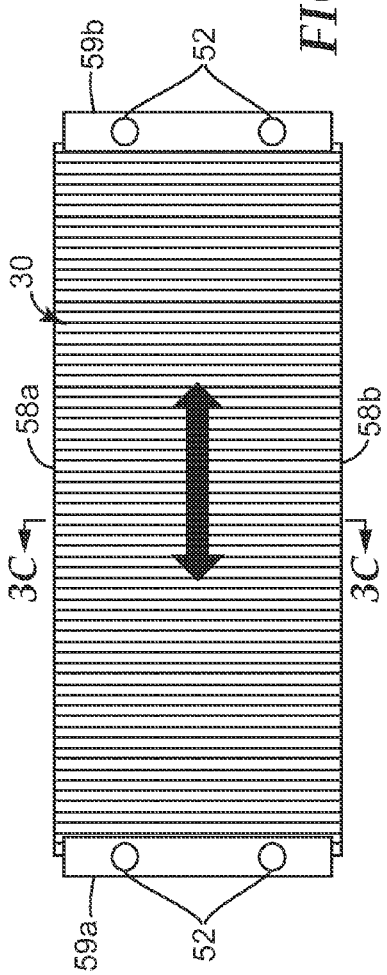
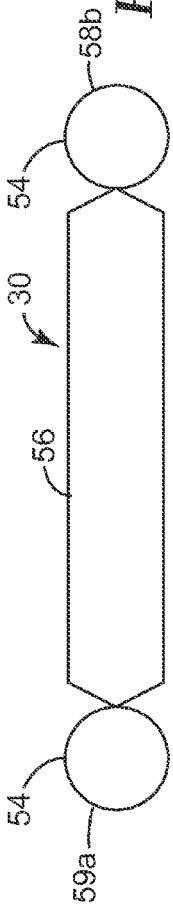


FIG. 3C



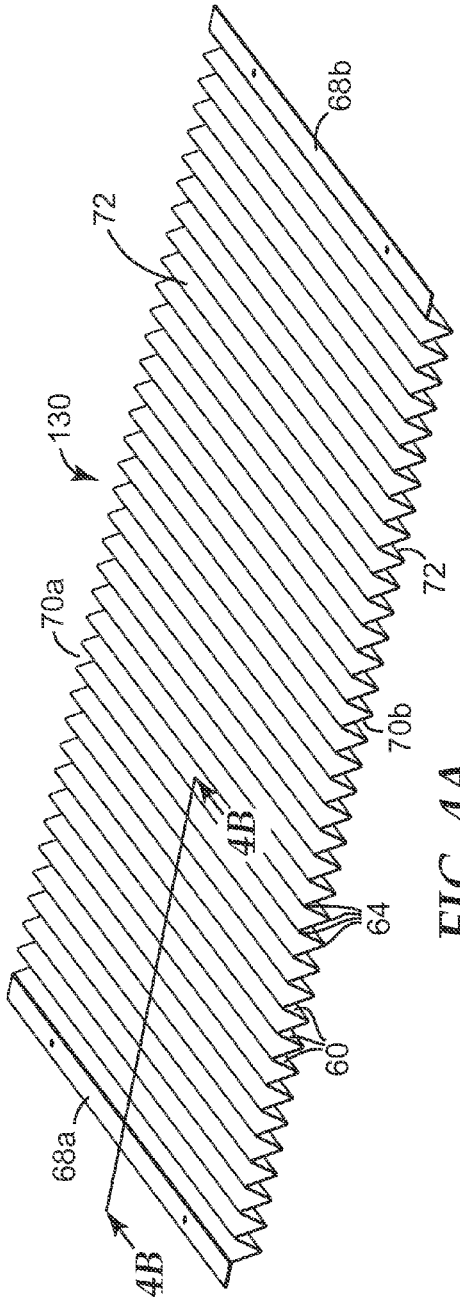


FIG. 4A

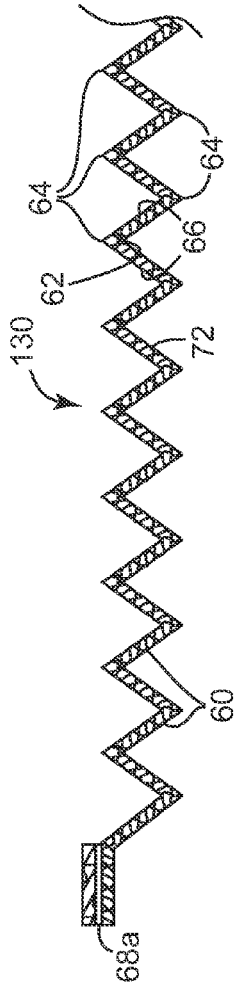


FIG. 4B

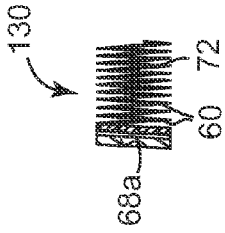


FIG. 4C

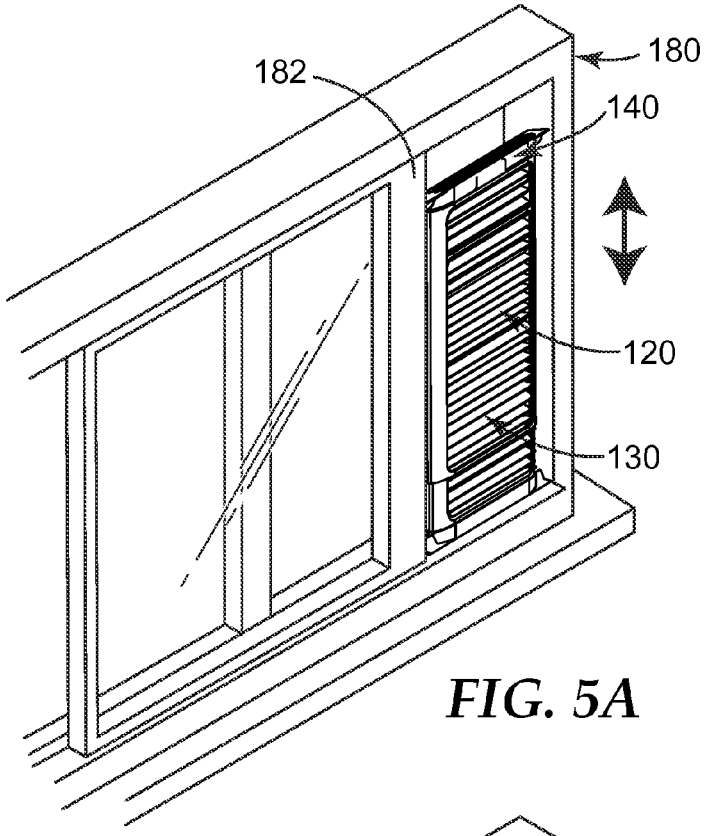


FIG. 5A

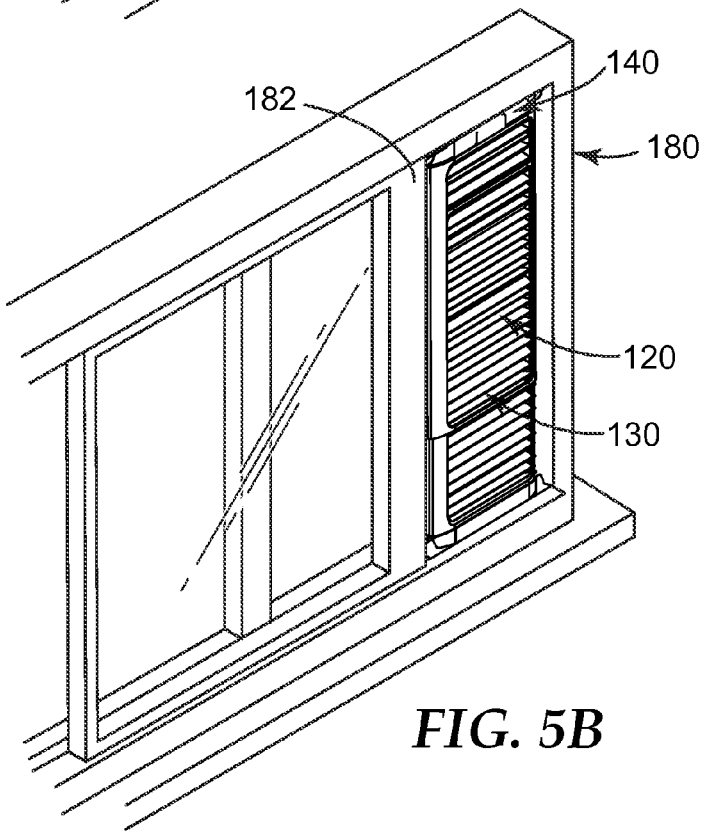


FIG. 5B

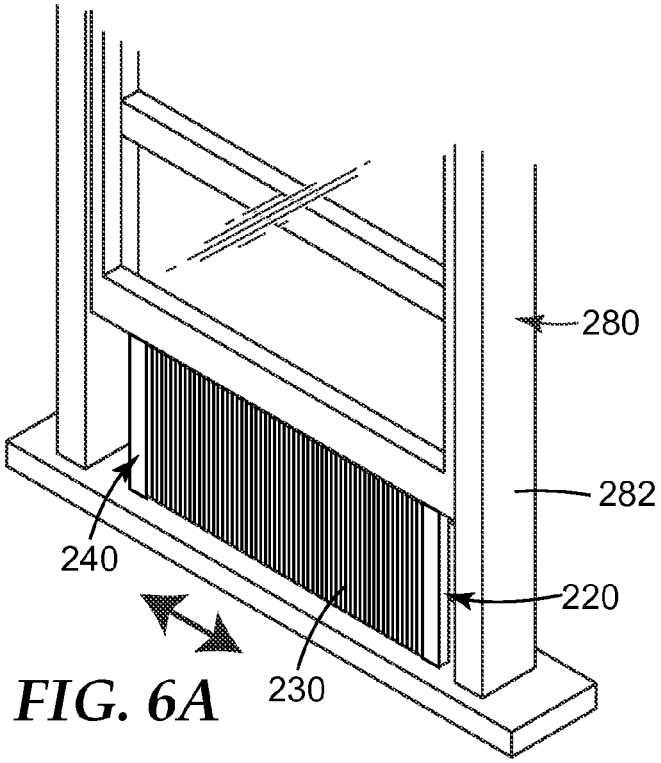


FIG. 6A

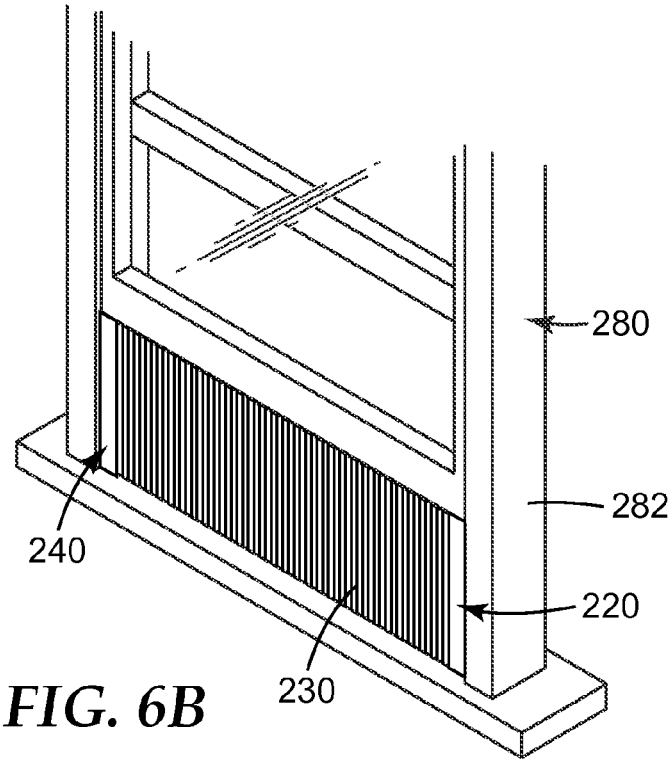


FIG. 6B

WINDOW AIR FILTER

TECHNICAL FIELD

[0001] 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

[0002] 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 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_{25}, bacteria, and viruses. Gaseous outdoor pollutants such as odors, NO_R, SO_2, ozone, and others may also be of concern in some locations.

SUMMARY

[0003] 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.

[0004] 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.

[0005] 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.

[0006] 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.

[0007] 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.

[0008] In some embodiments, the frame assembly is made of at least one of plastic, metal, paper, wood, and/or cardboard.

[0009] 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.

[0010] 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.

[0011] 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.

[0012] 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.

[0013] 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.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. **1** is a cross-sectional view of a window air filter in accordance with principles of the present disclosure; FIG. **2**A 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

[0015] FIG. **2**B 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;

[0016] FIG. **3**A is a side view of a partially assembled window air filter in accordance with principles of the present disclosure;

[0017] FIG. **3**B is a side view of the window air filter of FIG. **3**A fully assembled in accordance with principles of the present disclosure;

[0018] FIG. **3**C is a cross-sectional view of a filter media useful with the window air filter of FIG. **3**B in accordance with principles of the present disclosure;

[0019] FIG. **4**A is a perspective view a pleated filter media assembly useful with window air filters of the present disclosure and in an expanded condition;

[0020] FIG. **4**B is a cross-sectional view of the pleated filter media assembly of FIG. **4**A, taken along the line **4**B-**4**B;

[0021] FIG. **4**C is a side view of a portion of the pleated filter media assembly of FIG. **4**A in a collapsed condition;

[0022] FIG. **5**A 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;

[0023] FIG. **5**B is a perspective view of the window air filter of FIG. **5**A in an expanded state;

[0024] FIG. **6**A 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

[0025] FIG. **6**B is a perspective view of the window air filter of FIG. **6**A in an expanded state.

[0026] 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

[0027] 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.

[0028] 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. **5**A and **6**A) to an expanded, end-use state (see, e.g., FIGS. **5**B and **6**B), 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 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 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 adjusted to fit window openings of various sizes.

[0029] The window air filter **20** is typically removably installed in a partially opened window. The 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. **2**A-**2**B, 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 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**.

[0030] The expandable side frame members **36**, **38** provide dimensional adjustability to the window filter **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 relative to one another in a telescoping-like fashion. Each of the side frame members **36**, **38** can include a first portion **36***a* can be at least partially nested within a second portion **36***b* (identified for the first side frame **36** in FIGS. **2**A-**2**B). The first portion **36***a* and the second portion **36***b* can be adjustable with respect to one another along a longitudinal axis. In one embodiment, the portions **36***a*, **36***b* are spring-loaded to be biased to extend away from each other. Alternatively, the portions **36***a*, **36***b* can be frictionally adjustable or threaded for screw-like adjustment. Regardless, the length of each of the portions **36***a*, **36***b* is less than the total length of the side frame member **36** in an extended state. The first and second portions **36***a*, **36***b* 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.

[0031] 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 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. **2**A), 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 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 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.

[0032] In some embodiments, the end frame members **32**, **34** are identical. Optionally, as illustrated in FIG. **2**B, one or more end frame members **32**, **34** can include a spring-loaded end cap **50** or similar 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 extendable in a second direction perpendicular from the first extendable direction formed by the side frame members **36**, **38**.

[0033] 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. **3**A, the filter media assembly **30** can be 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.

[0034] As illustrated in FIG. **3**A, 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. **3**B and **3**C. 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.

[0035] The attachments **54** are illustrated as circular attachments in the cross-sectional view of FIG. **3**C, sized and shaped to accommodate circular side frame members **36**, **38**. As shown in FIGS. **3**A-**3**C, 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.

[0036] 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.

[0037] 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. **3**A and **3**B, 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. **3**B 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 **58***a*, **58***b* and opposing sides **59***a*, **59***b*.

[0038] In another example, and as shown in FIGS. **4**A through **4**C, 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. **4**B and a collapsed condition as in FIG. **4**C, 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. **5**B and **6**B) 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 **68***a*, **68***b* and opposing sides **70***a*, **70***b*.

[0039] 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. Pat. No. 6,740,137 to Kubokawa et al. and U.S. Pat. No. 7,622,063 to Sundet et al., the entire teachings of both of which are incorporated herein by reference.

[0040] 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. Pat. 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.

[0041] 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. Pat. 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.

[0042] 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.

[0043] Other nonwoven webs useful with the filter media **72** can be a high loft spunbond web, such as described, for example, in U.S. Pat. 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. Pat. 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. Pat. 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. Pat. No. 7,858,163, the entire teaching of which are incorporated herein by reference.

[0044] FIG. **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.

[0045] 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. **5**A and **5**B illustrate a window air filter **120**

installed in a horizontally opening window **180** (i.e., having a horizontally operable sash **182**). FIGS. **6**A and **6**B 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.

[0046] 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).

[0047] With additional reference to FIGS. **1** through **3**C, 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 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**.

[0048] 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. Pat. No. 62/206,928 can be used in the air filters of the present disclosure.

[0049] 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.

[0050] All references mentioned herein are incorporated by reference in their entirety.

[0051] 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.

[0052] 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).

[0053] 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.

1. A window filter assembly, comprising 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

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.

3. The window filter assembly of claim **1**, 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.

4. The window filter assembly of claim **1**, 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.

5. The window filter assembly of claim **1**, wherein the side frame members are tubular.

6. The window filter assembly of claim **1**, wherein the first and second side frame members are configured to removably couple with the first and second end frame members.

7. The window filter assembly of claim **1**, 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.

8. The window filter assembly of claim **1**, wherein the frame assembly is made of at least one of plastic, metal, paper, wood, and/or cardboard.

9. The window filter assembly of claim **1**, 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.

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

11. The window filter assembly of claim **1**, 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.

12. The window filter assembly of claim **1**, 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.

13. The window filter assembly of claim **1**, 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.

14. The window filter assembly of claim **1**, wherein the filter media is self-supporting.

15. The window filter assembly of claim **1**, wherein the filter media has an electrostatic charge.

16. The window filter assembly of claim **1**, wherein the filter media includes at least one of porous foam, a nonwoven, paper, and/or fiberglass.

17. The window filter assembly of claim **1**, wherein the filter media is wire-backed.

18. The window filter assembly of claim **1**, wherein at least one of the first and second end frame members has lengthwise adjustability.

19. The window filter assembly of claim **1**, wherein at least one of the first and second end frame members includes a spring-loaded feature.

20. The window filter assembly of claim **1**, wherein the window filter assembly can self-retain the shape of the selected expanded and/or collapsed state.

21. The window filter assembly of claim **1**, wherein the window filter assembly can be adjusted to fit windows of various sizes.

22. The window filter assembly of claim **1**, 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 claim **1**, comprising:

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 complete frame assembly.

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