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(71) Applicant (for all designated States except US): **CAMFIL FARR, INC.** [US/US]; One North Corporate Drive, Riverdale, New Jersey 07457 (US).

(72) Inventor; and

(71) Applicant (for US only): **GORMAN, Joseph J.** [US/US]; 6 Briar Drive, Sussex, New Jersey 07461 (US).

(74) Agent: **TABOADA, Keith P.**; Patterson & Sheridan, L.L.P., 3040 Post Oak Blvd., Suite 1500, Houston, Texas 77056-6582 (US).

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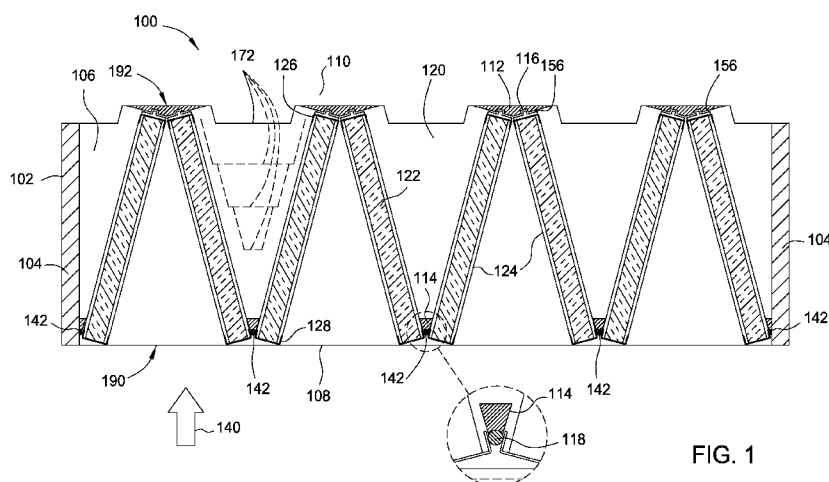
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: V-BANK FILTER ASSEMBLY WITH REPLACEABLE FILTERS



V-BANK FILTER ASSEMBLY WITH REPLACEABLE FILTERS

BACKGROUND

Field

[0001] The present invention relates to an air filter assembly having replaceable filters.

Description of the Related Art

[0002] V-bank filter assemblies are commonly used in air filtration applications where large amounts of filtration media are desirable, particularly in high flow, low pressure drop applications. A V-bank filter assembly typically includes a housing having two or more pairs of filter banks, where the filter banks further include two filter media elements, arranged in a V-configuration. The V-bank filter assembly is generally formed by applying a sealant between the edges of the filter media elements and the housing. In this manner, all of the filter media elements are connected to each other and to the housing. Therefore, during the fabrication or operation of the V-bank filter assembly, if a single filter media element is damaged, the housing and all of the filter media elements coupled to the housing must be replaced as a single unit. Replacing the entire V-bank filter assembly is undesirable because it increases the cost of manufacturing and the cost of ownership. Some V-bank filter assemblies have been designed with replaceable panels having individual filter media elements. However, these designs have not been commercially viable due to high material costs and/or significant air leakage between the filter media elements and housing rendering the design unsatisfactory for many filtration applications.

[0003] Thus, there is a need for an improved V-bank filter assembly having replaceable filter media elements.

SUMMARY OF THE INVENTION

[0004] In one embodiment, a V-bank filter assembly includes a top panel and bottom panel coupled together in a spaced apart relation, and a plurality of panel end seal struts extending between the top and bottom panels. Each of the top and bottom panels has a first edge and a second edge. The plurality of panel end seal struts are located adjacent the second edge of the panels. Each of the panel end seal struts has a first mating sealing feature facing the first edge of the top and bottom panels. The first mating sealing feature is configured to sealingly engage a replaceable filter panel. A plurality of filter panel receiving tracks are defined between the top and bottom panels are configured to align filter panels disposed in the tracks with a respective first mating sealing feature.

[0005] In another embodiment, a V-bank filter assembly includes a top panel and bottom panel coupled together in a spaced apart relation, a plurality of panel side seal strut assemblies and a plurality of panel end seal struts extending between the top and bottom panels. Each of the top and bottom panels has a first edge and a second edge. The plurality of panel end seal struts are located adjacent the second edge of the panels. The panel side seal strut assemblies are disposed adjacent and offset from the first edge of the top panel. The plurality of panel side seal strut assemblies each include at least one second seal. A plurality of filter panel receiving tracks are disposed between the panels and configured to retain replaceable filter panels between the top and bottom panels in a v-shaped configuration. Each pair of filter panel receiving tracks align a respective filter panel with a respective first mating sealing feature of the panel end seal struts.

[0006] In one embodiment a replaceable air filter includes a replaceable air filter panel comprising a filter media element disposed in a frame. The frame has a first side, a second side, a third side and a fourth side circumscribing the filter media element. The sides are oriented perpendicular to the orientation of the filter media element. A mating sealing feature extends outward from an exterior of the fourth side of the frame and away from the filter media element.

[0007] In one embodiment, a method of replacing a filter panel of a filter

housing is provided that includes removing a used filter panel from the filter housing and inserting a new filter panel into a tapered filter panel receiving rack of the filter housing.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] So that the manner in which the above recited features of the present disclosure can be understood in detail, a more particular description of the disclosure, briefly summarized above, may be had by reference to embodiments, some of which are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this disclosure and are therefore not to be considered limiting of its scope, for the disclosure may admit to other equally effective embodiments.

[0009] Figure 1 is a cross-sectional view of a V-bank filter assembly with replaceable filter panels;

[0010] Figure 2 is an enlarged cross-sectional view one embodiment of a panel end seal strut;

[0011] Figure 3 is an enlarged partial cross-sectional view of the V-bank filter assembly of Figure 1 illustrating another embodiment of a mating sealing feature;

[0012] Figure 4 is an enlarged partial cross-sectional view of the V-bank filter assembly of Figure 1 illustrating one embodiment of a panel side seal strut assembly;

[0013] Figure 5 is an enlarged partial cross-sectional view of the V-bank filter assembly of Figure 1 illustrating another embodiment of a panel side seal strut assembly;

[0014] Figure 6 is a cross sectional view of the V-bank filter assembly of Figure 1 with the replaceable filter panels removed;

[0015] Figure 7 is a perspective view of one embodiment of a replaceable filter panel;

[0016] Figure 8 is partial cross-sectional view on another embodiment of a replaceable filter panel;

[0017] Figure 9 a partial cross-sectional view of the another embodiment of a replaceable filter panel;

[0018] Figure 10 is a partial cross-sectional view of the V-bank filter assembly of Figure 1 engaged with another embodiment of a replaceable filter panel; and

[0019] Figure 11 is a partial cross-sectional view of the V-bank filter assembly of Figure 1 engaged with another embodiment of a replaceable filter panel.

[0020] To facilitate understanding, identical reference numerals have been used, where possible, to designate identical elements that are common to the figures. It is contemplated that elements and features of one embodiment may be beneficially incorporated in other embodiments without further recitation.

DETAILED DESCRIPTION

[0021] Figure 1 is a cross-sectional view of one embodiment of a V-bank filter assembly 100. The V-bank filter assembly 100 includes a frame 102 and two or more replaceable filter panels 122, wherein at least two of the filter panels are arranged to form a v-bank 124. The V-bank filter assembly 100 include a first side 108 and a second side 110. In normal operation, air enters the V-bank filter assembly 100 from the first side 108, is filtered by the replaceable filter panels 122, then exits the V-bank filter assembly 100 from the second side 110, as indicated by flow arrow 140. Optionally, air may be filtered through the V-bank filter assembly 100 in the opposite direct.

[0022] The frame 102 includes a top panel 106, a bottom panel (not seen), two side panels 104, a plurality of panel end seal struts 112, and a plurality of panel side seal strut assemblies 142. The top and side panels 106, 104 may be fabricated from wood, plastic, glass reinforced plastic, metal or other suitable material. The top panel 106 includes a first edge 190 and a second edge 192, respectively disposed at the first side 108 and the second side 110 of the V-bank filter assembly 100. The top panel 106 may optionally have one or more cut-outs 172 (some shown in phantom) located proximate the second edge 192 of the top panel 106 between the panels 106 to reduce the amount of material

used to fabricate the top panel 106, thereby minimizing costs and shipping weight. The bottom panel is identical to the top panel 106 and faces the top panel 106 in a mirror image orientation.

[0023] The two side panels 104 couple the top panel 106 and the bottom panel together in a spaced apart relation. The side panels 104 may extend completely from the first side 108 to the second side 110 of the V-bank filter assembly 100 so that the frame 102 takes a rectangular tubular form, thereby protecting the panels 106 disposed therein from inadvertent contact and damage. Alternatively, the side panels 104 may only extend a portion of the distance between the first side 108 to the second side 110 of the V-bank filter assembly 100 to minimize costs.

[0024] The panel end seal struts 112 also extend between the top panel 106 and bottom panel and are located proximate the second edge 192 of the top panel 106 and bottom panel defined at the second side 110 of the V-bank filter assembly 100. The panel end seal struts 112 are utilized to seal one end, such as the downstream end, of the filter panels 122 to the frame 102. The panel end seal struts 112 may be fabricated from wood, plastic, glass reinforced plastic, metal or other suitable material. In one embodiment, the panel end seal struts 112 are fabricated from stamped steel, extruded plastic or extruded aluminum. In another embodiment, the panel end seal struts 112 may be hollow, as shown in Figure 2.

[0025] Continuing to refer to Figure 1, the panel end seal struts 112 include a first mating sealing feature 116 extending substantially along the entire length of the panel end seal struts 112, for example, from the facing surfaces of the top and bottom panels once assembled as part of the V-bank filter assembly 100. The first mating sealing feature 116 generally faces the second side 110 of the V-bank filter assembly 100. The first mating sealing feature 116 is configured to engage and substantially provide an air seal with a corresponding second mating sealing feature 156 disposed on one side of each to the filter panels 122, as further discussed below. In the embodiment depicted in Figure 1, the first mating sealing feature 116 is a groove, and in one embodiment, the groove has a rectangular profile. In alternative embodiment depicted in Figure 3, the

first mating sealing feature 116 is a rib 198 that extends substantially along the entire length of the panel end seal struts 112, for example, from the facing surface of the top panel 106 and bottom panel. In embodiments where the first mating sealing feature 116 is in the form of a rib 198, the rib 198 may be an integral or separate element of the panel end seal strut 112. For example, the first mating sealing feature 116 in the form of a rib 198 may be an extruded section of the panel end seal strut 112 or may be bonded or otherwise affixed to the panel end seal strut 112. The first mating sealing feature 116 in the form of a rib 198 may be fabricated from the same material as the panel end seal strut 112, or of a different material, such as a plastic or elastomer. In one embodiment, the first mating sealing feature 116 in the form of a rib 198 may have a rectangular profile.

[0026] The plurality of panel side seal strut assemblies 142 also extend between the top panel 106 and bottom panel proximate the first side 108 of the V-bank filter assembly 100. Each panel side seal strut assembly 142 is located adjacent and offset from the first edge 190 of the top filter panel 106 and bottom panel defined at the first side 108 of the V-bank filter assembly 100. The panel side seal strut assemblies 142 are utilized to seal the opposite end, such as the upstream end, of the filter panel 122 to the frame 102.

[0027] The panel side seal strut assemblies 142 include a seal strut 114 and at least one seal 118. The seal strut 114 may be fabricated from wood, plastic, glass reinforced plastic, metal or other suitable material. In one embodiment, the seal strut 114 is fabricated from stamped steel, extruded plastic or extruded aluminum.

[0028] The seal 118 is mounted adjacent to the seal strut 114 at a side of the seal strut 114 closer to the first edge 190 of the top panel 106 and runs substantially the entire length of the panel side seal strut assembly 142, for example, from the facing surfaces of the top panel 106 and bottom panel. The seal 118 may be fabricated from an elastomer, may be adhered, bonded or formed in place in the seal strut 114. The seal 118 is utilized to provide an air seal between the seal strut 114 and adjacent filter panel 122. The air seal may be substantially leak free, or have a certain amount of allowable by-pass

depending on the intended use of the V-bank filter assembly 100. In one embodiment, one seal 118 may be utilized to seal both filter panels 122 adjacent either side of the seal strut 114. In another embodiment, at least two seals 118 are utilized to seal the seal strut 114 to the filter panels 122, with at least one seal 118 providing a seal between the seal strut 114 and the filter panel 122 adjacent the first side of the seal strut 114 and at least one seal 118 providing a seal between the seal strut 114 and the filter panel 122 adjacent the second side of the seal strut 114.

[0029] For example in the embodiment depicted in Figure 4, the panel side seal strut assembly 142 includes a seal strut 114 having a v-shaped body 402. The v-shaped body 402 includes a flat land 160 at the vertices of the body 402 to which the seal 118 is mounted. The seal 118 provides a seal against the facing sides of the filter panels 122 adjacent the seal strut 114. In another example depicted in the embodiment of Figure 5, panel side seal strut assembly is in the form of a strut 502 having two seals 504. The strut 502 has a first side 506 and a second side 508 which are oriented at an acute angle flaring away from the first side 108 of the V-bank filter assembly 100. The one of the two seals 504 is mounted to the first side 506 while one of the two seals 504 is mounted to the second side 508.

[0030] It is contemplated that the panel side seal strut assembly 142 may optionally be omitted, and that the filter panels 122 may have gaskets to enable adjacent filter panels 122 to seal to each other. Alternatively, the adjacent filter panels 122 may seal to each other using other means, such as tapes, clamps or adhesives.

[0031] Figure 6 is a cross sectional view of the V-bank filter assembly 100 of Figure 1 with the filter panels 122 removed exposing an inside surface 602 of the top panel 106. The bottom panel is identically constructed as discussed above. The inside surface 602 of the top panel 106 includes a plurality of filter panel receiving tracks 604. The tracks 604 are arranged at an acute angle relative to the flow direction as shown by arrow 140, which is also perpendicular to the first side 108 of the V-bank filter assembly 100. Each track 604 defines a recess 606 which is configured to receive one side of the filter panels 122. The

recess 606 may be defined by a groove formed in the inside surface 602 of the top panel 106, by ridges extending from the inside surface 602 of the top panel 106, or a combination thereof. The tracks 604 may alternatively be coupled to the inside surface 602 of the top panel 106 in a multi-piece construction. The tracks 604 hold the filter panels 122 in a "V-shaped" configuration within the frame 102.

[0032] The recess 606 of each track 604 is open at the first edge 190 of the top panel 106 to allow the filter panel 122 to slide into the aligned and opposing recesses 606 disposed on the top panel 106 and bottom panel of the V-bank filter assembly 100. The recess 606 of each track 604 ends at the panel end seal struts 112. The recess 606 of the track 604 advantageously allows for the filter panel 122 (not shown) to be slid into sealing engagement with the panel end seal strut 112.

[0033] In one embodiment, the lateral width of the track 604 is tapered towards the second edge 192 of the top panel 106 and bottom panel of the V-bank filter assembly 100. Due to the taper of the track 604, the filter panel 122 may be secured by friction within the frame 102 without the use of a fastener, clip or other fastening device. Furthermore, the track 604 allows a single filter panel 122 to be replaced by sliding the filter panel 122 in and out of the track 604 without disturbing the seal between the other filter panels 122 and the frame 102. Thus, the track 604 allows a single filter panel 122 to be easily replaced without having to replace the entire V-bank filter assembly.

[0034] Figure 7 depicts one embodiment of the replaceable filter panel 122. It is contemplated that the filter panel 122 may be configured differently and not limited in use for only V-bank filter assemblies. The replaceable filter panel 122 includes a frame 700 and a filter media element 702. The filter media element 702 is retained in the frame 700, and in some embodiments, may be sealed to the frame 700 using polyurethane or other suitable adhesives. The filter media element 702 may be a woven, non-woven or other suitable filtration element. The filter media element 702 is pleated to increase the amount of filtration media present in the filter panel 122. The filter media element 702 may have a MERV, ASHRAE or other efficiency rating.

[0035] The frame 700 may be fabricated from metal, plastic, wood, cardboard or other suitable material. The frame 700 is generally a quadrilateral and includes a first side 704, a second side 706, a third side 708 and a fourth side 710. The sides 704, 706, 708, 710 have an orientation perpendicular to the planar orientation of the filter media element 702. Each of the sides 704, 706, 708, 710 may include two flanges 714 extending inward and perpendicular from each side 704, 706, 708, 710. The flanges 714 form a c-channel with the sides 704, 706, 708, 710 thereby facilitating the retention of the filter media element 702 within the frame 700 and retaining adhesive used to provide a seal between the filter media element 702 and the frame 700. The flanges 714 also provide a continuous flat surface for engaging the seals 118, thereby sealing the fourth side 710 of the filter panel 122 to the frame 102 of the V-bank filter assembly 100.

[0036] The first side 704 is generally perpendicular to the plane of the top panel 106. In one embodiment the first side 704 of the frame 700 does not include any sealing features. The second side 706 and the third side 708 are sized to fit within the recess 606 of the track 604. The fourth side 710 of the frame 700 includes the second mating sealing feature 156 which engages first mating sealing feature 116 when the filter panel 122 is slid completely within the recess 606 of the track 604. In the embodiment depicted in Figure 7, the first mating sealing feature 116 is in the form of a rib 712. In the embodiment depicted in Figure 8, the second mating sealing feature 156 is in the form of a groove 802.

[0037] Referring now to Figure 9, to enhance the retention of the filter panel 122 within the track 604, the third side 708 may include two lips 902 extending from the third side 708. The second side 706 may be identically configured. The lips 902 allow the filter panel 122 to be sealingly fit within the recess 606. The lips 902 may be parallel, tapered to match the tapering of the recess 606, or tapered as a wider angle than the taper of the recess 606 to ensure an interference fit with the top and bottom panels to promote retention and sealing. In one embodiment, the lips 902 may be formed from a resilient material or structure that allows the filter panel 122 to be sealingly fit within the recess 606.

In another embodiment, the lips 902 may be formed from the same material as the third side 708. The lips 902 may be formed integrally with the third side 708 as a single element, or the lips 902 may be a separate element affixed to the third side 708.

[0038] Referring to Figure 10, the lips 902 may begin to slightly deflect as the filter panel 122 is pushed deeper within the track 604, thereby friction fitting the filter panel 122 within the recess 606 while also providing an air seal between the filter panel 122 and the frame 102.

[0039] In another embodiment, shown in Figure 11, the third side 708 has a width that extends beyond a width of the tapered track 604. The lips 902 are therefore positioned inward of the flanges 714 to engage with the recess 606 of the tapered track 604.

[0040] Thus, a V-bank filter assembly 100 has been provided that allows fast and easy fabrication with replaceable filter panels 122. The filter panels advantageously allows replacement without having to remove or discard the entire V-bank filter assembly 100 either during fabrication or during operation of the V-bank filter assembly 100.

[0041] It is contemplated, however, that the filter panel receiving tracks discussed above are not limited to V-bank filter assemblies only and may be applicable for sealing other filter elements or filter headers in a filter housing assembly.

[0042] While the foregoing is directed to embodiments of the present disclosure, other and further embodiments of the disclosure may be devised without departing from the basic scope thereof, and the scope thereof is determined by the claims that follow.

What is claimed is:

1. A V-bank air filter assembly comprising:
 - a top panel and bottom panel coupled in a spaced apart relation, each of the top and bottom panels having a first edge and a second edge;
 - a plurality of panel end seal struts extending between the top and bottom panels, each panel end seal struts having a first mating sealing feature facing the first edge of the top and bottom panels, the first mating sealing feature configured to sealingly engage a replaceable filter panel, wherein the plurality of panel end seal struts are located adjacent the second edge; and
 - a plurality of filter panel receiving tracks defined between the top and bottom panels configured to align filter panels disposed in the tracks with a respective first mating sealing feature.
2. The V-bank air filter assembly of claim 1, wherein the first mating sealing feature is a rib.
3. The V-bank air filter assembly of claim 1, wherein the first mating sealing feature is a groove.
4. The V-bank air filter assembly of claim 1, wherein each of the tracks further comprises:
 - a recess.
5. The V-bank air filter assembly of claim 4, wherein the recess is tapered towards the second edge of the top panel.
6. The V-bank air filter assembly of claim 1 further comprising:
 - a plurality of panel side seal strut assemblies each comprising at least one second seal, the panel side seal strut assemblies disposed adjacent and offset from the first edge of the top panel.

7. A V-bank air filter assembly comprising:
 - a top panel and bottom panel coupled in a spaced apart relation, each of the top and bottom panels having a first edge and a second edge;
 - a plurality of panel end seal struts extending between the top and bottom panels, each panel end seal struts, wherein the plurality of panel end seal struts are located adjacent the second edge;
 - a plurality of panel side seal strut assemblies each comprising at least one second seal, the panel side seal strut assemblies disposed adjacent and offset from the first edge of the top panel; and
 - a plurality of filter panel receiving tracks configured to retain replaceable filter panels between the top and bottom panels in a v-shaped configuration, each pair of filter panel receiving tracks aligning a respective filter panel with a respective first mating sealing feature of the panel end seal struts.
8. The V-bank air filter assembly of claim 7, wherein the first mating sealing feature is a rib.
9. The V-bank air filter assembly of claim 7, wherein the first mating sealing feature is a groove.
10. The V-bank air filter assembly of claim 7, wherein each of the tracks further comprises:
 - a recess.
11. The V-bank air filter assembly of claim 10, wherein the recess is tapered towards the second edge of the top panel.
12. A replaceable air filter panel comprising:
 - a filter media element;
 - a frame having a first side, a second side, a third side and a fourth side circumscribing the filter media element, the sides perpendicular to the orientation of the filter media element; and

a mating sealing feature extending outward from an exterior of the fourth side of the frame away from the filter media element.

13. The air filter of claim 12, wherein the mating sealing feature is a groove.

14. The air filter of claim 12, wherein the mating sealing feature is a rib.

15. The air filter of claim 12, wherein the frame further comprises:

a pair of ribs extending outward from the second and third sides of the frame, the second and third sides of the frame disposed adjacent to the fourth side of the frame.

16. The air filter of claim 12, wherein the first side of the frame does not include a sealing feature.

17. A method of replacing a filter panel of a filter housing, comprising:

removing a used filter panel from the filter housing; and

inserting a new filter panel into a tapered filter panel receiving track formed in the filter housing.

18. The method of claim 17, wherein inserting further comprises:

mating a back side of the new filter panel with a feature formed in the filter housing.

19. The method of claim 17, wherein inserting further comprises:

sealing front sides of the new filter panel to the filter housing.

20. The method of claim 17 further comprising:

inserting a second new filter panel into the filter housing, the new filters forming a vee.

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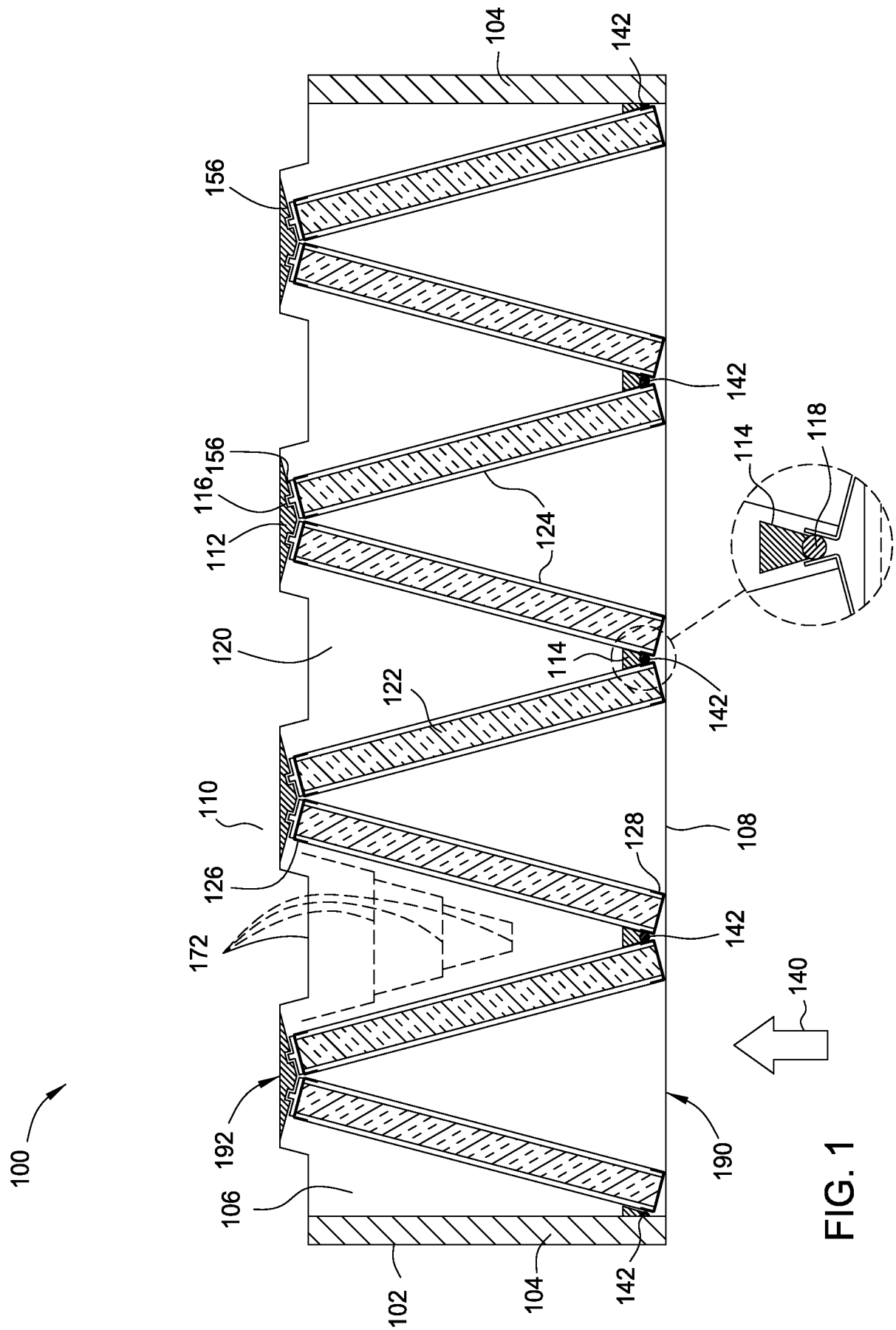


FIG. 1

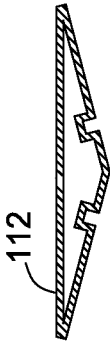


FIG. 2

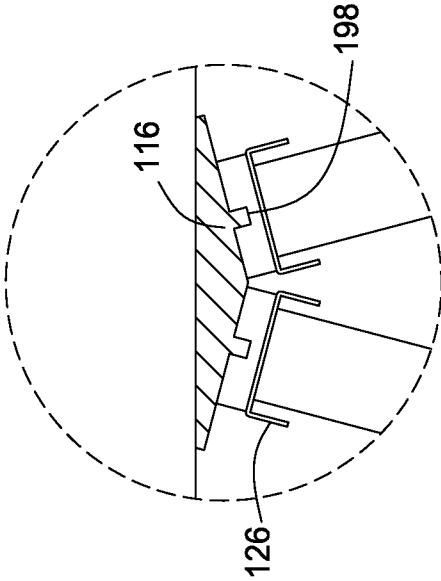


FIG. 3

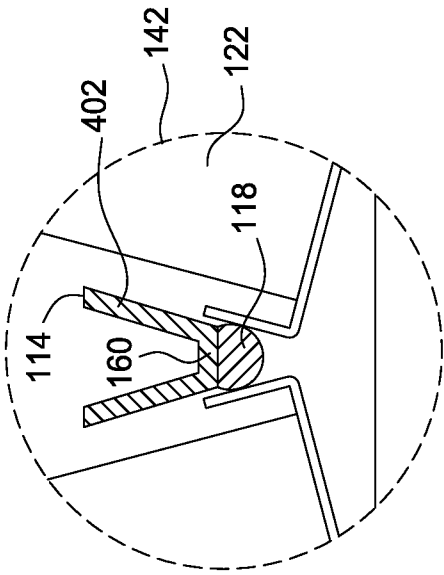


FIG. 4

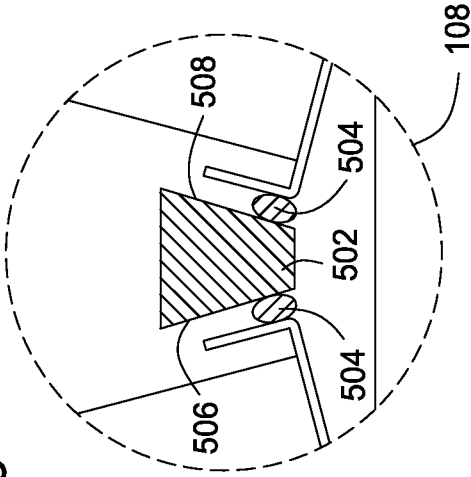


FIG. 5

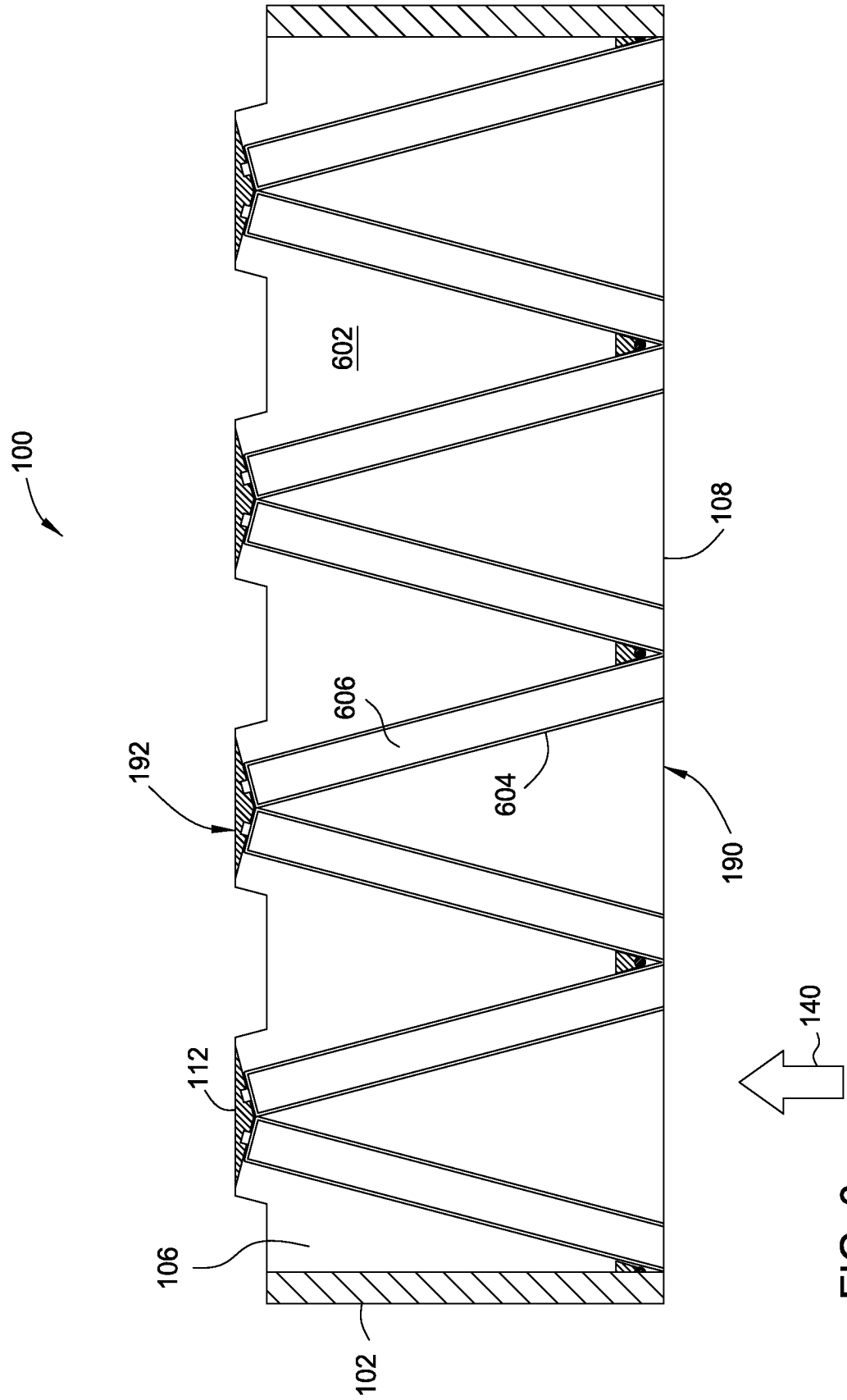


FIG. 6

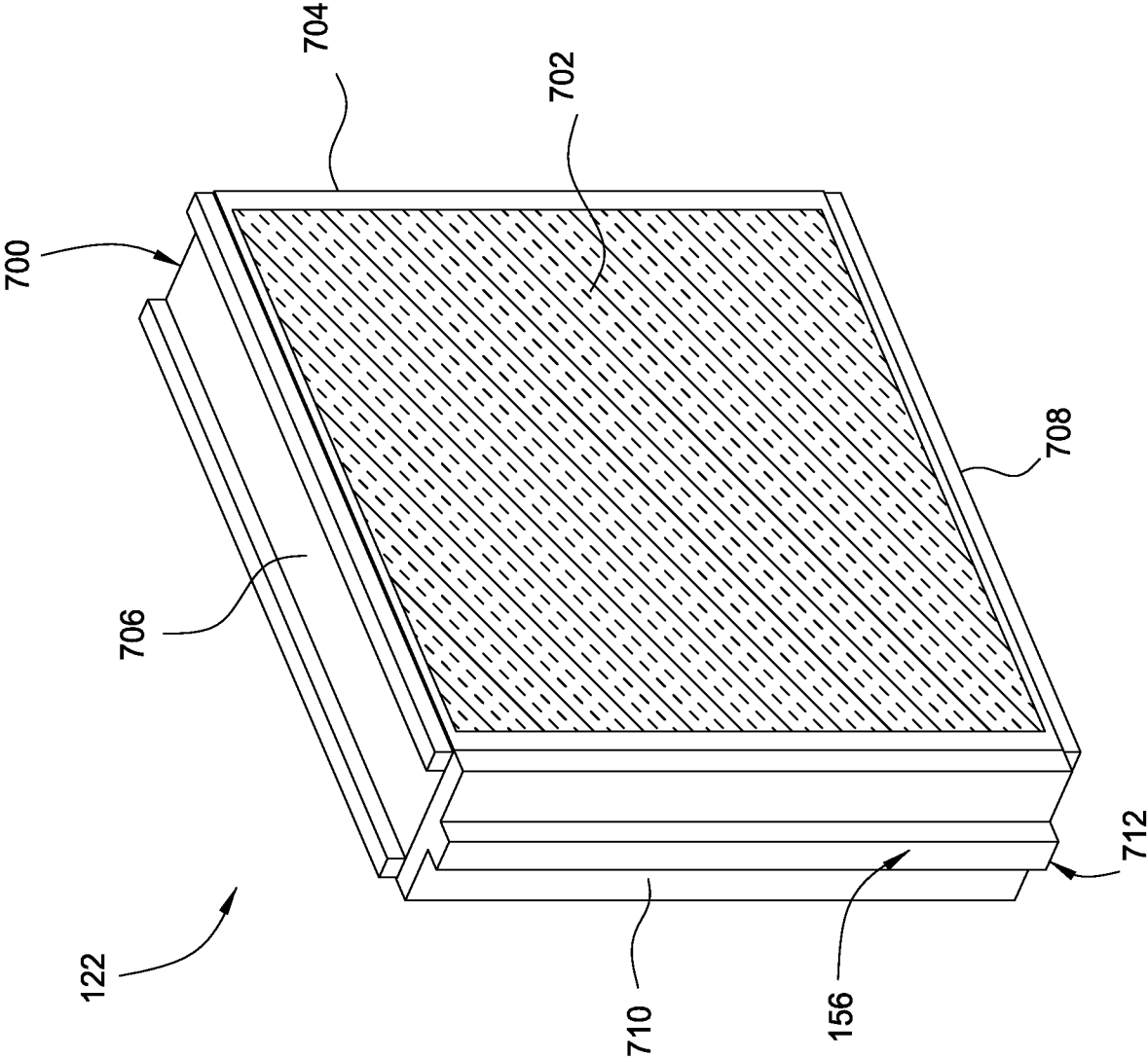


FIG. 7

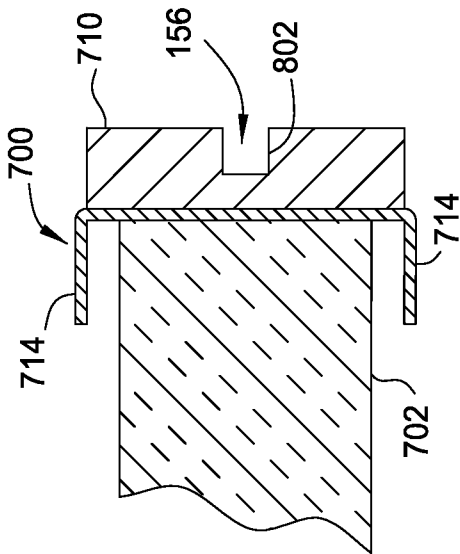


FIG. 8

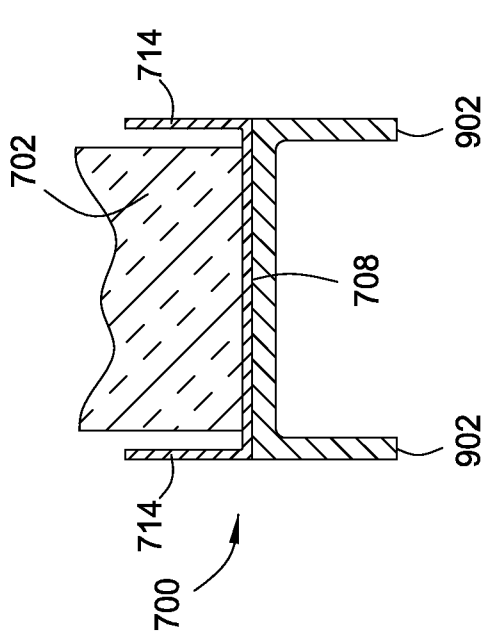


FIG. 9

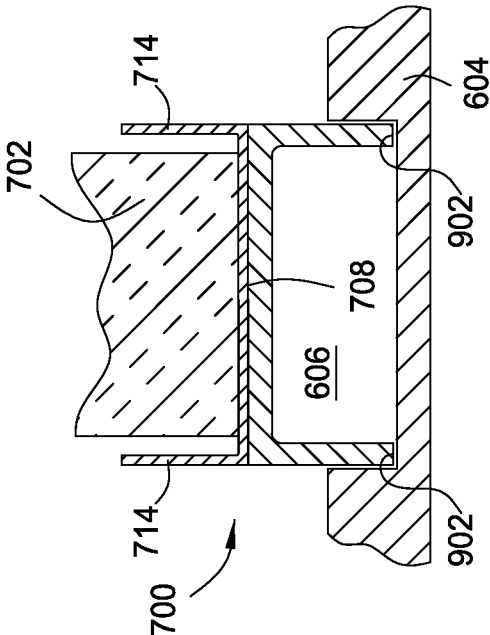


FIG. 10

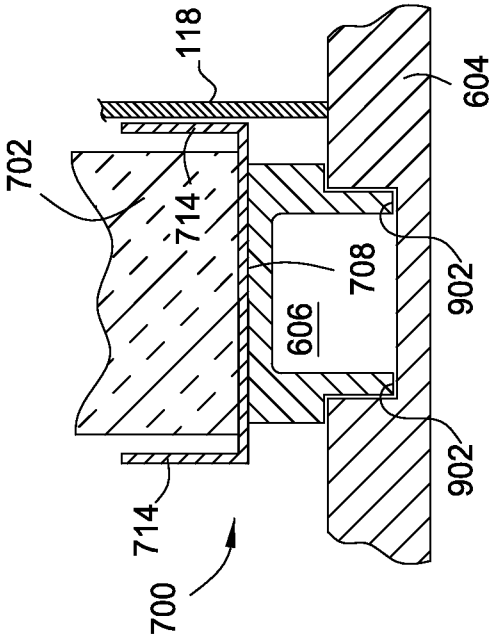


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US12/72267

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B01D 39/00, 46/00; B03C 3/00, 155 (2013.01)

USPC - 55/51 1, 495, 490; 96/66, 69, 83, 67, 88

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 39/00, 46/00; B03C 3/00, 155 (2013.01)

USPC: 55/51 1, 495, 490; 96/66, 69, 83, 67, 88

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)

MicroPatent (US-Granted, US-Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); DialogPRO (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstracts Online, Inside Conferences); Google Scholar; IP.com; air*, filter*, cleaner*, v-bank*, v-shape*, replac*, cartrid*, disposa*, seal*, strut*, track*, taper*, narrowing*

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/0326279 A1 (WISER, FC et al.) December 30, 2010; figures 1-4, 9-13, 16, 18; paragraphs [0011], [0049], [0055], [0057], [0058], [0061]-[0064], [0066]-[0069], [0086]	1-11, 17-20
X	US 2009/0320426 A1 (BRAUNECKER, L et al.) December 31, 2009; figures 6A, 6G, 11A; paragraphs [0021], [0054], [0058]	12-14, 16
Y		15
Y	Polyurethane, Epoxy And Silicone Thermoset Resin Systems For Encapsulants Coatings Adhesives Sealants Castings. Datasheet [online]. Greenfield Polymers. 27 October 2010 [retrieved on 2013-05-30]. Retrieved from the Internet: <URL: http://web.archive.org/web/20101027150450/http://www.greenfieldpolymers.co.uk/applications.asp?parent=&id=42 >.	15
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A	US 3494113 A (KINNEY, WL) February 10, 1970; entire document	1-20
A	US 5512074 A (HANNI, RS et al.) April 30, 1996; entire document	1-20

☐ Further documents are listed in the continuation of Box C.

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"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

30 May 2012 (30.05.2013)

Date of mailing of the international search report

17 JUN 2013

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

Authorized officer:

Shane Thomas

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US12/72267

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.:
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:

- " *-Please See Supplemental Page-***-

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.

-" -Continued from Box III-***-

Group I: Claims 1-11 and 17-20 are directed toward a V-bank filter assembly comprising: a top panel and bottom panel coupled in a spaced apart relation, each of the top and bottom panels having a first edge and a second edge; a plurality of panel end seal struts extending between the top and bottom panels, each panel end seal struts having a first mating sealing feature facing the first edge of the top and bottom panels, the first mating sealing feature configured to sealingly engage a replaceable filter panel, wherein the plurality of panel end seal struts are located adjacent the second edge; and a plurality of filter panel receiving tracks defined between the top and bottom panels configured to align filter panels disposed in the tracks with a respective first mating sealing feature; and a V-bank air filter assembly comprising: a top panel and bottom panel coupled in a spaced apart relation, each of the top and bottom panels having a first edge and a second edge; a plurality of panel end seal struts extending between the top and bottom panels, each panel end seal struts, wherein the plurality of panel end seal struts are located adjacent the second edge; a plurality of panel side seal strut assemblies each comprising at least one second seal, the panel side seal strut assemblies disposed adjacent and offset from the first edge of the top panel; and a plurality of filter panel receiving tracks configured to retain replaceable filter panels between the top and bottom panels in a v-shaped configuration, each pair of filter panel receiving tracks aligning a respective filter panel with a respective first mating sealing feature of the panel end seal struts; and a method of replacing a filter panel of a filter housing, comprising: removing a used filter panel from the filter housing; and inserting a new filter panel into a tapered filter panel receiving track formed in the filter housing.

Group II: Claims 12-16 are directed toward a replaceable air filter panel comprising: a filter media element; a frame having a first side, a second side, a third side and a fourth side circumscribing the filter media element, the sides perpendicular to the orientation of the filter media element; and a mating sealing feature extending outward from an exterior of the fourth side of the frame away from the filter media element.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical features of Group I include a V-bank filter assembly comprising: a top panel and bottom panel coupled in a spaced apart relation, each of the top and bottom panels having a first edge and a second edge; a plurality of panel end seal struts extending between the top and bottom panels, each panel end seal struts having a first mating sealing feature facing the first edge of the top and bottom panels, the first mating sealing feature configured to sealingly engage a replaceable filter panel, wherein the plurality of panel end seal struts are located adjacent the second edge; and a plurality of filter panel receiving tracks defined between the top and bottom panels configured to align filter panels disposed in the tracks with a respective first mating sealing feature; and a V-bank air filter assembly comprising: a top panel and bottom panel coupled in a spaced apart relation, each of the top and bottom panels having a first edge and a second edge; a plurality of panel end seal struts extending between the top and bottom panels, each panel end seal struts, wherein the plurality of panel end seal struts are located adjacent the second edge; a plurality of panel side seal strut assemblies each comprising at least one second seal, the panel side seal strut assemblies disposed adjacent and offset from the first edge of the top panel; and a plurality of filter panel receiving tracks configured to retain replaceable filter panels between the top and bottom panels in a v-shaped configuration, each pair of filter panel receiving tracks aligning a respective filter panel with a respective first mating sealing feature of the panel end seal struts; and a method of replacing a filter panel of a filter housing, comprising: removing a used filter panel from the filter housing; and inserting a new filter panel into a tapered filter panel receiving track formed in the filter housing, which are not present in Group II, Group II having special technical features including a replaceable air filter panel comprising: a filter media element; a frame having a first side, a second side, a third side and a fourth side circumscribing the filter media element, the sides perpendicular to the orientation of the filter media element; and a mating sealing feature extending outward from an exterior of the fourth side of the frame away from the filter media element.

Groups I-II share the technical features including a replaceable air filter panel comprising: a filter media element; a frame having a first side, a second side, a third side and a fourth side circumscribing the filter media element, the sides perpendicular to the orientation of the filter media element; and a mating sealing feature extending outward from an exterior of the fourth side of the frame away from the filter media element.

However, these shared technical features are previously disclosed by US 2009/0320426 A1 to Braunecker, et al. (hereinafter 'Braunecker'). Braunecker discloses a replaceable air filter panel (abstract; figure 6G air filter assembly can be extracted; disposable air filter sub-assembly) comprising: a filter media element (abstract); a frame having a first side (figures 6A, 6G), a second side (figures 6A, 6G), a third side (figures 6A, 6G) and a fourth side (figures 6A, 6G) circumscribing the filter media element (15) (figures 6A, 6G), the sides perpendicular to the orientation of the filter media element (15) (figures 6A, 6G); and a mating sealing feature (151) extending outward from an exterior of the fourth side of the frame away from the filter media element (15) (figures 6A, 6G).

Since none of the special technical features of the Group I-II inventions is found in more than one of the inventions, unity of invention is lacking.