



- (51) International Patent Classification:  
*H01L 21/673* (2006.01) *H01L 21/02* (2006.01)
- (21) International Application Number:  
PCT/US2012/031906
- (22) International Filing Date:  
2 April 2012 (02.04.2012)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
61/470,766 1 April 2011 (01.04.2011) US
- (71) Applicant (for all designated States except US): **ENTEGRIS, INC.** [US/US]; 129 Concord Road, Billerica, MA 01821 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **SMITH, Mark, V.** [US/US]; 4110 Bobbie Kay Place, Colorado Springs, CO 80908 (US). **BURNS, John** [US/US]; 6046 Bow River Drive, Colorado Springs, CO 80918 (US).
- (74) Agents: **CHRISTENSEN, Douglas, J.** et al.; Patterson Thuente Christensen Pedersen, P.A., 4800 IDS Center, 80 South Eighth Street, Minneapolis, MN 55402-2100 (US).
- (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, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, 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, RS, SE, SI, SK,

[Continued on next page]

(54) Title: SUBSTRATE SHIPPER WITH LOCKING DEVICE

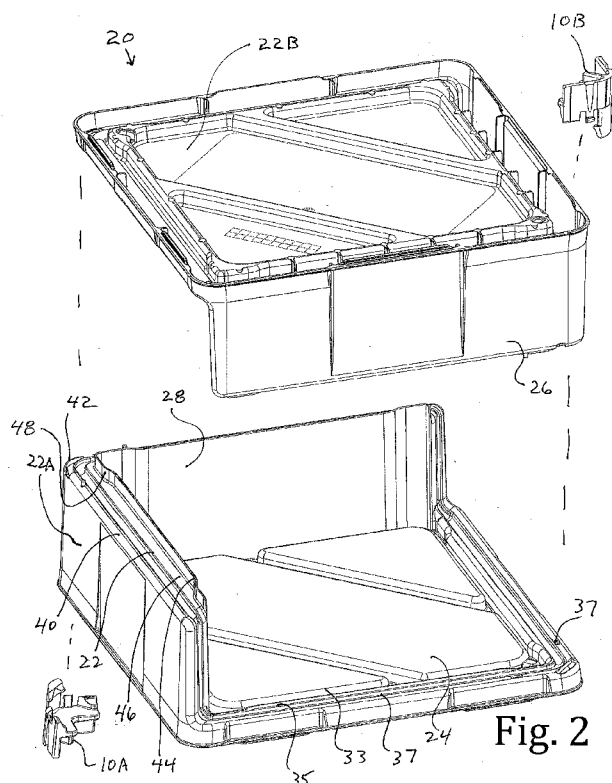


Fig. 2

(57) Abstract: The invention is directed to a two piece shipping package such as a substrate shipping container that is used to ship solar cells or other substrate wafers and locking device for use therewith. One or more latching members having permanent and multi-use tab features are used to join the components of a readily constructed container. The container is generally made up of two identical container portions, each container portion having a horizontally-disposed base member and two vertically disposed side members constructed of impact-absorbing double walls. The locking device provides an integrated locking snap connector that holds two container portions together at opposing corners, the containers of which are generally shaped for being readily coupled with one another in reversed and inverted orientations.



SM, 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))*

## SUBSTRATE SHIPPER WITH LOCKING DEVICE

### RELATED APPLICATION

5 This application claims the benefit of U.S. Provisional Patent Application No. 61/470,766, filed on April 1, 2011, the disclosure of which is hereby incorporated by reference in its entirety.

### FIELD OF THE INVENTION

10 The present invention relates to a substrate shipping container with a locking device. More particularly, the present invention relates to a two piece container for packaging substrates such as solar cell wafers having a locking device used to lock the two pieces together.

### BACKGROUND OF THE INVENTION

15 Solar cells are manufactured from substrates and accordingly are fragile, requiring significant protection and care when being transferred from one location to another. Containers and packaging for such devices need to be well suited for the task. Clean and largely contamination free environments during their transport and in between manufacturing process steps are also important. Additional required or desirable characteristics of containers to transport and/or store substrates like solar cells include light weight, rigidity, cleanliness, and cost effective manufacturability. Such containers need to keep the wafers clean, uncontaminated, and undamaged.

20 Wafers and solar cells require protection before, during, and after shipping. To enhance the protection of these items it is desirable to reduce the number of transfers these wafers and cells make. It is further advisable to reduce the number of carriers that are required to be managed and to reduce any cell damage that might occur during the transfer or handling process.

25 A desired aspect of a shipping container having multiple pieces is that the pieces of the shipping container be readily secured and unsecured in a reliable way. Moreover, a locking component which is inexpensive and easy to integrate with container features is

needed. It is desirable that this locking structure be reusable and able to be easily assembled.

## SUMMARY OF THE INVENTION

Embodiments of the present invention are directed to a two piece shipping package  
5 such as a substrate shipping container that is used to ship solar cells or other substrate  
wafers that includes a latch that may be configured as a latching member attachable to  
container components. One or more latch members having latching portions are used to  
join the components of a readily constructed container. The container is generally made  
up of two identical container portions, each container portion having a horizontally-  
10 disposed base member and two vertically disposed side members constructed of impact-  
absorbing double walls. The latching member may be configured as a locking snap  
connector that has a finger portion and a wedge portion with a retaining surface that  
secures two container portions together at opposing corners, the containers of which are  
generally shaped for being readily coupled with one another with one in a reversed and  
15 inverted orientation from the other.

In some embodiments, the latching device includes a unitary connector of multiple  
tab features that may be integrated into apertures in opposing corners of a substrate  
shipping container. Each latching member may generally have two perpendicularly-  
disposed sides that intersect to form a common corner. The corner of the latching member  
20 further includes a central locking snap and smaller adjacent permanent snaps on either side  
of the central snap at spaced apart locations. Further, horizontally and vertically disposed  
support structures of the device serve to reinforce the structure. The latching member  
provides a permanent or semi-permanent snap fit to a first of two interlocking container  
portions and a multi-use temporary snap fit to the second container portion. Accordingly,  
25 a two piece substrate shipping container that requires only two latch devices in diagonally  
opposing corners of the container is made possible.

## DESCRIPTION OF THE DRAWINGS

Figures 1 is a perspective view of an assembled two piece substrate shipping  
container connected by latching portions according to the invention.

Figure 2 is an exploded view of a two piece substrate shipping container and latch members according to the invention herein.

Figure 3 is a top view of an assembled two piece substrate shipping container and latch members according to the invention herein.

5        Figure 4 is a top view of an assembled two piece substrate shipping container without latch members according to the invention herein.

Figure 5 is a perspective view of a latching member according to the invention herein.

10       Figure 6 is a perspective view of a latching member according to the invention herein.

Figure 7 is a perspective view of a latching member according to the invention herein.

Figure 8 is a perspective view of a container portion of a two piece substrate shipping container and a latching member according to the invention herein.

15       Figure 9 is a view of the container portion of Figure 8 according to the invention herein.

Figure 10 is a partial cross-sectional view through the center of a latching member when assembled in the substrate shipping container according to the invention herein.

20       Figure 11 is a partial perspective view of a container portion for a substrate shipping container according to an embodiment of the present invention.

## DETAILED DESCRIPTION

While various compositions and methods are described, it is to be understood that this invention is not limited to the particular compositions, designs, methodologies or protocols described, as these may vary. It is also to be understood that the terminology  
25       used in the description is for the purpose of describing the particular versions or

embodiments only, and is not intended to limit the scope of the present invention which will be limited only by the appended claims.

Referring to Figures 1-4, a substrate shipping container 20 incorporating latch members 10 according to an embodiment of the present invention is illustrated. In general, two latch members 10 having different orientations are associated with each substrate shipping container. The two latch members 10 are identical in terms of structure, although they are generally shown in reversed and inverted orientations. The latch members 10 may also be referred to as latch members 10A and 10B here at times for convenience of description. The shipping container 20 comprises generally two portions 22, namely, a first container portion 22A and a generally identical second container portion 22B. Each container portion, has a base wall 24 and a pair of double side walls 26 and 28. The container portions 22 are preferably made of a polypropylene material or other polymer material or, alternatively, of a molded pulp material. Polypropylene materials, other plastics, and molded pulp materials are believed to be suitable materials to sensitive shipping applications.

The base wall 24 is generally horizontally-disposed with four sides defining four corners and serves as the bottom or top of the shipping container. Square or pseudo square wafers or substrates, such as solar cells, may be horizontally stacked in a coin stacked disposition on the base 24. Surrounding the base 24 is an integrally formed shallow latching groove 35. This groove 35 extends along the two sides of the container portion 22 which do not contain side walls. An inner groove 33 can also extend around base 24. The side walls 26 and 28 are generally vertically-disposed with respect to the horizontal plane of the base and have a hollow interior. The outer walls 36 and inner walls 38 join one another at a top edge 40. This top edge 40 bends at corner 42 to form an "L" shape protrusion that serves as an engagement structure. In some embodiments, such as shown in Figures 1 and 2, a further inner lip 44 at a top of the wall and groove 46 is shown inside the top edge 40 which contains a recessed corner 48 to protect the fragile corners of the wafers or solar cells 30. This can be seen in Figure 2, for example. When container portions 22A, 22B are mated together, inner lips 44 define insert portions on each container portion that can interface with inner grooves 33 on the opposite portion to constrain the container portions relative to each other.

Figure 3 generally illustrates a top view of an assembled shipping container 20 where latch members 10 are used. Figure 4 illustrates a similar view of an assembled shipping container 20 where latch members 10 have not been used to latch the assembly together. Specifically, only a small portion of each of the latch members 10A and 10B can be seen in the assembled configuration of Figure 3.

Figures 5-7 illustrate perspective views of the latching member 10 from various views. In general, the latching member 10 is a unitary connector defined by two outer side walls 60 and 62, a centrally disposed locking snap or latch member or portion 64, two spaced apart permanent or semi-permanent latching tabs 66 and 68, horizontally-disposed support structure 70, and a vertically-disposed support structure 72. The latching member 10 may be made of polypropylene or other similar materials, for example.

In general, the side walls 60 and 62 are perpendicularly aligned with one another and have relatively flat exterior surfaces. However, the corner 74 at which the walls converge can have a rounded outer surface and a pair of recessed features at the base of the latching tabs 66 and 68. Centrally disposed at the rounded corner 74 of the device extends latching snap 64. The latching portion 76 of the snap 64 can be configured as a snap lip and can extend toward the interior of the device. Further, the top of the snap lip 76 can have a central recessed area. Adjacent this latching snap 64 in spaced-apart relation on side walls 60 and 62 are a pair of smaller permanent latching tabs 66 and 68. These tabs 66 and 68 do not extend as high as the latching snap 64 and can have tab lips 78 which extend away from the interior of the device, in a direction opposite of snap lip 76.

On the interior side of the device, a horizontally-disposed support structure 70 extends around the inside perimeter of the side walls 60 and 62. This support structure 70 is located near the middle of the latching device and is supported at its center by a vertically disposed support structure 72. The vertical support structure 72 extends inwardly from the base of the rounded corner 74. These structures 70, 72 provide structural rigidity for latching member 10.

Prior to assembly of the entire container 20, the latching members 10 may be initially assembled into their respective container portions 22, as shown in Figures 8 and 9. Specifically, the latching members 10 are each inserted up through the hollow interior of the impact-absorbing double walls 26 and 28 and partially out elongate apertures 80

located at the container corners 42. When the latching members 10 are inserted through these apertures 80 the permanent locking tabs 66 and 68 catch in recesses 82 in the upper lip of the container walls 26 and 28 in a secure fashion. The tabs 66 and 68 are not easily deflected and, accordingly, latching members 10 are effectively joined to their respective container portion 22 by these tabs 66 and 68. In one embodiment, minimal to no clearance between aperture 80 and tabs 66 and 68 is provided such that locking device 10 is effectively permanently attached to container portion 22 when joined therewith. In another embodiment, locking device 10 can be readily removable by forcing tabs 66, 68 backwards off of recesses 82 and into opening 80. Locking snaps 64 are shown to remain projecting through apertures 80 in Figure 8 and a second temporarily unused receiving aperture 84 at the corner opposite the locking snap 10 can be seen. Aperture 84 can define a latch engaging or engagement portion by virtue of one or more of the walls that define aperture.

After the latch members 10 are engaged and the bottom container portion 22A is subsequently loaded with substrates, the container 20 is ready for completion of assembly. Accordingly, a first container portion 22A may be releasably engaged with a second container portion 22B to complete the shipping container. First, the second container portion 22B is inverted and rotated 180 degrees with respect to the first container portion 22A. The top edge 40 of the first (lower) container portion 22A is fit into the groove portion 35 of the second container portion 22B. The top edge 40 of the second container portion 22B is aligned with the groove portion 35 of the first container portion 22A. In one embodiment, the top edges 40 and groove portions 35 are fit together in an interference fit with one another in a tongue and groove fashion. In another embodiment, the top edges 40 and grooves 35 do not interlock or abut each other. The locking snap 64 of container portion 22A is fit within the open aperture 84 of container portion 22B, and the locking snap 64 of container portion 22B is fit within the open aperture 84 of container portion 22A.

As locking snap 64 is inserted through aperture 84, the angled surface 63 of snap lip 76 engages an inner rim 83 of aperture 84 to deflect locking snap 64 outwardly away from inner rim 83 so that it can extend through aperture 84. When the angled surface 63 of snap lip 76 has passed through aperture 84, the locking tab 64 snaps back from its deflected state such that snap lip 76 positively interlocks with inner rim 83 to prevent

locking tab 64 from being disconnected from container portion 22. In addition, as the container portions 22A, 22B are mated, locating nubs 85 on each container portion can mate with cooperating apertures 37 on the opposing container portion. In one embodiment, apertures 37 are more elongate than locating nubs 85 to provide a tolerance  
5 for fitting nubs 85 within apertures 37.

Figure 10 illustrates a cross-sectional view through the center of a locking device 10 in a corner 42 of an assembled substrate shipping container 20. The engagement of snap feature 64 through the apertures 80 and 84 of both of the container portions 22A and 22B can be seen as well as the general location of the locking device 10 within the  
10 surfaces of the container portions. The snap lip 76 can be seen in releasable engagement with the container portion 22B as well. An S-shaped portion of the upper container portion 22B is slightly compressed and constrained between the latch portion 64 and the top 94 of the wall portion.

Accordingly, once the container 20 is assembled and the latch portions or snaps 64  
15 of the latching members 10 are engaged, the container can be readily transported and shipped. Once the containers 20 reach their intended location, they may be disassembled and the substrates may be removed. Note that the locking snaps 64 are formed such that they are not permanently engaged within the apertures 84, and accordingly, may be disengaged by a user when he or she desires to reopen the container 20. To unlatch the  
20 container portions 22A, 22B from each other, the locking tab 64 can be bent outwardly to provide a clearance between snap lip 76 and inner rim 83 of aperture 84 to allow snap lip 76 to be removed through aperture 84, thereby disengaging locking device 10 from the opposing container portion.

A further aspect of these latch members 10 is that they can be color coded, such  
25 that the devices may provide an indication of some aspect or condition of the various container cells/batch or the shipper. The latch members may be replaceable with like tabs of different colors when appropriate to show condition as well.

In another embodiment, latch members 10 can be unitarily formed with container portions 22A, 22B. In one embodiment, latching member 10 can be injection molded as a  
30 unitary portion of container portion 22. Such an embodiment can appear similar to the

embodiment shown in Figures 8 and 9. Lock tab 64 can be a unitary extension of container portion 22 that extends outwardly from top edge 40.

Further description and disclosure of embodiments of substrate shippers and related components and methods may be found in PCT Application Nos. 5 PCT/US11/58615 and PCT/US11/58622, which are hereby incorporated by reference.

While several exemplary articles, compositions, apparatus, method embodying aspects of the present invention have been shown, it will be understood, of course, that the invention is not limited to these embodiments. Modification may be made by those skilled in the art, particularly in light of the foregoing teachings. For example, components and 10 features of one embodiment may be substituted for corresponding components and features of another embodiment. Further, the invention may include various aspects of these embodiments in any combination or sub-combination.

### Claims

1. A container for shipping substrates, comprising:

a pair of like container portions, each container portion comprising a base portion have four sides defining four corners and a pair of side walls extending upwardly from the base portion at two adjacent sides of the four sides with the other two sides being open, the two adjacent sides meeting at a common corner;

the pair of like container portions, with one of the pair inverted with respect to the other, assembleable into a container configuration where two base engaging portions of the two side walls of each of the pair of container portions engage two side wall engaging portions of the base of the other of the pair of container portions;

a latch portion positioned at the common corner of each container portion distally positioned on the common corner with respect to the base; and

a latch engaging portion positioned at the corner of the base portion of each container opposite the common corner, the latch engaging portion of each of the pair releasably latching with the latch portion of the other of the pair.

2. The container of claim 1, wherein the two side walls of each container portion that confront the base of the other container portion and the two side wall engaging portions of the other container portion each include an insert portion and an insert portion receiving groove.

3. The container of claim 2, wherein the two side walls of each portion have the insert portion and the base of the other container portion has the two insert portion receiving grooves.

4. The container of any of claims 1 to 3, wherein each latch engaging portion includes in cross-section an S-shaped portion that is compressed when the pair of container portions are latched together.

5. The container of any of claims 1 to 4, wherein each latch portion is unitarily formed with the corresponding container portion.

6. The container of any of claims 1 to 5, wherein each side wall is a double side wall having spaced apart inner and outer wall portions defining a hollow space therebetween.
7. The container of claim 6, wherein the latch portion is a part of a latching member that is selectively insertable into the hollow space in the double side walls, such that the latch portion extends through an aperture in a distal end of the common corner where the side walls meet.
8. The container of any one of claims 6 or 7, wherein the latching member further includes at least one lock tab having a tab lip, the tab lip operable to positively engage a recess in one of the side walls of the container portion to selectively lock the latching member in place on the container portion.
9. The container of any one of claims 6 to 8, wherein the latching member includes a pair of lock tabs disposed on opposing sides of the latching member for retaining the latching member within the side walls.
10. The container of any of claims 1 through 9, wherein the container portions are molded from a polymer material.
11. The container of any of claims 1 through 9, wherein the latch engagement portion engages the latch portion of the corresponding container to deflect the latch portion away from said latch engagement portion into a deflected position as the latch portion is advanced passed the engagement portion, the latch portion resiliently returning from the deflected position to positively engage the latching portion with the engagement portion.
12. The container of any of claims 1 through 9, wherein the latch engagement portion is defined by an aperture through the base.
13. A container for shipping substrates, comprising:  
  
a pair of like container portions, each container portion comprising a base portion having four sides defining four corners and a pair of side walls extending upwardly from the base portion at two adjacent sides of the four sides defining a common corner with the other two sides being open;

a latch member extending outwardly from the common corner of each container portion, the latch member including a latching portion; and

a cooperating engagement portion on the corner opposite the common corner of each base portion for releasably latching to the latch member of the other of the like portions;

wherein the two container portions are engageable with each other with one of the container portions inverted to define an enclosed substrate receiving region with the latch member of each container portion cooperating with the engagement portion of the other container portion to selectively lock the container portions together, and wherein the engagement portion engages the latching portion of the corresponding latch member to deflect the latch member away from said engagement portion into a deflected position as the latching portion is advanced passed the engagement portion, the latch member resiliently returning from the deflected position to positively engage the latching portion with the engagement portion when the latch portion is positioned beyond the engagement portion.

14. The container of claim 13, wherein the latching portion is configured as an angled surface.

15. The container of any one of claims 13 and 14, wherein the engagement portion is configured as a wall defining in part an aperture extending through the base.

16. The container of any one of claims 13 through 15, wherein each latch portion has a wedge shaped portion.

17. The container of any of claims 13 through 16, wherein each side comprises an inner wall portion and an outer wall portion with a cavity therebetween.

18. The container of any of claims 13 through 17, wherein the latch member is insertable into the cavity between the inner wall and outer wall such that the latch portion extends through an aperture the common corner where the side walls meet.

19. The container of any of claims 13 through 18, wherein the latching member further includes at least one lock tab having a tab lip extending in a direction opposite of the

latching portion of the latch member, the tab lip operable to positively engage a recess in one of the side walls of the container portion to selectively lock the latching member in place on the container portion.

20. The container any of claims 13 through 19, wherein the latching member includes a pair of lock tabs disposed on opposing sides of the latching portion.

21. The container any of claims 13 through 20, wherein the container portions are molded from a polymer material.

22. The container of any of claims 13 through 21, wherein the container portions are engageable with each other such that an insert portion of each side wall engages a cooperating groove in the opposing base.

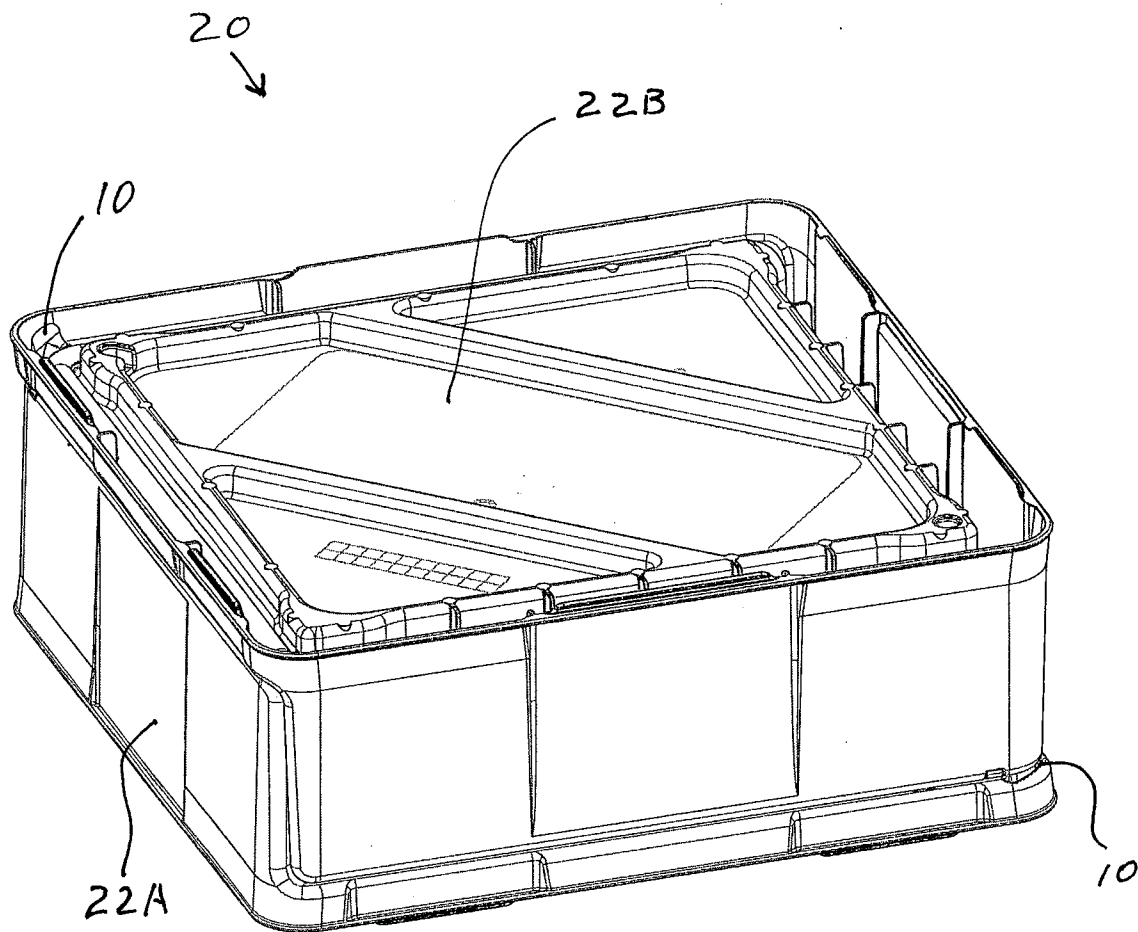
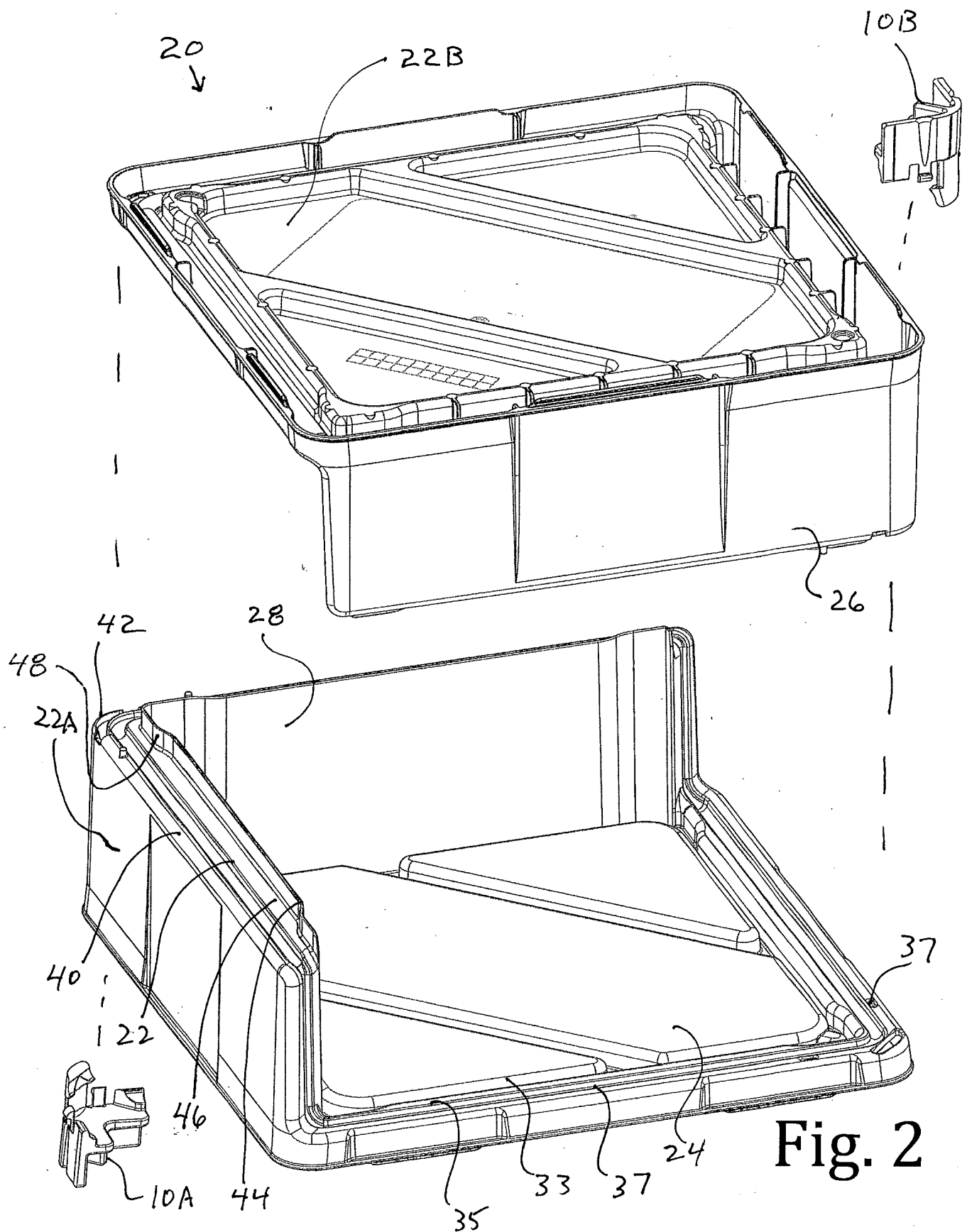
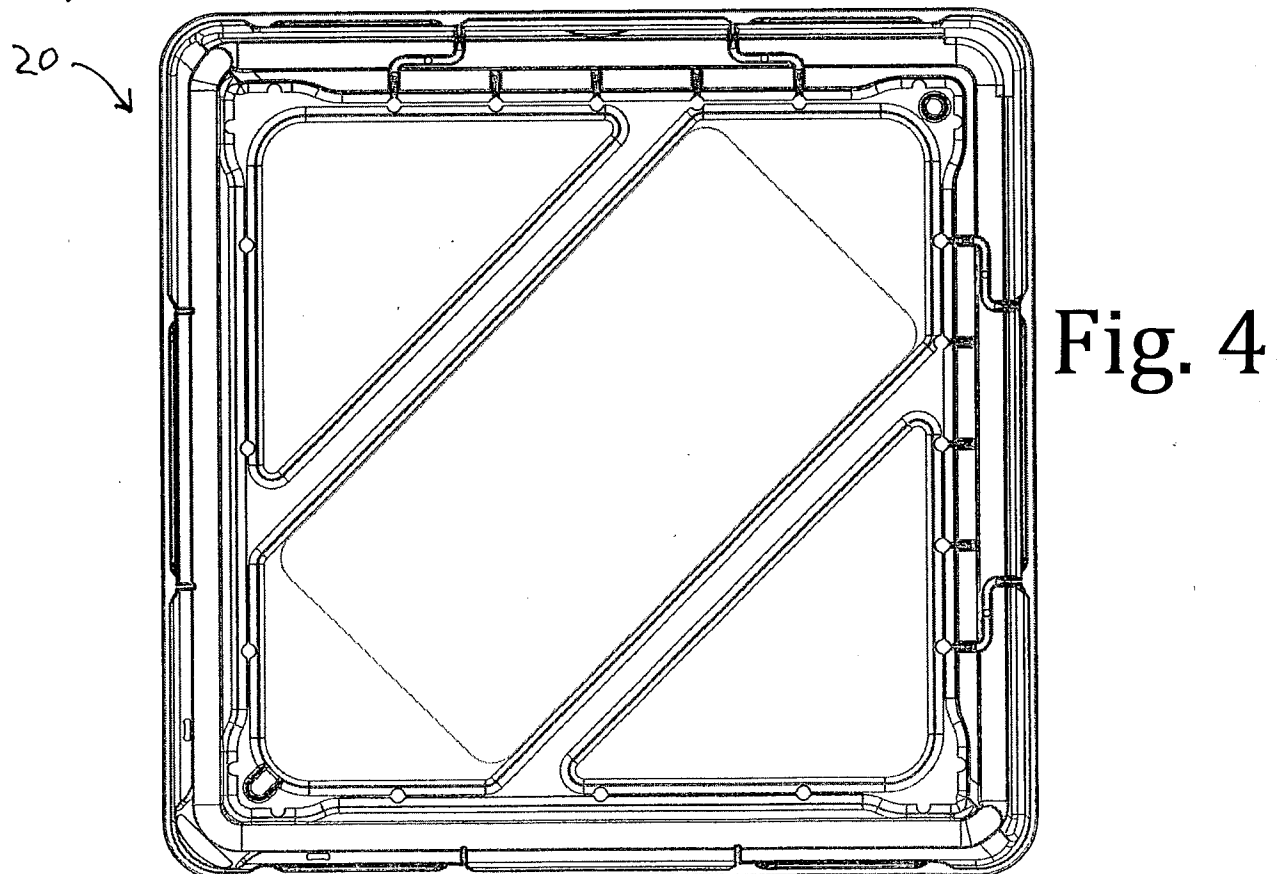
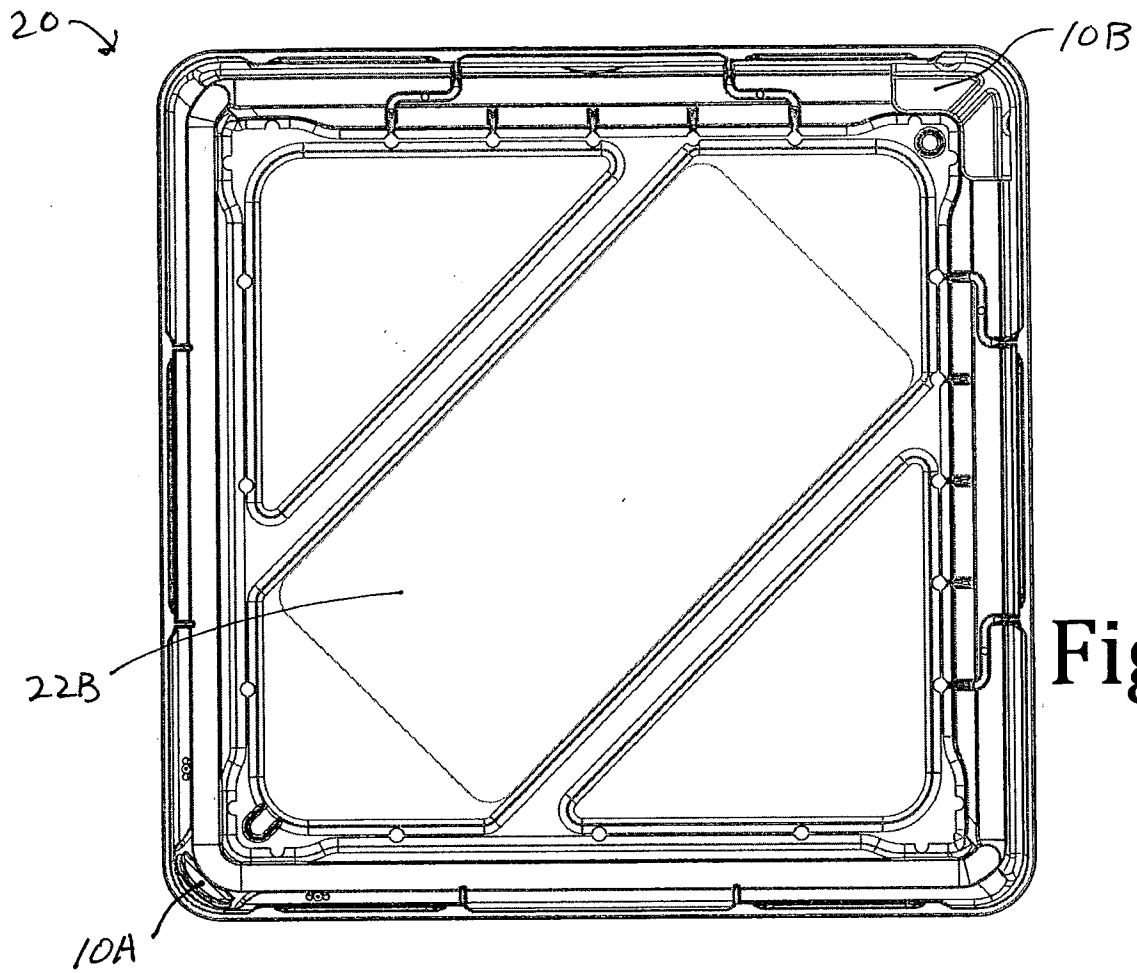


Fig. 1





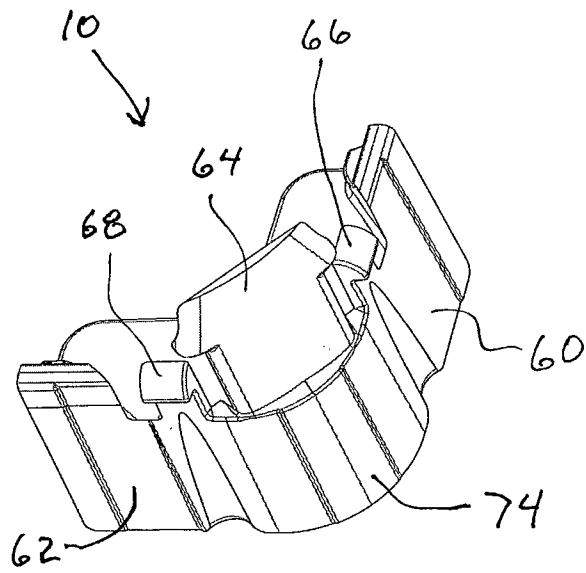


Fig. 5

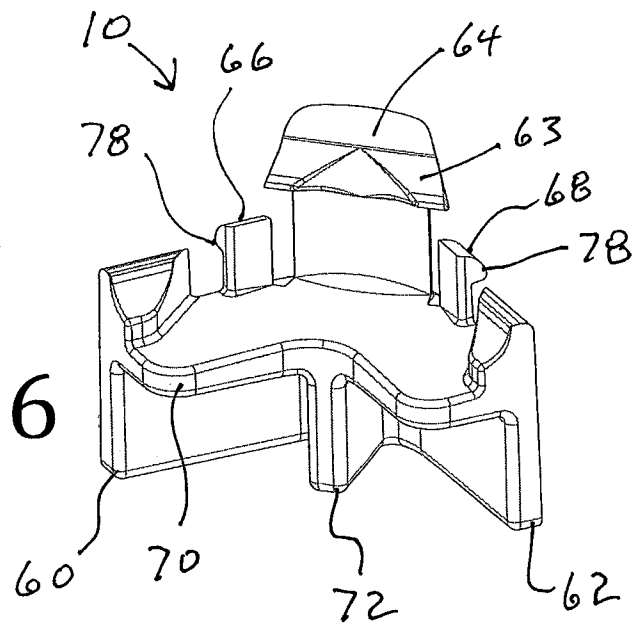


Fig. 6

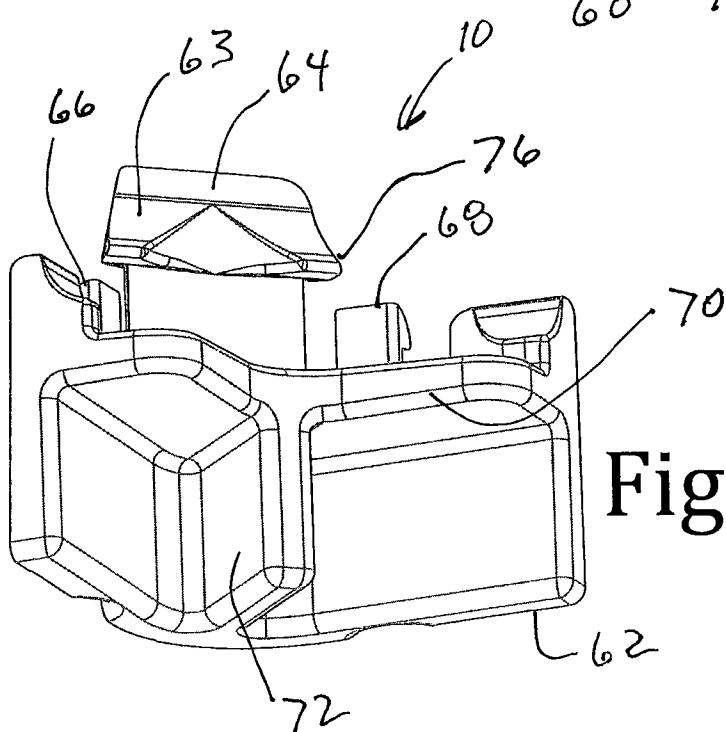
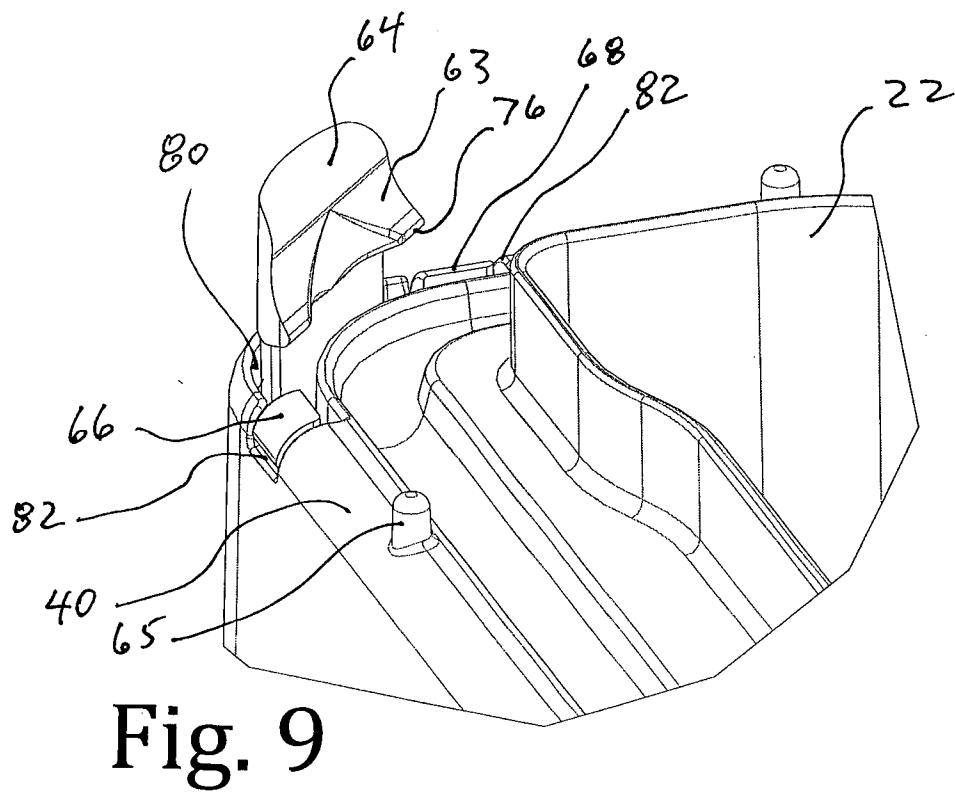
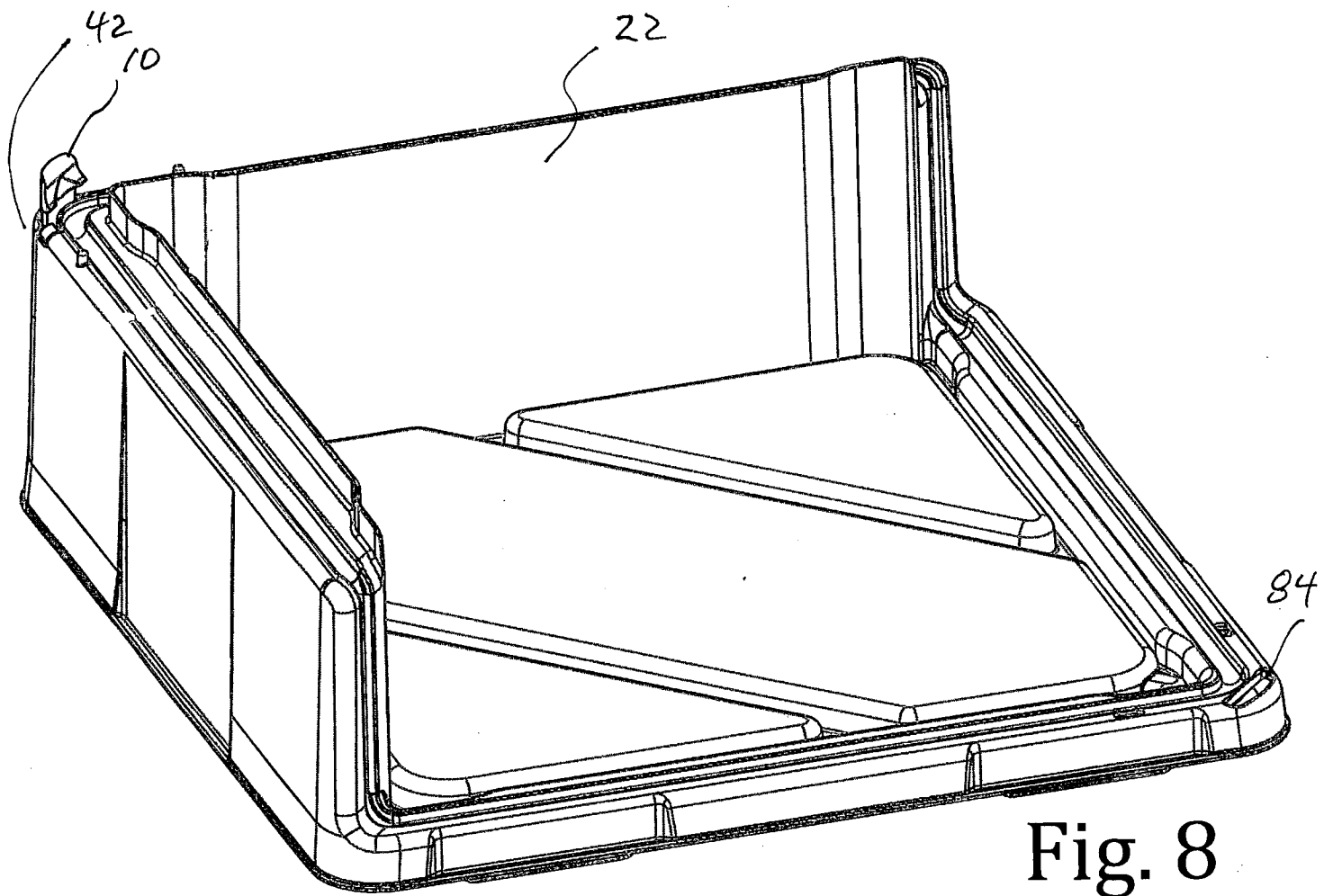


Fig. 7



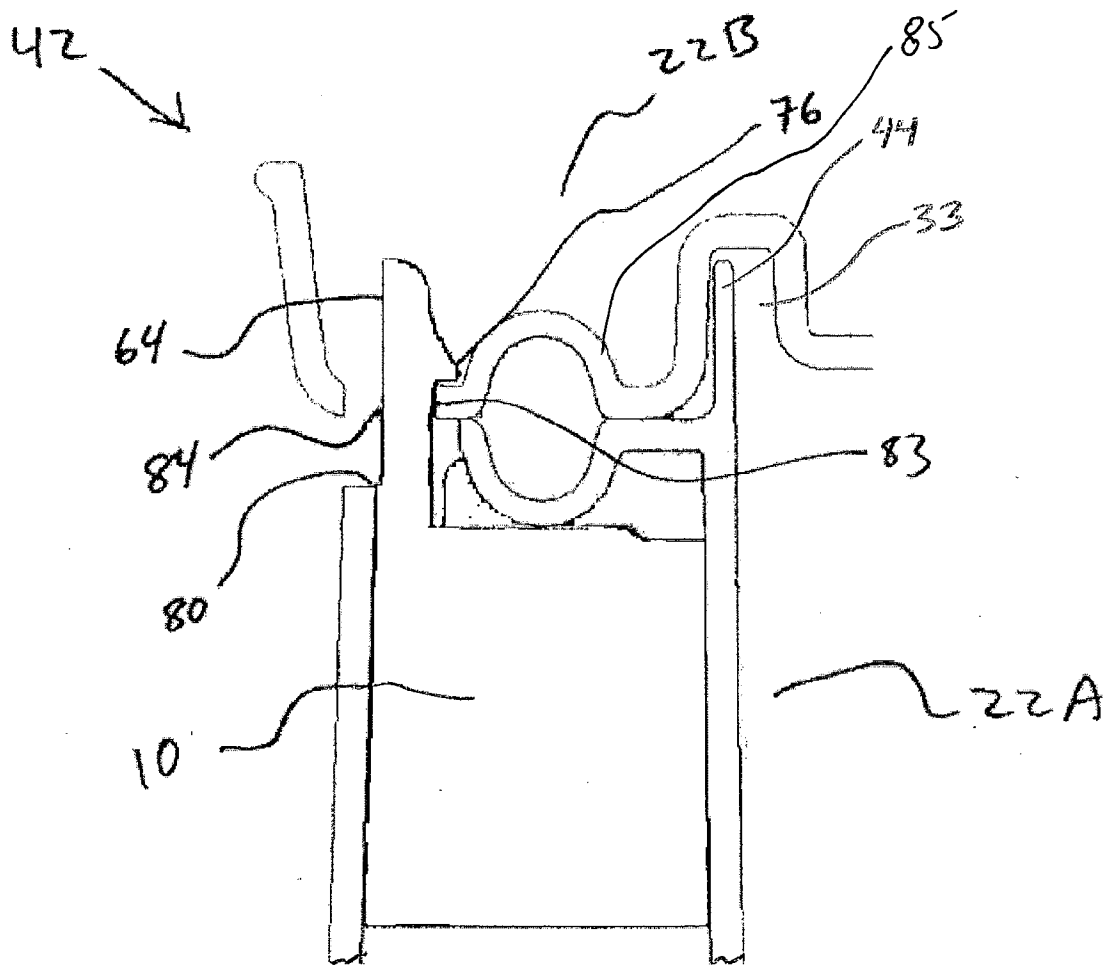


Fig. 10

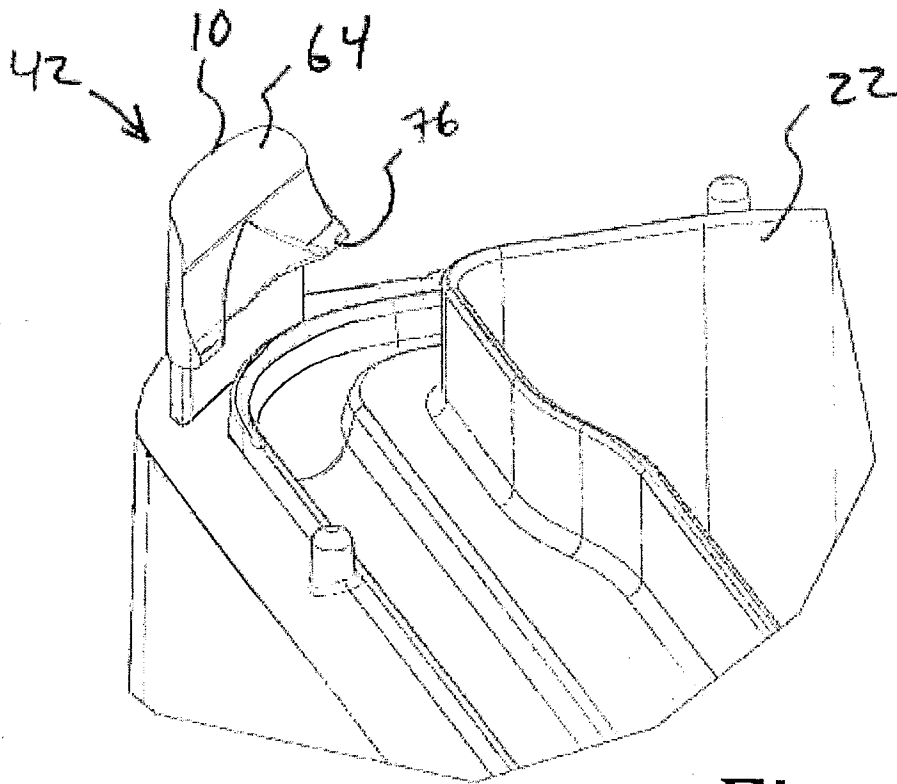


Fig. 11