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(54) **FLEXIBLE IMPACT PROTECTIVE CASES AND METHODS OF MAKING**

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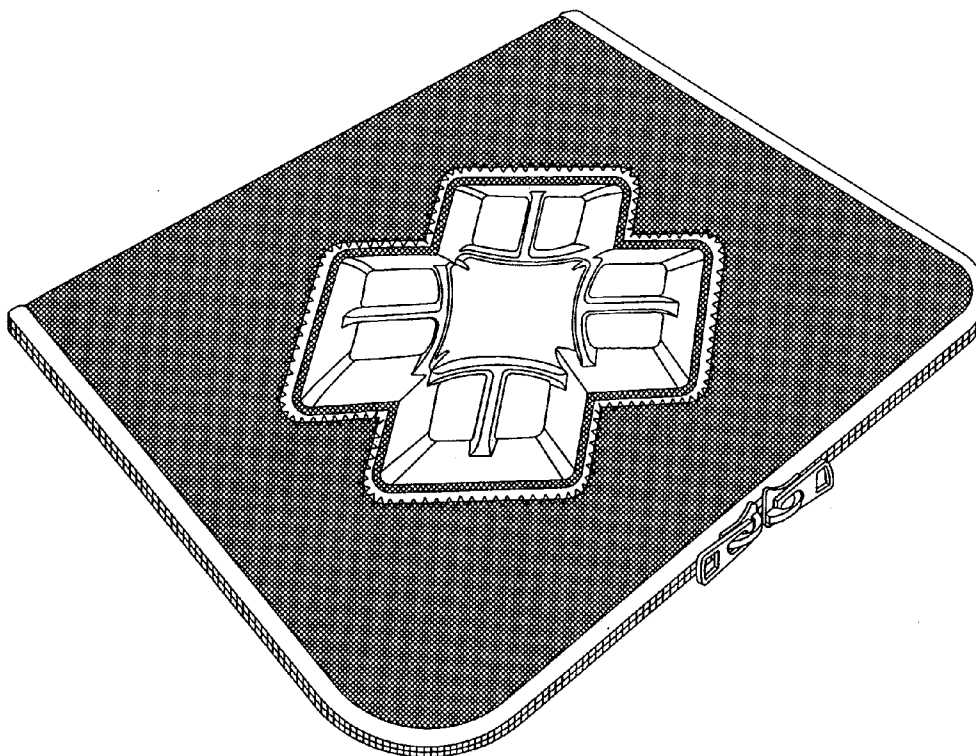
(57) **ABSTRACT**

Related U.S. Application Data

(60) Provisional application No. 61/404,906, filed on Oct. 12, 2010, provisional application No. 61/412,767,

Disclosed herein are protective cases for sensitive devices, including devices with screen interfaces, which cases provide protection from front, back and edge impacts.

100
↓



100
↓

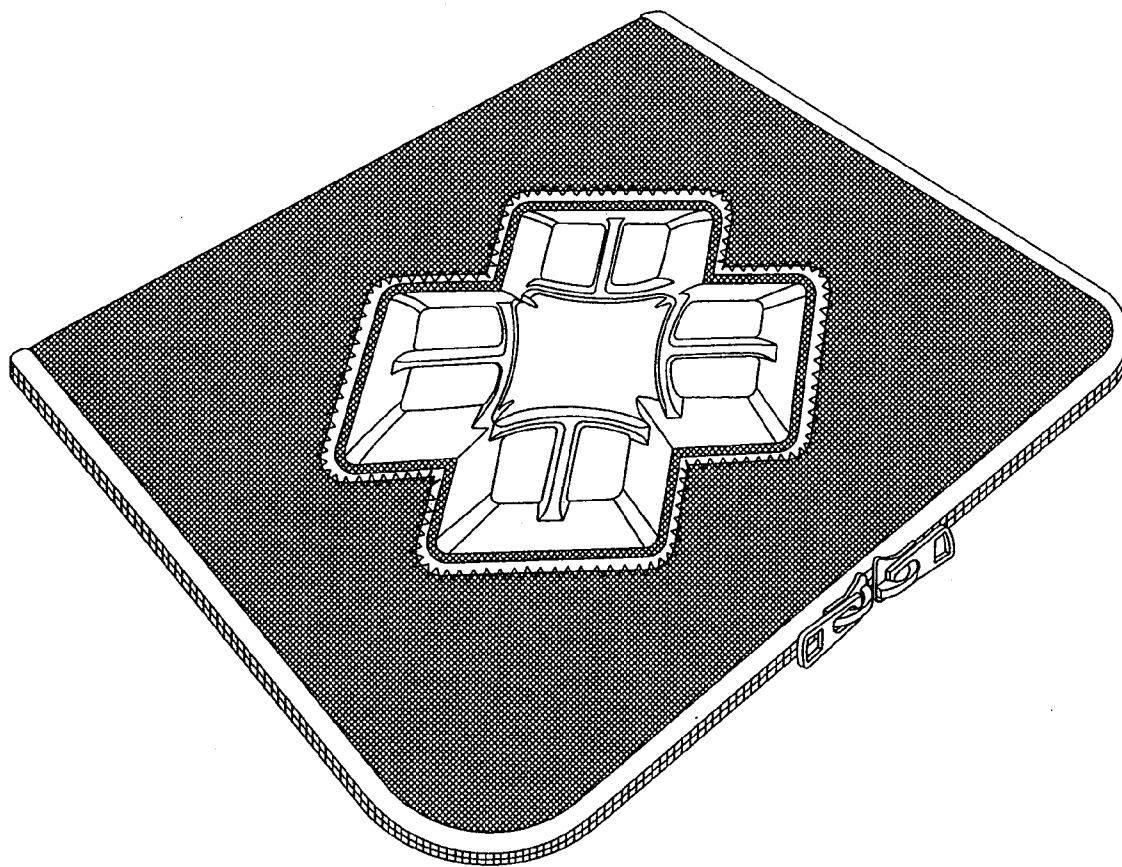


FIG. 1

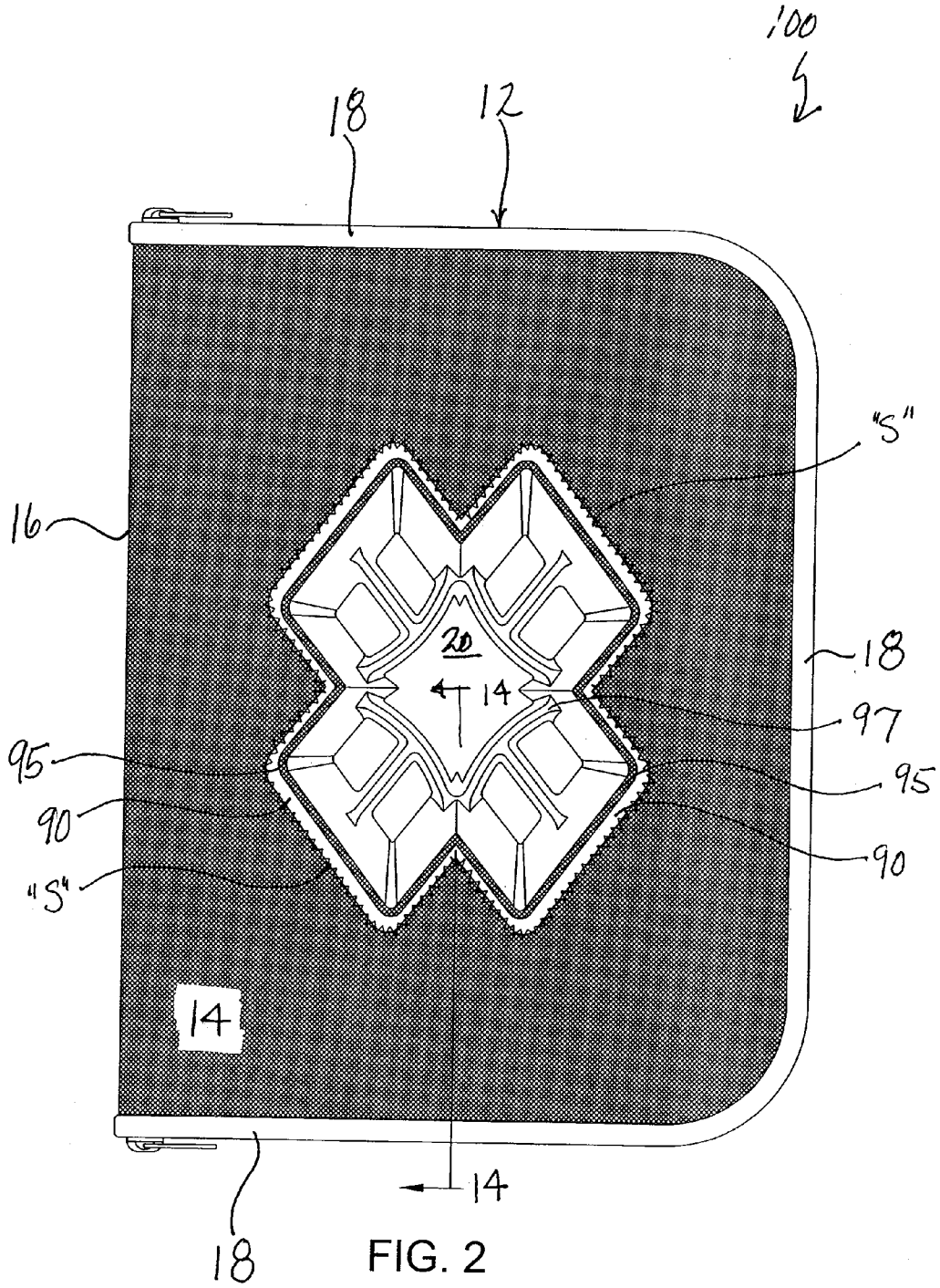


FIG. 2

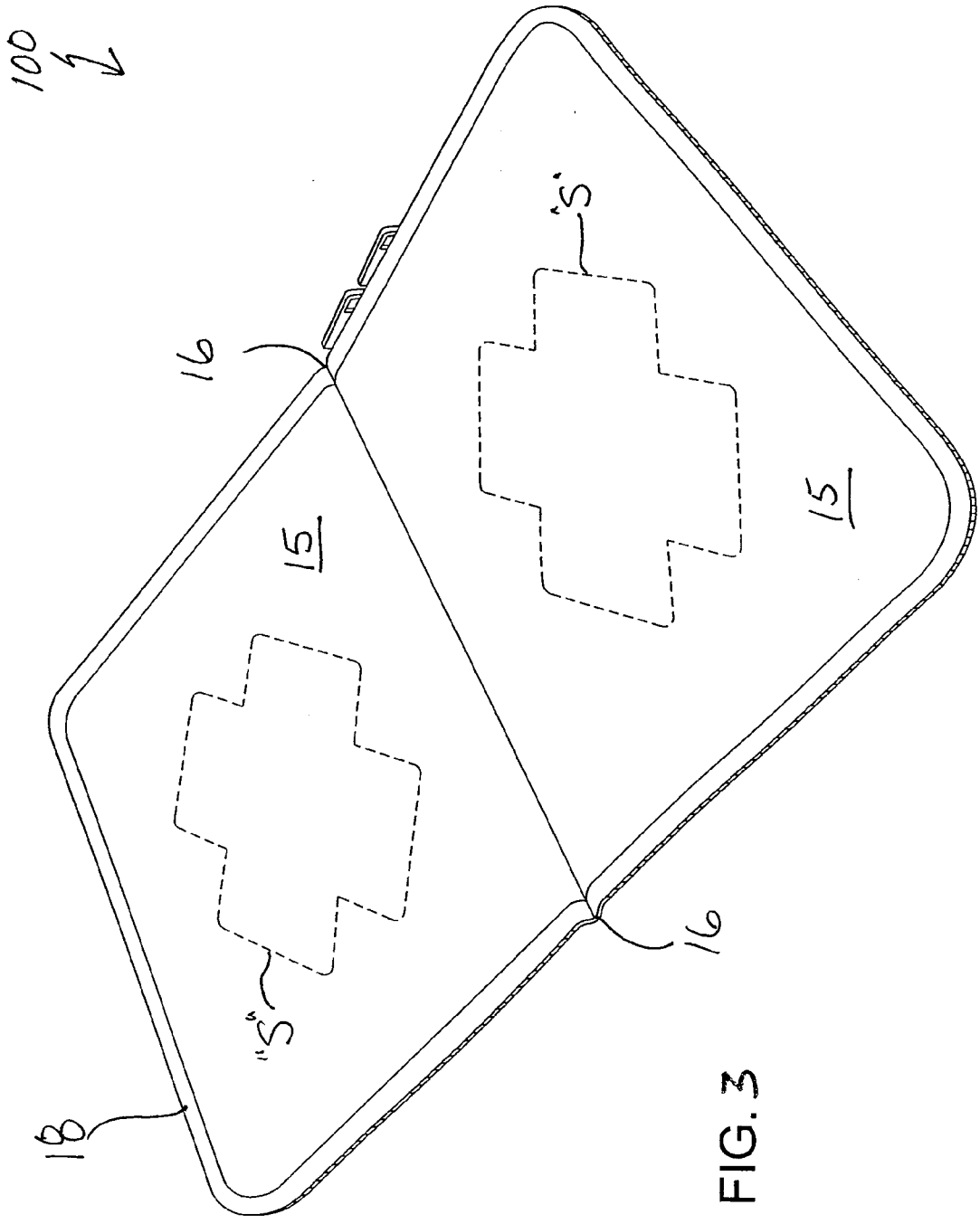


FIG. 3

200
↓

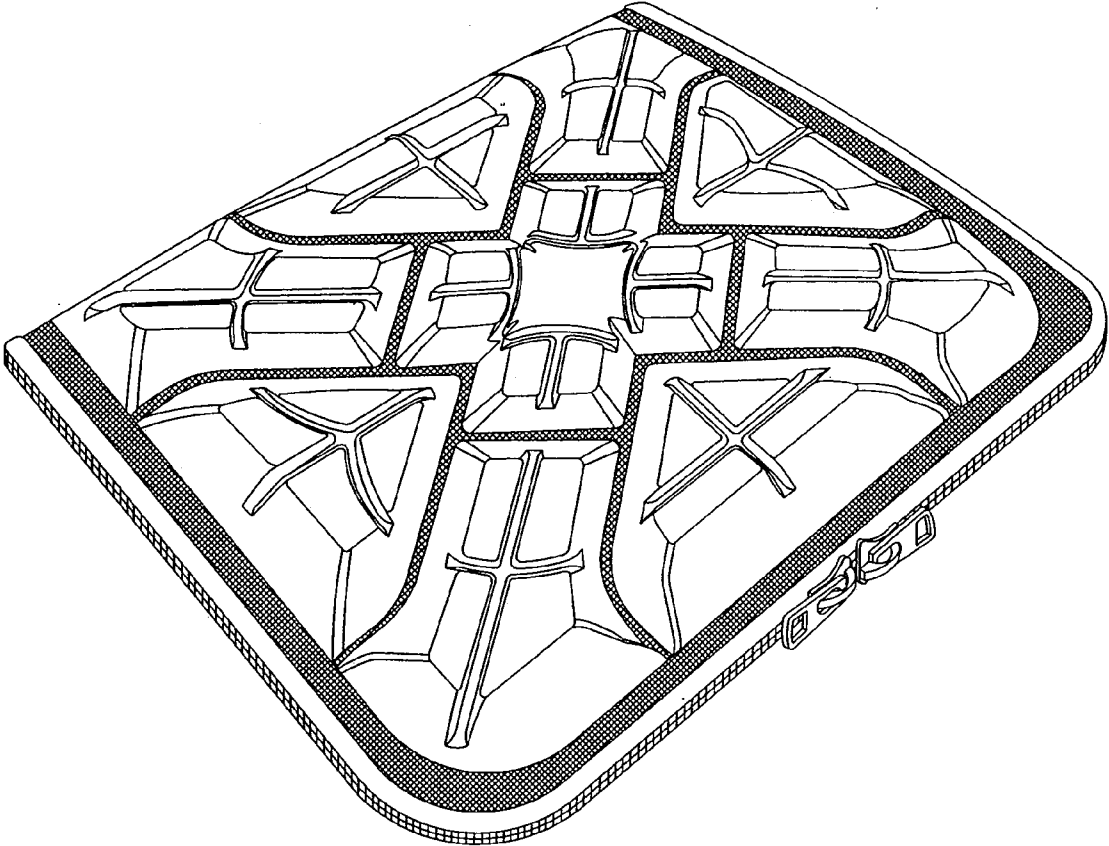


FIG. 4

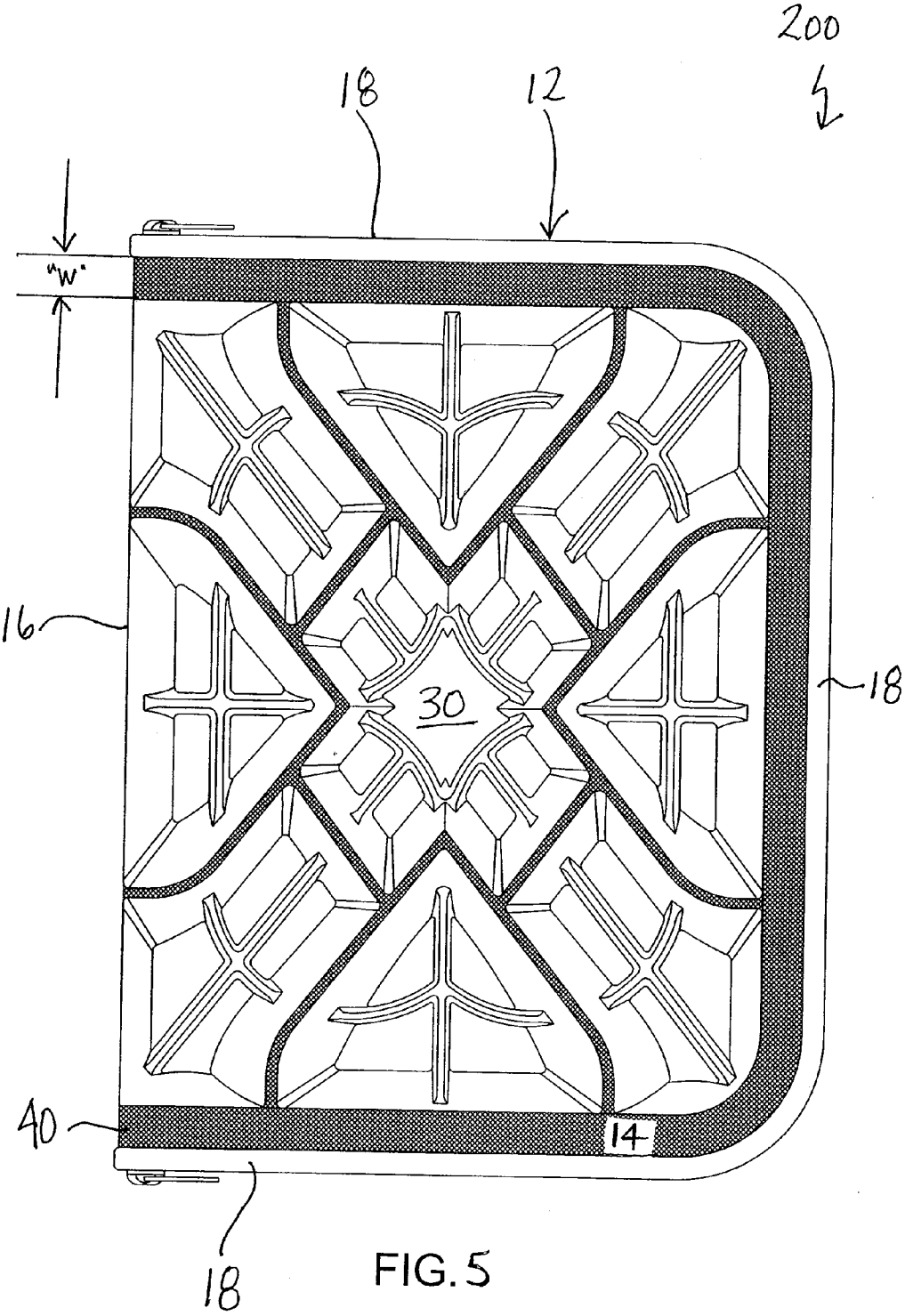


FIG. 5

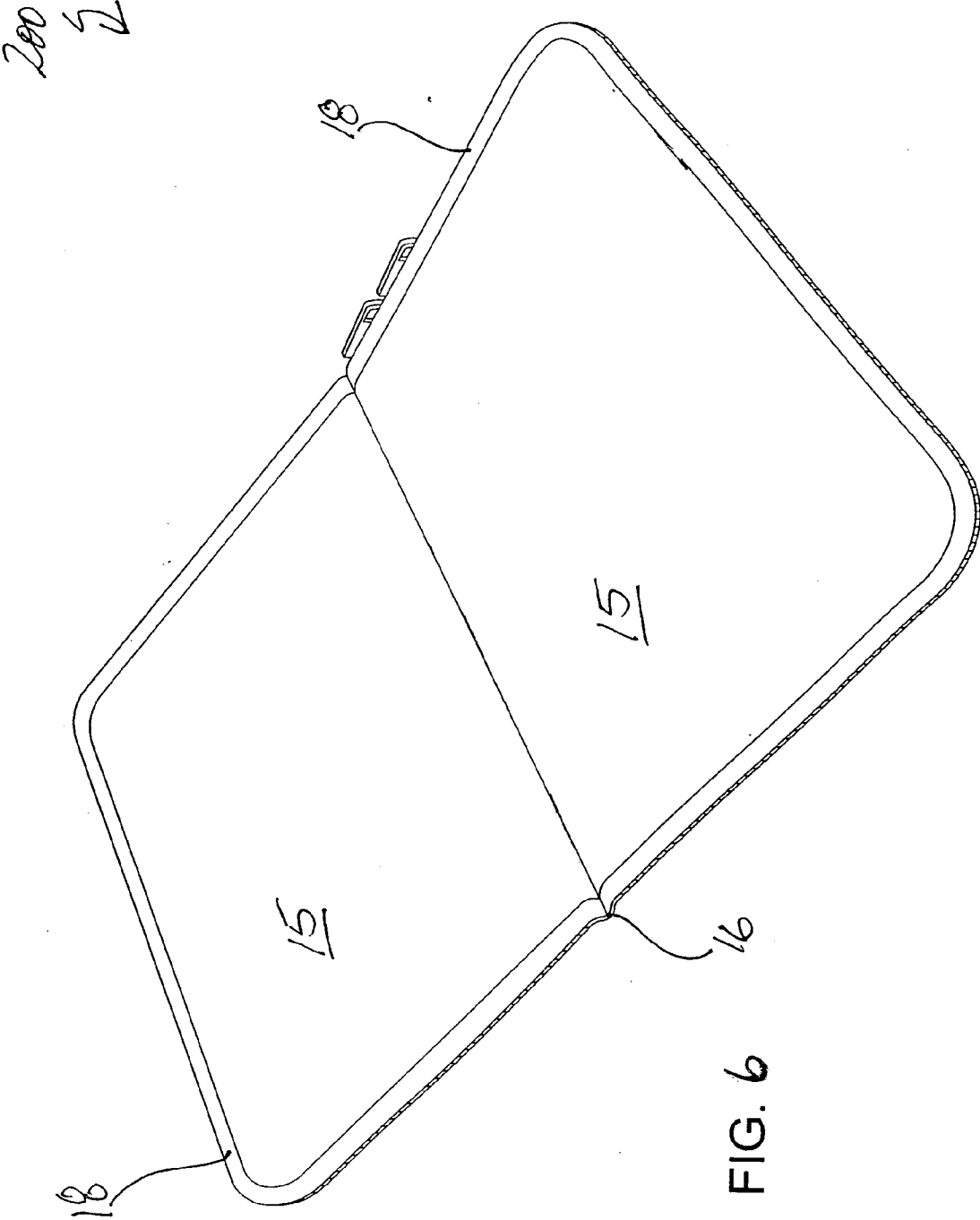


FIG. 6

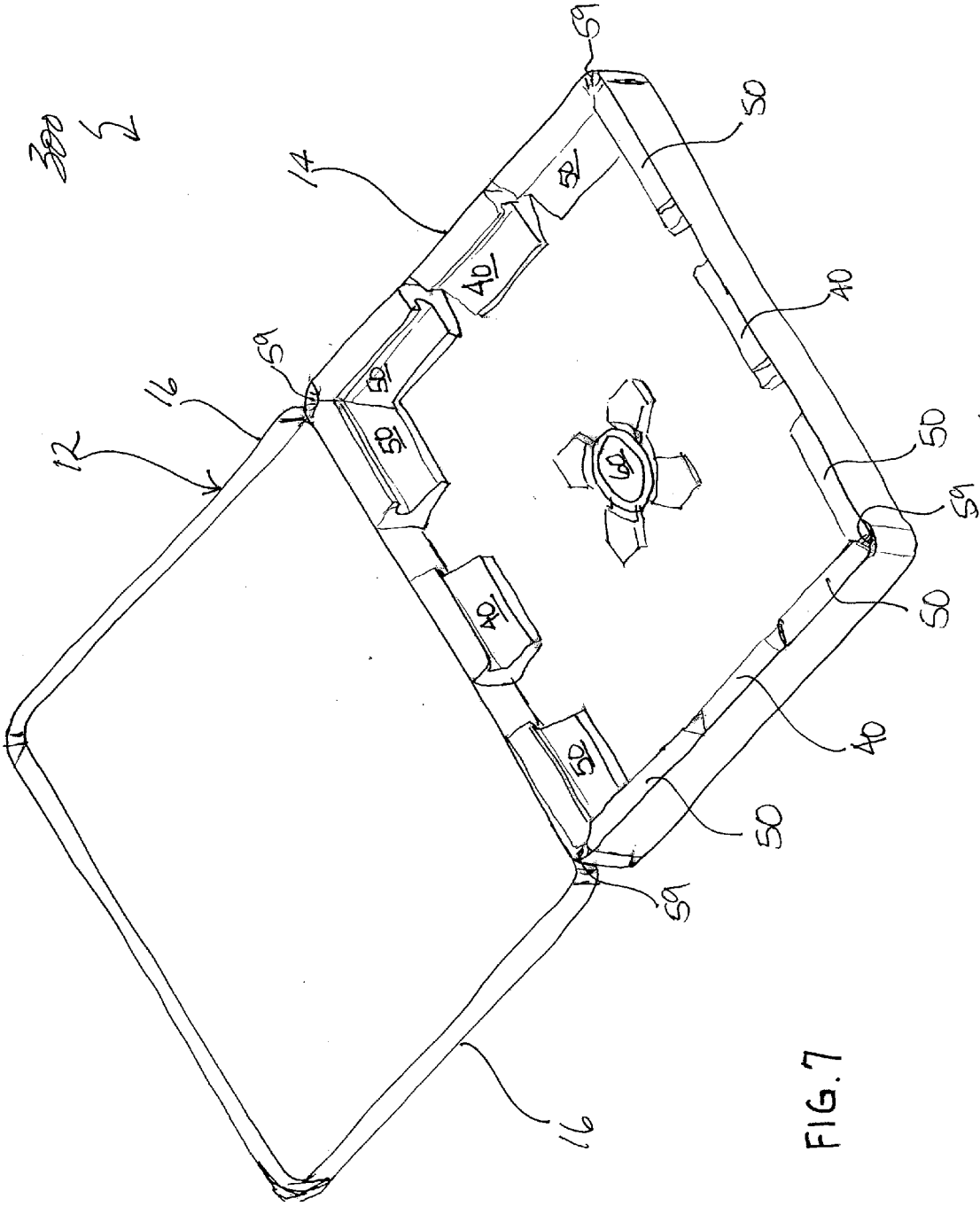


FIG. 7

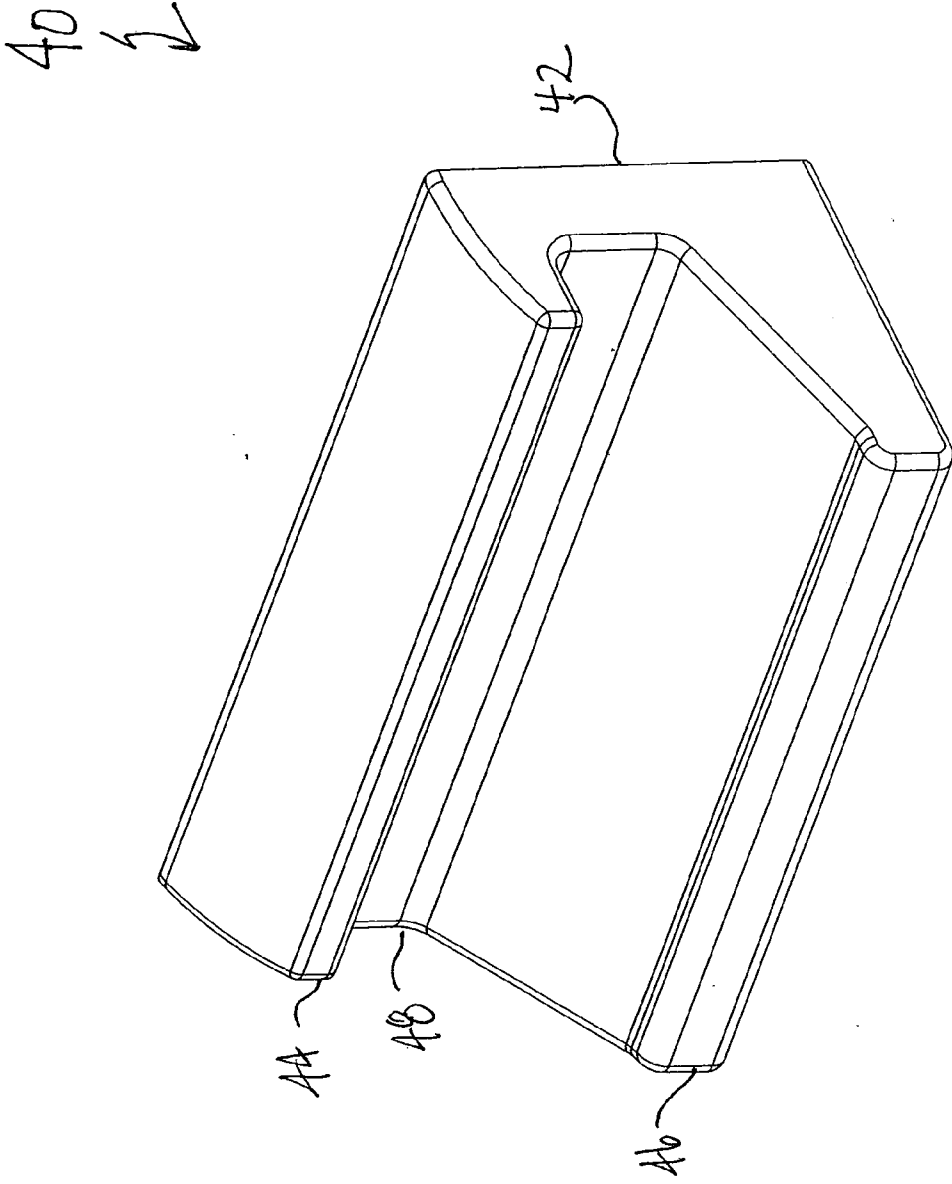


FIG. 8

40 ↘

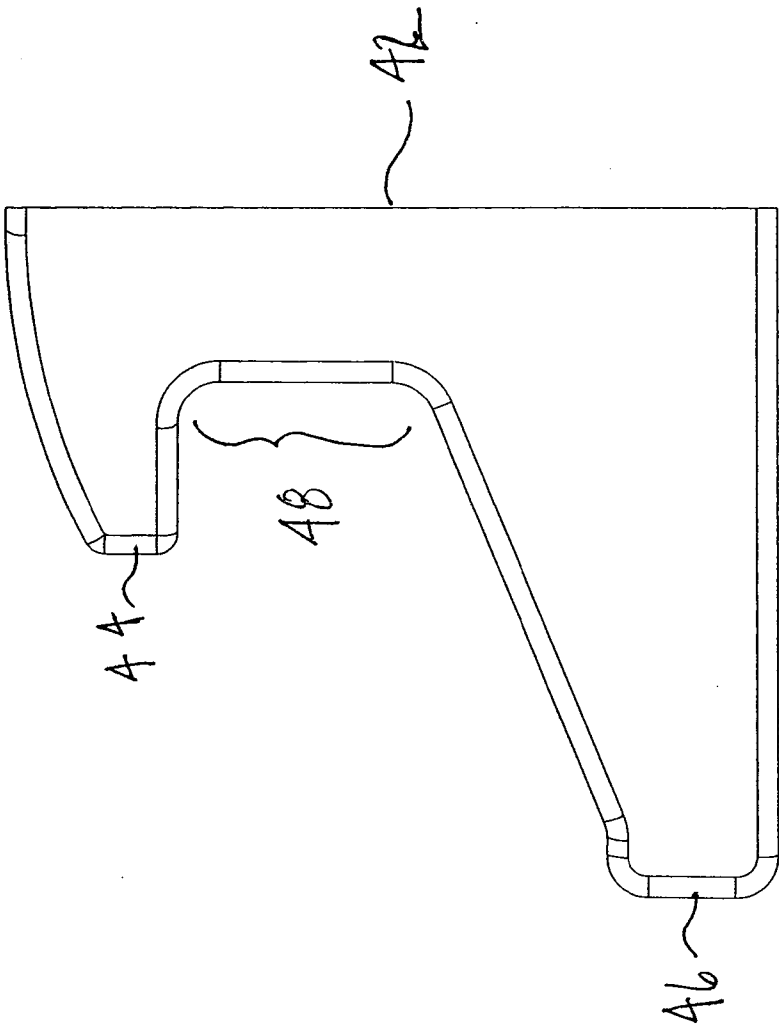


FIG. 9

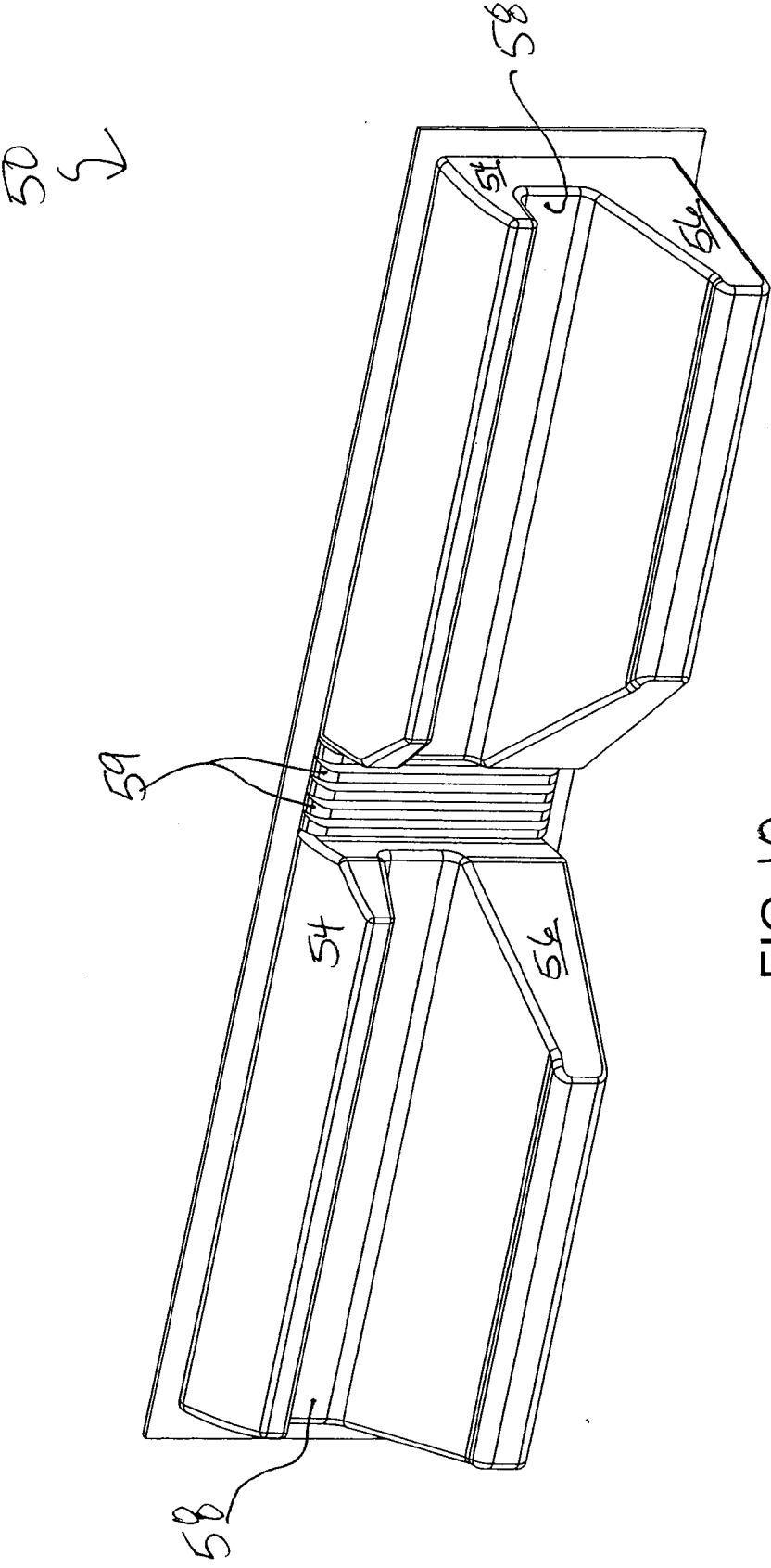


FIG. 10

50 ↘

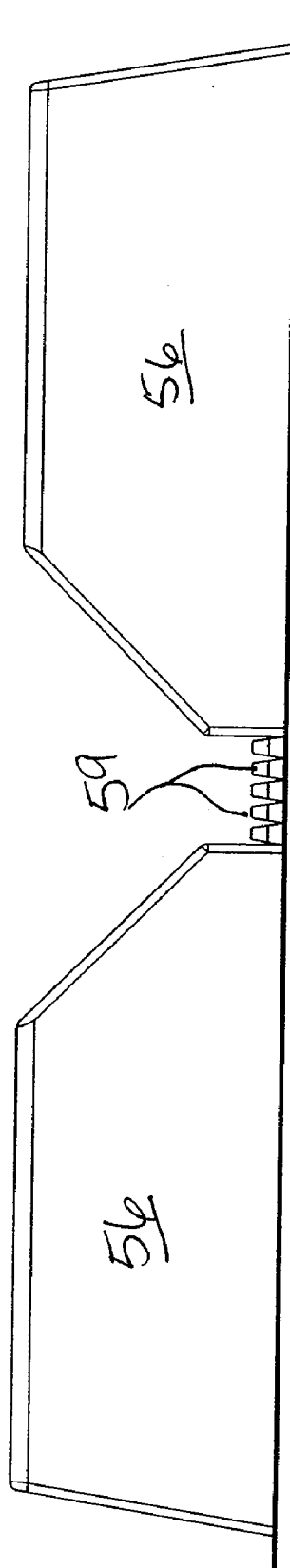


FIG. 11

50 ↘

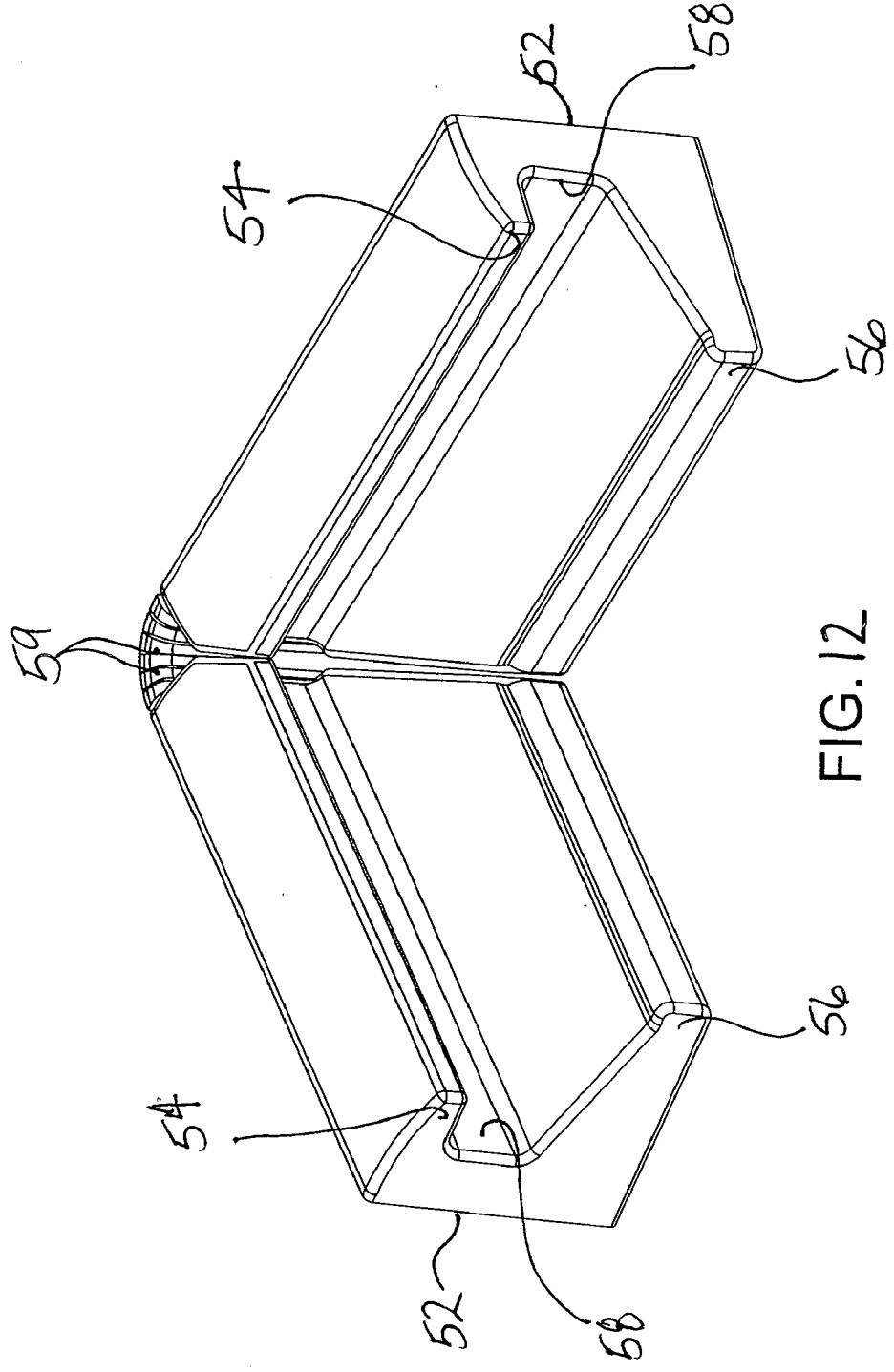


FIG. 12

50 ↘

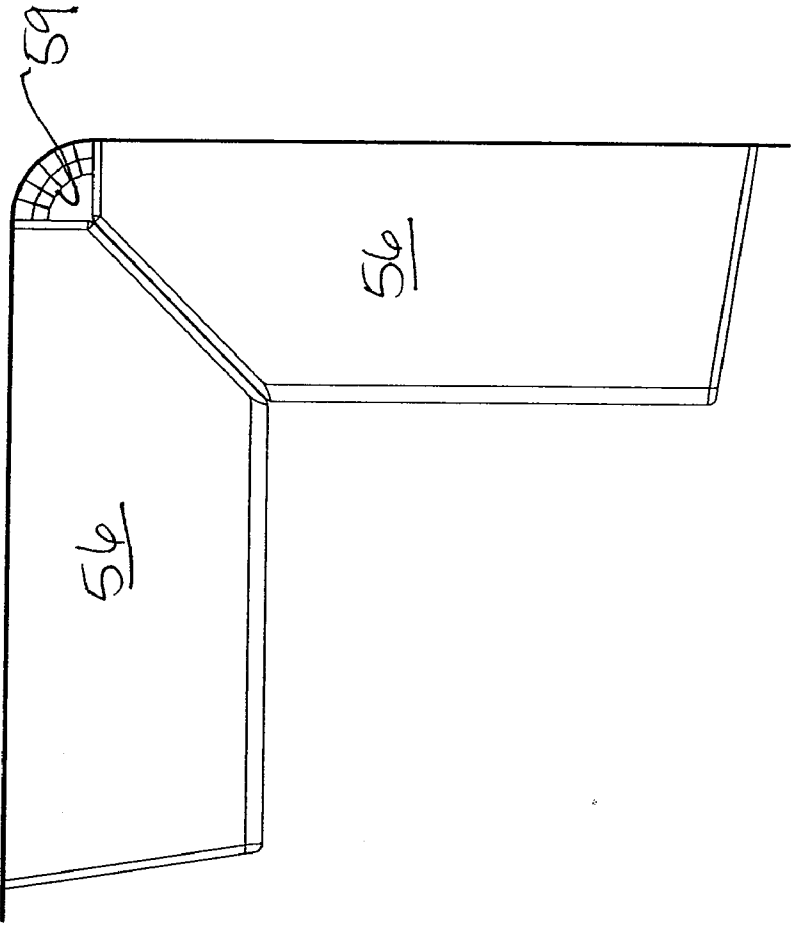


FIG. 13

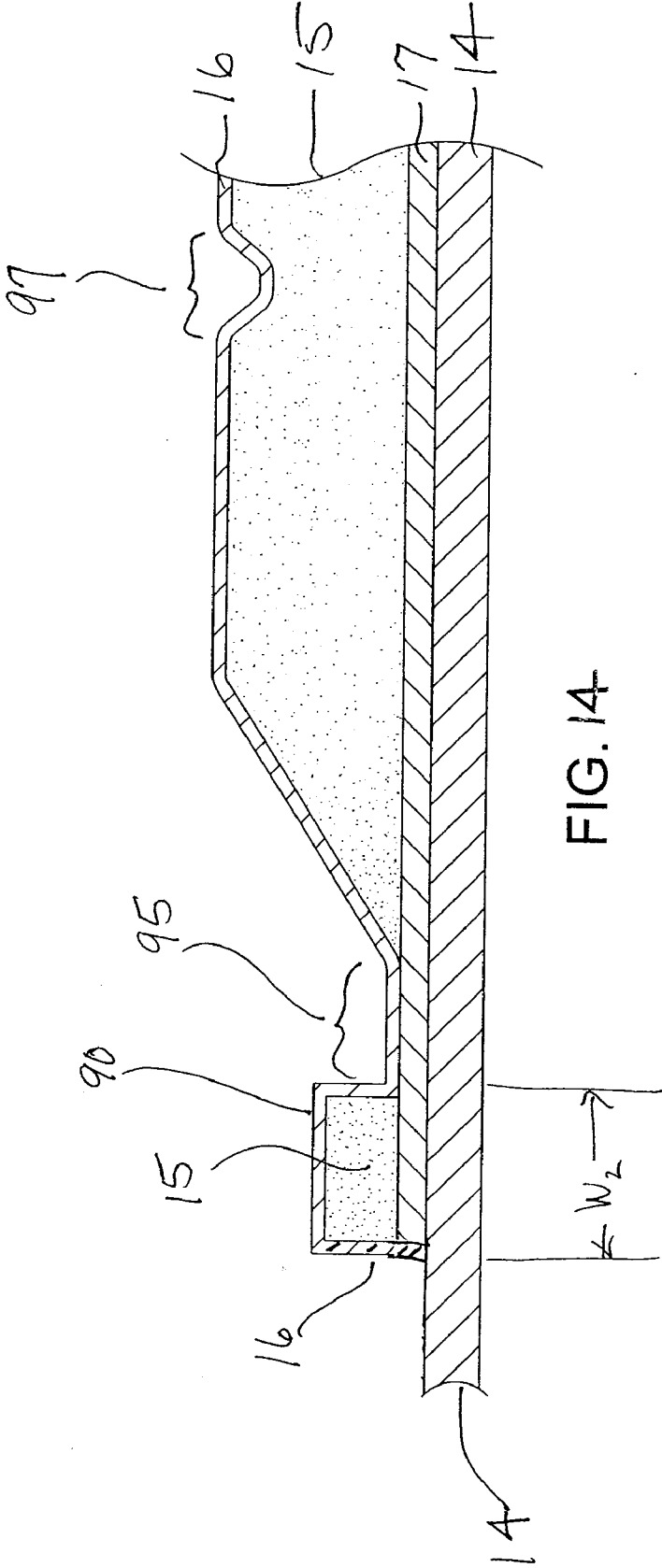


FIG. 14

FLEXIBLE IMPACT PROTECTIVE CASES AND METHODS OF MAKING

CROSS REFERENCE TO RELATED CASES

[0001] Priority under 35 U.S.C. §119(e) is hereby claimed to commonly-owned and co-pending U.S. Provisional Application No. 61/404,906, which was filed on Oct. 12, 2010; U.S. Provisional Application No. 61/412,767, which was filed on Nov. 11, 2010; U.S. Provisional Application No. 61/495,371 which was filed on Jun. 9, 2011; U.S. Provisional Application No. 61/520,546, which was filed on Jun. 10, 2011; U.S. Provisional Application No. 61/501,140, which was filed on Jun. 24, 2011; U.S. Provisional Application No. 61/571,623, which was filed on Jul. 1, 2011; and U.S. Provisional Application No. 61/575,363, which was filed on Aug. 19, 2011. The subject matter of each of the foregoing applications is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The disclosure relates to flexible impact protective cases and methods of making.

BACKGROUND

[0003] Protective cases for sensitive equipment, devices or instruments are usually designed with padding on the interior or exterior, or both. Many times the padding is formed of continuous sheets of protective materials, such as neoprenes, foams and/or laminated materials, and the like. Such cases often do not offer sufficient protection from impact, vibration, and the like. Protection for the devices may be improved by using thicker materials, but increasing the thickness may not be desirable due to the added bulk or weight. Moreover, increased weight and bulk may be undesirable for streamlined electronic devices, for which users usually pay a premium in order to obtain slim and/or lightweight products.

[0004] Many electronic devices have a screen interface used to display information to users, so it is necessary to expose the screen during use. However, screen interfaces are known to be delicate, tending to break easily when dropped or otherwise impacted.

[0005] Portable electronic devices, such as laptop computers, or medical equipment, also have screen interfaces, and to protect the screen interface, such devices often include a hinged protective cover that provides some protection from dropping or impact, when not in-use. However, many cell phones, media devices, and tablet-style computers or netbooks do not include such covers. Therefore, a screen or edge impact can easily cause severe damage to the screen and/or device. In addition, some devices, such as iPad devices, are very thin and delicate, which exacerbates their ability to withstand an impact. As a result, many companies now manufacture covers, cases and shells that can be purchased separately from the devices, which tends to fall into a few different categories.

[0006] One type of case is a rigid plastic shell, which may include internal or external padding, such as rubber or silicone. Although the rigid shells offer some protection, there are some disadvantages. First, the shells are made for specific device sizes and configurations, and therefore cannot be used for “next-generation” devices, such as when a device is upgraded or changed. Also, a store must stock multiple stock keeping units (“SKU(s)”) to accommodate the range of devices of even a like kind. Another disadvantage is that such

rigid shells, even with some soft added elements, may not protect well against a drop of the face or open screen. Even devices that include a protective bezel do not absorb energy, unless made very thick, so a drop on the screen side may result in a broken screen.

[0007] Another type of case is a soft “skin,” generally made of rubber, silicone or other thermoplastic elastomeric (“TPE”) material. Like rigid plastic shells, skins are made for specific device sizes and configurations, and therefore cannot be used for “next-generation” devices. Other disadvantages are that they are generally thin, and therefore provide only minor impact protection and mostly scratch protection. Once again they are not generally able to protect the device from a significant drop on the screen side

[0008] Another type of case is a portfolio-style case, to which the electronic devices may be attached using clips, elastic bands or other features. However, these types of cases do not provide screen side impact protection, and generally offer little impact protection.

[0009] There is a need for an improved case for sensitive equipment, devices or instruments, which is lightweight and provides improved impact protection, particularly for exposed screen or “in-use” devices, and which is not specific to one device size, but instead can accommodate a range of device sizes.

SUMMARY

[0010] The present disclosure is directed, in one embodiment, to a protective case for a device. The case can comprise a case body comprising a closure, at least one protective element disposed on the case body. The at least one protective element can comprise a base layer, an intermediate layer of a rate dependent material, and a surface layer.

[0011] The rate dependent material can be encapsulated by the base layer and the surface layer. The at least one protective element can be disposed on one or more surfaces selected from the group consisting of an external surface of the case body, an internal surface of the case body, and combinations thereof. The case body can comprise a base, a sidewall extending upwardly from the base, and at least one sidewall protective element disposed against the sidewall.

[0012] The case body can comprise four corners, and further can comprise a corner protective element disposed in the at least one corner. The case body can comprise a base, and can further comprise a protective element disposed in the base. The case body can comprise a base, and can further comprise a protective element disposed in the base. The protective element can comprise a flange, and the rate dependent material in the flange can be encapsulated by the base layer and the outer layer. The protective element can comprise a flange, and the flange can be spaced apart from the protective element by a channel.

[0013] The channel can comprise the base layer and the outer layer, and the base layer and the outer layer in the channel can be bonded together. A portion of the rate dependent foam is disposed between the bonded base and outer layers in the channel. The surface layer is continuously bonded to the rate dependent material. The base layer is continuously bonded to the rate dependent material. The surface layer and the base layer are both continuously bonded to the rate dependent material. The surface layer can comprise a thermoplastic polyurethane selected from aliphatic or aromatic polyether polyurethane, aliphatic or aromatic polyester polyurethane, and combinations of the foregoing.

[0014] The present disclosure is directed, in one embodiment, to a protective case for a device. The case comprises a case body comprising a closure, the case body comprising an extensible material comprising elastane; at least one protective element disposed on the case body, the at least one protective element comprising a base layer, an intermediate layer of a rate dependent polyurethane foam, and a surface film of polyester polyurethane; wherein the protective element can comprise a flange spaced apart from the protective element by a channel, and the channel the base layer and the outer layer in the channel are bonded together. The base layer and the outer layer in the channel can be continuously bonded together. The rate dependent rate dependent polyurethane foam can be encapsulated by the base layer and the surface layer. The base layer and the outer layer in the channel can be continuously bonded together. The base layer can comprise an extensible material comprising elastane.

[0015] Another embodiment of the protective case comprises a case body with a closure. The case body can comprise an extensible material layer comprising elastane. At protective element can be disposed on the case body, and the protective element can comprise a cushioning region disposed between a surface layer of polyester polyurethane and the extensible material layer. The protective element can comprise a channel, and the extensible layer and the surface layer in the channel can be bonded together. The case also can comprise a flange, and the flange can be spaced apart from the cushioning region by the channel. The extensible material and the surface layer in the channel can be continuously bonded together. The rate dependent polyurethane foam can be encapsulated by the extensible layer and the surface layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] The foregoing and other features and advantages will be apparent from the following more particular description of exemplary embodiments of the disclosure, as illustrated in the accompanying drawings, in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the disclosure.

[0017] FIG. 1 is a front perspective view of one exemplary embodiment of a protective case according to the present disclosure, in a closed position;

[0018] FIG. 2 is a front view of the protective case shown in FIG. 1;

[0019] FIG. 3 is a perspective view of the protective case shown in FIG. 1, in an open position;

[0020] FIG. 4 is a front perspective view of another exemplary embodiment of a protective case according to the present disclosure, in a closed position;

[0021] FIG. 5 is a front view of the protective case shown in FIG. 4;

[0022] FIG. 6 is a perspective view of the protective case shown in FIG. 4, in an open position;

[0023] FIG. 7 is a front perspective view of another exemplary embodiment of a protective case according to the present disclosure, in an open position;

[0024] FIG. 8 is a perspective view of one protective element shown in the protective case of FIG. 7;

[0025] FIG. 9 is a side view of the protective element shown in FIG. 8;

[0026] FIG. 10 is a perspective view of a corner protective element shown in the protective case of FIG. 7, in an unfolded position;

[0027] FIG. 11 is a bottom view of the corner protective element shown in the FIG. 10, in an unfolded position;

[0028] FIG. 12 is a perspective view of the corner protective element shown in the FIG. 10, in a folded position; and

[0029] FIG. 13 is a top view of the corner protective element shown in the FIG. 10, in a folded position; and

[0030] FIG. 14 is a cross-sectional view of the corner protective element shown in FIG. 10.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0031] The present disclosure is directed to a protective case that provides improved impact protection, particularly for devices with screen interfaces, as are found in many electronic and medical devices.

[0032] One aspect of the disclosure is a flexible protective case, which is advantageous because it is capable of accommodating a range of device shapes and sizes. Therefore, the cases can be designed and used for any type of sensitive device or item that may need protection, such as musical instruments, wine and liquor bottles, crystal, and the like.

[0033] The present cases and methods of making provide improved impact protection, lighter weight, reduced bulk, improved aesthetics, reduced manufacturing costs, improved fit, and less abrasion to the contained article.

[0034] Some embodiments comprise a film of polyester polyurethane, which has unexpectedly improved the performance of the present cases in certain harsh environments, such as during repeated commercial laundering, and it is thought that the unexpected performance is due to the continuous bonding of the materials, particularly at the perimeter of the protective elements, and to the encapsulation of the intermediate layer, as will be discussed in detail below. As a result, the cases are hygienic, and are capable of withstanding the high temperatures and caustic chemicals used in commercial-grade laundering.

[0035] FIGS. 1-3, when taken together, show one embodiment of an exemplary protective case 100 according to the present disclosure. As shown, case 100 comprises a flexible, rectangular case body 12 with a front exterior surface 14, a back exterior surface (not illustrated), an interior surface 15, a closed edge 16, and a closure 18 that extends around three (3) edges of the case body 12. Those of ordinary skill in the art will recognize that it is not necessary for the case to have rectangular shape, and that it may have any shape and/or configuration. Those of ordinary skill in the art will recognize that a variety of types of closures including, but not limited to, zippers, including waterproof, air resistant and plastic ziplock-style zippers; pillow flap type enclosures; envelope-style enclosures; hook and eye tape; magnets; clips; and the like.

[0036] Case 100 comprises a protective element 20 disposed on one or both of the front exterior surface 15 and back exterior surfaces. Those of ordinary skill in the art will recognize that any number of protective elements may be used, that the protective element(s) may be positioned anywhere on the case body, and that the protective elements may have any shape, size and/or configuration, as desired.

[0037] FIGS. 4-6, when taken together, show another exemplary embodiment of a flexible, protective case 300 according to the present disclosure. Case 300 comprises the

same features described above with respect to case **100**. In the present embodiment, in addition to the features described above, the protective element **30** has a larger area, and is spaced apart from the edges of the case body **12** by a spacer region **40**. The spacer region **40** has a width “ W_1 ” that can range in width as desired, provided there is sufficient space to accommodate the zipper closure, or alternative closures.

[0038] In the present embodiment, the larger area of the protective element **30** may be desirable for devices that require larger protective areas, while the presence of the spacer region maintains flexibility in the edge regions of the case.

[0039] The case body **100** and optional liner can comprise a variety of materials with different aesthetic and functional characteristics, and which can be varied as needed or desired for a particular application or design. Suitable materials for the case body and optional liner include, but are not limited to, synthetic and/or non-synthetic materials including, but not limited to, paper, fabric, metal, metallized plastic, plastic film, metal foil, and/or the like, as well as composites, laminates thereof, and/or combinations comprising at least one of the foregoing. Other suitable materials include, but are not limited to, fabrics, leather, vinyl, composites, laminates thereof, and/or combinations comprising at least one of the foregoing. If fabric is used, it can be synthetic or non-synthetic, knit, woven, non-woven, laminates thereof, and combinations comprising at least one of the foregoing. Any of the foregoing materials can be laminated and/or can comprise a coating on one or both surfaces, to impart desirable functional or aesthetic characteristics, such as water repellency, and the like.

[0040] Examples of suitable non-extensible or low stretch materials from which the case body and optional liner may be made include, but are not limited to, nonwoven materials, including nonwoven fabrics, leather, woven materials, such as ballistic fabrics, and the like. Examples of ballistic materials include, but are not limited to, reinforced and un-reinforced polyester, nylon, rayon, polyamides (such as aramids and para-aramids), and the like, and combinations thereof. Examples may include Cordura, Kevlar, Twaron, Spectra, Zylon, ripstop weaves thereof, and combinations thereof. One suitable ballistic material is a woven 1680 denier ballistic Nylon sold by RockyWoods, which has a weight of approximately 12 ounces per square yard (oz/sq yd), a polyurethane coating of approximately 1-1.25 oz/sq yds on one side for water resistance, and a durable water repellent (“DWR”) finish on the opposite side. Other suitable materials include 1050 ballistic nylon and Cordura, both with and without the polyurethane coating and DWR.

[0041] Examples of suitable extensible materials from which the case body and liner may be made include, but are not limited to elastane, and the like.

[0042] Construction of the foregoing cases **100**, **200** comprises selecting a suitable material for the case body, selecting suitable dimensions for the case body, and forming or attaching the closure. The sheet of case body material can comprise dimensions larger than the item to be protected, in order to accommodate a seam allowance. In the foregoing embodiments, the material for the case body is folded to form edge **16**, but those of ordinary skill in the art will recognize that separate sheets of case body material can be attached to form edge **16**. Those of ordinary skill in the art will recognize that a variety of attachment methods may be used to form the edge **16** and/or case body including, but not limited to, stitching,

gluing, welding of any kind, or a combination of the foregoing. In instances in which water resistance is desired, it may be more desirable to heat seal, glue and/or welding the seams and/or zipper together.

[0043] In the foregoing embodiments, which both include zipper closures, the zipper is attached to the case body at the closure end by stitching adjacent to the zipper teeth, along stitching line “s”.

[0044] In the embodiment depicted in case **100**, the protective element is attached to the case body by stitching through the case body and the flange along stitching line “S,” whereas in the embodiment depicted in case **200**, the protective element(s) **30** are attached to the case body by welding. The protective elements **30** may be attached to the case body material prior to or after constructing the case and/or exposed through a corresponding opening in the case body.

[0045] As shown above, in both of the foregoing embodiments, the protective elements **20**, **30** are attached to exterior of the case body, as shown above. However, if desired, the protective elements **20**, **30** can be attached to the interior of the case body. In addition, protective elements can be attached to both the interior and the exterior surfaces of the case body and/or to the optional liner and/or to the optional insert.

[0046] Those of ordinary skill in the art will recognize that a combination of the foregoing materials and techniques can be used to make flexible protective cases for a variety of devices that need to be protected. The ability to withstand commercial laundering also applies to other dirty environments including, but not limited to, muddy areas, chemical exposure, hospitals, military, and the like. Those of ordinary skill in the art will also recognize that the foregoing techniques can be modified and/or combined with other features to be used for protection of other items.

[0047] The foregoing flexible cases fit snugly, but stretch and conform to the device, resulting in an integrated protection system that protects the device from impact better than other products, because the pad is in constant and direct contact with the device. Cases incorporating the protective elements provide improved protection from impact, because the base of the protective element, or the material to which the base of the protective element is attached, can be maintained in direct contact with the device during use. That is, without the degree of flexibility of the present cases, they would not be capable of conforming to the case. For ease of discussion, the term “flexible,” as used herein, means the ability of the case to move by bending, twisting, flexing and/or stretching, and the like.

[0048] Another aspect of the disclosure is a protective case with a rigid housing and configurable protective inserts. The present case is advantageous because it is capable of accommodating a range of device shapes and sizes, by varying the size, shape and configuration of the inserts, which are replaceable.

[0049] FIGS. 7-13, when taken together, show one embodiment of an exemplary protective case **300** according to the present disclosure. As shown, case **100** comprises a rigid, rectangular case body **12** with a case body base **14** and a cover **16**. Those of ordinary skill in the art will recognize that it is not necessary for the case to have rectangular shape, and that the case may have any shape and/or configuration.

[0050] Case body **12** can comprise a variety of materials, as described above, and additionally may comprise a lightweight, rigid, impact-resistant material. One suitable material

is polycarbonate. Those of ordinary skill in the art will recognize that any light-weight, rigid, impact-resistant material may be used.

[0051] Case **300** comprises various protective elements disposed in the interior of the case, having different shapes. Those of ordinary skill in the art will recognize that case **300** can comprise any number of protective elements, and that the protective elements may have any quantity, shape, location and/or configuration.

[0052] Disposed on the inner surface of the base **14** is a protective element **60**, which is similar in construction to protective elements **20,30**, as described above. However, sidewall and corner protective elements **40,50** comprise more complex molded shapes than protective elements **20,30**, and are designed to receive the sidewall of, for example, a laptop computer.

[0053] Disposed against the sidewall of base **14** are four (4) sidewall protective elements **40**. Each sidewall protective element comprising a sidewall **42** and upper and lower retaining arms **44,48** extending outwardly from the sidewall to define a recess **48** for receiving the edge of a rectangular item, such as a laptop computer.

[0054] Disposed in each corner of base **14**, against the sidewall of base **14**, are four (4) corner protective elements **50**. Each corner protective element **50** comprises a left side "L" and a right side "R", with a plurality of flexible flanges **50**, disposed an accordion-style, between the left and right sides L and R, which allows the element to be folded for insertion into the corners of the base **14**. Each of the left and right sides L and R comprise a sidewall **52**, and upper and lower retaining arms **54,58** extending outwardly from the sidewall **52** to define a recess **58** for receiving the edge of a rectangular item, such as a laptop computer.

[0055] As shown above, the protective elements **40, 50** are disposed in the interior of the case, in the base. However, if desired, the protective elements **40, 50** can be disposed against the sidewalls and corners of the interior of the cover **14**. Similarly, additional protective elements **60** can be attached to one or both of the interior and the exterior surfaces of the case body and/or to the optional liner and/or to the optional insert.

[0056] Optionally, any of the cases **100, 200, 300** disclosed above can comprise a plurality of access ports to provide access to various functional keys on the device and/or to external devices, such as battery chargers, and the like. Those of ordinary skill in the art will recognize that that any number of access ports may be included, that the access port(s) may be positioned anywhere on the case body, and that the access ports may have any shape, size and/or configuration, as desired, and can be disposed in any location, as desired, to correspond with the location of such features as found on commercial electronic devices, or any device to be protected.

[0057] Optionally, any of the cases **100, 200, 300** disclosed above can comprise a liner (not illustrated) attached to the interior of one or both of the front and back sides of the case.

[0058] Optionally, any of the cases **100, 200, 300** disclosed above can comprise a variety of accessories (not illustrated), such as pockets for paper and/or writing instruments, handles, straps, zippers, straps or other devices, including devices that allow the case to be attached to other items, such as backpacks, luggage, clothing, jackets, and the like, or integrated into the foregoing items as a pocket or sleeve, and the like. Those of ordinary skill in the art will recognize that that any number of accessories may be included, that the accessories

may be positioned anywhere in or on the case body, and that the accessories may have any shape, size and/or configuration, as desired.

[0059] Optionally, any of the cases **100, 200, 300** disclosed above can comprise a structural insert (not illustrated) disposed in the case body, or when a liner is included, disposed between the liner and the case body. Alternatively, the insert can comprise the same material as used for the protective elements, or can comprise the rigid material as described above for case **300**. Optionally, the rigid material in the case may be designed to be larger in length and width than the electronic device stored in the device case, to provide additional edge impact protection for the edges of the device.

[0060] FIG. **14** shows a partial cross-section of protective element **30**, disposed adjacent to the case body **12**. As shown, protective element **30** comprises an upper surface **70**, a back surface **72**, a perimeter **P**, and an intermediate layer **80** disposed between optional surface and base layers **82,84**. In addition, an additional layer or layers of materials can be disposed adjacent to, including bonded to, the surface layer for extreme durability and/or aesthetics.

[0061] Optionally, the upper surface **70** of the protective element may be contoured using a variety of geometries, including planar surfaces, curved surfaces, and combinations of planar and curved surfaces.

[0062] Optionally, one or more hinges **95** and/or grooves **97** may be formed in the upper surface **80** of the protective elements, to define cushioning regions **99**. The hinges **95** and the grooves **97** increase the flexibility of the protective element, and as the thickness of the cushioning layer **80** in the grooves **97** is decreased, the flexibility of the grooves **97**, and protective element **30**, increases. The width, depth, orientation and position of the grooves **97** may be varied, depending on a number of factors including, but not limited to, the desired direction and amount of flexibility, and the like.

[0063] In the present embodiment, protective element **30** comprises an optional perimeter flange **90**, which has a width " W_2 " defined by the spacing " S_2 " between the perimeter of the outermost cushioning region **99** and the perimeter **P** of the protective element. The width W_2 of the perimeter flange **90** and the spacing " S_2 " may vary, as desired. As will be described in greater detail below, the perimeter flange **90** is thinner than the cushioning regions, allowing the protective element to be attached to items such as clothing along the flange area using a variety of techniques, such as by sewing, gluing, bonding, and the like.

[0064] The size, shape, thickness and material composition of the protective elements may be varied, depending on a number of factors including, but not limited to, desired amount of flexibility for the protective element. In addition, the configuration of the protective elements may be varied, and more than one type of medallion shape may be used in the protective elements.

[0065] Suitable materials and methods of making the protective elements are disclosed in U.S. Publication Nos. 2007/0261274, 2008/003614, 2009/0255625, the subject matter of which is incorporated herein by reference in its entirety. The foregoing applications describe methods that can be used to mold any of the foregoing protective elements.

[0066] The molds for the protective elements can be designed to compress the layers together under conditions sufficient to minimize or eliminate the foam in the channels, while allowing the layers to bond together, either with a chemical or thermal bond, or both. As a result, the interme-

diate layer can be encapsulated, which improves performance of the protective elements in high humidity and under harsh conditions, such as encountered in commercial laundering, cleaning procedures in medical environments, and the like. Further improvements in performance are found when the protective elements comprise the foregoing outer flange. It is thought that the further improvements are the result of the continuous bonding of the inner and outer layers to the intermediate layer, but also because after molding, very little or none of the material used in the intermediate layer remains, so the inner and outer layers are bonded to one another in the channel adjacent to the flange, essentially locking out fluids from entering the perimeter of the protective element. In addition, the channels with little or no foam can be designed to achieve areas of flexibility, such as around corners, stress points and/or complex shapes and, to improve washability and durability. The construction of the protective elements is also advantageous because the intermediate material is locked in place, so that it is not possible for the material to shift, or for gaps to open up in the material. In other words, the protective elements provide lightweight flexibility, without shifting areas of protection.

[0067] In many embodiments, the protective elements may comprise cushioning regions, hinges and channels, as described in the applications mentioned above, but none of the foregoing is necessary.

[0068] The protective elements can comprise a variety of materials such as, but not limited to, polymeric materials, including foamed polymeric materials, composite materials, and the like. In one exemplary embodiment, the material can comprise a dilatant or shear thickening material, such as rate dependent materials. In one exemplary embodiment, the material can comprise d3O. In one exemplary embodiment, the material can comprise a material such as polyborosiloxane. In another exemplary embodiment, the material can comprise rate dependent foam. For such applications, it can be desirable for such foams to have a density ranging from about 5 to about 35 pounds per cubic foot (pcf), more particularly from about 10 to about 30 pcf, and more particularly still from about 15 to about 25 pcf. Suitable rate dependent foams are available from Rogers Corporation under the brand names PORON® and PORON XRD®, both of which are open cell, microcellular polyurethane foams.

[0069] The optional outer layer is described in detail in the referenced publications. Suitable outer layers can comprise any material capable of providing sufficient elasticity to prevent tearing and/or stretching when a force is applied thereto; sufficient structural integrity to be formed into predetermined shapes; and that is capable of withstanding the environment in which it is intended to be used (e.g., repetitive deformations such as twisting, bending, flexing, stretching, and the like), without substantial degradation. Examples of suitable extensible materials include, but are not limited to, thermoplastic elastomer (“TPE”) film. Thermoplastic polyurethanes (“TPU”), both polyester and polyether, whether aromatic or aliphatic, have been found suitable. Suitable film thicknesses can range from about 1 milli-inch (“mil(s)”) to about 15 mils, more particularly between about 2 mils to about 10 mils, and even more particularly from about 3 mils to about 7 mils. However, when increased durability is desired, film thicknesses may be increased to, for example, 10-60 mils, or more, limited only by the characteristics and performance of the film after molding.

[0070] One exemplary material is a polyester thermoplastic polyurethane (“TPU”) made by Bayer and sold under the name PS5400. As noted above, polyester polyurethanes have been found to perform unexpectedly well during repeated commercial laundering, and it is thought that the unexpected performance is due to the bonding of the materials, particularly at the perimeter of the protective elements, and to the encapsulation of the intermediate layer.

[0071] Optionally, any of the foregoing cases **100**, **200**, **300** disclosed above can comprise a protective binding and/or gusset (not illustrated) attached to or forming part of the outer edge, including on the closure. The binding can comprise the same material as used for the protective elements, particularly with ballistic fabric, which provides a rugged edge. The binding can be disposed such that the ballistic material is inverted, so protective element is internal on the edge, and vice versa.

[0072] Those of ordinary skill in the art will recognize that a combination of the foregoing materials and techniques can be used to make semi-rigid or rigid protective cases for a variety of devices that need to be protected, while providing the capability to modify the interior of the case by replacing the protective elements with those having a different size, shape and configuration, to adapt to different devices. The case and protective elements also can withstand commercial laundering also applies to other dirty environments including, but not limited to, muddy areas, chemical exposure, hospitals, military, and the like. Those of ordinary skill in the art will also recognize that the foregoing these techniques can be modified and/or combined with other features to be used for protection of other items.

[0073] The cases disclosed herein can comprise one or more of the following advantages: 1) the provide lightweight impact resistance; 2) certain of the case described above are flexible, and can accommodate devices of different dimensions, in contrast to other types of cases, which are designed specifically for one type of device; and 3) improved economics as a result of the methods of making the panels and retaining devices; and 4) the encapsulated protective elements provide items that are rugged, durable, and able to withstand the temperatures, detergents and mechanical action used in industrial and/or commercial laundering, unlike other cases, which cannot be washed, or tend to degrade under such harsh conditions.

[0074] It should be noted that the terms “first,” “second,” and the like herein do not denote any order or importance, but rather are used to distinguish one element from another, and the terms “a” and “an” herein do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced items. Similarly, it is noted that the terms “bottom” and “top” are used herein, unless otherwise noted, merely for convenience of description, and are not limited to any one position or spatial orientation. In addition, the modifier “about” used in connection with a quantity is inclusive of the stated value and has the meaning dictated by the context (e.g., includes the degree of error associated with measurement of the particular quantity).

[0075] Compounds are described herein using standard nomenclature. For example, any position not substituted by an indicated group is understood to have its valency filled by a bond as indicated, or a hydrogen atom A dash (“-”) that is not between two letters or symbols is used to indicate a point of attachment for a substituent. For example, —CHO is attached through the carbon of the carbonyl group. Unless defined otherwise herein, all percentages herein mean weight

percent (“wt. %”). Furthermore, all ranges disclosed herein are inclusive and combinable (e.g., ranges of “up to about 25 weight percent (wt. %), with about 5 wt. % to about 20 wt. % desired, and about 10 wt. % to about 15 wt. % more desired,” are inclusive of the endpoints and all intermediate values of the ranges, e.g., “about 5 wt. % to about 25 wt. %, about 5 wt. % to about 15 wt. %”, etc.). The notation “+/-10% means that the indicated measurement may be from an amount that is minus 10% to an amount that is plus 10% of the stated value. [0076] Finally, unless defined otherwise, technical and scientific terms used herein have the same meaning as is commonly understood by one of skill in the art to which this disclosure belongs.

[0077] While the disclosure has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the disclosure without departing from the essential scope thereof. Therefore, it is intended that the disclosure not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this disclosure, but that the disclosure will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A protective case for a device, comprising: a case body comprising a closure; and at least one protective element disposed on the case body, the at least one protective element comprising a base layer, an intermediate layer of a rate dependent material, and a surface layer; wherein the rate dependent material is encapsulated by the base layer and the surface layer.
2. The protective case of claim 1, wherein the at least one protective element is disposed on one or more surfaces selected from the group consisting of an external surface of the case body, an internal surface of the case body, and combinations thereof.
3. The protective case of claim 1, wherein the case body comprises a base, a sidewall extending upwardly from the base, and at least one sidewall protective element disposed against the sidewall.
4. The protective case of claim 1, wherein the case body comprises four corners, and further comprising a corner protective element disposed in the at least one corner.
5. The protective case of claim 3, wherein the case body comprises a base, and further comprising a protective element disposed in the base.
6. The protective case of claim 4, wherein the case body comprises a base, and further comprising a protective element disposed in the base.
7. The protective case of claim 1, wherein the protective element comprises a flange, and wherein the rate dependent material in the flange is encapsulated by the base layer and the outer layer.
8. The protective case of claim 1, wherein the protective element comprises a flange, the flange is spaced apart from the protective element by a channel, and the channel comprises the base layer and the outer layer, and the base layer and the outer layer in the channel are bonded together.
9. The protective case of claim 10, wherein a portion of the rate dependent foam is disposed between the bonded base and outer layers in the channel.
10. The protective case of claim 1, wherein the surface layer is continuously bonded to the rate dependent material.
11. The protective case of claim 1, wherein the base layer is continuously bonded to the rate dependent material.
12. The protective case of claim 1, wherein the surface layer and the base layer are both continuously bonded to the rate dependent material.
13. The protective case of claim 1, wherein one or more channels are defined in the protective element.
14. The protective case of claim 1, wherein one or more grooves are defined in the protective element.
15. The protective case of claim 1, wherein the rate dependent material comprises a rate dependent foam.
16. The protective case of claim 1, wherein the rate dependent material comprises a rate dependent polyurethane.
17. The protective case of claim 1, wherein the rate dependent material comprises a polyurethane foam.
18. The protective case of claim 1, wherein each of the base layer and the surface layer are selected from the group consisting of film, fabric composites thereof, and combinations of the foregoing.
19. The protective case of claim 6, wherein the film is a thermoplastic elastomer.
20. The protective case of claim 18, wherein the thermoplastic elastomer is a thermoplastic polyurethane.
21. The protective case of claim 19, wherein the thermoplastic polyurethane is selected from aliphatic or aromatic polyether polyurethane, aliphatic or aromatic polyester polyurethane, and combinations of the foregoing.
22. The protective case of claim 18, wherein the film has a thickness ranging from about 1 milli-inch (“mil”) to about 15 mils.
23. The protective case of claim 18, wherein the film has a thickness ranging from about 2 mils to about 10 mils.
24. The protective case of claim 18, wherein the film has a thickness ranging from about 3 mils to about 7 mils.
25. The protective case of claim 18, wherein the film has a thickness of greater than about 10 mils to about 60 mils.
26. The protective case of claim 1, wherein the case body comprises a woven nylon fabric or composite thereof.
27. The protective case of claim 1, wherein the case body comprises an extensible material.
28. The protective case of claim 9, wherein the extensible material comprises elastane.
29. The protective case of claim 10, wherein, when the case body is disposed on an item comprising an outer surface, and the case body conforms to the outer surface of the item.
30. A protective case for a device, comprising: a case body comprising a closure, the case body comprising an extensible material comprising elastane; and at least one protective element disposed on the case body, the at least one protective element comprising a base layer, an intermediate layer of a rate dependent polyurethane foam, and a surface film of polyester polyurethane; wherein the protective element comprises a flange spaced apart from the protective element by a channel.
31. The protective case of claim 30, wherein the base layer and the outer layer in the channel are bonded together.
32. The protective case of claim 30, wherein the base layer and the outer layer in the channel are continuously bonded together.
33. The protective case of claim 30, wherein the rate dependent rate dependent polyurethane foam is encapsulated by the base layer and the surface layer.

34. The protective case of claim **32**, wherein the base layer and the outer layer in the channel are continuously bonded together.

35. The protective case of claim **30**, wherein the base layer comprise an extensible material comprising elastane.

36. A protective case for a device, comprising:
a case body comprising a closure, the case body comprising an extensible material layer comprising elastane;
and

at least one protective element disposed on the case body, the at least one protective element comprising a cushioning region disposed between a surface layer of polyester polyurethane and the extensible material layer;

wherein the protective element comprises a channel, and the extensible layer and the surface layer in the channel are bonded together.

36. The protective case of claim **35**, further comprising a flange, and wherein the flange is spaced apart from the cushioning region by the channel.

37. The protective case of claim **35**, wherein the extensible material and the surface layer in the channel are continuously bonded together.

38. The protective case of claim **35**, wherein the rate dependent polyurethane foam is encapsulated by the extensible layer and the surface layer.

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