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S. [US/US]; 306 2nd Avenue NW, New Prague, MN 56071 (US). **THOMAS, Ronald, E., Jr.** [US/US]; 1 Manaer Flats, P.O. Box 792, Mount Baldy CA 91759 (US).

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(74) Agents: **CHRISTENSEN, Douglas, J.** et al.; Patterson, Thuente, Skaar & Christensen, P.A., 4800 IDS Center, 80 South 8th Street, Minneapolis, MN 55402-2100 (US).

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(71) Applicant (*for all designated States except US*): **ENTEGRIS, INC.** [US/US]; 3500 Lyman Boulevard, Chaska, MN 55318 (US).

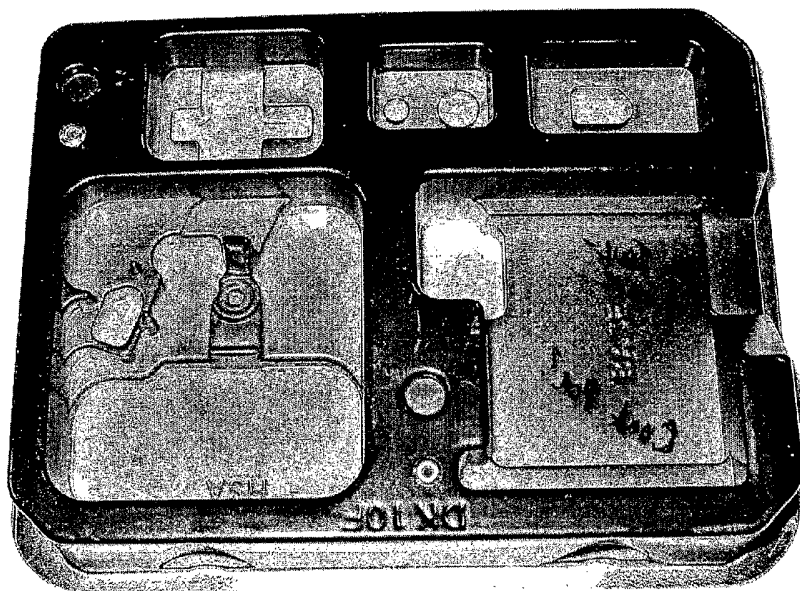
(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **ADAMS, Michael,**

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[Continued on next page]

(54) Title: UNIVERSAL PACKAGING TRAY FOR DISK DRIVE ASSEMBLY



(57) Abstract: A universal component carrier tray for use in assembly line production of disk drives includes a framework structure that defines a number of openings of variable size and geometry. Tray portions having form-fitting structure for receiving the unique and varying configured componentry of disk drives are removably seatable into the openings. The framework and tray portions are preferably injection molded for facilitating extended life and better constaint of the componentry. The trays have stacking structure allowing a plurality of the trays to be stacked whereby each tray stacked above a tray serves as a retainer or closure for the tray below that may prevent the components from being dislodged or misoriented from the holding structure during handling of the stack and protect the components from particulate contamination.



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UNIVERSAL PACKAGING TRAY FOR DISK DRIVE ASSEMBLY

Related Applications

This application claims benefit of U.S. Provisional Application Ser. No. 60/611,064, filed September 17, 2004, which is hereby fully incorporated herein by
5 reference.

Field of the Invention

The present invention relates to component trays. In particular, the invention relates the component trays for use in an assembly line production of hard disk drives.

Background of the Invention

10 The assembly of hard disk drives for the computer industry involves the conveyance of component parts through a manual assembly line. The components are typically loaded into a pocket tray carrier like the one shown in prior art FIG. 1. The pocket tray may be used to arrange the components in a sequential manner relative to the assembly process, as well as in a particular orientation that allows the assembler to
15 complete a task more efficiently. Often, the pocket trays are loaded in advance and are stored for a period of time before being transported through the assembly process. As a practical matter, storage of the loaded trays involves stacking and relocating them to a temporary storage area.

During the assembly process, the loaded trays are placed on a conveyor for
20 transport through the various phases of assembly. Assemblers must remove the components from the pocket tray by hand. At the end of the assembly process, the empty trays are typically collected and cleaned before being returned to start the process anew.

The pocket tray of prior art FIG. 1 was fabricated using a thermoforming process. The shape of the various pockets, as well as the protrusions and recesses unique to each
25 pocket, aid in the preferred sequencing and the proper orientation of the components for the assembly process.

There are certain inherent disadvantages to using the thermoformed pocket tray for assembly line processing. The pocket concept often makes it difficult to remove certain components from the tray. Some of the smaller components that are housed in the lower recesses of a given pocket are difficult to grasp with human fingers. Also, in the process of stacking, relocating and unstacking the pocket trays, the components do not always retain the preferred orientation. These problems tend to slow the assembly process, thereby reducing overall productivity.

The pocket tray carrier is also inherently difficult to clean. The pocket geometry is prone to recirculation in the corner regions during the wash down process. The recirculating solution can collect in these areas and leave a residue that is undesirable from the standpoint of contamination control.

Finally, the thermoformed tray has a life expectancy of only a few months. The thin walls and cross members are subject to wear and fracture after repeated washing, stacking and handling.

Summary of the Invention

The various embodiments of the invention herein presented feature an improved component tray system for the assembly of hard disk drives. A plurality of stackable like-configured trays each have a framework preferably configured as a framed lattice structure of cross-members and periphery members defining a plurality of openings with a plurality of tray portions removably seated therein. Each tray portion having form-fitting structure for constraining various componentry for assembly of disk drives.

In a preferred embodiment, the lower edges of the cross-members and periphery members may be flush with respect to each other so as to define a registration plane. Each of the openings have at least one support that extends laterally from the lower edges of cross-members such that the upper surfaces of the supports are flush with the registration plane.

A plurality of inserts configured as individual tray portions, preferably one tray portion for each opening in the lattice structure, are dimensioned to seat within the

openings, thereby registering against the upper surfaces of the supports and preferably frictionally engaging against the cross-members of the respective opening.

The inserts each have a base, floor surface or mounting surface. Form fitting structure configured as protrusions preferably extend upward from the mounting surface or
5 base and are shaped in a manner that secures or constrains the individual componentry.

The lattice structure is preferably formed from a thermoforming or an injection molding process. The openings need not be of uniform dimension and are preferably of various optimal or desirable sizes defined by irregular spacing between cross-members and periphery members. Moreover, the openings may be of any shape that is amenable to
10 the components being assembled. For example, a tray may have a series of rectangular openings, a series of circular or elliptical openings, a combination of rectangular and elliptical openings, or odd-shaped openings to accommodate sets of or specific components.

Each tray has stacking structure, for example, support columns that define the
15 overall height of the tray on each of the four corners of the tray. These columns allow the trays to be stacked and laterally constrain each tray with respect to any adjacent tray. The columns are configured so that the foot of the column mate with the top of the column of the tray below when stacked for example by male-female or other engaging structure.

An advantage of the present invention is the ease of both loading and removing
20 components from the inserts relative to the pocket tray carrier. With conventional pocket carriers, personnel are constrained by the side walls of the pockets, allowing access only from the top of the pocket. Often, the constraints imposed by a given pocket makes the grasping of components therein difficult, both in the loading and in the assembly line phase. With the present invention, the tray portion or insert can be readily removed from
25 the tray, where after an assembler can access the components on the insert from all sides as well as from the top, that is the fingers or pickup tool does not have to go into a pocket. Moreover, a select portion after the insert has been loaded or the component removed, the insert is readily placed back into the tray.

Moreover, the removable trays allow different tray portion sets configured to
30 receive different component sets to be used in the same framework. Additionally, the

removable tray portions create a modular system where individual parts of the trays may be replaced or cleaned separate from the other parts. Moreover the different components, that is the framework and plurality of tray portions may be made of different materials. Additionally the framework could be injection molded and the tray portions could be
5 vacuum formed.

Another advantage of preferred embodiments of the present invention is that the protrusions that retain the components on the inserts may be dimensioned so that the upper surfaces of the components are at a uniform height when installed on the insert and mounted in the tray. Thus, when a given tray is loaded with components and stacked with
10 other trays, the bottom surfaces of the tray assembly above it serves as a cover that assures components will not dislodge from the protrusions.

Still another advantage of preferred embodiments of the present invention is that protrusions may also be more intricately shaped for better retention of components. Thermoformed trays are inherently non-intricate with respect to the profile of a given
15 protrusion. The preferred injection molding process of the present invention is not so limited. Hence, the protrusions can be designed to better capture components, making them less susceptible to dislodgement or orientation changes during handling.

Another advantage of the various embodiments is that the present invention, in the embodiments relating to injection molding of the lattice structure or the tray portions
20 provides a more durable handling device with an expected longer life than the prior art.

A further advantage of the present invention is that a variety of unique insert configurations can be utilized in the same lattice structure. The thermoformed trays of the prior art can be loaded with only the components of a single disk drive. If one minor change is required to just one of the pocket compartments, the whole tray must be
25 replaced. With the present invention, only the insert that houses the modified component or layout need be replaced.

Another advantage of the present invention is that the assembly is less difficult to clean than the pocket tray design. Pocket trays are prone to wash recirculation zones in the corners of the pockets during the washing process. The present invention can be

configured to be free of pocketed geometries, resulting in open surfaces that are easier to wash off.

Brief Description of the Drawings

FIG. 1 is a thermoformed pocket tray of the prior art;

5 FIG. 2 is an isometric projection of an assembled component carrier tray according to the invention, as viewed from above;

FIG. 3 is an isometric projection of an assembled component carrier tray according to the invention, as viewed from below;

FIG. 4 is an isometric projection of the invention with inserts removed;

10 FIG. 5 is a cross-sectional view of an exemplary cross-member;

FIG. 6 is an isolation view of an exemplary insert of the invention;

FIG. 7 is an isolation view of an exemplary insert of the invention;

FIG. 8 is an isolation view of an exemplary insert of the invention;

FIG. 9 is an isolation view of an exemplary insert of the invention;

15 FIG. 10 is an isolation view of an exemplary insert of the invention with components mounted;

FIG. 11 is an isolation view of an exemplary insert of the invention with components mounted;

20 FIG. 12 is an isolation view of an exemplary insert of the invention with components mounted;

FIG. 13 is an isolation view of an exemplary insert of the invention with components mounted;

FIG. 14 shows an embodiment of an assembled, unloaded component carrier tray according to the invention;

FIG. 15 shows an embodiment of an assembled, loaded component carrier tray according to the invention;

5 FIG. 16 shows a stack of loaded trays of the invention;

FIG. 17 shows a portion of a tray according to the invention;

FIG. 18 shows a cross-sectional view of the FIG. 17 embodiment of the invention;

FIG. 19 shows a stack of trays in cross-section according to the invention;

10 FIG. 20 shows an embodiment of the invention having circular and elliptical openings.

Detailed Specification

An embodiment of the present invention in the form of a component carrier tray 10 is shown in FIGS. 2 - 4. Figures 2 and 3 respectively show a top view and a bottom view of tray 10 in full assembly, while FIG. 4 shows tray 10 without inserts. Tray 10 has a framework 30 with peripheral members 31 and cross-members 40 that create a lattice structure 20 having openings 50. Lattice structure 20 has an upper surface 120 that may be substantially planar. Frame 30 may have an integral skirt 55 that projects downward to define a lower extremity 57 of tray 10. Tray 10 may be configured such that the bottom surfaces 60 of cross-members 40 are flush with respect to each other, thereby defining a registration plane 70. A multiplicity of support structures 80 integral to bottom surfaces 60 project laterally from frame 30 and cross-members 40 such that the upper surfaces (also referred to as registration surfaces 90) of support structures 80 are also tangent to registration plane 70. Support structures 80 may be such that they cantilever from a single cross-member 40, or the support structures may span between two cross-members 40 or between a cross-member 40 and frame 30, as shown in FIG. 4.

A number of spacer or support columns 92 project upward from frame 30 and terminate at an upper end 95. In this particular embodiment, spacer columns 92 are

located at the corners of frame 30, and are dimensioned and positioned so that when a second tray is placed on top of a first tray, upper end 95 of a given spacer column 92 fits within the boundaries of skirt 55 of the second tray (see FIG. 14).

Referring to FIG. 5, the structural integrity of both the cross-members and the support structures may be enhanced by configuring cross-member 40 with a rib 45 that projects downward from bottom surface 60 and below registration plane 70. While the FIG. 5 embodiment depicts a hollow cross-member, cross-member 40 may also be solid.

A plurality of inserts 100 configured as tray portions are seated within receiving regions configured as openings 50 of lattice structure 20. In other embodiments some or all of the receiving regions may be closed and be defined areas of the tray framework. Tray portions 100 rest on registration surfaces 90 of support structures 80. Referring to FIGS. 6 - 9, exemplary inserts 100 are shown in isolation. Each insert 100 has a perimeter 160 and an upper or mounting surface 110 that, when seated in opening 50, may be substantially flush with upper surface 120 of lattice structure 20.

The embodiment of FIGS. 2 - 9 illustrate a number of ways to secure inserts 100 to lattice structure 20. First, frame 30 and each of cross-members 40 have a multiplicity of nubs 150 that project slightly into openings 50. The nubs are dimensioned so that when an insert 100 is placed into an opening 50, nubs 150 that are in a given opening are in simultaneous and frictional contact with perimeter 160 of insert 100. The frictional force thus generated retains insert 100 within lattice structure 20. Alternatively, insert 100 may be dimensioned to form an interference fit with lattice structure 20 without use of nubs 150.

Another retention means is provided by a retention finger structure 170 that works in conjunction with a clip 200. Retention finger structure 170, located on one edge of a given opening 50, is integral to or otherwise connected or bonded to upper surface 120 of lattice structure 20 and extends laterally over opening 50 such that the lower surface of retention finger 170 is substantially flush with upper surface 120 of lattice structure 20. Each insert 100 has a leading edge 180 that, when inserted into opening 50, slides under retention finger structure 170. Opposite leading edge 180 of insert 100 is a trailing edge 190. Clip 200 is located near trailing edge 190 of insert 100.

Referring to FIG. 9, clip 200 may be of an arcuate shape, having a proximate portion 210 that is integral to and extends upward from upper surface 110, and a distal portion 220 that extends downward such that a free end 230 of the clip may extend below insert 100. A barb 240 may be positioned on free end 230. To install insert 100 within
5 tray 10, leading edge 180 is first slid under retention finger structure 170 so that leading edge 180 is in contact with frame 30 or cross-member 40 from which retention finger structure 170 projects. Then trailing edge 190 is lowered into opening 50 until it registers on registration surfaces 90 of the adjacent support structures 80. Clip 200 is dimensioned and positioned so that barb 240 is in sliding contact with frame 30 or cross-member 40
10 during the insertion, thereby deflecting clip 200 inward toward insert 100 as it is lowered into opening 50. As the barb passes through registration plane 70, the force created by the deflection of clip 200 causes barb 240 to snap into place and hook the adjacent frame 30 or cross-member 40. This means of retention secures the insert on two ends: by the retention finger structure that extends over upper surface 110 on one end, and by engagement of clip
15 200 on the other end. Clip 200 also serves as a handle for assembly personnel to lift, control or otherwise manipulate insert 100.

To remove the insert with the illustrated embodiment, a force is exerted on distal portion 220 that deflects clip 200 inward, so that barb 240 is released. Trailing edge 190 is then lifted out of opening 150, and insert 100 is translated laterally so that leading edge
20 180 is removed from under retention finger structure 170.

Other embodiments may employ one or more of these retention means, or none at all, depending on the retention requirements of the application.

Inserts 100 may have a multiplicity of corner protrusions 250 that extend upward from upper surface 110 of insert 100, as shown in FIGS. 6 and 7. Referring to FIGS. 10
25 and 11, corner protrusions 250 are configured and spaced so as to loosely hold a component 260 on its perimeter and in a fixed position. The corner protrusions also elevate component 260 above mounting surface 110 of insert 100. The elevation allows an assembler to grasp component 260 easier. The elevation may also be sized so that upper faces or extremities 270 of all components 260 are located on a same plane that is
30 substantially parallel upper surface 120 of lattice structure 20 when tray 10 is fully loaded.

As shown in FIGS. 8, 9, 12 and 13, inserts 100 may additionally or alternatively have a multiplicity of axial protrusions 280 and grouped protrusions 290 that extend upward from upper surfaces 110 of inserts 100. These protrusions also retain components 260, but by a different means. Rather than securing components 260 about their perimeter, protrusions 280, 290 either pass through orifices on components 260, serve as receptacles that grip appendages that extend from components 260, or simply provide a pedestal that suspends a portion of component 260 above upper surface 110 of insert 100. Axial and grouped protrusions 280, 290 can also be configured so that the suspension of components 260 is such that their upper extremities 270 are substantially on the same plane. Protrusions 250, 280 and 290 may both suspend and hold component 260 in a preferred orientation.

Referring to FIGS. 14 and 15, a tray 11 that is another embodiment of the present invention is shown, with unloaded and loaded inserts, respectively. The particular embodiment shown is designed to house the same components as the embodiment of FIGS. 2 through 13, but within a smaller footprint. Also, the embodiment features a continuous extended skirt 310, as well as a continuous ridge 320 that extends upward from frame 30 and encircles lattice structure 20. When these trays are stacked, extended skirt 310 from an upper tray and ridge 320 from a tray below may combine to completely enclose components 260 of the lower tray. This arrangement provides further protection of components 260 against damage and serves as a barrier inhibiting particulate contamination of components 260 when trays 11 are stacked. Alternatively, skirt 310 and ridge 320 may depend from other portions of lattice structure 20 to encapsulate only certain components, or each component individually. Where particulate contamination is of less concern, skirt 310 or ridge 320 need not be continuous.

Referring to FIG. 16, a stack 300 of fully assembled and loaded trays 11 is shown. Note how spacer columns 92 fit within skirt 55, thus preventing tray 11 from sliding off spacer columns 92 of the tray below. A cross-section of a portion of the stack is shown in FIGS. 17 - 19, which shows how a given tray in stack 300 serves as a retention lid and particulate barrier for the tray below. Components 260 (shown in phantom), as previously discussed, can be elevated on a given insert 100 so that upper faces 270 of all components 260 on a given tray 11 are at the same elevation. In the FIG. 16 embodiment, the elevation of upper faces 270 are such that when a first tray assembly 12 is placed on spacer columns

92 of a second tray assembly 13, the bottom extremities of first tray assembly 12 are just above or in slight contact with upper faces 270. Components 260 may thus be held in place during stacking and relocation to temporary storage.

In some configurations, certain protrusions 281 pass through or past components 260, as shown in FIG. 12. Such protrusions 281 thus extend above component 260. In such instances, protrusions 281 may be dimensioned so that first tray assembly 12 are just above or in slight contact with protrusions 281. In this way, first tray assembly 12 serves to cap protrusions 281, thereby capturing components 260 without contacting the components. By utilizing the tray above to hold components 260 in place, the various protrusions 250, 280 and 290 do not have to tightly grip the component; instead, a loose fit will suffice. This makes removal of the component easier during the assembly process.

Referring to FIG. 19, the present invention is not limited to inserts 100 and openings 50 that are primarily rectangular in shape. The FIG. 19 embodiment contemplates an insert 100 that is circular or elliptical in shape, with cross-members 40 and frame 30 configured to accommodate the geometry of the inserts.

The use of the invention also gives rise to a new method of using the various embodiments. The process starts with a tray that is fully assembled, but bearing no components. The inserts may be removed from the tray for the loading of components thereon. After a given insert is loaded, it is placed in the appropriate tray opening. This sequence is repeated until the desired inserts are loaded. Once a tray is loaded for the purpose of assembly, it may be stacked with other trays for dissemination on the assembly line at a later time. Note that there is no need to cover the tray for purposes of component retention.

At the appropriate time, trays may be placed sequentially on an assembly conveyor for transport through the various assembly phases. During assembly, assemblers may remove the inserts from the trays to more readily access the components thereon. After assembler has removed desired components, the insert is replaced in the appropriate opening and the tray is put back onto conveyor for transport to next assembly phase.

At end of the assembly phase, the trays, now containing empty inserts, are collected. To minimize the risks associated with particle contamination, the trays and

inserts are preferably washed in a detergent solution and rinsed. The trays and inserts may be washed with inserts installed in the tray frame, or with the inserts removed from the tray frame. Once the trays and inserts are washed and rinsed, the trays are reassembled as necessary and returned to the start of the process.

5 While the particular disk tray embodiments presented and discussed in detail above are fully capable of obtaining the objects and providing the advantages stated, it is to be understood that they are merely illustrative of the present invention. Various other modifications and changes with which the invention can be practiced and which are within the scope of the description provided herein will be readily apparent to those of ordinary
10 skill in the art.

Claims

What is claimed is:

1. A universal component carrier system for use in assembly line production of disk drives in combination with a plurality of sets of disk drive componentry, each set of componentry comprising parts for the assembly of a portion of or all of a disk drive, the component carrier system comprising:

a plurality of like configured component carrier trays in a vertically stacked arrangement, each tray comprising:

a horizontally extending framework structure that defines a plurality of openings, said framework structure having an upper face;

a plurality of removable inserts, each of said inserts having a base surface with upwardly extending structure for form fitting individual ones of said parts; and

wherein each tray of said stacked arrangement that is seated on another tray with componentry therein provides a cover said disk drive components contained in said another tray.

2. The universal component carrier system of claim 1, wherein the framework structure is configured as a lattice structure and wherein at least two of said openings of each carrier tray is of varying geometry.

3. The universal component carrier system of claim 2 wherein each of said inserts are held in position by friction between said perimeter of said insert and said lattice structure.

4. The universal component carrier system of claim 2 further comprising:

a clip integral to said insert, said clip having a free end extending beyond said perimeter of said insert;

a retention finger cantilevered from said upper face of said lattice structure and extending over one of said openings;

wherein said insert is mounted between said retention finger and said support structure; and

said free end of said clip engages said lattice structure.

5. The universal component carrier system of claim 2 wherein each tray serves as a lid or closure for a tray below for preventing said disk drive components from being dislodged from said inserts.

6. A method of arranging componentry for assembly of disk drives comprising the steps of:

(a) providing a plurality of stackable like-configured component trays, each tray comprising a framework base having a plurality of openings for receiving insert tray portions,

(b) placing in said plurality of openings a plurality of tray portions, each tray portion having form fitting structure for receiving disk drive componentry,

(c) placing sets of disk drive componentry in each of said tray portions,

(d) stacking the plurality of stackable like-configured component trays in a stack and moving same to an assembly area whereby the componentry may be removed from each of the component trays in the stack.

7. The method of claim 6 further comprising the step of injection molding the plurality of like configured component trays.

8. The method of claim 7 further comprising the step of injection molding the plurality of tray portions.

9. A component tray system for assembly of hard disk drives comprising a component tray having:

a lattice structure having a frame portion and at least one cross-member integral to said frame portion that defines a plurality of openings, said lattice structure having a lower surface that defines a registration plane;

a support structure that depends from said lattice structure, said support structure extending laterally into said openings and having an upper surface that is substantially flush with said registration plane;

a removable insert having a mounting surface, a leading edge and a perimeter, said perimeter dimensioned to fit within one of said openings, said insert contacting said support structure when placed in said opening;

a plurality of protrusions extending from said mounting surface, said protrusions arranged and shaped to secure a component.

10. The component tray system of claim 9 wherein at least one of said cross-members includes a rib portion extending below said lower surface of said cross-member.

11. The component tray system of claim 9 wherein said perimeter of said insert slidably engages said lattice structure, thereby frictionally retaining said insert within said lattice structure.

12. The component tray system of claim 9 further comprising a multiplicity of nubs that protrude laterally from said lattice structure into said openings, such that said perimeter of said insert slidably engages said nubs, thereby frictionally retaining said insert within said lattice structure.

13. The component tray system of claim 9 wherein said component is oriented to have an upper extremity, said protrusions being dimensioned to position said upper extremity at a predetermined distance from said registration plane.

14. The component tray system of claim 13 further comprising:

a retention finger depending from said lattice structure and extending partially over at least one of said openings;

a clip having a proximate end portion depending from said insert and a distal end portion opposite said proximate end portion; and

wherein said leading edge of said insert fits beneath said retention finger and said distal end portion of said clip engages said lattice structure.

15. The component tray system of claim 14 wherein said distal end portion of said clip further comprises a barb, said barb engaging said lower surface of said lattice structure.

16. The component tray system of claim 15 further comprising a plurality of spacers extending upward from said lattice structure.

17. The component tray system of claim 16 further comprising:

an upper component tray;

a lower component tray;

said upper component tray being supported by said spacers of said lower component tray; and

said upper component tray contacting said component of said lower component tray to retain said component of said lower component tray on said protrusions of said insert of said lower component tray.

18. The component tray system of claim 16 further comprising:

an upper component tray;

a lower component tray;

said upper component tray being supported by said spacers of said lower component tray; and

said upper component tray contacting at least one of said protrusions to retain said component of said lower component tray on said protrusions of said insert of said lower component tray.

19. The component tray system of claim 16 further comprising:

a lower component tray;

an upper component tray having a skirt projecting downward from said lattice structure of said upper component tray; and

wherein said upper component tray is placed over said lower component tray to enclose said component of said lower component tray.

20. The component tray system of claim 16 further comprising:

a lower component tray having a ridge extending upward from said lattice structure of said lower component tray;

an upper component tray having a skirt projecting downward from said lattice structure of said upper component tray; and

wherein said skirt of said upper component tray and said ridge of said lower component tray cooperate to enclose said component of said lower component tray.

21. The component tray system of claim 16 wherein said lattice structure and said support structure is injection molded.

22. The component tray system of claim 16 wherein said plurality of inserts are injection molded.

23. A component tray system for assembly of hard disk drives including a component tray and a set of disk drive components for assembly of a single disk drive, said tray comprising:

a lattice structure defining a plurality of tray portion receiving regions;

a plurality of removable tray portions sized to seat within said tray portion receiving regions;

form fitting structure on said removable tray portions sized for constraining individual components of said set of disk drive components for assembly of said single disk drive.

24. The component tray system of claim 23 further comprising a plurality of like configured trays arranged in a stack, each tray having stacking structure to laterally constrain each tray with respect to an adjacent stacked tray.

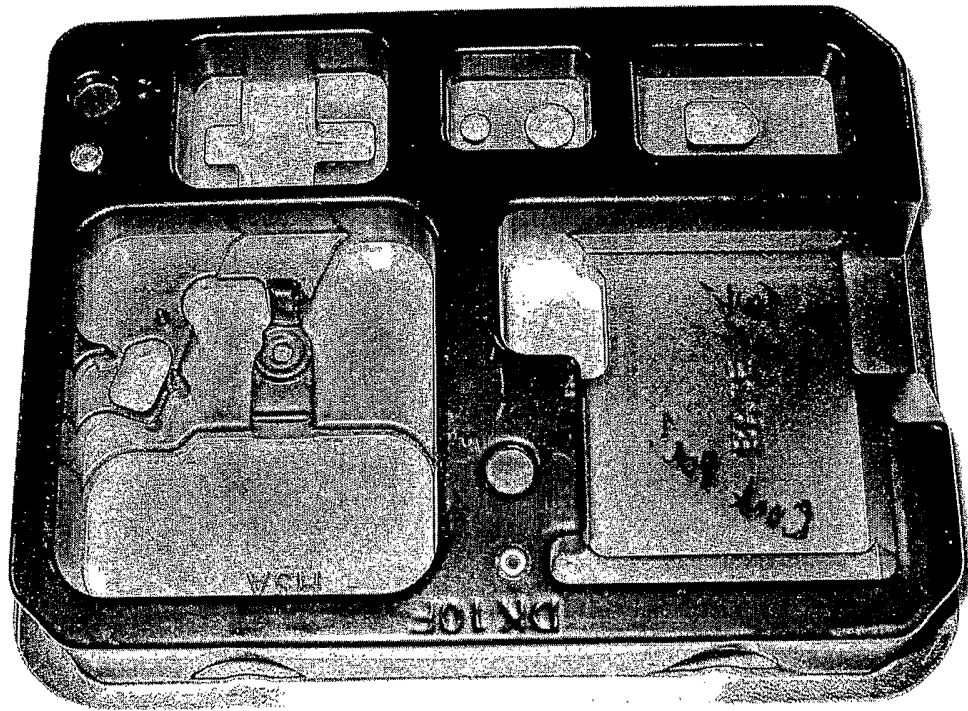
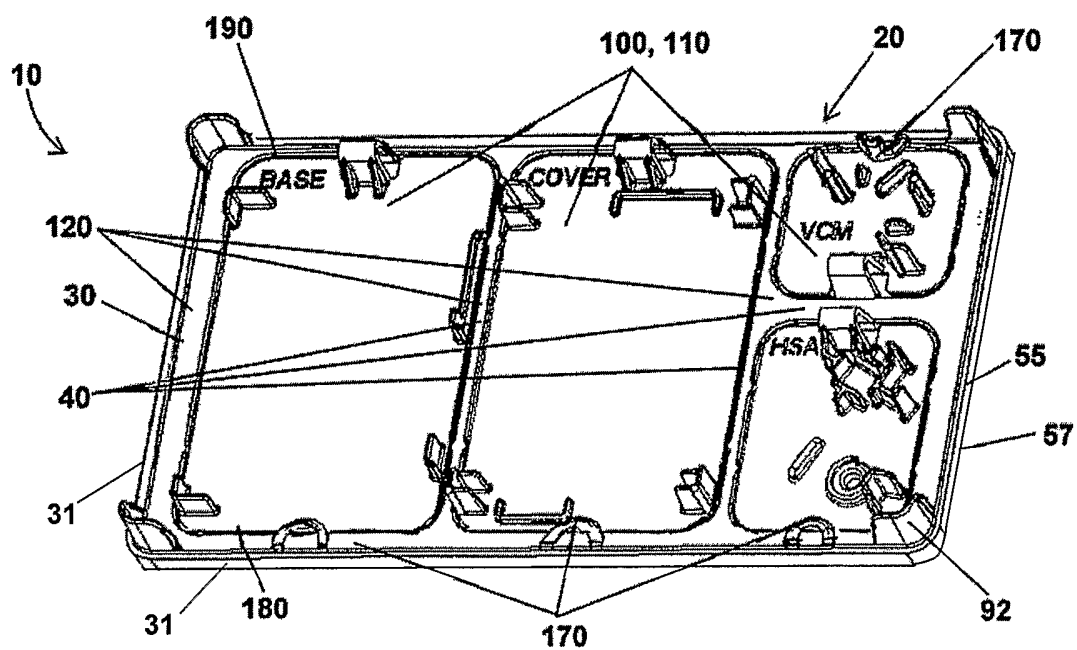
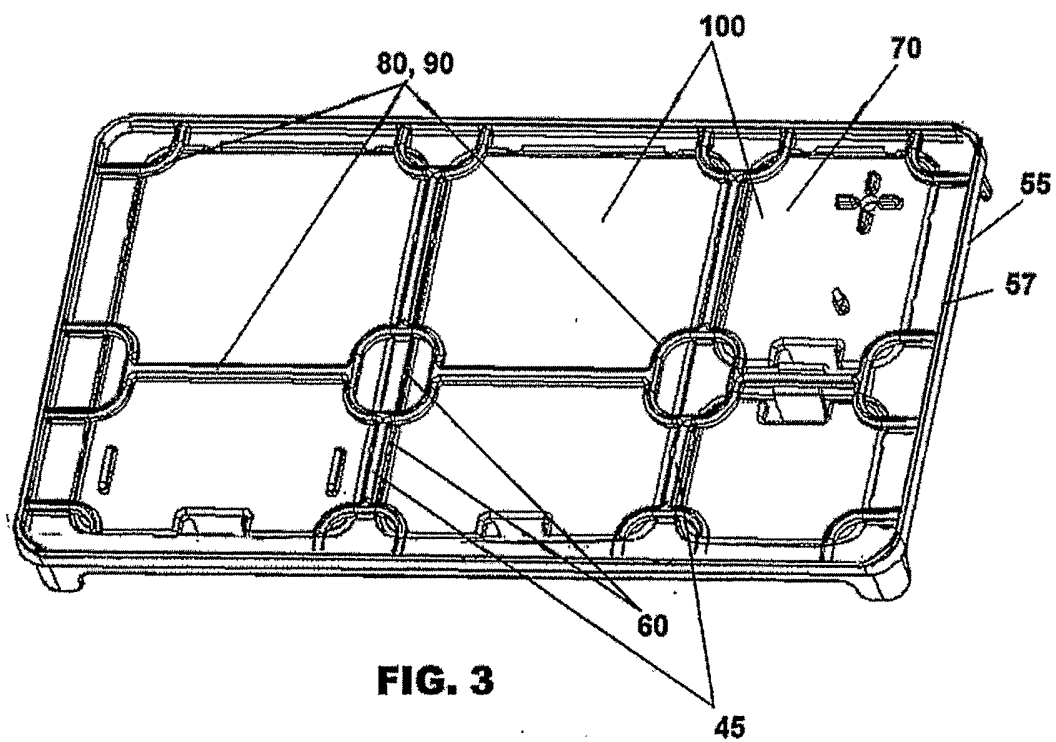
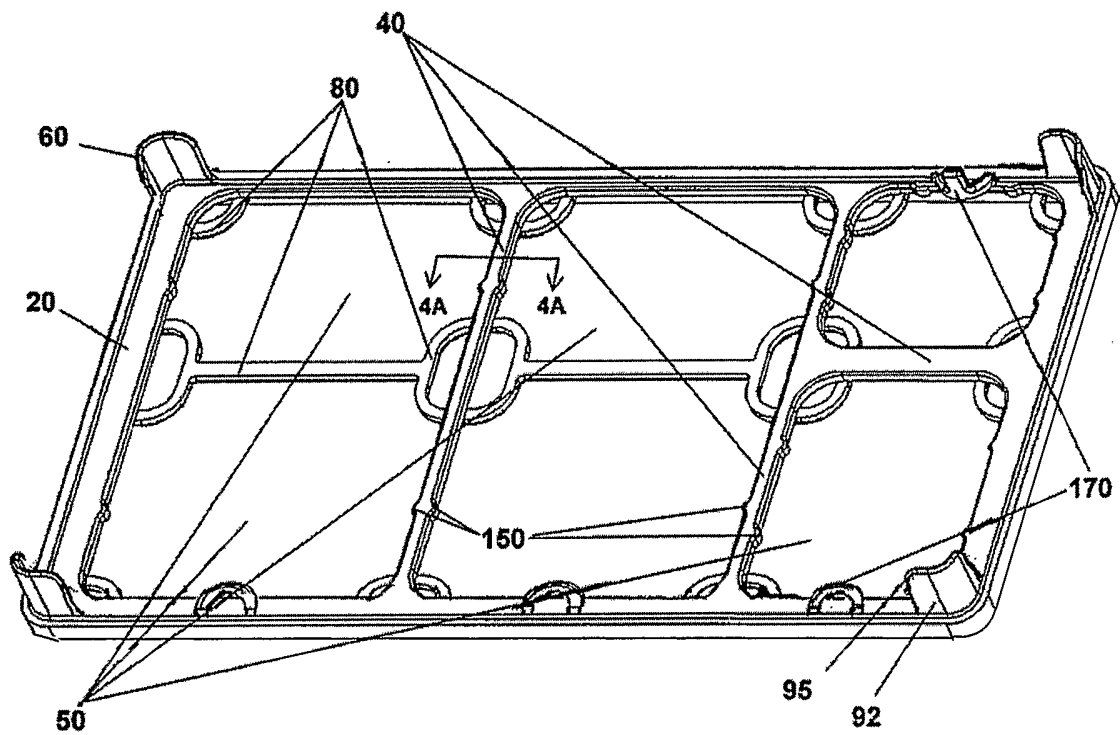
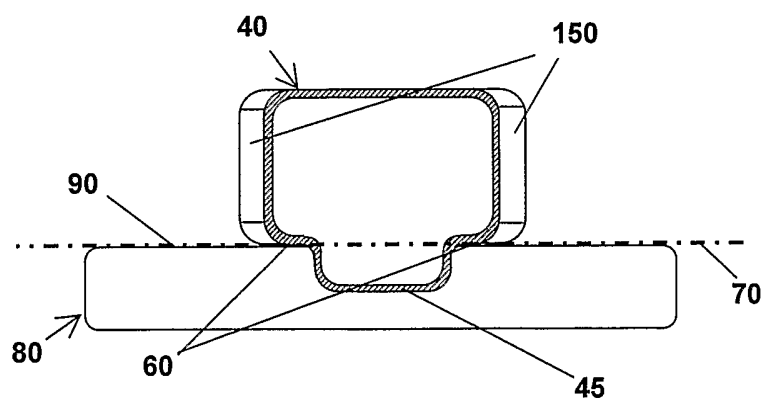


FIG. 1 (PRIOR ART)

**FIG. 2****FIG. 3**

**FIG. 4****FIG. 5**

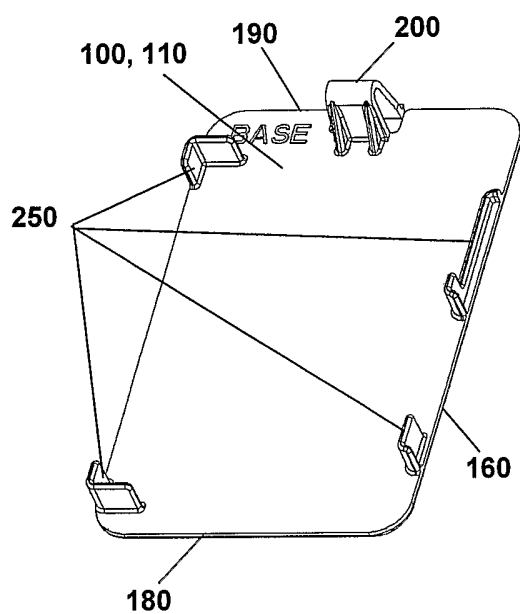


FIG. 6

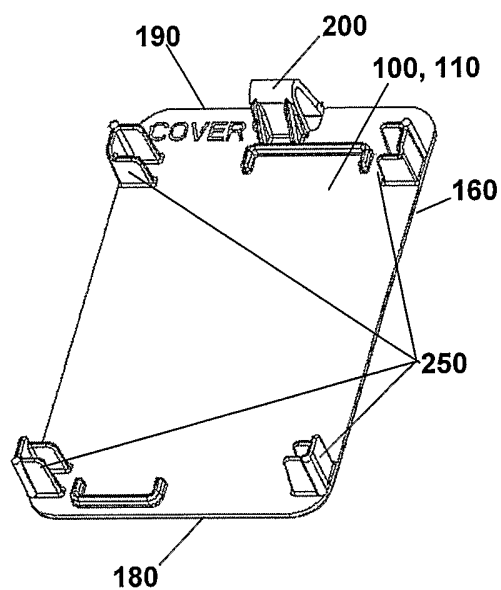


FIG. 7

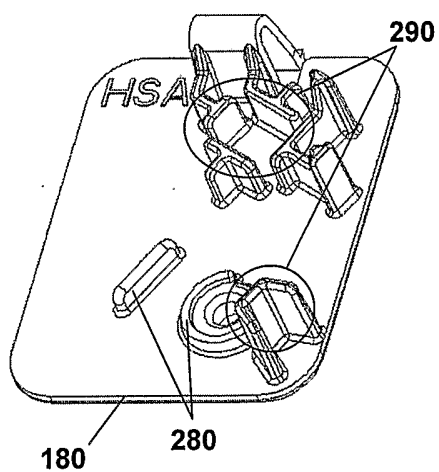


FIG. 8

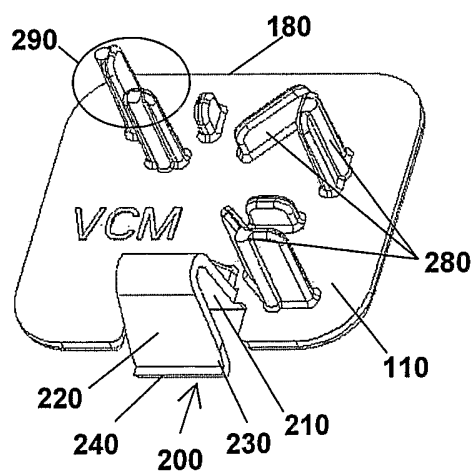


FIG. 9

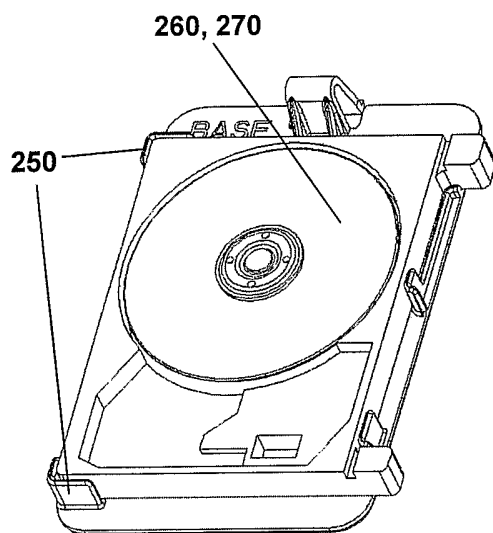


FIG. 10

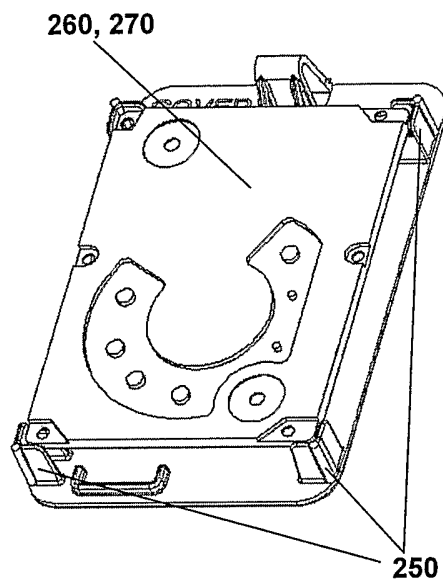


FIG. 11

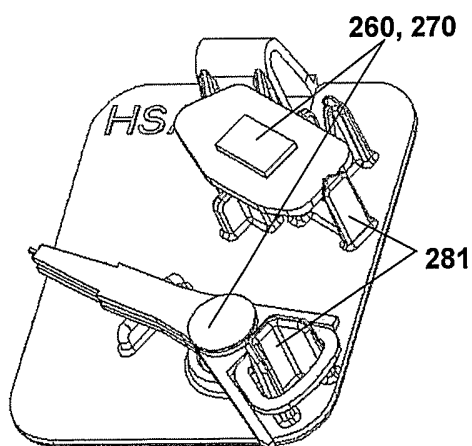


FIG. 12

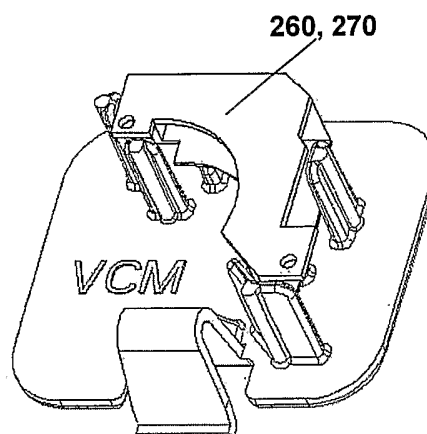


FIG. 13

11
↓

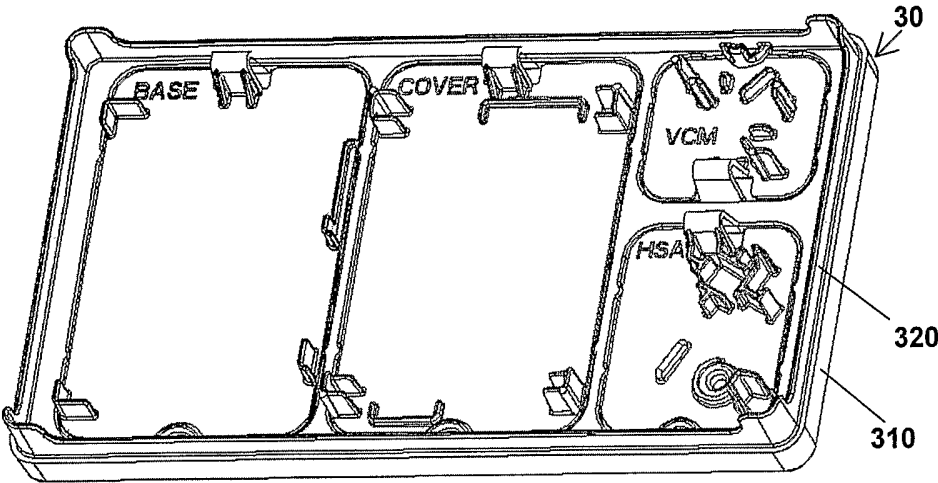


FIG. 14

11
↓

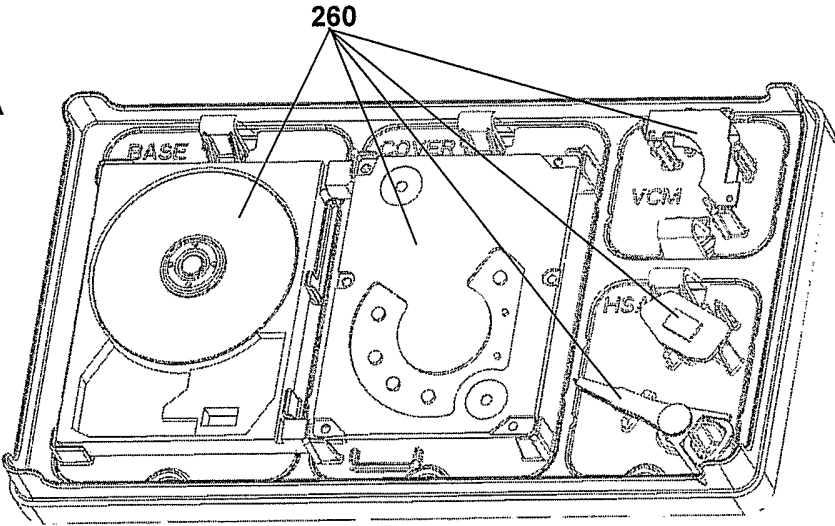


FIG. 15

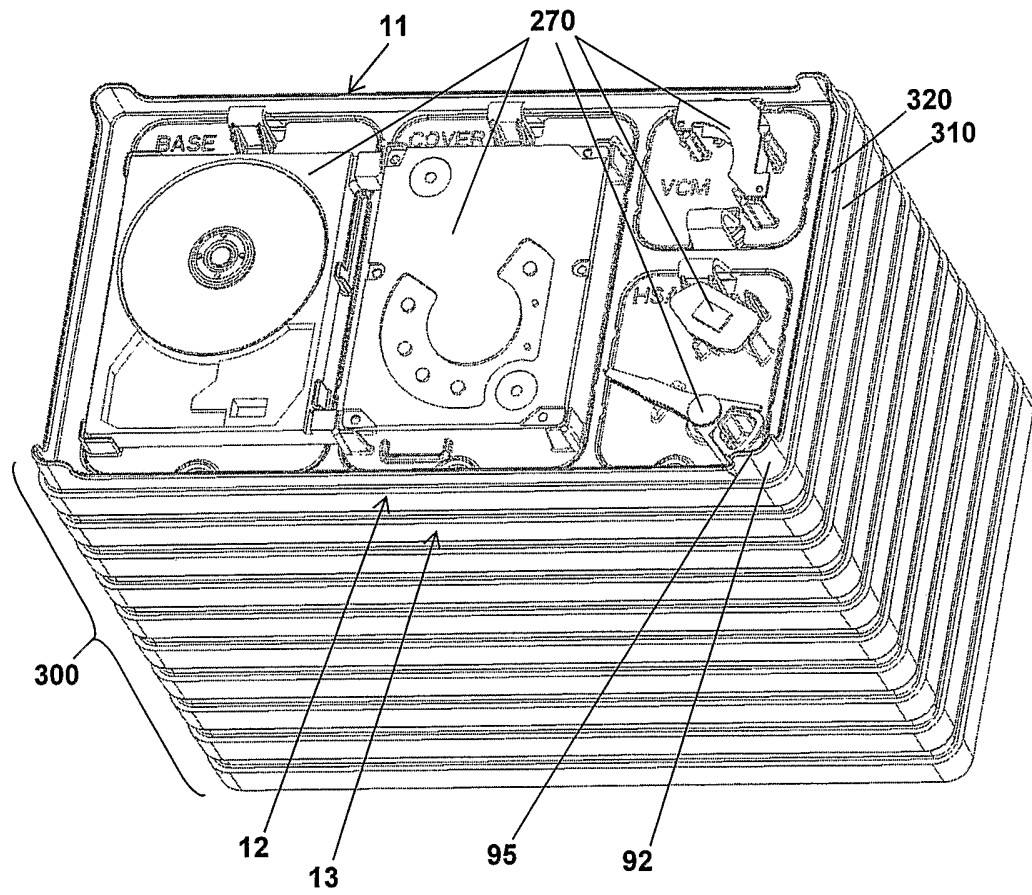


FIG. 16

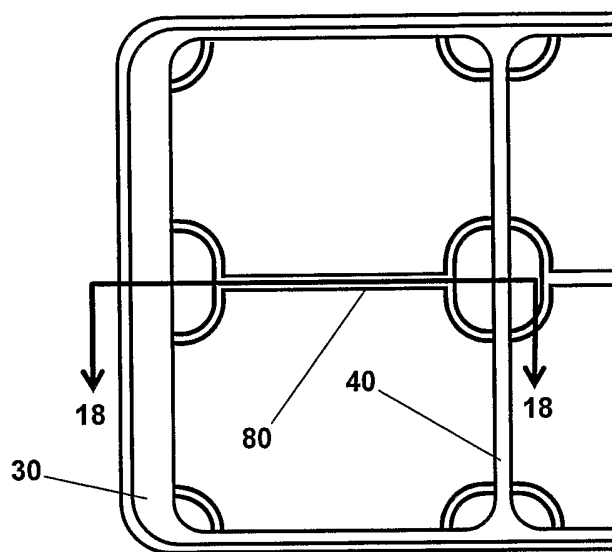


FIG. 17

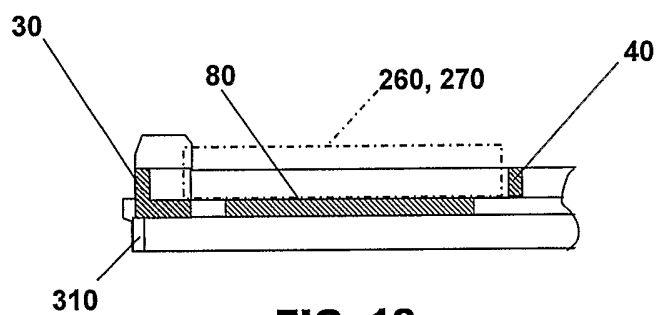


FIG. 18

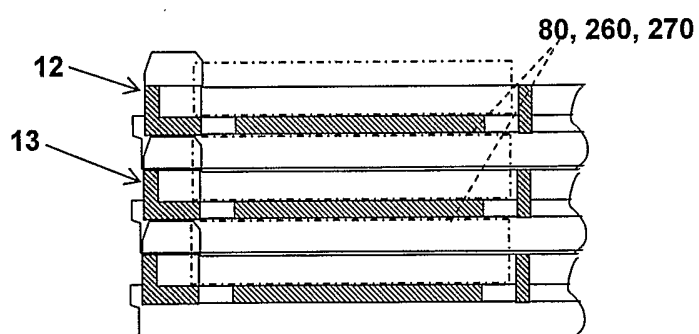


FIG. 19

