

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
13 August 2009 (13.08.2009)

PCT

(10) International Publication Number
WO 2009/100115 A2

(51) International Patent Classification:
B01D 46/52 (2006.01)

(21) International Application Number:
PCT/US2009/033053

(22) International Filing Date:
4 February 2009 (04.02.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/063,662 4 February 2008 (04.02.2008) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report (Rule 48.2(g))

(54) Title: AIR CLEANER ASSEMBLIES; COMPONENTS THEREFOR; AND, METHODS

(57) Abstract: Air cleaner assemblies, components therefor and features thereof are described herein. In general, an air cleaner assembly is depicted configured for servicing operation at a location of limited access to the air cleaner, by a service provider. Features relating to this include: provision of a hinged engagement between an access cover and a main housing body, which has an opening bias assembly associated therein. Also a locking or closing arrangement is described, to facilitate service without the service provider needing to reach around the air cleaner assembly body. Specific example features, and methods of assembly and use, are described.



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**AIR CLEANER ASSEMBLIES;
COMPONENTS THEREFOR; AND, METHODS**

This application is being filed on 4 February 2009, as a PCT International Patent application in the name of Donaldson Company, Inc., a U.S. national corporation, applicant for the designation of all countries except the US, and Steven K. Campbell, a citizen of the U.S., applicant for the designation of the US only, and claims priority to U.S. Provisional patent application Serial No. 61/063,662, filed February 4, 2008.

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Field of the Disclosure

The present disclosure concerns air cleaners for use, for example, for cleaning engine combustion air for vehicles and other equipment. The disclosure provides preferred components, assemblies and methods. The disclosure particularly concerns features facilitating air cleaner integrity, and servicing.

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Background

Gas streams often carry particulate material therein. In many instances it is desirable to remove some or all of the particulate material from the gas flow stream. For example, air intake streams to engines for motorized vehicles or power generation equipment often include particulate material therein. The particulate material, should it reach the internal workings of the mechanisms involved, can cause substantial damage. It is therefore preferred, for such systems, to remove the particulate material from the gas flow upstream of the engine or other equipment involved. A variety of air cleaner arrangements have been developed for particulate removal.

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There has been a general trend for the utilization of air cleaner arrangements that utilize, as a media pack, z-filter media constructions. In general, typical z-filter media constructions can be characterized as comprising fluted media sheet materials secured to facing media sheet material, formed in media pack configuration. An example is described in PCT publication WO 2005/107924 published November 17, 2005, incorporated herein by reference.

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An issue relating to air cleaner for use with vehicles and other equipment, relates to servicing. In particular the air cleaners can be positioned within locations of the vehicle, for example under an engine hood, in which there relatively little space for access to, and manipulation of the air cleaner assembly during servicing.

5 Improvements are desired.

Summary of the Disclosure

According to the present disclosure, an air cleaner assembly is described. The air cleaner assembly comprises a housing including a main housing body and a service access cover hingedly secured thereto. Arrangements are provided so that
10 the housing body can be conveniently secured closed; and, so that it can be conveniently opened.

Various specific features, components and techniques applicable to provide such an assembly, or usable in such assembly, are provided. Methods of assembly
15 and use are also described.

Brief Description of the Drawings

Fig. 1 is a fragmentary, schematic, perspective view of an example z-filter media useable in arrangements according to the present disclosure.

20 Fig. 2 is an enlarged, schematic, cross-sectional view of a portion of the media depicted in Fig. 1.

Fig. 3 is a schematic view of examples of various corrugated media definitions.

Fig. 4 is a schematic view of a useable process for manufacturing example
25 media according to Fig. 1.

Fig. 5 is an enlarged schematic cross-sectional view of an optional end dart for example media flutes useable in arrangements according to the present disclosure.

Fig 6 is a schematic representation of formation of a z-filter media stack, in
30 accord with principles described herein.

Fig. 7 is schematic inlet end perspective view an air cleaner assembly according to the present disclosure.

Fig. 8 is schematic side elevational view of the air cleaner assembly depicted in Fig. 7.

Fig. 9 is a schematic side elevational view of the air cleaner assembly of Fig. 7, directed toward an opposite side from Fig. 8, with some modification thereto, the air cleaner assembly of Fig. 9 being depicted mounted on a portion of a vehicle.

Fig. 10 is schematic top plan view of the assembly depicted in Fig. 9.

5 Fig. 11 is schematic side elevational view of the assembly, from the viewpoint of Fig. 9, depicted during an initial portion of a step of opening (or closing) an access cover thereof.

Fig. 12 is schematic cross-sectional taken generally along line 12-12, Fig. 10, depicted the air cleaner assembly in the orientation of Fig. 11.

10 Fig. 13 is a schematic side elevational view generally analogous to Figs. 9 and 11, depicting the air cleaner assembly in fully opened or nearly fully opened orientation.

Fig. 14 is schematic cross-sectional view analogous to Fig. 12, but depicting the air cleaner assembly in the orientation of Fig. 13.

15 Fig. 15 is a schematic front elevational view of the air cleaner assembly of Fig. 10, with portions broken away showing internal detail.

Fig. 16 is an enlarged fragmentary schematic view of a portion of Fig. 15.

Fig. 17 is an enlarged fragmentary schematic view of a second portion of Fig. 15.

20 Fig. 18 is an enlarged fragmentary schematic view of a first selected portion of Fig. 12.

Fig. 19 is an enlarged fragmentary schematic of a second selected portion of Fig. 12.

25 Fig. 20 is a schematic cross-sectional view taken generally along line 20-20, Fig. 10.

Fig. 21 is an enlarged fragmentary schematic view of a selected portion of Fig. 20.

Fig. 22 is schematic exploded perspective view of Fig. 20.

30 Fig. 23 is an enlarged fragmentary schematic view of an identified portion of Fig. 22.

Fig. 24 is a schematic perspective view of a filter cartridge usable in the air cleaner assembly of Figs. 1-20.

Fig. 25 is a schematic side elevational view of the filter cartridge of Fig. 24.

Fig. 26 is a schematic bottom plan view of the filter cartridge of Fig. 25.

Detailed Description

I. Z-Filter Media Configurations, Generally.

Fluted filter media can be used to provide fluid filter constructions in a variety of manners. One well known manner is as a z-filter construction. The term "z-filter construction" as used herein, is meant to refer to a filter construction in which individual ones of corrugated, folded or otherwise formed filter flutes are used to define longitudinal filter flutes for fluid flow through the media; the fluid flowing along the flutes between opposite inlet and outlet flow ends (or flow faces) of the media. Some examples of z-filter media are provided in U.S. patents 5,820,646; 5,772,883; 5,902,364; 5,792,247; 5,895,574; 6,210,469; 6,190,432; 6,350,296; 6,179,890; 6,235,195; Des. 399,944; Des. 428,128; Des. 396,098; Des. 398,046; and, Des. 437,401; each of these fifteen cited references being incorporated herein by reference.

One type of z-filter media, utilizes two specific media components joined together, to form the media construction. The two components are: (1) a fluted (typically corrugated) media sheet; and, (2) a facing media sheet. The facing media sheet is typically non-corrugated, however it can be corrugated, for example perpendicularly to the flute direction as described in U.S. provisional 60/543,804, filed February 11, 2004, incorporated herein by reference.

In certain z-filter arrangements, the fluted (typically corrugated) media sheet and the facing media sheet, together, can be used to define media having parallel inlet and outlet flutes. In some instances, the fluted sheet and non-fluted sheet are secured together and are then coiled to form a z-filter media construction. Such arrangements are described, for example, in U.S. 6,235,195 and 6,179,890, each of which is incorporated herein by reference. In certain other arrangements, some non-coiled sections of fluted media secured to flat media, are stacked on one another, to create a filter construction. An example of this is described in Fig. 11 of 5,820,646, incorporated herein by reference.

For specific examples described herein below, stacked arrangements are depicted, although many of the principles can be applied with coiled arrangements.

The term "corrugated" used herein to refer to structure in media, is meant to refer to a flute structure resulting from passing the media between two corrugation rollers, i.e., into a nip or bite between two rollers, each of which has surface features

appropriate to cause a corrugation affect in the resulting media. The term "corrugation" is not meant to refer to flutes that are formed by techniques not involving passage of media into a bite between corrugation rollers. However, the term "corrugated" is meant to apply even if the media is further modified or
5 deformed after corrugation, for example by the folding techniques described in PCT WO 04/007054, published January 22, 2004, incorporated herein by reference.

Corrugated media is a specific form of fluted media. Fluted media is media which has individual flutes (for example formed by corrugating or folding) extending thereacross.

10 Serviceable filter element or filter cartridge configurations utilizing z-filter media are sometimes referred to as "straight through flow configurations" or by variants thereof. In general, in this context what is meant is that the serviceable filter elements generally have an inlet flow end (or face) and an opposite exit flow end (or face), with flow entering and exiting the filter cartridge in generally the same
15 straight through direction. (The term "straight through flow configuration" disregards, for this definition, air flow that may pass out of the media pack through the outermost wrap of facing media.) The term "serviceable" in this context is meant to refer to a media containing filter cartridge that is periodically removed and replaced from a corresponding air cleaner. In some instances, each of the inlet flow
20 end and outlet flow end will be generally flat or planar, with the two parallel to one another. However, variations from this, for example non-planar faces, are possible in some applications.

A typical filter cartridge configuration as characterized herein, involving media is characterized, includes the flutes of the fluted media extending generally in
25 direction between the inlet flow and the outlet flow face. The flutes may extend completely from the inlet flow face to the outlet flow face, but for sealing; however the flutes may be modified, for example they may be folded or crushed adjacent one or both ends.

A straight through flow configuration is, for example, in contrast to
30 serviceable filter cartridges such as cylindrical pleated filter cartridges of the type shown in U.S. Patent No. 6,039,778, incorporated herein by reference, in which the flow generally makes a substantial turn as its passes through the serviceable cartridge. That is, in a 6,039,778 filter, the flow enters the cylindrical filter cartridge through a cylindrical side, and then turns to exit through an end face (in forward-

flow systems). In a typical reverse-flow system, the flow enters the serviceable cylindrical cartridge through an end face and then turns to exit through a side of the cylindrical filter cartridge. An example of such a reverse-flow system is shown in U.S. Patent No. 5,613,992, incorporated by reference herein.

5 The term "z-filter media construction" and variants thereof as used herein, without more, is meant to refer to any or all of: a web of corrugated or otherwise fluted media secured to (facing) media with appropriate sealing to inhibit air flow from one flow face to another without filtering passage through the filter media; and/or, such a media coiled stacked or otherwise constructed or formed into a three
10 dimensional network of flutes; and/or, a filter construction including such media. In many arrangements, the z-filter media construction is configured for the formation of a network of inlet and outlet flutes, inlet flutes being open at a region adjacent an inlet face and being closed at a region adjacent an outlet face; and, outlet flutes being closed adjacent an inlet face and being open adjacent an outlet face. However,
15 alternative z-filter media arrangements are possible, see for example US 2006/0091084 A1, published May 4, 2006 to Baldwin filters, also comprising flutes extending between opposite flow faces, with a seal arrangement to prevent flow of unfiltered air through the media pack.

 In general terms, it can be said that a z-filter media construction, or a media
20 pack of a type characterized herein, is provided with appropriate internal sealing or closure arrangements, such that air cannot flow into the inlet flow face through the media pack and out of the outlet flow face, without having been filtered by passage through the media of the media pack.

 In Fig. 1 herein, an example type of media 1 useable as z-filter media is
25 shown. The media 1 is formed from a fluted (in the example corrugated) sheet 3 and a facing sheet 4.

 In general, the (fluted corrugated) sheet 3, Fig. 1 is of a type generally characterized herein as having a regular, curved, wave pattern of flutes or corrugations 7. The term "wave pattern" in this context, is meant to refer to a flute
30 or corrugated pattern of alternating troughs 7b and ridges 7a. The term "regular" in this context is meant to refer to the fact that the pairs of troughs and ridges (7b, 7a) alternate with generally the same repeating corrugation (or flute) shape and size. (Also, typically in a regular configuration each trough 7b is substantially an inverse of each ridge 7a.) The term "regular" is thus meant to indicate that the corrugation

(or flute) pattern comprises troughs and ridges with each pair (comprising an adjacent trough and ridge) repeating, without substantial modification in size and shape of the corrugations along at least 70% of the length of the flutes. The term "substantial" in this context, refers to a modification resulting from a change in the process or form used to create the corrugated or fluted sheet, as opposed to minor variations from the fact that the media sheet 3 is flexible. With respect to the characterization of a repeating pattern, it is not meant that in any given filter construction, an equal number of ridges and troughs is necessarily present. The media 1 could be terminated, for example, between a pair comprising a ridge and a trough, or partially along a pair comprising a ridge and a trough. (For example, in Fig. 1 the media 1 depicted in fragmentary has eight complete ridges 7a and seven complete troughs 7b.) Also, the opposite flute ends (ends of the troughs and ridges) may vary from one another. Such variations in ends are disregarded in these definitions, unless specifically stated. That is, variations in the ends of flutes are intended to be covered by the above definitions.

In the context of the characterization of a "curved" wave pattern of corrugations, the term "curved" is meant to refer to a corrugation pattern that is not the result of a folded or creased shape provided to the media, but rather the apex 7a of each ridge and the bottom 7b of each trough is formed along a radiused curve. Although alternatives are possible, a typical radius for such z-filter media would be at least 0.25 mm and typically would be not more than 3 mm. (Media that is not curved, by the above definition, can also be useable.)

An additional characteristic of the particular regular, curved, wave pattern depicted in Fig. 1, for the corrugated sheet 3, is that at approximately a midpoint between each trough and each adjacent ridge, along most of the length of the flutes 7, is located a transition region where the curvature inverts. For example, viewing back side or face 3a, Fig. 1, trough 7b is a concave region, and ridge 7a is a convex region. Of course when viewed toward front side or face 3b, trough 7b of side 3a forms a ridge; and, ridge 7a of face 3a, forms a trough. (In some instances, region 30 can be a straight segment, instead of a point, with curvature inverting at ends of the segment 30.)

A characteristic of the particular regular, curved, wave pattern corrugated sheet 3 shown in Fig. 1, is that the individual corrugations are generally straight. By "straight" in this context, it is meant that through at least 70% (typically at least

80%) of the length between edges 8 and 9, the ridges 7a and troughs 7b do not change substantially in cross-section. The term "straight" in reference to corrugation pattern shown in Fig. 1, in part distinguishes the pattern from the tapered flutes of corrugated media described in Fig. 1 of WO 97/40918 and PCT Publication WO 03/47722, published June 12, 2003, incorporated herein by reference.. The tapered flutes of Fig. 1 of WO 97/40918, for example, would be a curved wave pattern, but not a "regular" pattern, or a pattern of straight flutes, as the terms are used herein.

Referring to the present Fig. 1 and as referenced above, the media 1 has first and second opposite edges 8 and 9. For the example shown, when the media 1 is coiled and formed into a media pack, in general edge 9 will form an inlet end for the media pack and edge 8 an outlet end, although an opposite orientation is possible in some applications.

In the example shown, adjacent edge 8 is provided sealant, in this instance in the form of a sealant bead 10, sealing the corrugated (fluted) sheet 3 and the facing sheet 4 together. Bead 10 will sometimes be referred to as a "single facer" bead, since it is a bead between the corrugated sheet 3 and facing sheet 4, which forms the single facer or media strip 1. Sealant bead 10 seals closed individual flutes 11 adjacent edge 8, to passage of air therefrom.

In the example shown, adjacent edge 9 is provided sealant, in this instance in the form of a seal bead 14. Seal bead 14 generally closes flutes 15 to passage of unfiltered fluid therein, adjacent edge 9. Bead 14 would typically be applied as the media 1 is coiled about itself, with the corrugated sheet 3 directed to the inside. Thus, bead 14 will form a seal between a back side 17 of facing sheet 4, and side 18 of the corrugated sheet 3. The bead 14 will sometimes be referred to as a "winding bead" since it is typically applied, as the strip 1 is coiled into a coiled media pack. If the media 1 is cut in strips and stacked, instead of coiled, bead 14 would be a "stacking bead."

Referring to Fig. 1, once the media 1 is incorporated into a media pack, for example by coiling or stacking, it can be operated as follows. First, air in the direction of arrows 12, would enter open flutes 11 adjacent end 9. Due to the closure at end 8, by bead 10, the air would pass through the media shown by arrows 13. It could then exit the media pack, by passage through open ends 15a of the flutes 15, adjacent end 8 of the media pack. Of course operation could be conducted with air flow in the opposite direction.

In more general terms, z-filter media comprises fluted filter media secured to facing filter media, and configured in a media pack of flutes extending between first and second opposite flow faces. A sealant or seal arrangement is provided within the media pack, to ensure that air entering flutes at a first upstream edge cannot exit the media pack from a downstream edge, without filtering passage through the media. Alternately stated, a z-filter media is closed to passage of unfiltered air therethrough, between the inlet face and the outlet flow face, typically by a sealant arrangement or other arrangement.

For the particular arrangement shown herein in Fig. 1, the parallel corrugations 7a, 7b are generally straight completely across the media, from edge 8 to edge 9. Straight flutes or corrugations can be deformed or folded at selected locations, especially at ends. Modifications at flute ends for closure are generally disregarded in the above definitions of "regular," "curved" and "wave pattern."

Z-filter constructions which do not utilize straight, regular curved wave pattern corrugation (flute) shapes are known. For example in Yamada et al. U.S. 5,562,825 corrugation patterns which utilize somewhat semicircular (in cross section) inlet flutes adjacent narrow V-shaped (with curved sides) exit flutes are shown (see Figs. 1 and 3, of 5,562,825). In Matsumoto, et al. U.S. 5,049,326 circular (in cross-section) or tubular flutes defined by one sheet having half tubes attached to another sheet having half tubes, with flat regions between the resulting parallel, straight, flutes are shown, see Fig. 2 of Matsumoto '326. In Ishii, et al. U.S. 4,925,561 (Fig. 1) flutes folded to have a rectangular cross section are shown, in which the flutes taper along their lengths. In WO 97/40918 (FIG. 1), flutes or parallel corrugations which have a curved, wave patterns (from adjacent curved convex and concave troughs) but which taper along their lengths (and thus are not straight) are shown. Also, in WO 97/40918 flutes which have curved wave patterns, but with different sized ridges and troughs, are shown.

In general, the filter media is a relatively flexible material, typically a non-woven fibrous material (of cellulose fibers, synthetic fibers or both) often including a resin therein, sometimes treated with additional materials. Thus, it can be conformed or configured into the various fluted, for example corrugated, patterns, without unacceptable media damage. Also, it can be readily coiled or otherwise configured for use, again without unacceptable media damage. Of course, it must be

of a nature such that it will maintain the required fluted (for example corrugated) configuration, during use.

In the corrugation or fluting process, an inelastic deformation is caused to the media. This prevents the media from returning to its original shape. However, once
5 the tension is released the flutes or corrugations will tend to spring back, recovering only a portion of the stretch and bending that has occurred. The facing sheet is sometimes tacked to the fluted sheet, to inhibit this spring back in the fluted (or corrugated) sheet.

Also, typically, the media contains a resin. During the corrugation process,
10 the media can be heated to above the glass transition point of the resin. When the resin then cools, it will help to maintain the fluted shapes.

The media of the corrugated sheet 3, facing sheet 4 or both, can be provided with a fine fiber material on one or both sides thereof, for example in accord with U.S. 6,673,136, incorporated herein by reference.

15 An issue with respect to z-filter constructions relates to closing of the individual flute ends. Typically a sealant or adhesive is provided, to accomplish the closure. As is apparent from the discussion above, in typical z-filter media, especially that which uses straight flutes as opposed to tapered flutes, large sealant surface areas (and volume) at both the upstream end and the downstream end are
20 needed. High quality seals at these locations are critical to proper operation of the media structure that results. The high sealant volume and area creates issues with respect to this.

Still referring to Fig. 1, at 20 tack beads are shown positioned between the corrugated sheet 3 and facing sheet 4, securing the two together. The tack beads
25 can be, for example, discontinuous lines of adhesive. The tack beads can also be points in which the media sheets are welded together.

From the above, it will be apparent that the example corrugated sheet 3 depicted is typically not secured continuously to the facing sheet, along the troughs or ridges where the two adjoin. Thus, air can flow between adjacent inlet flutes, and
30 alternately between the adjacent outlet flutes, without passage through the media. However air which has entered in inlet flute cannot exit from an outlet flute, without passing through at least one sheet of media, with filtering.

Attention is now directed to Fig. 2, in which a z-filter media construction 40 utilizing a fluted (in this instance regular, curved, wave pattern corrugated) sheet 43,

and a non-corrugated flat, facing, sheet 44, is depicted. The distance D1, between points 50 and 51, defines the extension of flat media 44 in region 52 underneath a given corrugated flute 53. The length D2 of the arcuate media for the corrugated flute 53, over the same distance D1 is of course larger than D1, due to the shape of the corrugated flute 53. For a typical regular shaped media used in fluted filter applications, the linear length D2 of the media 53 between points 50 and 51 will generally be at least 1.2 times D1. Typically, D2 would be within a range of 1.2 - 2.0, inclusive. One particularly convenient arrangement for air filters has a configuration in which D2 is about 1.25 - 1.35 x D1. Such media has, for example, been used commercially in Donaldson Powercore™ Z-filter arrangements. Herein the ratio D2/D1 will sometimes be characterized as the flute/flat ratio or media draw for the corrugated media.

In the corrugated cardboard industry, various standard flutes have been defined. For example the standard E flute, standard X flute, standard B flute, standard C flute and standard A flute. Figure 3, attached, in combination with Table A below provides definitions of these flutes.

Donaldson Company, Inc., (DCI) the assignee of the present disclosure, has used variations of the standard A and standard B flutes, in a variety of z-filter arrangements. These flutes are also defined in Table A and Fig. 3.

TABLE A

(Flute definitions for Fig. 3)

5	DCI A Flute: Flute/flat = 1.52:1; The Radii (R) are as follows: R1000 = .0675 inch (1.715 mm); R1001 = .0581 inch (1.476 mm); R1002 = .0575 inch (1.461 mm); R1003 = .0681 inch (1.730 mm);
10	DCI B Flute: Flute/flat = 1.32:1; The Radii (R) are as follows: R1004 = .0600 inch (1.524 mm); R1005 = .0520 inch (1.321 mm); R1006 = .0500 inch (1.270 mm); R1007 = .0620 inch (1.575 mm);
15	Std. E Flute: Flute/flat = 1.24:1; The Radii (R) are as follows: R1008 = .0200 inch (.508 mm); R1009 = .0300 inch (.762 mm); R1010 = .0100 inch (.254 mm); R1011 = .0400 inch (1.016 mm);
20	Std. X Flute: Flute/flat = 1.29:1; The Radii (R) are as follows: R1012 = .0250 inch (.635 mm); R1013 = .0150 inch (.381 mm);
25	Std. B Flute: Flute/flat = 1.29:1; The Radii (R) are as follows: R1014 = .0410 inch (1.041 mm); R1015 = .0310 inch (.7874 mm); R1016 = .0310 inch (.7874 mm);
30	Std. C Flute: Flute/flat = 1.46:1; The Radii (R) are as follows: R1017 = .0720 inch (1.829 mm); R1018 = .0620 inch (1.575 mm);
	Std. A Flute: Flute/flat = 1.53:1; The Radii (R) are as follows: R1019 = .0720 inch (1.829 mm); R1020 = .0620 inch (1.575 mm).

Of course other, standard, flute definitions from the corrugated box industry are known.

In general, standard flute configurations from the corrugated box industry can be used to define corrugation shapes or approximate corrugation shapes for corrugated media. Comparisons above between the DCI A flute and DCI B flute, and the corrugation industry standard A and standard B flutes, indicate some convenient variations.

II. Manufacture of Stacked Media Configurations Using Fluted Media, Generally.

In Fig. 4, one example of a manufacturing process for making a media strip corresponding to strip 1, Fig. 1 is schematically shown. In general, facing sheet 64 and the fluted (in the example shown corrugated) sheet 66 having flutes 68 are

brought together to form a media web 69, with an adhesive bead located therebetween at 70. The adhesive bead 70 will form a single facer bead 10, Fig. 1. An optional darting process occurs at station 71 to form center darted section 72 located mid-web. The z-filter media or Z-media strip 74 can be cut or slit at 75
5 along the bead 70 to create two pieces 76, 77 of z-filter media 74, each of which has an edge with a strip of sealant (single facer bead) extending between the corrugating and facing sheet. Of course, if the optional darting process is used, the edge with a strip of sealant (single facer bead) would also have a set of flutes darted at this location. The strips or pieces 76, 77 can then be cut across, for stacking, as
10 described below in connection with Fig. 6.

Techniques for conducting a process as characterized with respect to Fig. 4 are described in PCT WO 04/007054, published January 22, 2004 incorporated herein by reference.

Still in reference to Fig. 4, before the z-filter media 74 is put through the
15 darting station 71 the media 74 must be formed. In the schematic shown in Fig. 4, this is done by passing a flat sheet of media 92 through a pair of corrugation rollers 94, 95. In the schematic shown in Fig. 4, the flat sheet of media 92 is unrolled from a roll 96, wound around tension rollers 98, and then passed through a nip or bite 102 between the corrugation rollers 94, 95. The corrugation rollers 94, 95 have teeth 104
20 that will give the general desired shape of the corrugations after the flat sheet 92 passes through the nip 102. After passing through the nip 102, the flat sheet 92 becomes corrugated and is referenced at 66 as the corrugated sheet. The corrugated sheet 66 is then secured to facing sheet 64. (The corrugation process may involve heating the media, in some instances.)

25 Still in reference to Fig. 4, the process also shows the facing sheet 64 being routed to the darting process station 71. The facing sheet 64 is depicted as being stored on a roll 106 and then directed to the corrugated sheet 66 to form the Z-media 74. The corrugated sheet 66 and the facing sheet 64 are secured together by adhesive or by other means (for example by sonic welding).

30 Referring to Fig. 4, an adhesive line 70 is shown used to secure corrugated sheet 66 and facing sheet 64 together, as the sealant bead. Alternatively, the sealant bead for forming the facing bead could be applied as shown as 70a. If the sealant is applied at 70a, it may be desirable to put a gap in the corrugation roller 95, and possibly in both corrugation rollers 94, 95, to accommodate the bead 70a.

Of course equipment can be added to the assembly line, to apply the tack beads 20, Fig. 1, if used.

The type of corrugation provided to the corrugated media is a matter of choice, and will be dictated by the corrugation or corrugation teeth of the corrugation rollers 94, 95. One preferred corrugation pattern will be a regular curved wave pattern corrugation, of straight flutes, as defined herein above. A typical regular curved wave pattern used, would be one in which the distance D2, as defined above, in a corrugated pattern is at least 1.2 times the distance D1 as defined above. In one preferred application, typically $D2 = 1.25 - 1.35 \times D1$. In some instances the techniques may be applied with curved wave patterns that are not "regular," including, for example, ones that do not use straight flutes.

As described, the process shown in Fig. 4 can be used to create the center darted section 72. Fig. 5 shows, in cross-section, one of the flutes 68 after darting and slitting.

A fold arrangement 118 can be seen to form a darted flute 120 with four creases 121a, 121b, 121c, 121d. The fold arrangement 118 includes a flat first layer or portion 122 that is secured to the facing sheet 64. A second layer or portion 124 is shown pressed against the first layer or portion 122. The second layer or portion 124 is preferably formed from folding opposite outer ends 126, 127 of the first layer or portion 122.

Still referring to Fig. 5, two of the folds or creases 121a, 121b will generally be referred to herein as "upper, inwardly directed" folds or creases. The term "upper" in this context is meant to indicate that the creases lie on an upper portion of the entire fold 120, when the fold 120 is viewed in the orientation of Fig. 5. The term "inwardly directed" is meant to refer to the fact that the fold line or crease line of each crease 121a, 121b, is directed toward the other.

In Fig. 5, creases 121c, 121d, will generally be referred to herein as "lower, outwardly directed" creases. The term "lower" in this context refers to the fact that the creases 121c, 121d are not located on the top as are creases 121a, 121b, in the orientation of Fig. 5. The term "outwardly directed" is meant to indicate that the fold lines of the creases 121c, 121d are directed away from one another.

The terms "upper" and "lower" as used in this context are meant specifically to refer to the fold 120, when viewed from the orientation of Fig. 5. That is, they are

not meant to be otherwise indicative of direction when the fold 120 is oriented in an actual product for use.

Based upon these characterizations and review of Fig. 5, it can be seen that a preferred regular fold arrangement 118 according to Fig. 5 in this disclosure is one which includes at least two "upper, inwardly directed, creases." These inwardly directed creases are unique and help provide an overall arrangement in which the folding does not cause a significant encroachment on adjacent flutes.

A third layer or portion 128 can also be seen pressed against the second layer or portion 124. The third layer or portion 128 is formed by folding from opposite inner ends 130, 131 of the third layer 128.

Another way of viewing the fold arrangement 118 is in reference to the geometry of alternating ridges and troughs of the corrugated sheet 66. The first layer or portion 122 is formed from an inverted ridge. The second layer or portion 124 corresponds to a double peak (after inverting the ridge) that is folded toward, and in preferred arrangements, folded against the inverted ridge.

Techniques for providing the optional dart described in connection with Fig. 5, in a preferred manner, are described in PCT WO 04/007054, incorporated herein by reference. Other techniques for media management are described in PCT application US 04/07927, filed March 17, 2004, incorporated herein by reference.

Although usable with either, the techniques described herein are well adapted for use of media packs that result from arrangements that, instead of being formed by coiling, are formed from a plurality of strips of single facer.

Opposite flow ends or flow faces of the media pack can be provided with a variety of different definitions. In many arrangements, the ends are generally flat and perpendicular to one another.

The flute seals (single facer bead, winding bead or stacking bead) can be formed from a variety of materials. In various ones of the cited and incorporated references, hot melt or polyurethane seals are described as possible for various applications. These are useable for applications described herein.

In Fig. 6, schematically there is shown a step of forming a stacked z-filter media pack from strips of z-filter media. Referring to Fig. 6, strip 200 is being shown added to a stack 201 of strips 202 analogous to strip 200. Strip 200 can be cut from either of strips 76, 77, Fig. 4. At 205, Fig. 6, application of a stacking bead 206 is shown, between each layer corresponding to a strip 200, 202 at an opposite

edge from the single facer bead or seal. In Fig. 6, each layer is added to a top of the stack. Such layers could alternatively be added to the bottom.

Also, in some alternate processing approaches sealant bead 206 can be added to the underside (i.e., facing sheet side) of each strip, as opposed to the fluted sheet
5 (corrugated) side of each single facer strip.

Referring to Fig. 6, each strip 200, 202 has front and rear edges 207, 208 and opposite side edges 209a, 209b. Inlet and outlet flutes of the corrugated sheet/facing sheet combination comprising each strip 200, 202 generally extend between the front and rear edges 207, 208, and parallel to side edges 209a, 209b. Sides 209a,
10 209b are sometimes referenced as tail and lead ends of the media strips 200.

Still referring to Fig. 6, in the media pack 201 being formed, opposite flow faces are indicated at 210, 211. The selection of which one of faces 210, 211 is the inlet end face and which is the outlet end face, during filtering, is a matter of choice. In some instances the stacking bead 206 is preferably positioned adjacent the
15 upstream or inlet face 211. The flow faces 210, 211, extend between opposite side faces 220, 221.

The stacked media pack 201 being formed in Fig. 6, is sometimes referred to herein as a "blocked" stacked media pack. The term "blocked" in this context, is an indication that the arrangement is formed to a rectangular block in which all faces
20 are at or nearly at 90° relative to all adjoining wall faces. Alternate configurations are possible, as discussed in U.S. Provisional application 60/579,754, filed June 14, 2004, incorporated herein by reference. One example of an alternate configuration, would be one in which instead of each cross-section of the stacked media pack arrangement has a rectangular (or right quadrilateral) cross-section, at least one of
25 the cross-sections is a oblique parallelogram cross-section. In such a parallelogram, opposite sides are parallel to one another, but adjacent sides do not meet at a right angle, but rather meet at a defined angle other than 90°. Certain of the techniques described herein below can be used with either a blocked or a slanted stacked arrangement. In the figures, a blocked arrangement is shown.

30 Still other stacked shapes are possible, depending on how the individual sheets, in forming the stack, are positioned relative to adjacent sheets.

In some instances, the media pack 201 shown will be referenced as having a parallelogram shape in any cross-section, meaning that any two opposite side faces extend generally parallel to one another.

It is noted that a blocked, stacked arrangement corresponding to Fig. 6 is described in the prior art of U.S. 5,820,646, incorporated herein by reference. It is also noted that stacked arrangements are described in U.S. 5,772,883; 5,792,247; U.S. Provisional 60/457,255 filed March 25, 2003; and U.S.S.N. 10/731,564 filed
5 December 8, 2003. All four of these latter references are incorporated herein by reference. It is noted that the stacked arrangement at Fig. 6 of U.S.S.N. 10/731,504, is a slanted or oblique parallelogram stacked arrangement.

Of course the methods disclosed are merely examples. Useable z-filter media packs can be formed in alternate manners.

10

III. An Example Air Cleaner Assembly; Figs. 7-26.

The reference numeral 300, Fig. 7, generally indicates an air cleaner assembly (or arrangement) including features according to the present disclosure.
15 Referring to Fig. 7, the air cleaner assembly 300 includes a housing 301, defining an interior 301i; and, having: an air flow inlet arrangement 303; and, an air flow outlet arrangement 304. Positioned within the housing interior 301i, the air cleaner assembly 300 includes a removable and replaceable, i.e. serviceable, air filter cartridge 310. By the term "serviceable" in this context, it is generally meant that
20 the filter cartridge 310, and air cleaner housing 301, are configured such that the filter cartridge 310 can be removed from the housing 301 for servicing. Servicing would typically involve one of: removing the air filter cartridge 310, and replacing it with a new cartridge; removing the air filter cartridge 310, refurbishing it, and replacing it within an interior of 301i; and/or, removing air filter cartridge 310 and
25 replacing it with a another previously used, refurbished, filter cartridge. Herein, each of these approaches and variations of them, is meant to be referenced by the term "servicing" and variants thereof.

Still referring to Fig. 7, in general, the housing 301 includes a main housing body 312 and an access cover 313. In a typical application, the main housing body
30 312 will be mounted or secured in place on equipment with which the air cleaner assembly 300 is to be used, typically mobile equipment, such as a vehicle (as an example, a truck). The housing body 312, in general, includes a service access end 317 over which the access cover 313 is secured. The access cover 313 and housing body 312 are configured such that, when selected, the access cover 313 can be

moved from closing relation over the service access end 317 of the main housing body 312. This allows service access to interior 301i, for servicing of the air filter cartridge 310.

In general, then, the air cleaner housing 301 is configured such that air to be
5 filtered enters the housing 301 through air flow inlet arrangement 303, (inlet arrangement 303 comprising one or more air flow inlet apertures within the assembly 300). The air is then directed through interiorly received filter cartridge 310, with dust and other selected contaminate within the air being trapped within the filter cartridge 310 as the air passes through an media thereof. Filtered air then exits
10 the filter cartridge 310, and then exits the air cleaner housing 301 through air flow outlet arrangement 304. The air flow outlet arrangement may comprise one or more outlet apertures within housing 301, through which filtered air can leave. The filtered air is then typically directed to downstream equipment, typically, ultimately, to an air intake of an internal combustion engine, such as a diesel engine for a truck
15 or other equipment. Ductwork 318 is positioned to provide this.

Also, in general, the housing 301 is configured in sections which are separable from one another. A first section, referenced herein as the housing main body 312, has an open end or service end, i.e. end 317. The open end or service end 317 is sufficiently large for passage therethrough of necessary portions of the
20 cartridge 310, during installation. The opening at 317 is sized and shaped to be closable, selectively, by the access cover 313. When the access cover 313 is in the closed orientation, the housing 301 is closed for use, with cartridge 310 operably positioned therein. When the access cover 313 is depicted in a fully opened position, end 317 is sufficiently opened for service access to the cartridge 310. In
25 Fig. 7, the access cover 313 is in the closed orientation.

For the particular assembly 300 depicted, access cover 313 is pivotally, hingedly, secured to the main housing body 312, as shown by hinge arrangement 320. Thus, during assembly or servicing, the access cover 313 is not separated from a remainder of the housing 301, rather the access cover 313 is pivoted around hinge
30 arrangement 320 sufficiently, to open service access end 317 for servicing.

Herein, when the access cover 313 is characterized as being in the "hinged closed" position or orientation, or by variants thereof, it is meant that the access cover 313 is positioned in closing relationship to end 317, as would be typical for the housing 301 when air cleaner assembly 300 is oriented for a filtering operation.

This orientation is depicted, for example, in Fig. 7. Herein when it said that the access cover 313 is in a “hinged open” position or orientation, or by variants thereof, it is meant that the access cover is pivoted around the hinge arrangement 320 sufficiently, for access end 317 to be opened for servicing. Thus, in general terms, air cleaner assembly 300 includes an access cover 313 mounted by a hinge arrangement 320 in a pivoted manner between a hinged closed orientation and a hinged open orientation, selectively.

Still referring to Fig. 7, although alternatives are possible, it is noted that for the example air cleaner assembly 300 depicted, the air flow inlet arrangement 303 is positioned on the access cover 313; and, the air flow outlet arrangement 304 is positioned on the main housing body 312. In general, the air flow inlet arrangement 303 and the air flow outlet arrangement 304 are positioned such that air flowing into the air flow inlet arrangement 303 must pass through the air filter cartridge 310, with filtering thereby, before the air can exit the air flow outlet arrangement 304.

For the example air cleaner assembly 300 depicted, the air flow outlet arrangement 303 is secured to duct work 318, in the example shown by hose clamp 323. Alternative attachments are possible.

Referring still to Fig. 7, the air cleaner assembly 300 depicted can be characterized as having a housing 301 with: a top 301t and an opposite bottom 301b; a front end 301f and an opposite rear end 301r; and, first and second, opposite, sides 301m, 301n. For the example depicted, the front 301f comprises access cover 313; and, and side 301n comprises a side with air flow outlet arrangement 304 therein, although alternate arrangements are possible.

Herein, in this context, the term “top” is meant to refer to a portion of the housing 301 directed generally upwardly, when the air cleaner assembly 300 is installed on equipment for normal use. The term “bottom” is meant to refer a side of housing 301 opposite the top 301t. The term “front end” is meant to refer to an end or side of the housing 301 which is openable, in use, for service access. The term “rear side” is meant to refer to a side or end 301r opposite the front side 301f. The term “opposite sides” 301m, 301n are meant generally to refer to opposite sides that extend between the front side 301f and the rear side 301r, and also between the top 301t and the bottom 301b.

Still referring to Fig. 7, it is noted that the main housing body 312 can also be characterized as having: a top 312t and an opposite bottom 312b; a front side or

end 312f and an opposite rear side or end 312r; and, first and second, opposite, sides 312m, 312n, with the terms “top”, “bottom”, “front”, “rear”, and “first and second, opposite, sides” being analogously used to the way these terms are used above for the housing 301.

5 Referring now Fig. 8, air cleaner assembly 300 is depicted in a side elevational view, directed generally toward side 301m. Selected features previously identified and characterized are referenced by the same reference numerals.

As previously indicated, an air cleaner assembly such as air cleaner assembly 300 is typically mounted on equipment, such as mobile vehicle. The air cleaner 300
10 may be positioned, for example, under an engine cover or hood. In many instances, the mounting location may offer very limited space for service access to the air cleaner assembly 300 during servicing. Many of the features characterized herein, relate to convenient service access, for selected servicing of the air cleaner 300.

Referring to Fig. 8, assume for purposes of the example, that once the air
15 cleaner assembly 300 is fully installed, convenient access to the air cleaner 300, for servicing, is primarily toward the top, and the side viewable, i.e. side 301m, and even that side access is partially blocked. Further assume that service access to each of the bottom 301b, and the opposite side 301n is substantially impaired.

In general, assembly 300 should be provided with a closure arrangement 328
20 to ensure that the air cleaner access cover 313 is retained closed, i.e. in the hinged closed orientation, when the air cleaner assembly 300 is used. Further, the closure arrangement should be releasable, selectively, by a service provider, when desired, to allow access cover 313 to be pivoted to a hinged open orientation. Herein, the mechanism which allows for the access cover 313 to be secured closed and to be
25 released for opening, will be generally referred to as the “closure arrangement” or “locking arrangement” or by variants thereof. In some instances the term “latch assembly” and similar terms may be used.

In general, it would be preferred that whatever closure arrangement is selected to provide for securing the air cleaner access cover 313 closed, or to be
30 released to allow the air cleaner access cover 313 to open, be configured for relatively convenient operational access at an accessible side, in this instance side 301m. That is, it is a preferred that service operator would not need to reach underneath bottom 301b for servicing. The particular air cleaner assembly 300

depicted, as described below, includes features that allow for such convenient operation of the closure arrangement.

It is also preferred that the air cleaner assembly 300 be configured, so that the movement of the access cover 313 out of a service provider's way, during servicing, is managed in a convenient manner, and such that the access cover 313 is easily reinstalled in place. This too can be accomplished with features according the present disclosure.

Still referring to Fig. 8, in general it is noted that for the air cleaner assembly 300 depicted, to release the access cover 313 for opening, all the service provider need do is actuate a single actuator control 330, in this instance comprising a single button 330b. Thus, it is not necessary, for the configuration of air cleaner assembly 300 provided, that the service provider need to reach around portions of the housing 301, to open the housing 301. That is, for the particular example air cleaner assembly 300 depicted, to release the closure arrangement, all the service provider would need to do is press button 330b, an operation that can be easily be conducted when the air cleaner assembly 300 is positioned such that button 330b is readily accessible. (This is in contrast to arrangements such as those described in PCT WO 2006/076456; WO 2006/076479 or 2003/084641. For example in WO 2003/0841641, published October 16, 2003, the service provider may need to access a latch arrangement located underneath the air cleaner depending on installation orientation, see Fig. 4 thereof or, with arrangements generally in accord with the assembly of WO 2006/076479, Fig. 39, the service provider may need to reach across, or in some instances even around, the housing for access to multiple latches).

An aspect of this, in general terms, is that opening of the housing 301 merely requires the service provider to actuate a single actuator or actuator control 330, and that actuator or actuator control 330 can be positioned along a side, for convenient access.

Further, because the access cover 313 is hingedly secured to the main housing body 312, by hinge arrangement 320, all that is required during servicing, for service access to interiorly received filter cartridge 310, is that the access cover 313 be pivoted around hinge arrangement 320 to the hinged open orientation. This operation is described further below. In advantageous arrangements according to the present disclosure, hinge arrangement 320 is provided with an opening bias arrangement, which will operate to automatically pivot the access cover 313 around

the hinge arrangement 320, during opening, once the service provider has actuated the actuator control 330.

Arrangements according to the present disclosure can be configured so that the actuator control 330 is alternately located, for example on an opposite side (301n) if that side is the side most readily accessible during servicing. Further, as will be understood from descriptions below, the housing 301 can be configured such that the locking mechanism 328 operated by the control member 330 is such that the control member 330 can be positioned, during assembly, at a selected one of either side 301m, 301n, as selected for the intended use. Further, with alternate mechanisms to the specific one described herein, one can create an assembly with a control 330 on each side of the housing, either of which can be selectively used a single actuator member to control the closure arrangement for opening the housing 301.

Attention is now directed to Fig. 9, a schematic side elevational view generally taken toward an opposite side from that viewable Fig. 8, i.e. toward side 301m. Also, in Fig. 9, the air cleaner assembly 300 is shown mounted on a portion 333 of equipment, for use.

Referring to Fig. 9, at rear end 301r, housing 301 is provided with a pivot attachment arrangement 335, and a post arrangement 336. During mounting of air cleaner assembly 300, pivot arrangement 335 can be engaged with a pivot mount 340 on equipment or structure of the vehicle involved. The air cleaner housing 300 can be pivoted around pivot arrangement 335, until post 336 engages a grommet arrangement 341, securing the air cleaner assembly 300 in place. Of course alternate mounting arrangements can be used.

Referring still to Fig. 9, the particular air flow inlet arrangement 303 depicted, comprises a bellows engagement adapter 345. For the example depicted, the bellows engagement adapter 345 is an adapter piece 345a snap fit in place on an inlet channel section 346 of access cover 313. In general, the bellows engagement adapter 345 is sized and configured so that a bellows arrangement on a vehicle hood, when the hood is lowered, will engage (and be centered in air flow communication with) air flow inlet arrangement 303. The inlet channel section 346, is configured to receive air entering the air cleaner housing 301, and to direct that air into an internally received filter cartridge 310, not shown in Fig. 9, for filtering. Again, as

previously discussed, after filtering the air leaves housing 301 through air flow outlet arrangement 304.

Still referring to Fig. 9, it is noted that, in general, the inlet channel section 346 will be provided with an internal shape or confirmation appropriate for desired air flow. Typically, a curved shaped turning the air toward main body 312 (and the internally received filter cartridge 310) will be desirable.

Attention is now directed to Fig. 10, a top plan view of the assembly 300 in Fig. 9. Referring to Fig. 10, engagement between pivoted attachment arrangement 335 and pivot mount 340, is viewable. Other features previously identified and characterized, are numbered analogously.

In Fig. 11, a schematic depiction of air cleaner assembly 300 is provided showing housing 301 during a step of pivoting access cover 313 for service access to interior 301i, in particular to a filter cartridge 310 positioned therein. (Or alternately, access cover 313, Fig. 11, can be viewed as having an appearance during a closing operation). Thus, in Fig. 11, the position of the access cover 313 relative to the main housing body 312 is such as it would appear either shortly after opening or just before closing.

Fig. 12 is a view analogous to Fig. 11, of air cleaner assembly 300, except presented as a cross-sectional view; the cross-section being along a similar line to line 12-12 of Fig. 10. Referring to Fig. 12, filter cartridge 310, discussed in greater detail below, is viewable. The cartridge 310 generally comprises: media pack 348; and, housing seal arrangement 349. The media pack 348, in general, comprises air filter media 348a through which air to be filtered is directed. The particular media pack 348 depicted (and cartridge 310) has an air flow inlet flow face 350 and an opposite air outlet flow face 351, in the example shown each face (350, 351) being planar, parallel to one another and generally perpendicular to air flow. The filter cartridge 310 may include selected cartridge features generally in accord with those described in PCT Publication WO 2006/076456, published July 20, 2006 and/or PCT Publication WO 2006/076479, published July 20, 2006, each of which is incorporated herein by reference. The cartridge features are characterized in greater detail below.

In general, housing seal arrangement 349 is mounted in cartridge 310 to be releasably sealed to the housing 301, when the cartridge 310 is installed. By “releasably sealed” in this context, it is meant that when the cartridge 310 is

operably installed, a seal is provided between the seal arrangement 349 (and thus cartridge 310) and the housing 301; that seal being such that when the access cover 313 is opened for service access, the cartridge 310 (including the housing seal arrangement 349) can be removed from the housing 301 without damage to either.

5 Herein, the term “housing seal arrangement”, and variants thereof, is meant to refer to a seal typically positioned on the filter cartridge 310, which provides for sealing of the filter cartridge 310 to the housing 301 at an appropriate location to inhibit unfiltered air from bypassing the filter cartridge 310, during use. A variety of types of seal arrangements can be used in assemblies according to the present
10 principles.

For the particular example cartridge 310 depicted, the housing seal arrangement 349 is positioned to extend around the media pack 348. When this type of configuration is used, the housing seal engagement 349 may sometimes be referred to as a peripheral seal member, or by similar terms.

15 In the example air cleaner assembly 300 depicted, the housing seal arrangement 349 is provided in a form having a pinch seal projection 355, which circumscribes the media 348, and is pinched or engaged, during sealing, between the access cover 313 and main housing body 312, when the access cover 313 is closed. Further detail relating to the configuration of the housing seal arrangement 349, and
20 its engagement with the housing 301, is discussed below. It is noted that the air filter cartridge 310 and housing 301 could be configured for engagement with an alternate sealing arrangement including a seal that does not operate as a pinch seal between housing sections 312, 313, while still using other principles characterized herein.

25 Attention is now directed to Fig. 13. In Fig. 13, air cleaner assembly 300 is depicted with the access cover 313 completely pivoted around hinge arrangement 320. In general, the pivoting is complete when a portion of the access cover 313, (for the example shown the bellows adapter 345) engages structure along top 312t of housing body 312. For the particular example assembly 300 depicted in Figs.7-13,
30 this engagement will occur when bellows adapter 345 engages projection arrangement 360; projection arrangement 360 being a strengthening ridge or gusset arrangement, in top 312t, which supports hinge arrangement 320.

Still referring to Fig. 13, in general, the access cover 313 can be characterized as being in the hinged open configuration. In the preferred hinge open

configuration, as shown, the access cover 313 is positioned above housing main body 312, i.e. over top 312t of main housing body 312. This leaves a region at access end 317 of housing main body 312 (alternately stated at end 312f) for manipulation of cartridge 310. This will be convenient, for pulling cartridge 310
5 out, and lifting it up, during servicing.

Attention is now directed to Fig. 14, a view analogous to Fig. 13 except generally taken as a cross-sectional view along a line analogous to line 12-12, Fig. 10, and with the access cover 313 pivoted as generally shown in Fig. 13. Here, mounting lever or arm arrangement 365 is shown providing engagement between a
10 remainder of access cover 313 and hinge arrangement 320. Thus, the hinge arrangement 320 provides for a pivotal engagement between housing main body 312 and arm arrangement 365.

Referring to Figs. 13 and 14 together, it can be seen that when air cleaner assembly 300 is configured as depicted, a service provider can reach cartridge 310
15 and withdraw it from housing 301. Also, a cartridge 310 could be readily installed in housing 301.

Again, in accord with characterizations previously provided herein, when air cleaner assembly 300 (or access cover 313) is configured as shown in Figs. 13 and 14, it is generally characterized as being in the "hinged open" orientation.

20 Typically, when the air cleaner assembly 300 is mounted as thus far described, a servicing operation (after housing opening) would involve pulling the cartridge 310 in the general direction of arrow 370, Figs. 13 and 14, and pivoting and lifting the cartridge 310 in the general direction of arrow 371, Figs. 13 and 14. Of course, a typical servicing operation would involve a movement of cartridge 310
25 that involves a motion comprising in a combination of these two directions of movements.

Comparing Figs. 9, 11 and 14, it will be understood that within equipment in which the air cleaner assembly 300 is mounted, sufficient clearance needs to be provided in front of front end 301f, Fig. 9, to allow for the arcuate motion from the
30 hinged closed position to the hinged open position (and vice versa) for the access cover 313. To facilitate the opening without requiring substantial clearance for this pivoting operation, the hinge arrangement 320 is mounted recessed toward air cleaner housing rear end 301r, from each of: cartridge inlet flow face 350 (Fig. 12); and, a forward most region or edge 312bf of housing main body bottom 312b.

Alternately stated, the housing main body 312 can be characterized as having a top 312t, an opposite bottom 312b, front end 312f; and, an opposite rear end 312r. The service access end 317 of the housing main body 312, generally comprises the front end 312f. An edge of the service access end 317, adjacent the housing main
5 body top 312t is recessed toward the main housing rear end 312r, relative to an edge 312bf of the service access end 317 adjacent the housing main body bottom 312b. Typically, the amount of this recess is at least 30 mm and not more than 120 mm, usually it is within the range of 30-90 mm, inclusive. As a result of the recess, represented generally in Fig. 14 at dimension X, the hinge 320 is recessed toward
10 312r from edge 312bf, and as access cover 313 is pivoted to the hinged open position, a forward portion 312f of cartridge 310 is left exposed, i.e. projecting outwardly from main body 312t, for access. Further, as the cartridge 310 is withdrawn, it can be tipped up sooner, than if there was no recess. Also access cover 313, as a result of mounting on projection 365, can pivot well out the service
15 provider's way, over top 312t of housing main body 312.

Alternately, the hinge arrangement 320 can be characterized with respect to its recess from front face 350 toward rear face 351 of installed cartridge 310. The amount of recess would typically be at least 40 mm, usually at least 45 mm, typically not more than 140 mm, and often within the range of 45-140 mm,
20 inclusive.

Referring to Figs. 7-14, collectively, in a typical air cleaner assembly 300, there will be provided an opening bias arrangement 374 which provides for automatic biasing of the access cover 313 from the hinged closed position, to the hinged open position, when a service provider has unlocked or released the closure
25 or lock arrangement 328 for the air cleaner assembly 300. Herein, the term "hinged open position" is meant to refer to a position generally as discussed in connection with Figs. 13 and 14, in which the access cover 313 is pivoted to fully open the open end or service access end 317 of the main body 312 for service access to cartridge 310. Typically, the hinged open position will be a position of a maximum allowable
30 movement for the access cover 313 around the hinge arrangement 320.

Herein, again, the term "hinged closed position" is generally meant to refer to a position analogous to that discussed in connection with Fig. 9, in which the access cover 313 is positioned on main body 312 oriented as it would be for normal

air filtering operation, i.e. closing service access end 317 of the main housing body 312, or, alternately stated, closing housing 301.

A variety of arrangements can be used for the opening bias arrangement 374. It is expected that in a typical assembly 300, the opening bias arrangement 374 will
5 comprise a hinge arrangement 320 provided with a torsion spring arrangement 375, Fig. 20, thereon; with the torsion spring arrangement 375 configured such that when the access cover 313 is in a closed orientation, Fig. 9, the torsion spring arrangement is under maximum bias or torsion, such that when the closure arrangement 328 (Fig. 8) is released, the release of rotational tension or torsion within the spring
10 arrangement 375 will tend to bias the access cover 313 to the position indicated in Figs. 13 and 14. Further the torsion spring arrangement 375 will be positioned such that as the service provider moves the access cover 313 around the hinge arrangement 320 from the hinged open position of Figs. 13 and 14 to the hinged closed position in Fig. 9, torsion or tension is put back into the spring arrangement
15 375.

In a typical application of the principles described herein, it will be preferred that the opening bias arrangement 374 be provided such that opening of the access cover 313 is not a quick, snap, reaction as the torsion spring arrangement looses tension. To accomplish this, grease can be applied to the hinge arrangement 320, to
20 provide an opening with a slower, hydraulic, feel.

An example, usable, opening bias arrangement 374 can be understood by reference to Figs. 20-23.

Referring first to Fig. 20, a cross-sectional view is provided, taken generally along line 20-20, Fig. 10. In Fig. 20, the cross-sectional view is taken through the
25 hinge arrangement 320.

The hinge arrangement 320 can be seen as comprising hinge pin arrangement 376, mounted in hinge housing 377, with torsion spring arrangement 375 mounted therein. The torsion spring arrangement 375 is appropriately engaged to be under an amount of coil spring or torsion desirable, for operation of the opening bias
30 arrangement 374.

Still referring to Fig. 20, it can be seen that for the particular example hinge arrangement 320 depicted, the hinge pin arrangement 376 comprises first and second pin sections 376a, 376b. Further, the torsion spring arrangement 375 can be seen as

comprising two spring sections 375a, 375b; one each being associated with one each of the pins 376a, 376b respectively.

Attention is now directed to Fig. 21, an enlarged fragmentary view of a portion of Fig. 20. Here, pin section 376a is viewable, with spring section 375a thereon. The pin section 376a is mounted in place by head 376h, the pin section 376a being received within housing 377. The spring 375a can be captured and secured at opposite ends 375ax, 375ay. Thus, as head 376h is rotated, spring section 375a is selectively tightened or loosened with respect to torsion. The head 376h, then, can be used to provide, at assembly, a desired amount of torsion in spring section 375a.

Still referring to Fig. 21, hinge housing 377 includes housing section 377a secured in place on housing main body 312. Housing section 377b is rotatably mounted around pin 376, and is secured as part of access cover 313. At end 375ax, spring section 375a is secured from rotation relative to housing section 377a, by head 376h. End 375ay of spring section 375a is secured to hinge housing section 377b. Thus, as torsion within the spring section 375a between ends 375ax and 375ay is released (while head 376h is not adjusted), hinge section 377b will rotate around pin 376, relative to housing section 377a. This, of course, will correspond to pivoting of access cover 313 around hinge 320.

Referring to Fig. 20, an analogous, mirror image, construction is provided for pin section 376b, spring section 375b, and hinge housing section 377c, which is secured in place on housing main body 312.

Attention is now directed to Fig. 22, in which pin section 376a is shown partially exploded from housing 377. It can be seen that the housing section 377c, which comprises a portion of access cover 313, Fig. 10, includes an end catch 320x, for spring section 375a.

Referring to Fig. 22, it is noted that for the view depicted, pin section 376b and spring section 375b are completely removed.

Comparing Figs. 21 and 22 to Fig. 20, it can be seen that for the example hinge arrangement 320 depicted, hinge pin section 376b and hinge pin section 375b can be mounted analogously to hinge pin 376a and spring section 375a, except as a mirror image.

In Fig. 23, an enlarged view of a portion of Fig. 22 is depicted, for further inspection of detail relating to hinge pin section 376a, housing 377 and spring

section 375a. It can be seen that pin section 376a includes a threaded section 376at, for adjustment with respect to hinge housing section 377a.

In general terms, the air cleaner assembly 300 includes an opening bias arrangement 374. The opening bias arrangement 374, for the example air cleaner assembly 301 depicted, comprises a hinge arrangement 320 including a hinge pin arrangement 376 and torsion spring arrangement 375. The torsion spring arrangement 375 is configured to bias the access cover 313 to the hinged open position, Fig. 13, when released; and, the torsion spring arrangement 375 is configured to be retightened, as the access cover 313 is pivoted from the hinged open orientation to the hinged closed orientation.

In general, it will be desired, for the air cleaner assembly 300, that there be provided a closure (locking) arrangement for securing the access cover 313 closed against the main housing body 312 in a manner that resists opening, until a positive action to release the closure arrangement is provided. Reasons for this include:

- (a) it is important to maintain the air cleaner assembly 300 locked closed during operation to filter air;
- (b) as will be understood from the description, for the particular housing seal arrangement 349 used, a closing force between access cover 313 and main housing body 312 is necessary, to maintain a good housing seal; and,
- (c) opening pressure of the opening bias arrangement 374, for example comprising torsion spring arrangement 375, must be resisted, to keep air cleaner housing 301 closed during operation.

To accomplish this, the air cleaner assembly 300 is provided with a closure (or lock) arrangement 328, Fig. 7, which can be engaged when the service operator pivots the access cover 313 around hinge arrangement 320, to the orientation shown in Fig. 9. That is, once the pivoting to the hinged closed position of the access cover 313 occurs, the closure arrangement 328 can be actuated to retain the access cover 313 closed.

Preferably, the closure or lock arrangement 328 is an automatic closure arrangement 386, Fig 11. By "automatic" in this context, it is meant that preferably the closure arrangement 385 is configured such that once pivoting to the orientation of Fig. 9 occurs, for example by the service provider pushing the access cover 313 to the closed orientation, the closure arrangement 328 automatically engages, without further service provider action, to retain the access cover 313 in the hinged

closed orientation. A variety of mechanisms can be used to accomplish this. An example arrangement is depicted, as follows.

For the particular example assembly 300 depicted, the access cover includes a projection arrangement 390, Fig. 11, thereon; and, the housing main body 312
5 includes a receiver arrangement 391 thereon. The projection arrangement 390 and the receiver arrangement 391 together form a projection/receiver arrangement 392. The hinged closed orientation (Fig. 9) involves rotation the access cover 313 until the projection arrangement 390 is fully received by the receiver arrangement 391.

For the particular example arrangement depicted, the projection arrangement
10 390 comprises first and second projections 390x, 390y. Projection 390x is viewable in Fig. 11, and projection 390y is viewable in Fig. 12. In Fig. 7, a perspective view, the relative location of these pins 390x, 390y is viewable.

The pins 390x, 390y can be generally identical, but mounted spaced laterally. An enlarged view of one of the pins 390y is provided in Fig. 18.

15 Referring to Fig. 18, pin 390y can be viewed as having: tip 390t; cammed engagement surface 390s; and, catch recess 390c. The catch recess 390c is spaced from the tip 390t by cammed engagement surface 390s.

In general terms, 390y is a "keeper." As the pin 390y is pushed into a appropriately configured spring loaded aperture, surface 390s will cam the aperture
20 to a position allowing the pin 390y to be received. Upon further insertion, the spring loaded aperture of the recess will bias back, into catch 390c. This will lock the pin 390y, and analogously pin 390x, in position.

Example features of a specific receiver arrangement will be understood by reference to Figs. 15-17.

25 Referring first to Fig. 15, receiver arrangement 391 is viewable with portions broken away to show internal detail. In general terms, receiver arrangement 391 comprises a first receiver aperture 400x for receipt of pin 390x; and, a second receiver aperture 400y for receipt of pin 390y.

In Fig. 16, an enlarged fragmentary view of a portion of Fig. 15 is viewable.

30 Referring to Fig. 16, at 410 a central transfer rod is depicted having slide members 411x, 411y engaged at opposite ends thereof. Each of the slide members 411x, 411y is capable of movement back and forth in the general directions indicated by double headed arrow 415. In the configuration of Fig. 16, the slide members 411x, 411y and the transfer rod 410 are biased to the right, i.e. in the

direction of arrow 417. This would be an orientation that allows for release of the projection/receiver arrangement 392, i.e. allows for movement of the access cover 313 around the hinge arrangement 320, Fig. 13.

Referring again to Fig. 16, when closure of the access cover 313 is initiated,
5 typically the slides 411x, 411y (and with them the apertures 400x, 400y), would be in the maximum positioned moved in the direction of arrow 418).

As the pins 390x, 390y, Fig. 7 are pushed into receivers 400x, 400y, Fig. 16 an eccentric alignment is initially provided. The cammed surfaces of the pins 390x, 390y will tend to bias the apertures in the direction of arrow 417 during this entry,
10 i.e. to the orientation of Fig 16. In general, this biasing will be against a mechanically provided bias or spring pressure, such as by spring arrangement 416 comprising springs 416a, 416b tending to bias slides 411x, 411y in the direction of arrow 418. When the pins 390x, 390y have entered sufficiently far, pressure by the spring or bias arrangement 416 moves the slides 411x, 411y slightly in the direction
15 of arrow 418. This will remain until pins 390x, 390y are pushed in for enough for aperture rims of apertures 400x, 400y engage with pin catches, for example pin catch 390c, Fig. 18. Under the spring biasing pressure, engagement between rims of apertures 400x, 400y and the catches 390c will serve to secure the access cover 313 in a locked closed orientation.

20 When a single actuator member, in this instance button 430, Fig. 16, is actuated, the sides 411x, 411y are biased in the direction of arrow 417. This will move rims of apertures 400x, 400y out of the catches 390c, and allow the pins 390x, 390y to be free for movement. At this point the bias opening arrangement will move the access cover 313 around hinge 320 toward the hinged open position.

25 A variety of alternate mechanical configurations are usable, however, to accomplish the desired result.

It is noted that in Fig. 16, the button 430 is depicted in a fully depressed position, the position it would occupy if the latch arrangement 328 was being opened.

30 In Fig. 17, an enlarged fragmentary of a portion of Fig. 16 is viewable for convenience.

In Figs. 24-26, cartridge 310 is depicted separated from the remainder of air cleaner assembly 300, Figs. 7-14. Referring to Fig. 24, as previously indicated, cartridge 310 comprises a media pack 348 in the form of media 348a. The media

348a can comprise, for example, a blocked, stacked, arrangement 440 comprising strips of single facer material, generally in accord with Fig. 6 discussed above, with the strips extending between sides 448x, 448y. Referring to Fig. 24, the media pack 348 defines an inlet flow face 350 and opposite outlet flow face 351.

5 The media pack 348 generally has a top 348t and an opposite bottom 348b. Further, the media pack 348 has first and second, opposite, sides, 498x, 498y covered by molded-in-place side panels 444, 445. The molded-in-place side panels, seal the media pack 348, along opposite sides 498x, 498y. The molded-in-place side panels 444, 445, for example, can comprise molded-in-place polyurethane, as for the
10 exemplified described for similar opposite molded panels in PCT WO 2006/076479 and WO 2006/076456, each of which has previously been incorporated herein by reference.

 In panel 445, opposite arcuate grooves 447, 448 are depicted. These grooves 447, 448 can comprise artifacts from mold standoffs used in a mold in which panel
15 445 is formed. Analogous groove would typically be present in side 444.

 Still referring to Fig. 24, housing seal arrangement 349 is shown mounted on and surrounding media pack 348. The housing seal arrangement 344 generally extends across media pack top 348t and media pack bottom 348b; and, extends across side panels 444, 445. In a typical arrangement, the housing seal arrangement
20 344 would be molded-in-place as a single piece, once the media pack 348 comprising the media stack 440 and panels 444, 445 is formed.

 The particular housing seal arrangement 344 depicted, includes, as a portion thereof, pinch seal member 355, which operates as a pinch seal member as previously described, compressed between housing main body 312 and a portion of
25 access cover 313, when the access cover 313 is in the "hinged closed" orientation.

 In Fig. 25, a side elevational view of cartridge 310 taken generally toward panel 445 is depicted. It can be seen that in extension across panel 445 (and in mirror image across panel 444) pinch seal member 355 is slanted at an angle Y with respect to a direction between inlet flow face 350 and outlet flow face 351. Angle Y
30 is typically at least 60° and not usually greater than 87°. Usually angle Y is within the range of 75-85° inclusive. It is noted that analogous angled seal arrangements are also described in PCT WO 2006/076479 and WO 2006/076456.

 Still referring to Fig. 25, as a result of angle Y, and a slant of pinch seal member 355 in housing seal arrangement 344 (generally away from face 350, in a

direction across panels 444, 445, while extending from bottom 348b toward top 348t), a corner 360 and top inlet edge 361t of cartridge 310 is left upstream of the seal member 355.

5 In Fig. 26, a view taken toward bottom 348b is provided. Here, a receiving trough 481 is viewable between pinch seal flange 355 and a remainder of media pack 348. Such a receiving trough is analogous to those described in PCT WO 2006/076479 and WO 2006/076456. The operation of housing seal arrangement 344, including receiver member 481 is analogous in the arrangement described herein, to the arrangements described in the two PCT publications identified.

10 Attention is now directed to Fig. 19, an enlarged fragmentary of a portion of Fig. 12. Referring to Fig. 19, a portion of pinch seal member 355 is shown being pinched between selected portions of the housing main body 312 and the access cover 313, for example as closure is occurring. Referring to Fig. 19, the housing main body 312 is depicted as having a front edge 317. Along and surrounding the front edge 317, a seal receiver 500 is formed comprising inner projection 501, outer rim or circumferential projection 502, and central radial wall 503. The radial wall 503 generally extends radially outwardly between the projection 501 and the outer rim projection 502. This creates receiver space 500 in extension peripherally around edge 317, to receive seal projection 355 projecting therein.

15 20 In general, the housing seal arrangement 349 depicted, comprises pinch seal member 355 mounted on base 520 with receiver 481 between a portion of pinch seal member 355 and a remainder of media pack 348. The receiver 481 receives, projecting therein, projection 501 when the cartridge 310 is positioned operably in main housing body 312.

25 The seal member 349 may comprise a single, molded-in-place, member for example a polyurethane member. Typically, the polyurethane will be a foamed polyurethane with: an as-molded density of not greater than 30lbs/cu.ft. (0.48g/cc), typically no greater than 22 lbs/cu.ft. (0.35 g/cc) and usually within the range of 10 lbs/cu.ft. (0.16 g/cc) to 22 lbs/cu.ft. (0.35 g/cc); and, with a hardness, Shore A, of typically no greater than 30, preferably not greater than 25 and often within the range of 10-22, inclusive. The same material can be used for the opposite panels 444, 445.

30 Referring to Fig. 14, access cover 313 includes edge 540. Edge 540 engages pinch seal arrangement 355, when the access cover 313 is in the hinged closed

orientation. Edge 540 generally includes radially inwardly projecting, strengthening fins 541.

Referring to Fig. 19, as edge 540 is moved into pinch seal member 355, the pinch member 355 is compressed, in a direction between opposite surfaces 355x, 355y. That is, pinch seal member 355 is compressed between and inner surface 503i of projection 503 and, fins 541 at tips 541t, engaging surface 355x.

While the specific configurations of the housing surfaces engaged differ, in general this type of system is as described for a certain analogous structures in PCT WO 2006/076479 and PCT WO 2006/076456. It is noted that in these PCT publication, in some instances a seal bead is depicted on a housing component, for example bead 690, Fig. 42 of WO 2006/076479. Such a bead could be used with the arrangement of Fig. 19 herein, but it is not necessarily preferred.

Referring to Figs. 14 and 19, the projection 501 being received in receiver 481, while a portion of pinch seal member 355 is received within receiver 500, provides for a secured positioning and easy centering of the service provider, of cartridge 310 in main housing body 312, before access cover 313 is pivoted to the hinged closed position.

The general principles characterized herein are shown applied in a specific example arrangement. There is no requirement that an assembly include all of the specific features characterized herein, in order to some benefit according to the present disclosure.

IV. Some General Comments and Observations

According to one aspect of the present disclosure, an air cleaner assembly is provided. The air cleaner assembly generally includes a housing defining: an interior; an air flow inlet arrangement; and, an air flow outlet arrangement. The air cleaner housing comprises a main housing body with a service access end; and, an access cover. The access cover is mounted on the air cleaner housing by a hinge arrangement. Specifically, the access cover is pivotable around the hinge arrangement between two extreme positions: a hinged open position; and, a hinged closed position. The access cover is positioned such that when in a hinged closed position, the access cover is positioned closing the service access end of the housing body, for air cleaner operation. Further, when the access cover is in the hinged open

position, the access cover is positioned opening the service access end of the housing body for servicing.

In an example system, a releasable locking (closure) arrangement selectively actuatable to secure the access cover in the hinged position and to release the access cover to pivot around the hinge arrangement, is provided. In an example depicted, 5 the releasable locking arrangement comprises a projection/receiver arrangement. In particular, an example projection/receiver arrangement is described and shown, in which a projection arrangement on the housing cover, projects into a receiver arrangement on the main housing body, and while therein engages a spring loaded 10 lock arrangement, to secure the access cover closed.

In an example depicted, the spring loaded lock arrangement can be actuated (released) by a service provider accessing an actuator position on a side of the housing body. An example actuator depicted, is a (single) button.

The particular releasable locking arrangement described herein, is configured 15 so that locking the access cover closed in place on the housing does not require the service provider to reach underneath portions of the housing. Rather, for the particular assembly depicted, the actuator for the releasable locking arrangement is positioned at a side portion (in the example depicted, a corner) of the housing, that can be orientated for relatively easy access during servicing.

Also, in the example arrangement described herein, the air cleaner assembly 20 includes an opening bias arrangement automatically biasing the access cover to the hinged open position, when the releasable (closure) locking arrangement is released. In the example depicted, the opening bias arrangement comprises a torsion spring arrangement, associated with the hinge arrangement. A specific example is shown 25 and described.

A serviceable air filter cartridge is depicted operably positioned in the air cleaner assembly. The serviceable air filter cartridge in general comprises: a media pack having opposite inlet and outlet flow faces with flutes extending in a direction therebetween; and, a housing seal arrangement releasably sealing the air filter 30 cartridge to the air cleaner housing. The serviceable filter cartridge is generally sized to be removable from the air cleaner housing, when the access cover is in the hinged open position.

Typically, the media pack will comprise a stack of single facer strips, the strips generally comprising fluted media secured to facing media. Example media features and media formation techniques are generally described herein.

5 In an example assembly depicted, the housing seal arrangement comprises a pinch seal, which is pinched between the access cover and the main housing body, when the access cover is in the hinged closed orientation. An example pinch arrangement is depicted, in which pinching occurs between a seal receiver trough positioned on the air cleaner housing main body, and a plurality of spaced ribs or fins on the access cover as depicted.

10 In an example described, the air cleaner housing main body has: a top and an opposite bottom, a front end and an opposite rear end, and first and opposite sides. The hinge arrangement is positioned on the top of the housing main body, and the access cover is positioned to pivot to a location above the main body top, when in the hinged open position.

15 An arrangement in which the front or open edge of the housing body defines a slanted plane of opening, is described. In this example, the edge of the service access end adjacent a housing main body top is recessed toward the main housing rear end, relative to an edge of the service access and adjacent the housing main body bottom.

20 In an example assembly, the filter cartridge is provided such that an extension across opposite sides thereof, in a direction between the cartridge bottom (or housing bottom) to the cartridge top (or housing top) the pinch seal extends at an acute angle Y (less than 90°) relative to a direction between the inlet flow face and the outlet flow face, i.e. in a direction of flow through the main cartridge media
25 pack.

As characterized herein above, there is no specific requirement that an air cleaner assembly include all the features characterized herein, to obtain some benefit according to the present disclosure.

Also according to the present disclosure the method of opening an access
30 cover an air cleaner housing, for servicing of a internally received air filter cartridge, is provided. The method generally comprises a step of actuating an actuator for closure lock arrangement by manipulating the actuator at a first side only of the air cleaner housing, typically without a need for reaching under the air cleaner housing. The step of actuating typically comprises manipulating a single actuator, to

completely release the access cover for opening. In an example described, the step of actuating comprises pressing a button.

In a typical method, the access cover is hingedly secured to the housing by hinge arrangement, including an opening bias arrangement, therein. And, the step of actuating is conducted to release the access cover for automatic hinged movement
5 around the hinge arrangement, to a hinged open orientation, under a opening bias by the opening bias arrangement.

Also as described herein, a method of closing an access cover on an air cleaner is provided. The method generally comprises a step of providing an air
10 cleaner housing with an access cover mounted on the housing main body by a hinge; the access cover having a projection member of a projection/receiver arrangement thereon; and, the housing main body having a receiver member for projection/receiver arrangement thereon. Typically, the assembly includes an automatic closure lock arrangement actuated when the projection arrangement is
15 pushed into the receiver arrangement. The method generally involves a step of closing the access cover around the hinge, to the hinged closed position in which the projection member is received within the receiver member. The step of closing also typically includes pinching a housing seal member of an operably received filter cartridge, between the access cover and the main housing body.

What is claimed is:

1. An air cleaner assembly comprising:
 - (a) an air cleaner housing defining: an interior; an air flow inlet arrangement; and, an air flow outlet arrangement;
 - (i) the air cleaner housing comprising: a housing main body with a service end; and, an access cover; and,
 - (ii) a hinge arrangement securing the access cover to the main body; the access cover being pivotable around the hinge arrangement between a hinged open position and a hinged closed position; the access cover being positioned such that:
 - (A) when in a hinged closed position, the access cover is positioned closing the service access end of the housing body, for air cleaner operation; and,
 - (B) when in the hinged open position, the access cover is positioned opening the service access end of the housing body for servicing;
 - (b) a releasable locking arrangement selectively actuatable to secure the access cover in the hinged closed position and to selectively release the access cover to pivot around the hinge arrangement;
 - (c) an opening bias arrangement automatically biasing the access cover to the hinged open position, when the releasable locking arrangement is released; and,
 - (d) a serviceable air filter cartridge; the serviceable air filter cartridge comprising:
 - (i) a media pack comprising opposite inlet and outlet flow faces with flutes extending in a direction therebetween; and,
 - (ii) a housing seal arrangement releasably sealing the air filter cartridge to the air cleaner housing;

- (iii) the serviceable air filter cartridge being sized to be removable from the air cleaner housing, when the access cover is in the hinged open position.
- 2. An air cleaner assembly according to claim 1 wherein:
 - (a) the opening bias arrangement comprises a torsion spring arrangement in the hinge arrangement.
- 3. An air cleaner assembly according to any one of claims 1 and 2:
 - (a) the releasable locking arrangement comprises an actuator arrangement actuated by service provider engagement with a single actuator control member.
- 4. An air cleaner assembly according to claim 3 wherein:
 - (a) the single actuator control member comprises a single control button.
- 5. An air cleaner assembly according to any one of claim 1-4 wherein:
 - (a) the releasable locking arrangement comprises a projection arrangement on the access cover and a receiver arrangement on the main housing body;
 - (i) the releasable locking arrangement being such that:
 - (A) when the projection arrangement is pushed into the receiver arrangement, an automatic locking engagement between the projection arrangement and receiver arrangement occurs; and,
 - (B) whenever the actuator control member is actuated, the projection arrangement is released from locking engagement with the receiver arrangement.

6. An air cleaner assembly according to any one of claims 1-5 wherein:
 - (a) the air cleaner housing main body has a top and an opposite bottom; a front end and opposite rear end; and first and second, opposite sides;
 - (i) the hinge arrangement being positioned on the top of the housing main body;
 - (ii) the access cover being positioned over a front of the housing main body, when in the hinged closed positioned; and,
 - (iii) the access cover being positioned above the main body top, when in the hinged open positioned.
7. An air cleaner assembly according to any one of claims 1-6 wherein:
 - (a) the housing main body has: a top and an opposite bottom; and, a first end and an opposite rear end;
 - (i) the service access end of the housing main body being the front end;
 - (ii) an edge of the service access end adjacent the housing main body top being recessed toward the main housing rear end, relative to an edge of the service access end adjacent the housing main body bottom.
8. An air cleaner assembly according to claim 7 wherein:
 - (a) the edge of the service access end adjacent the housing main body top is recessed at least 30 mm and not more than 120 mm toward the rear end, relative to the edge of the service access end adjacent the housing main body bottom.
9. An air cleaner assembly according to any one of claims 1-8 wherein:
 - (a) the air flow inlet arrangement is positioned on the access cover; and,
 - (b) the air flow outlet arrangement is positioned on the main housing body.

10. An air cleaner assembly comprising:
- (a) an air cleaner housing defining: an interior; an air flow inlet arrangement; and, an air flow outlet arrangement;
 - (i) the air cleaner housing comprising: a housing main body with a service end; and, an access cover; and,
 - (ii) a hinge arrangement securing the access cover to the main body; the access cover being pivotable around the hinge arrangement between a hinged open position and a hinged closed position; the access cover being positioned such that:
 - (A) when in a hinged closed position, the access cover is positioned closing the service access end of the housing body, for air cleaner operation; and,
 - (B) when in the hinged open position, the access cover is positioned opening the service access end of the housing body for servicing;
 - (b) an opening bias arrangement automatically biasing the access cover to the hinged open position when actuated;
 - (i) the opening bias arrangement comprising a torsion spring arrangement in the hinge arrangement; and,
 - (c) a serviceable air filter cartridge; the serviceable air filter cartridge comprising:
 - (i) a media pack comprising opposite inlet and outlet flow faces with flutes extending in a direction therebetween; and,
 - (ii) a housing seal arrangement releasably sealing the air filter cartridge to the air cleaner housing; and,
 - (iii) the serviceable air filter cartridge being sized to be removable from the air cleaner housing, when the access cover is in the hinged open position.

11. An air cleaner assembly comprising:
- (a) an air cleaner housing defining: an interior; an air flow inlet arrangement; and, an air flow outlet arrangement;
 - (i) the air cleaner housing comprising: a housing main body with a service end; and, an access cover; and,
 - (ii) a hinge arrangement securing the access cover to the main body; the access cover being pivotable around the hinge arrangement between a hinged open position and a hinged closed position; the access cover being positioned such that:
 - (A) when in a hinged closed position, the access cover is positioned closing the service access end of the housing body, for air cleaner operation; and,
 - (B) when in the hinged open position, the access cover is positioned opening the service access end of the housing body for servicing;
 - (b) a releasable locking engagement selectively actuatable to secure the access cover in the hinged closed position and to release the access cover to pivot around the hinge arrangement.
 - (i) the releasable locking arrangement comprises a projection arrangement on the access cover and a receiver arrangement on the main housing body; and,
 - (ii) the releasable locking arrangement comprises an actuator arrangement actuated by service provider engagement with a single actuator control member;.
 - (A) the single actuator control member being positioned at a side of the housing main body.
12. An air cleaner assembly according to any one of claims 1-11 wherein:
- (a) the media pack comprises a stack of single facer strips comprising fluted media sheet secured to facing media sheet; and,

- (b) the housing seal arrangement comprises a pinch seal member positioned: on the filter cartridge surrounding the media pack; and, pinched between the access cover and the housing main body, when the access cover is in the hinged closed position.
- 13. A method of opening an across cover hingedly secured to an air cleaner housing, for servicing of a internally serviced air filter cartridge; the method comprising a step of:
 - (a) actuating an actuator for a closure lock arrangement by manipulating the actuator at a first side only of the air cleaner housing without a need for reaching under the air cleaner housing;
 - (i) the step of actuating comprising manipulating a single actuator to completely release the access cover for opening.
- 14. A method according to claim 13 wherein:
 - (a) the access cover is hingedly secured to the housing by a hinge arrangement including an opening bias arrangement therein; and,
 - (b) the step of actuating is conducted to release the access cover for automatic hinged movement around the hinge arrangement, to a hinged open orientation, under an opening bias by the opening bias arrangement.
- 15. A method according to any one of claims 13 and 14 wherein:
 - (a) the step of actuating comprising pressing a button.
- 16. A method of closing an access cover of an air cleaner; the method comprising a step of:
 - (a) providing an air cleaner housing with an access cover mounted on a housing main body by a hinge;
 - (i) the access cover having a projection member of a projection/receiver arrangement thereon; and,
 - (ii) the housing main body having a receiver member of a projection/receiver arrangement thereon; and,

- (A) the assembly including an automatic closure lock arrangement actuated when the projection arrangement is pushed into the receiver arrangement; and,
 - (b) closing the access cover around the hinge to the hinged closed arrangement in which the projection member is received within the receiver member.
- 17. A method according to claim 16 wherein:
 - (a) the step of closing includes pinching a housing seal member, of an operably received filter cartridge, between the access cover and the housing main body.

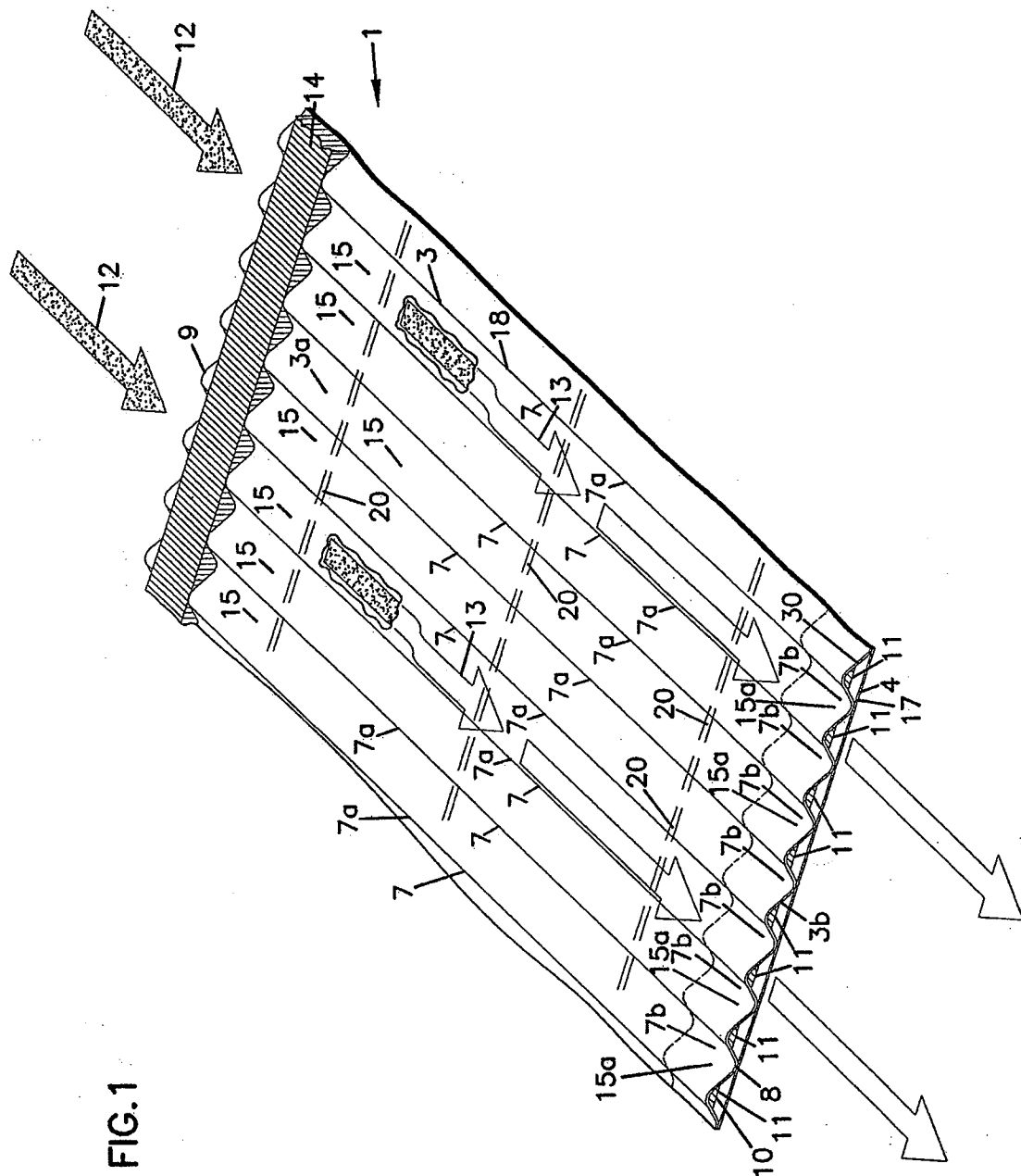


FIG.2

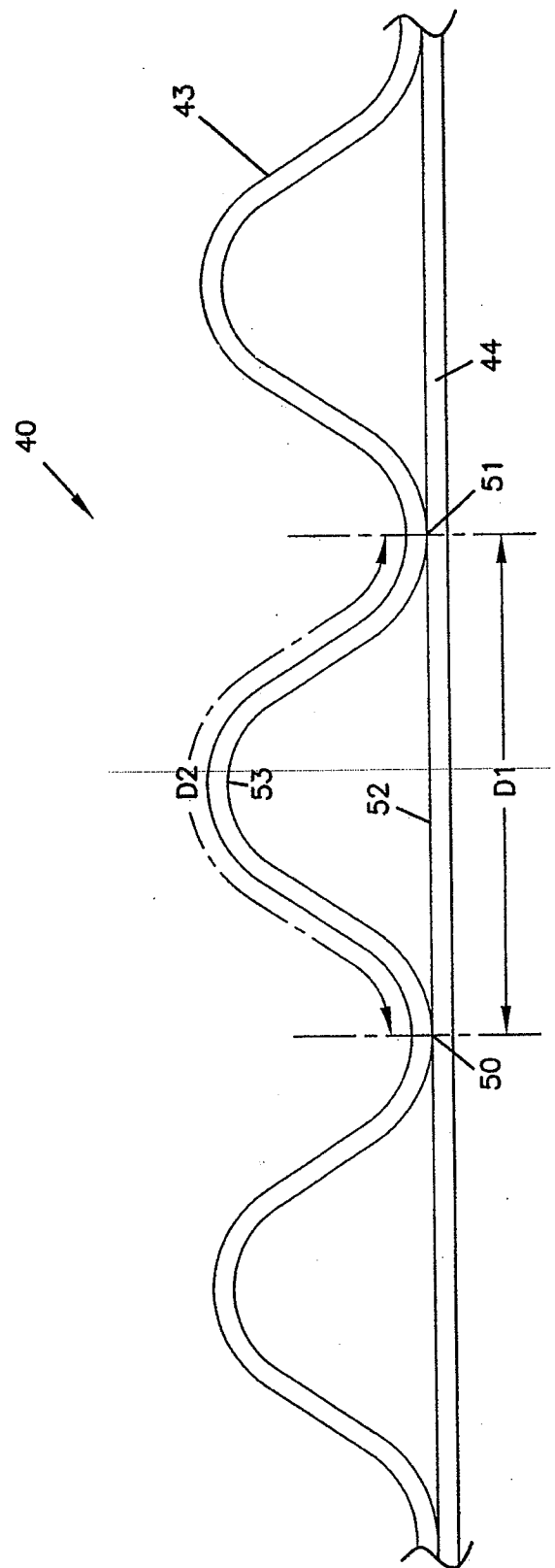
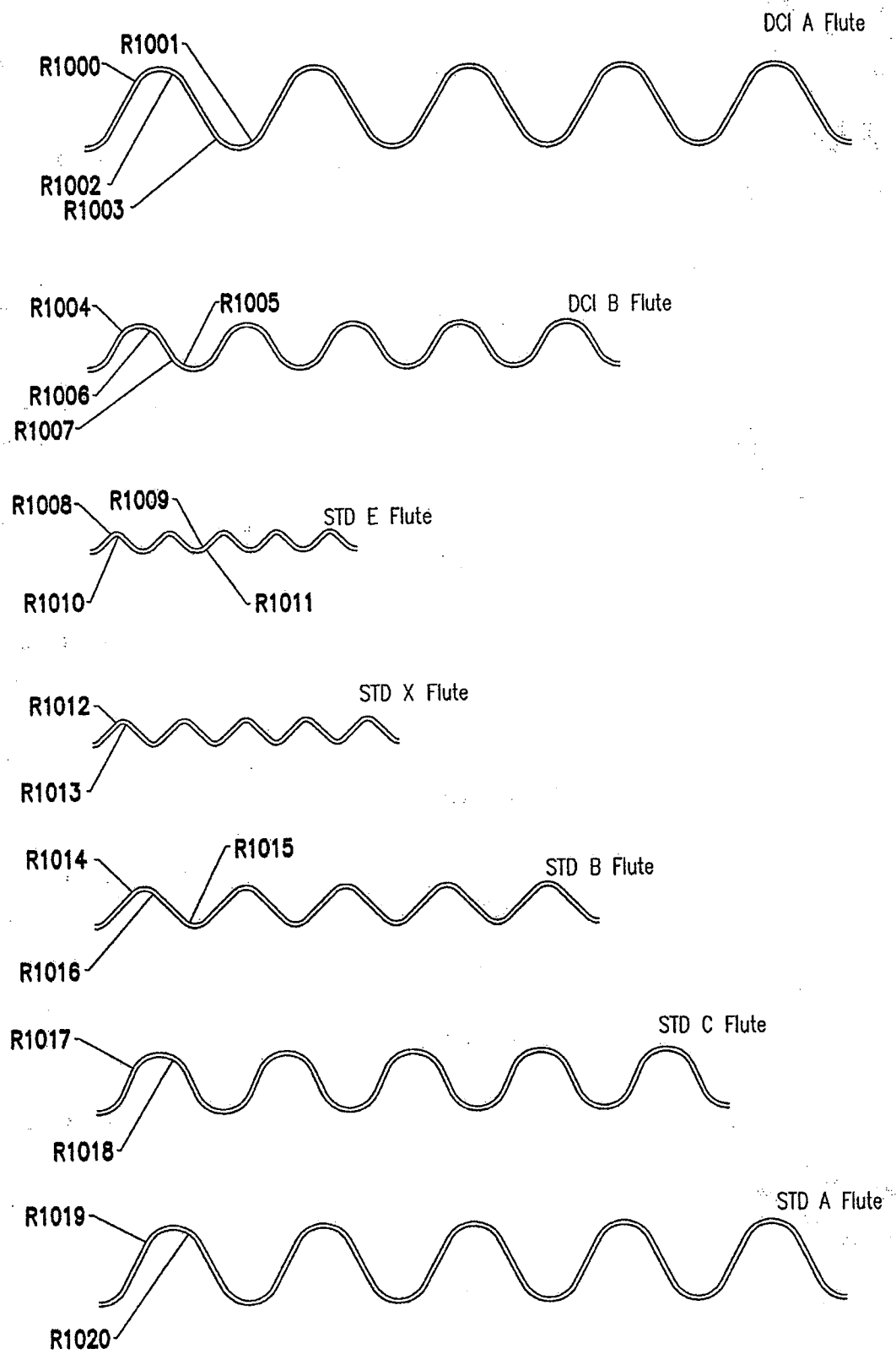


FIG.3



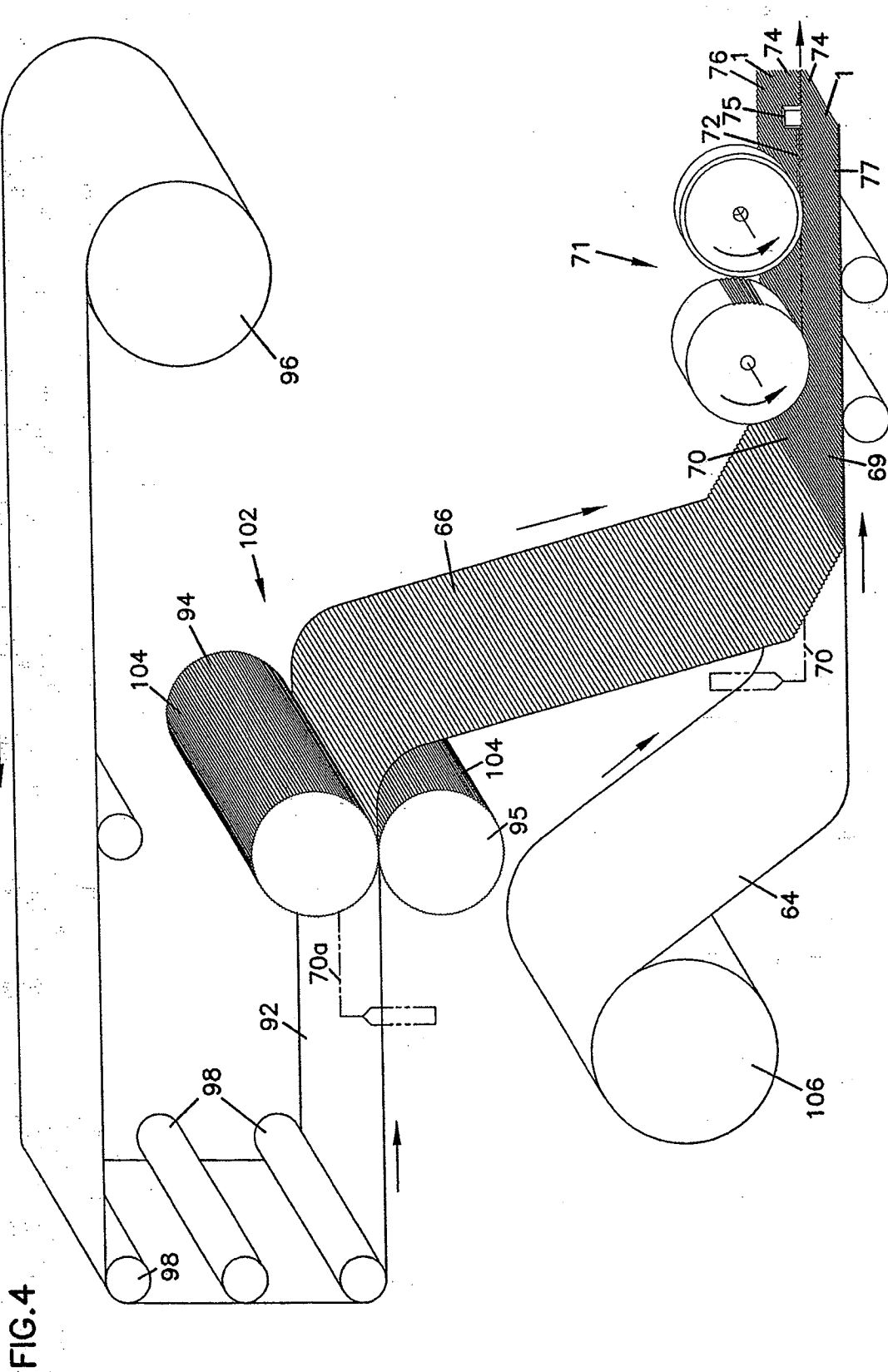


FIG.5

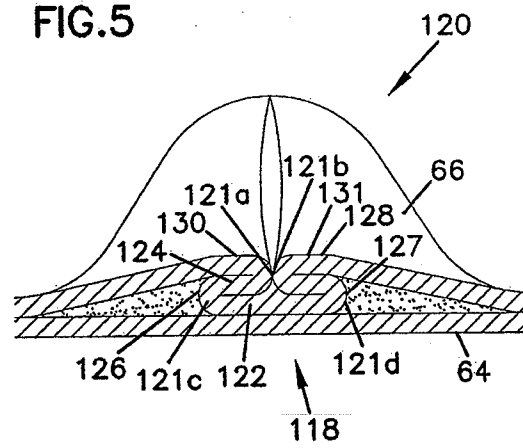
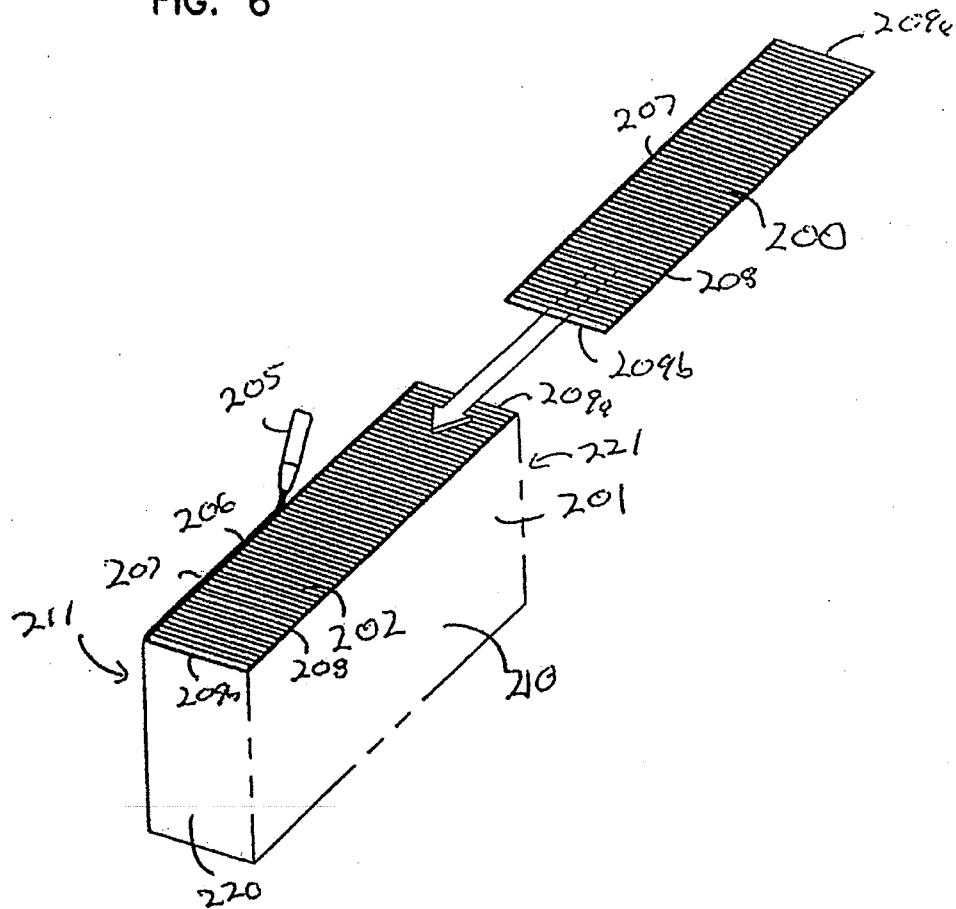


FIG. 6



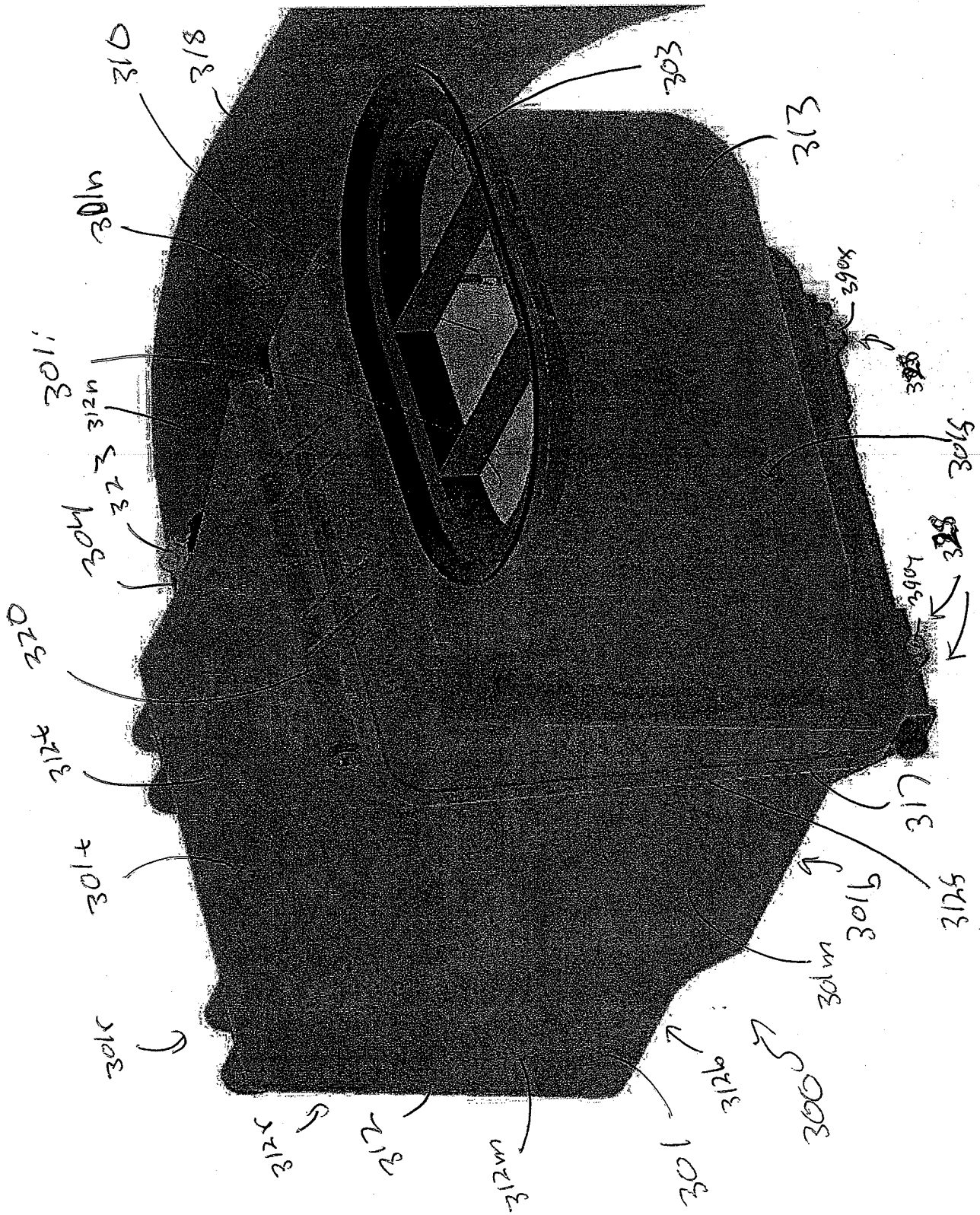
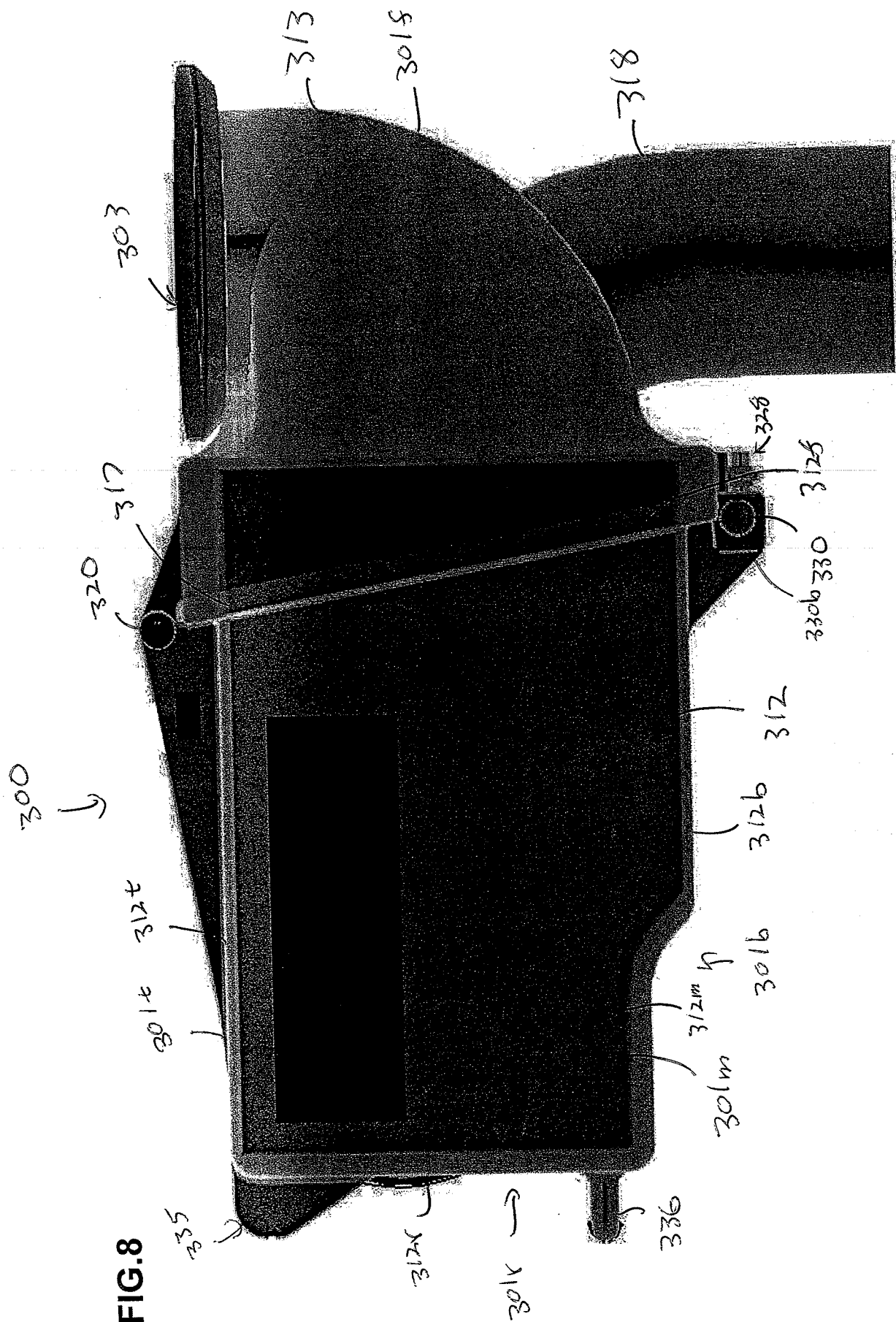


FIG. 7



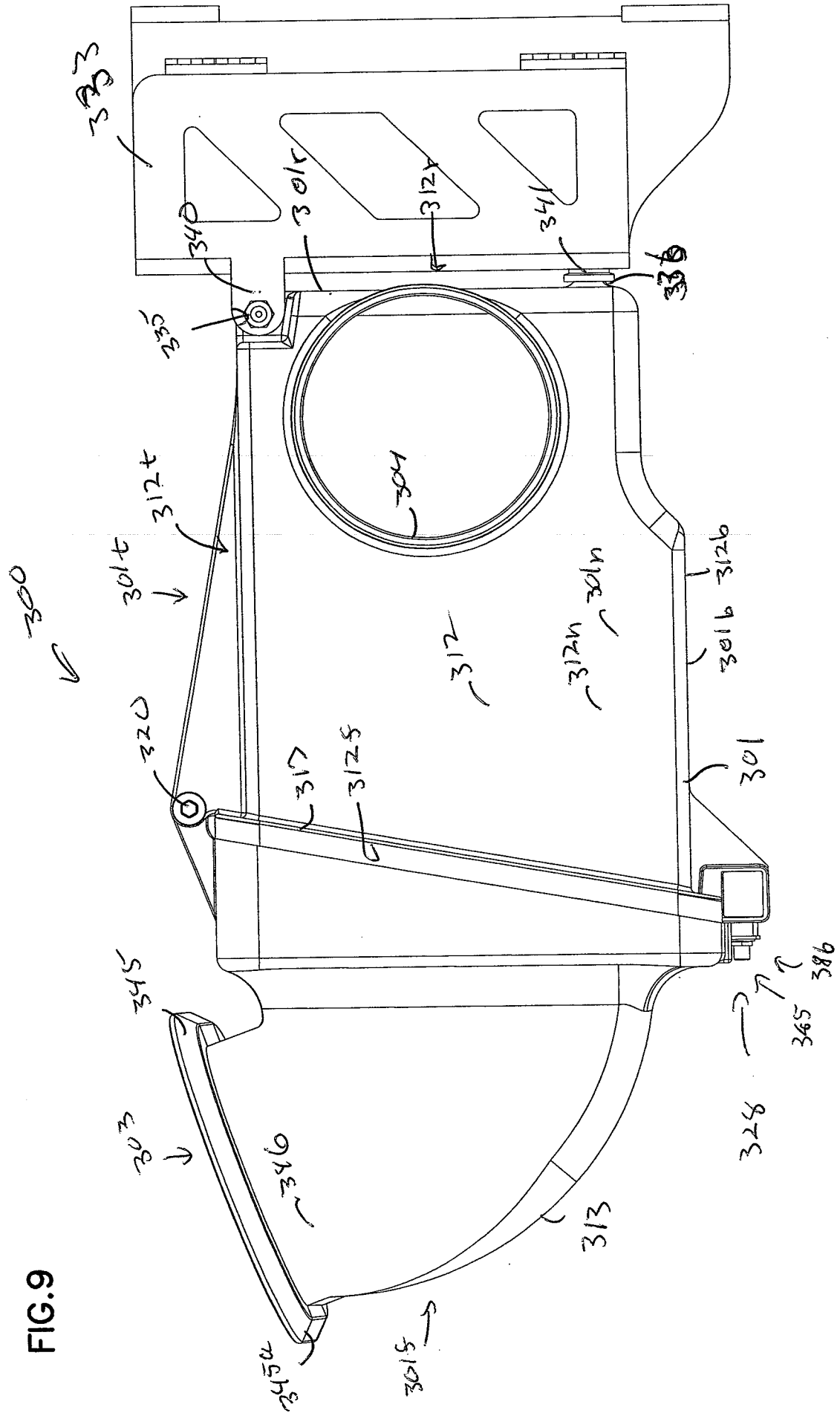


FIG.10

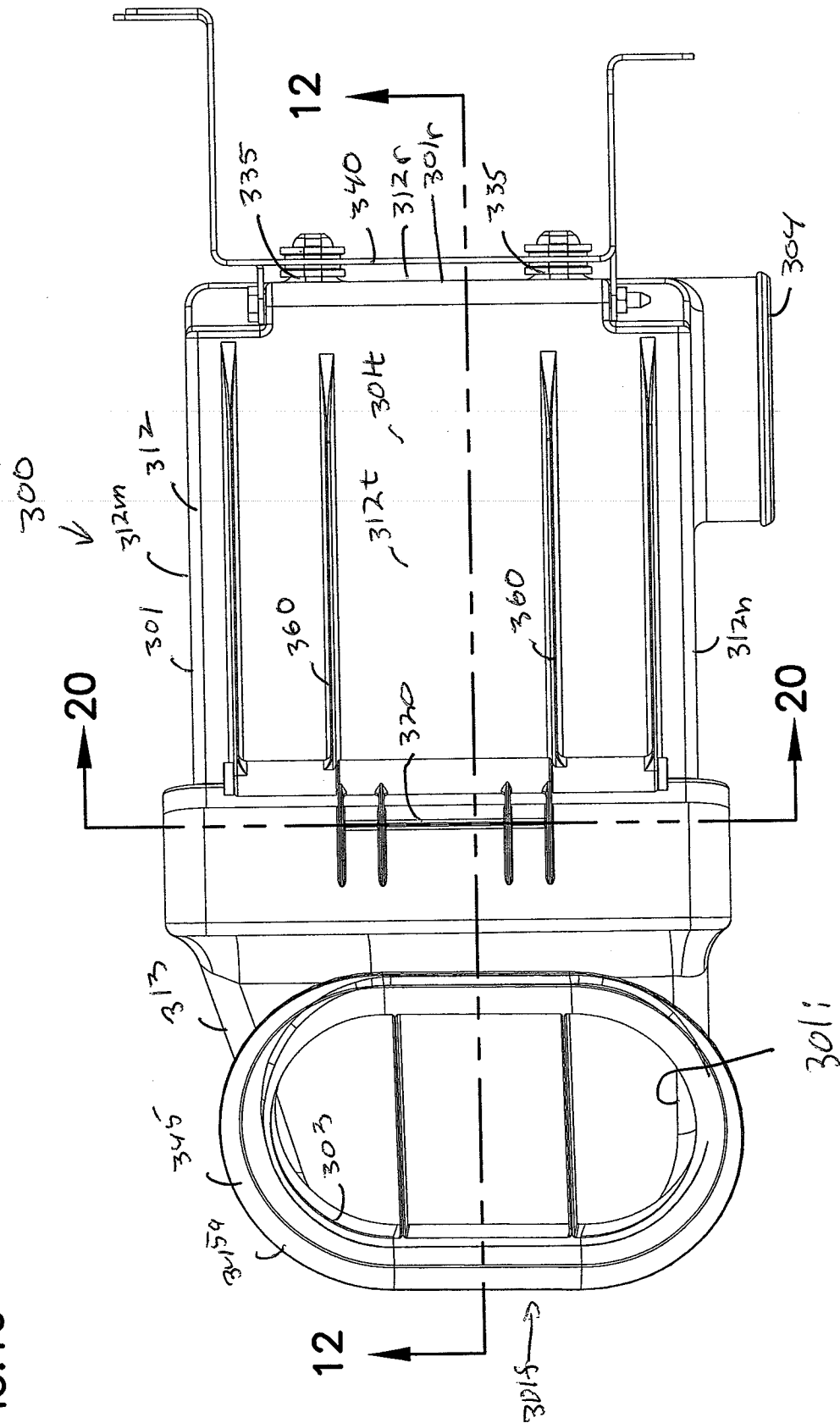


FIG.12

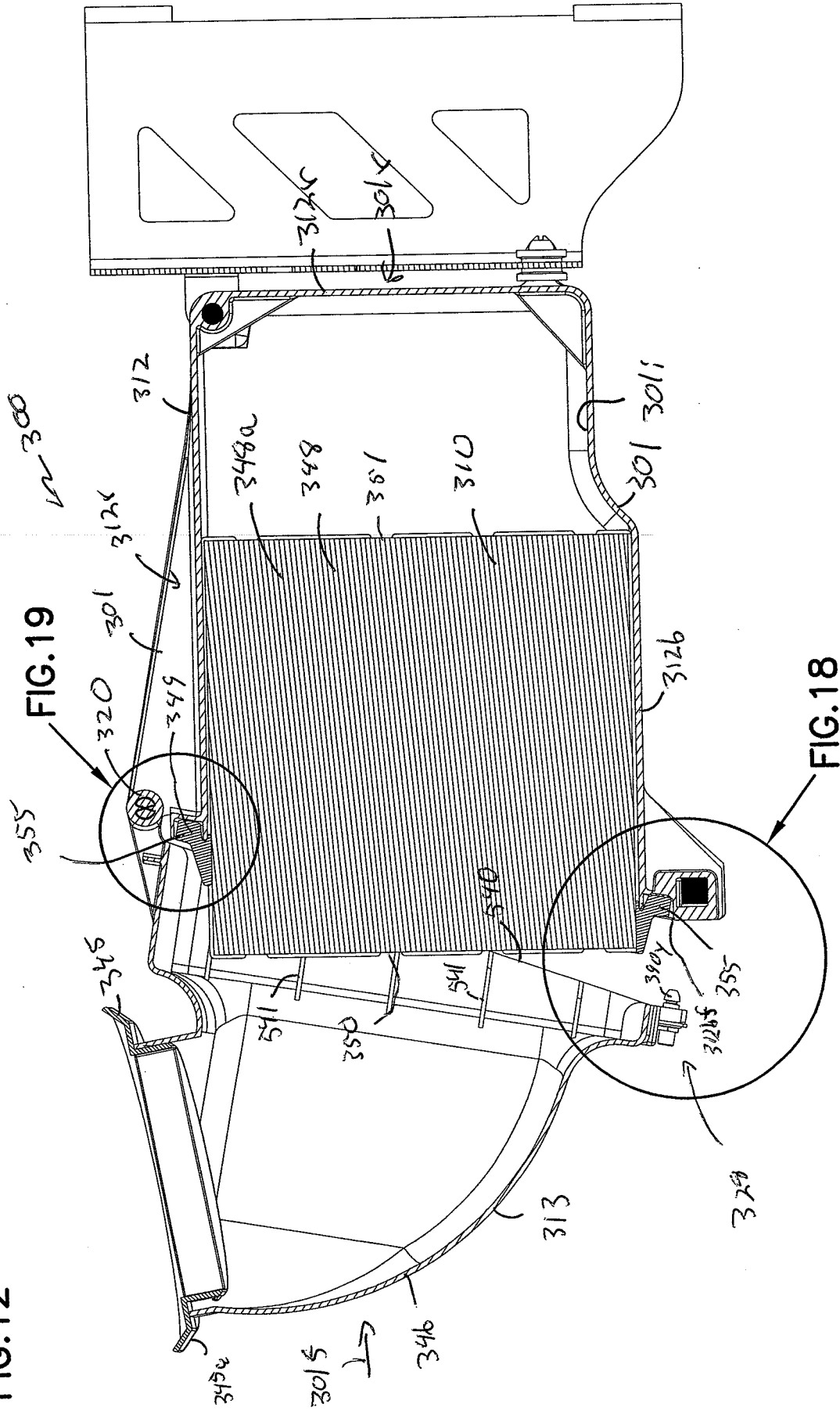


FIG.18

FIG. 14

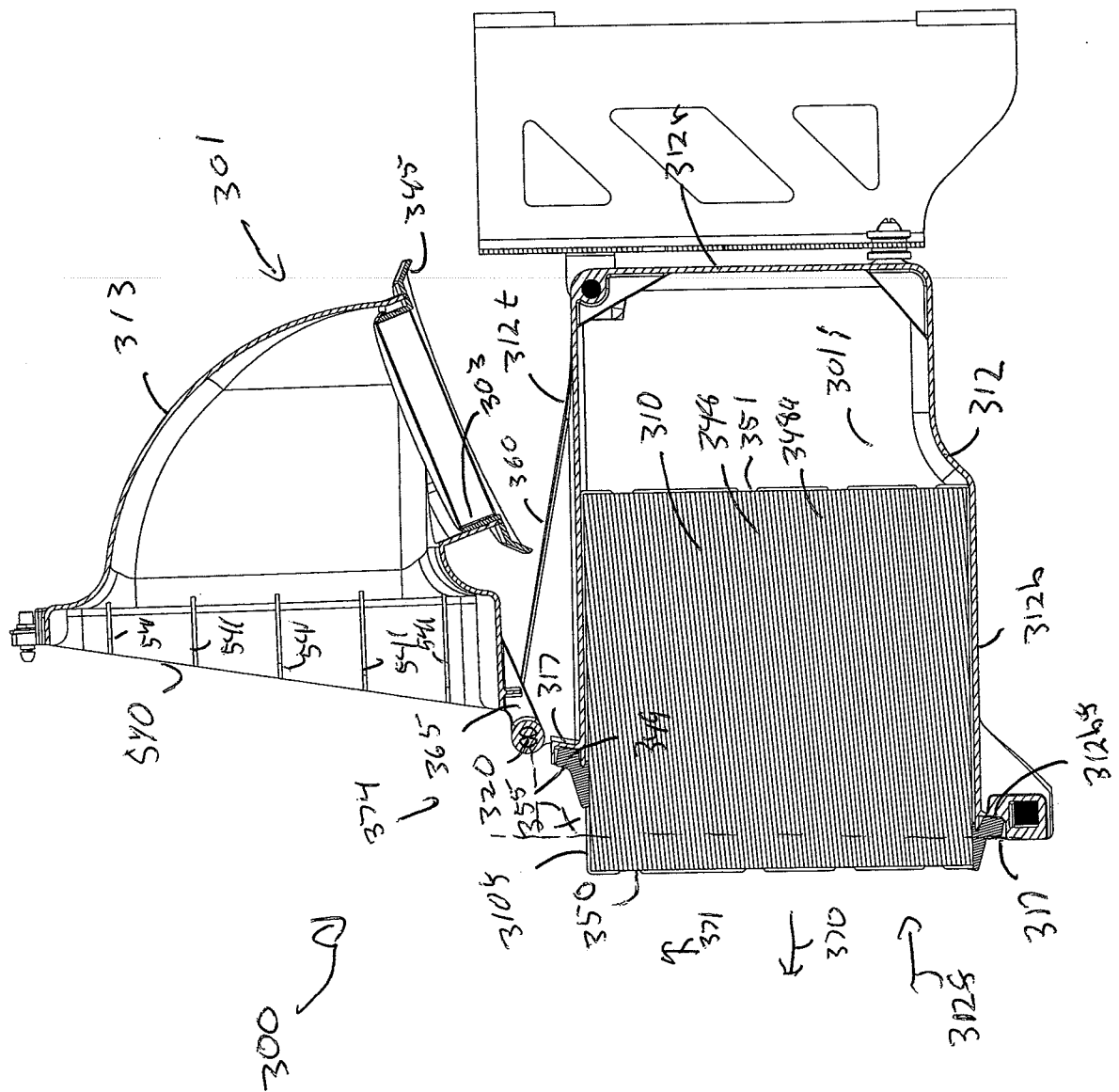


FIG.15

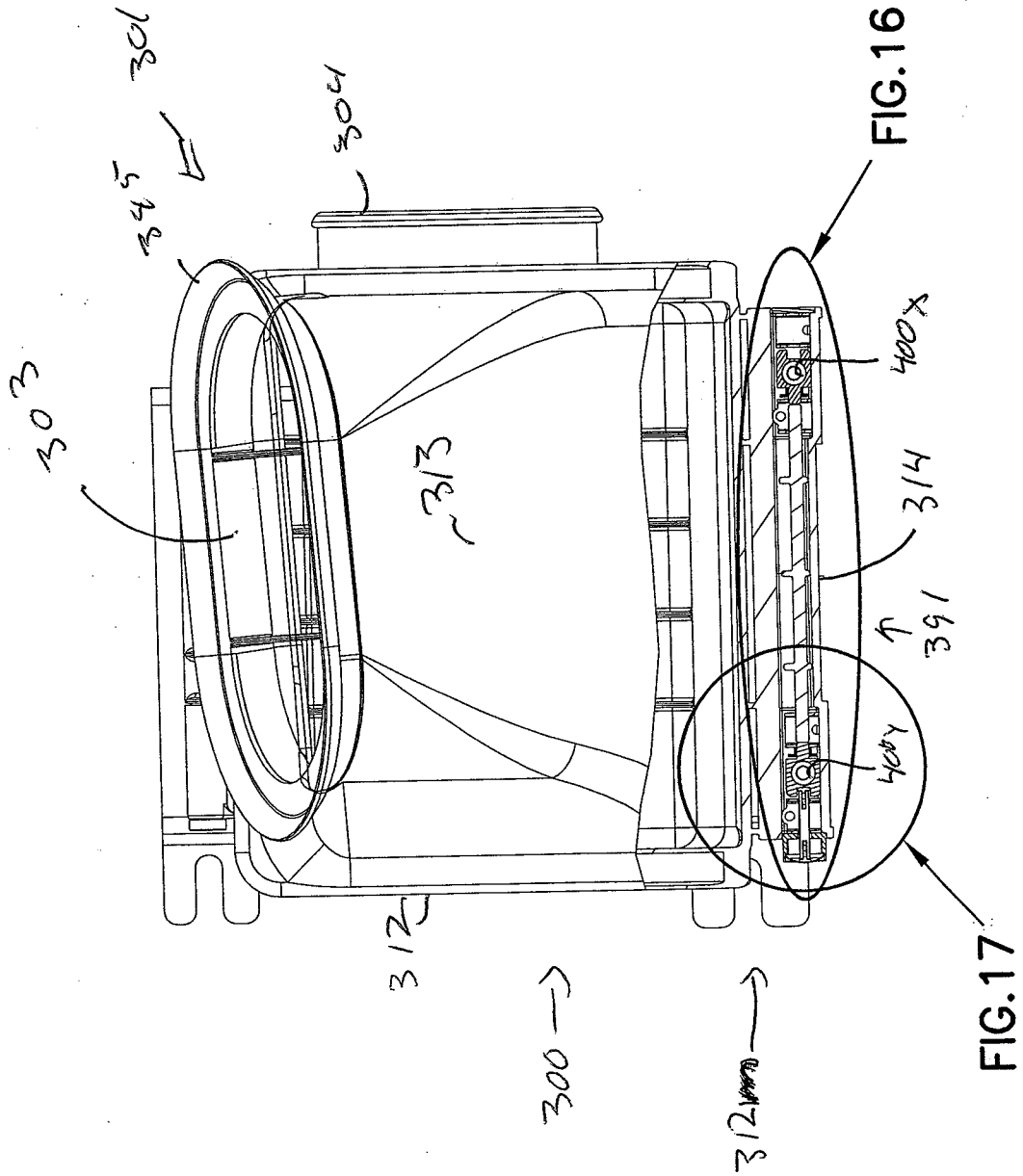


FIG. 16

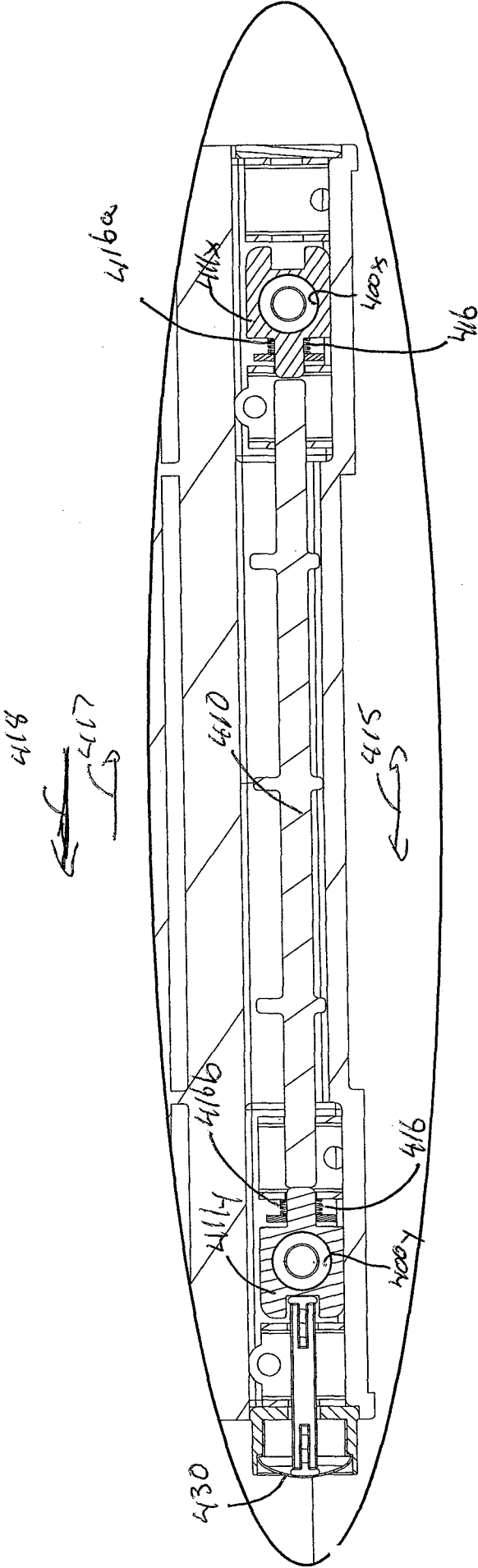


FIG. 17

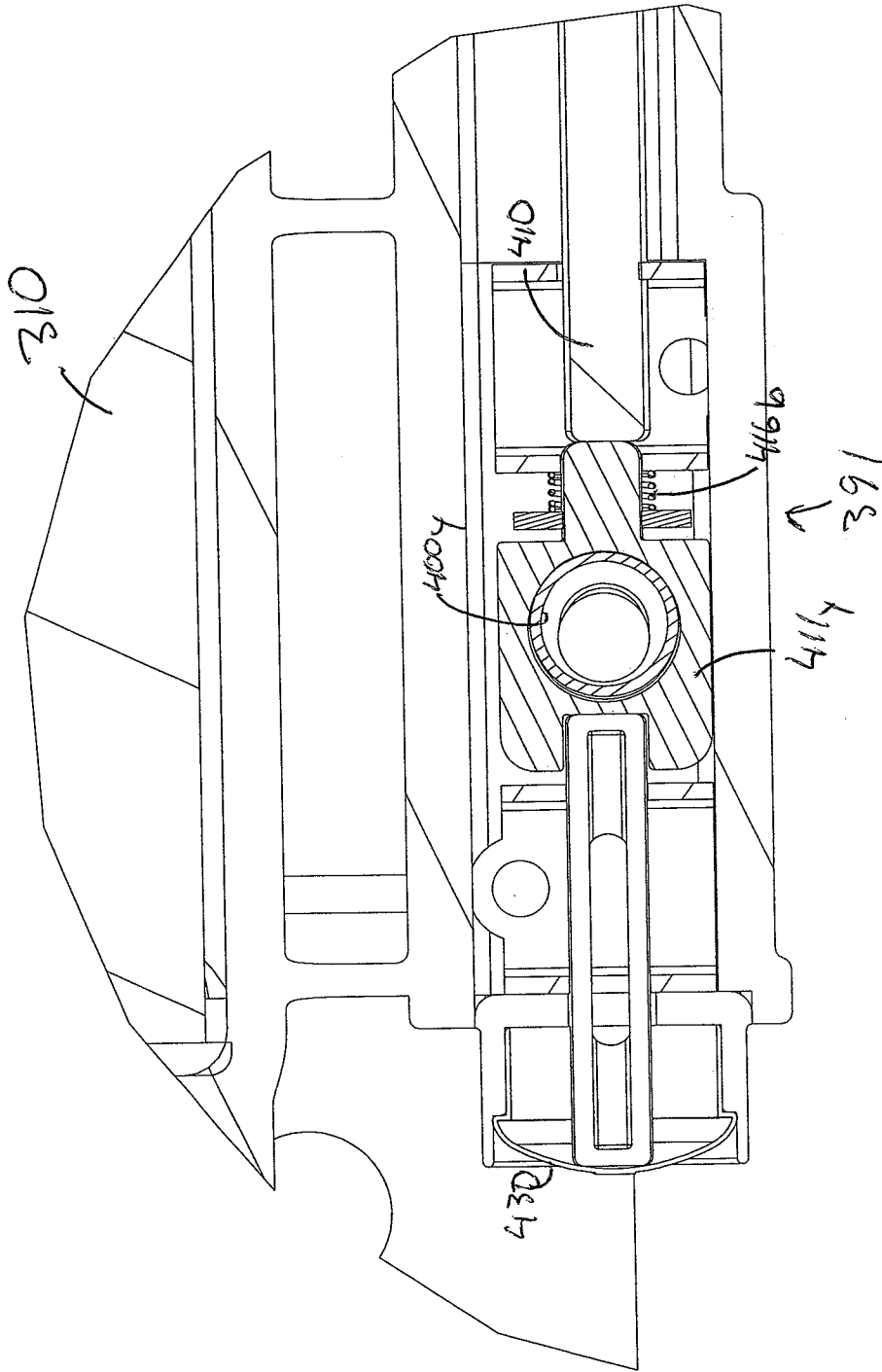


FIG. 18

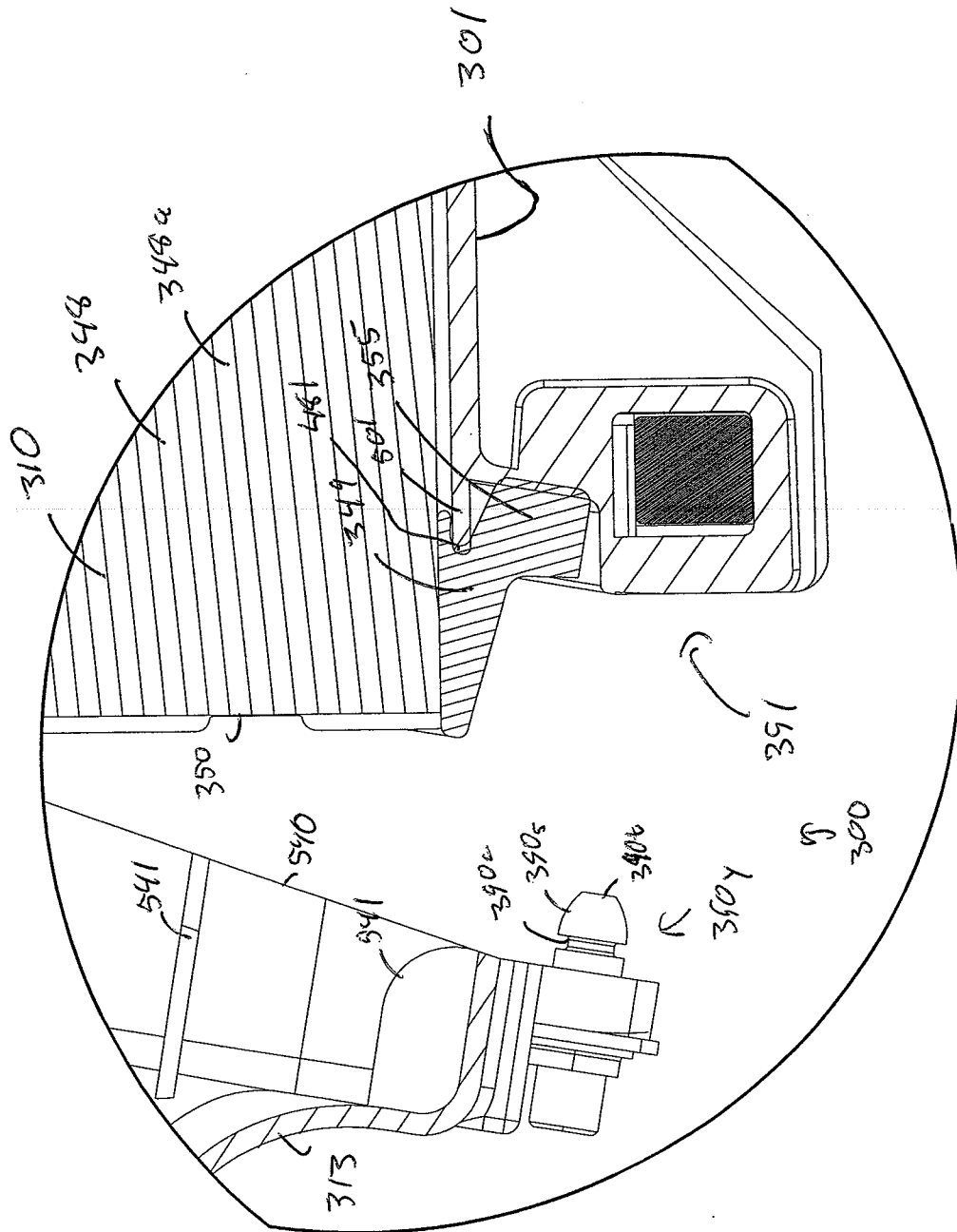


FIG.20

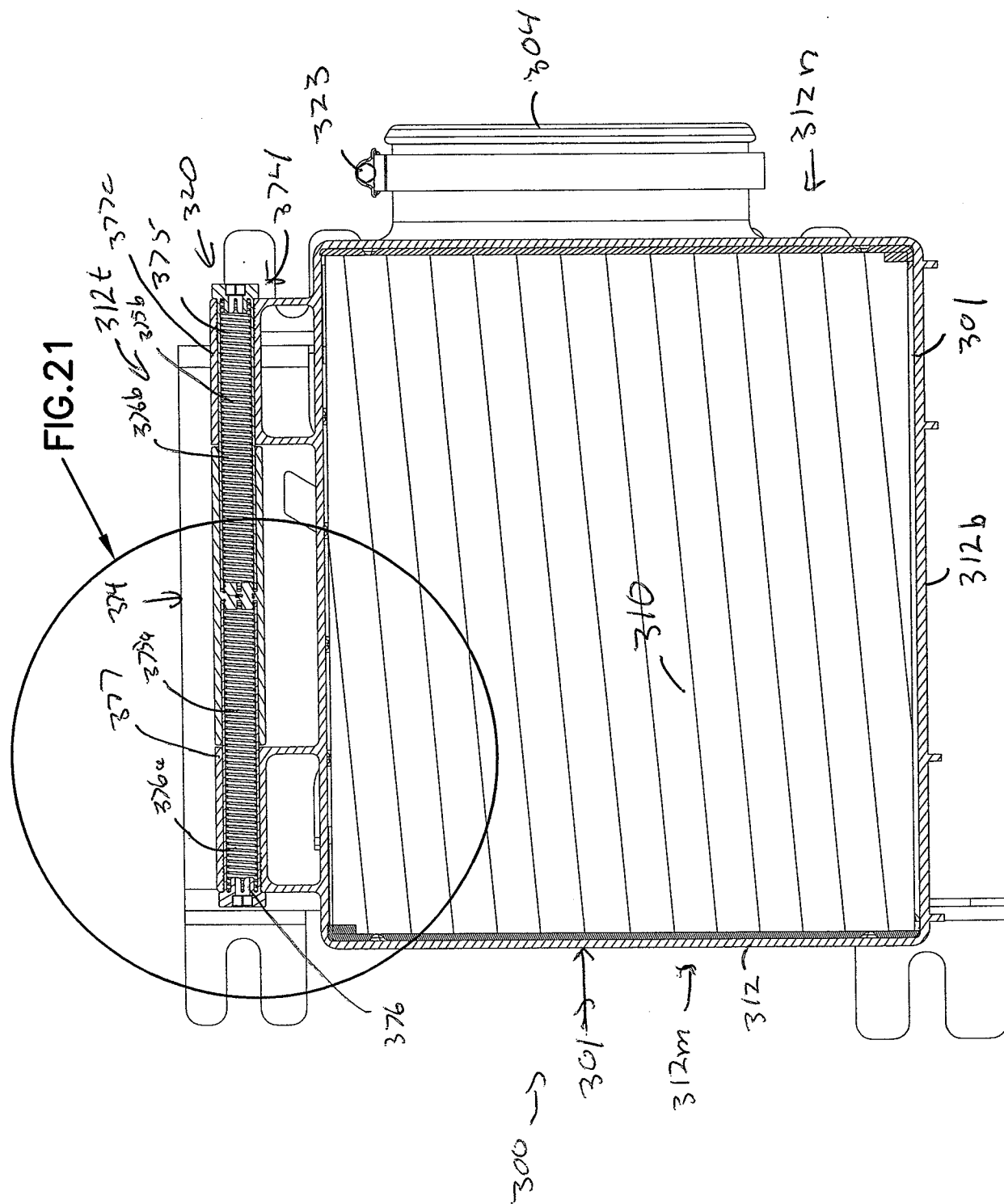


FIG.21

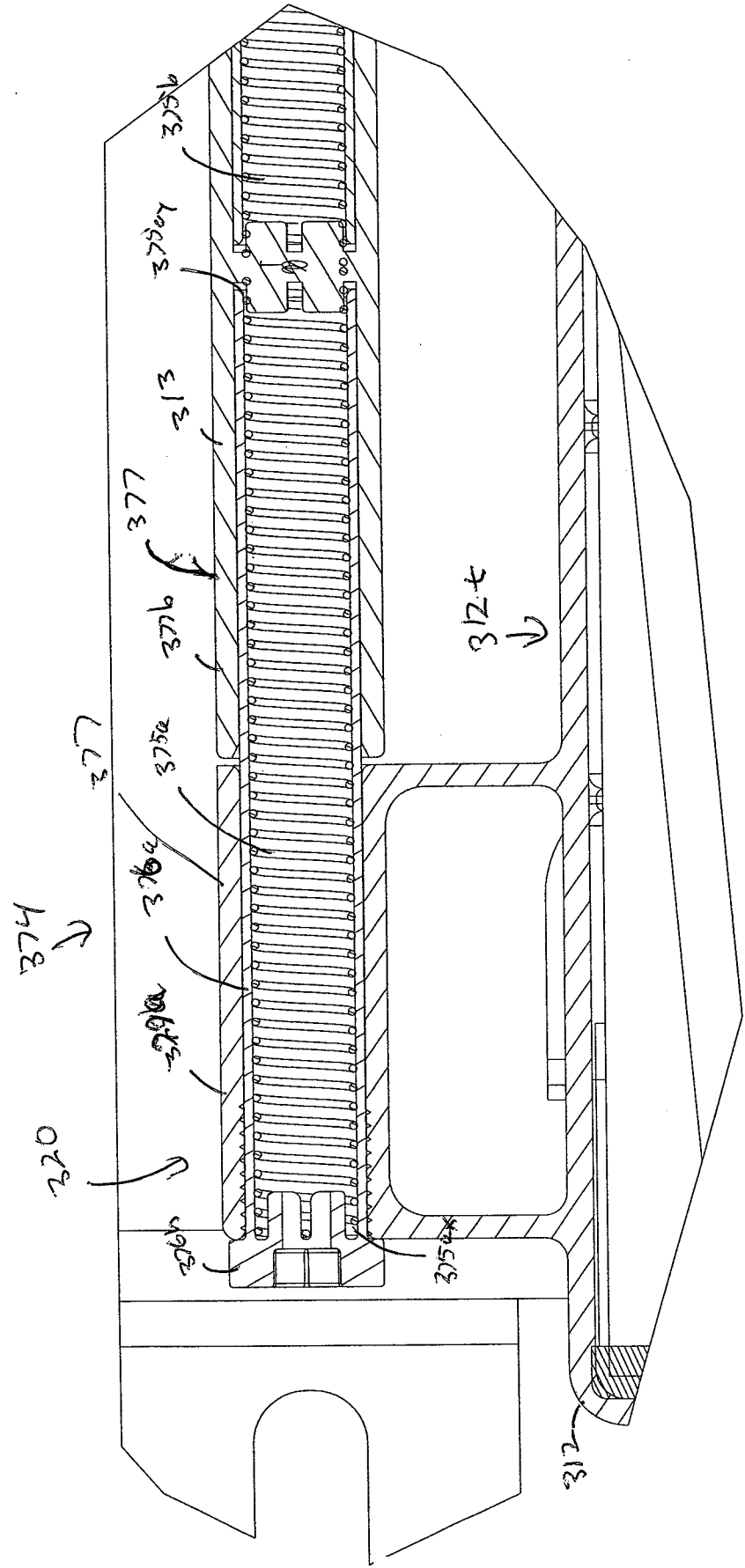


FIG.22

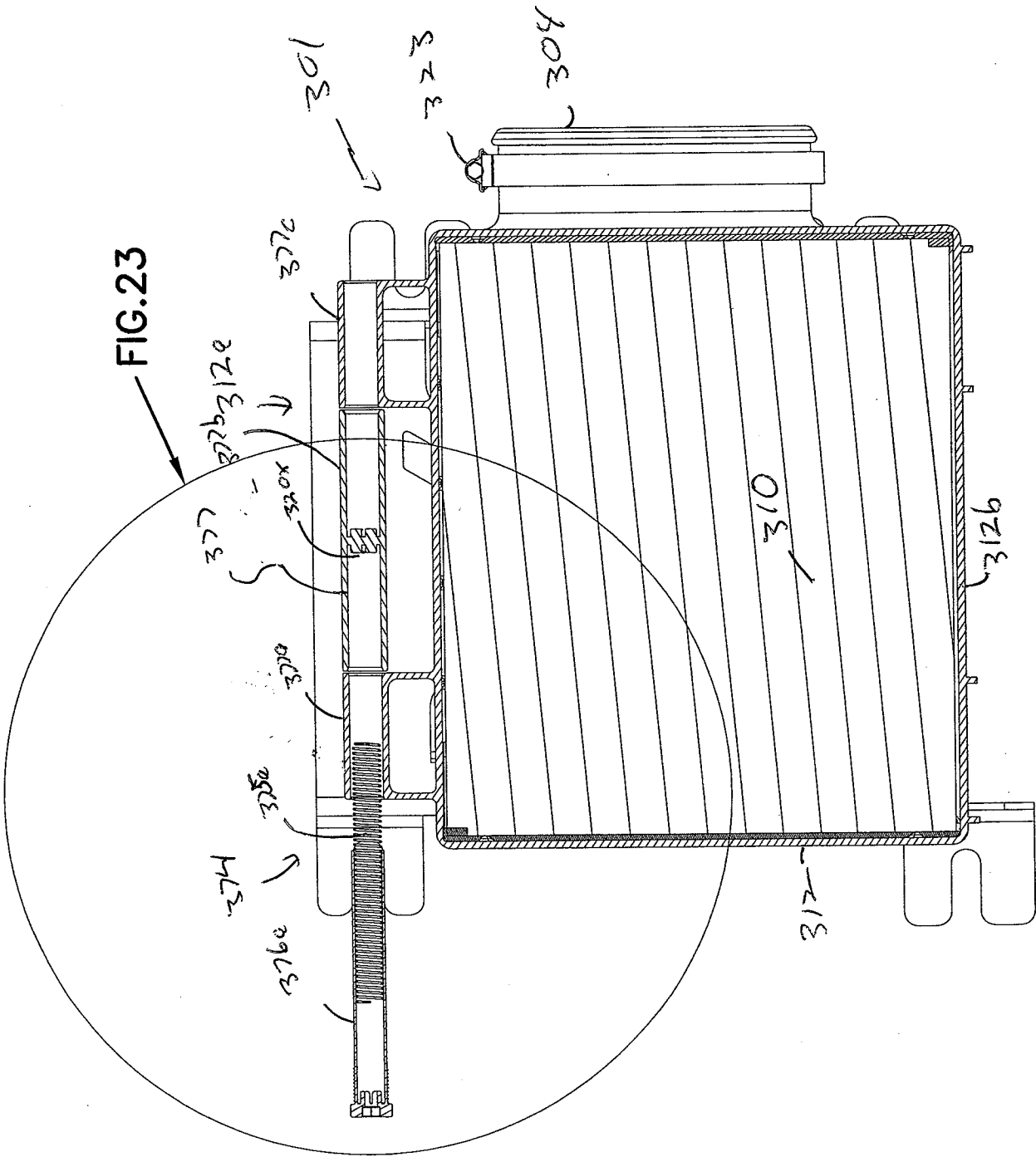


FIG. 23

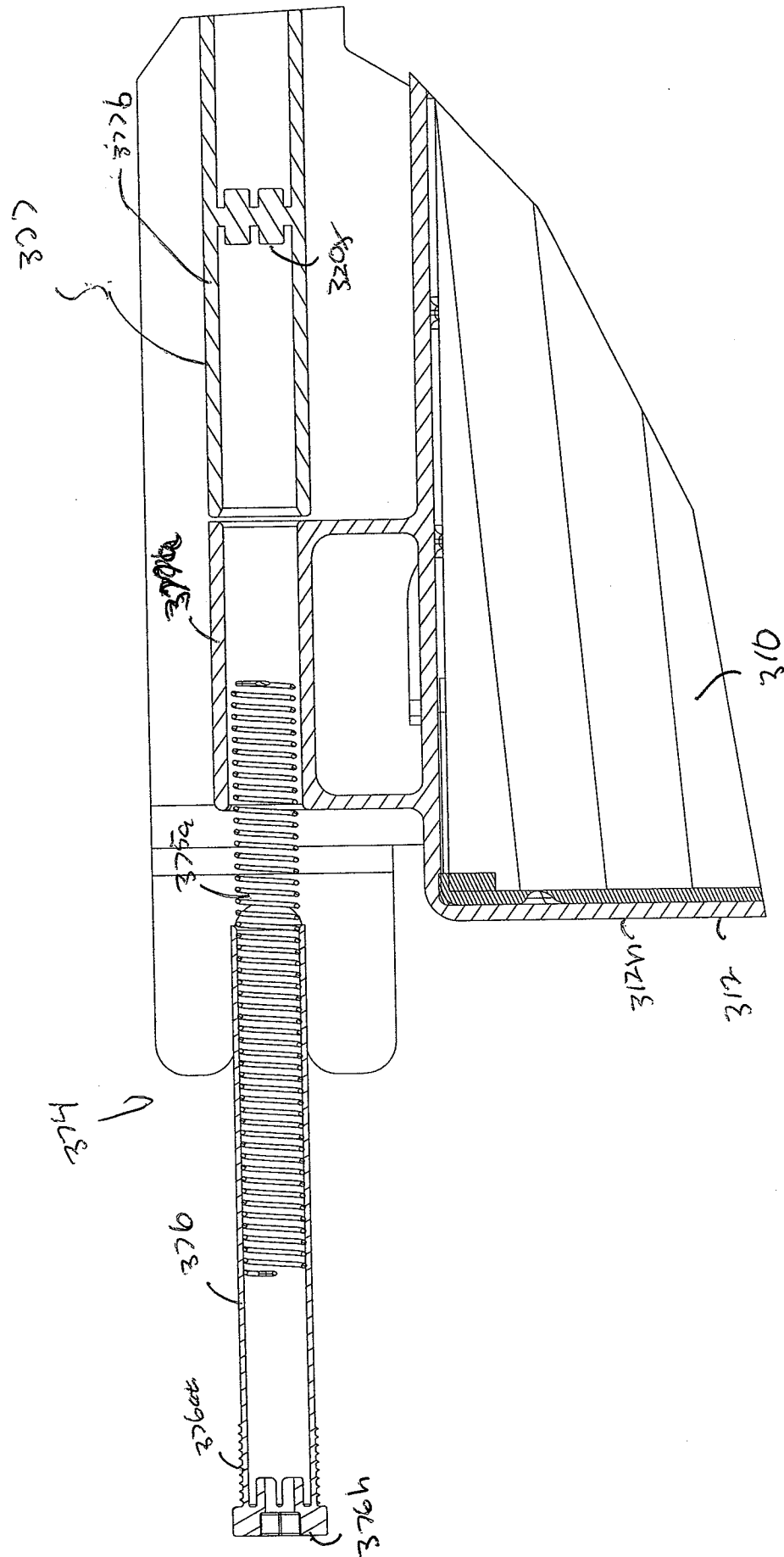
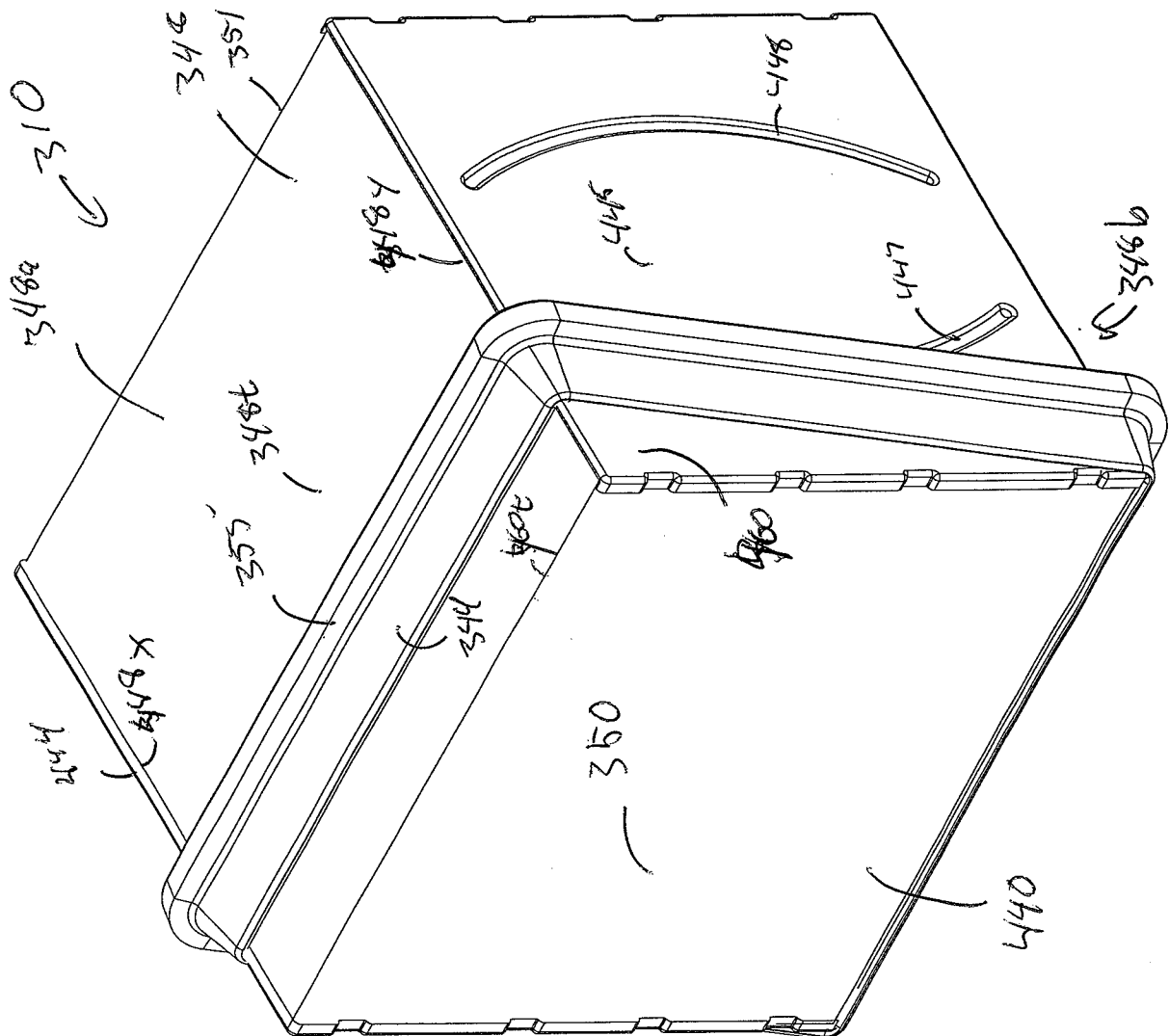


FIG. 24



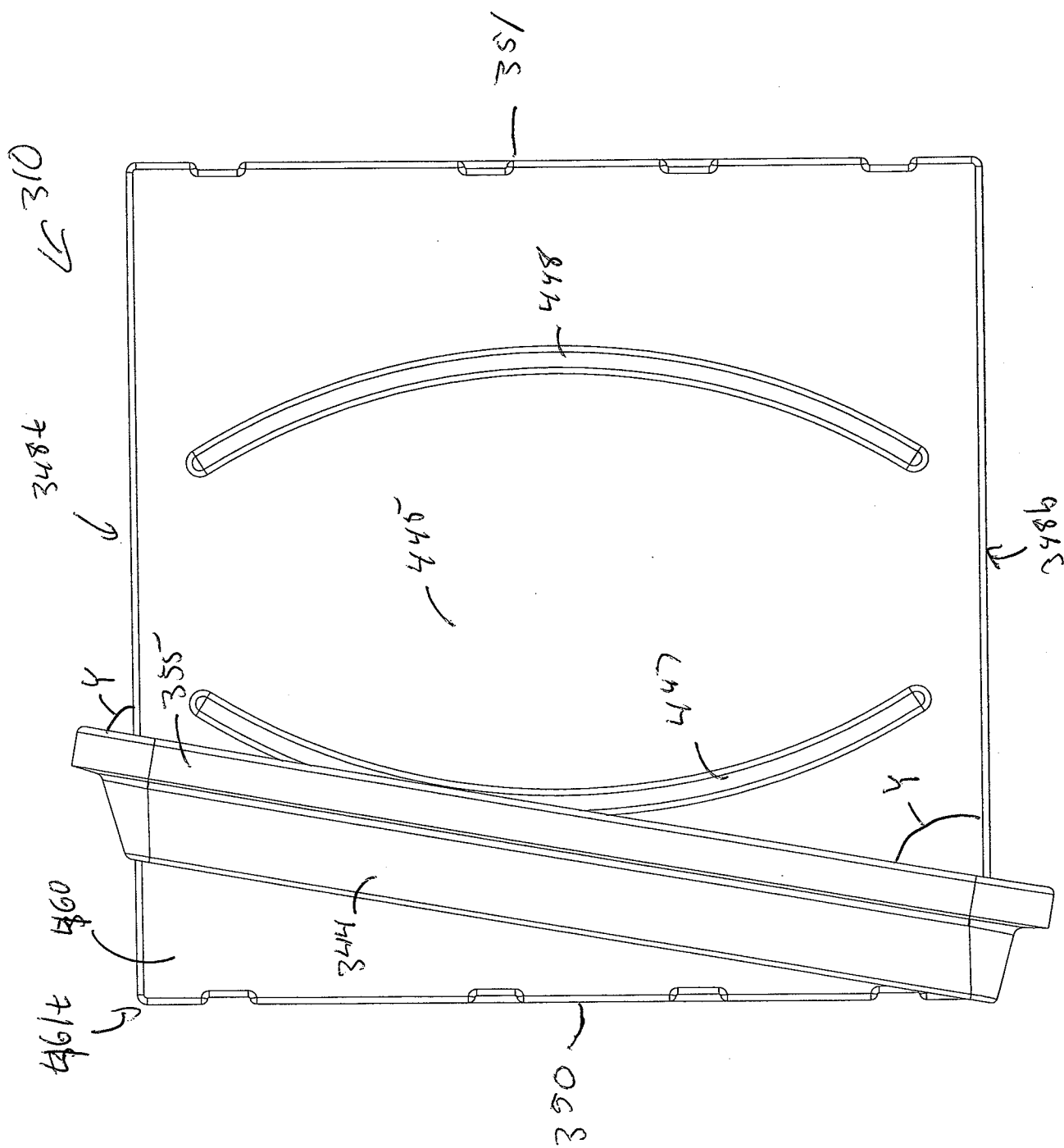


FIG. 25

FIG.26

