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(54) **TRIM PANEL HAVING INTEGRAL DOOR COVER**

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(22) **Filed:** **Sep. 5, 1997**

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Reissue of:

(64) **Patent No.:** **5,447,328**
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(52) **U.S. Cl.** **280/728.3; 280/732**
(58) **Field of Search** **280/728.3, 731,**
280/732

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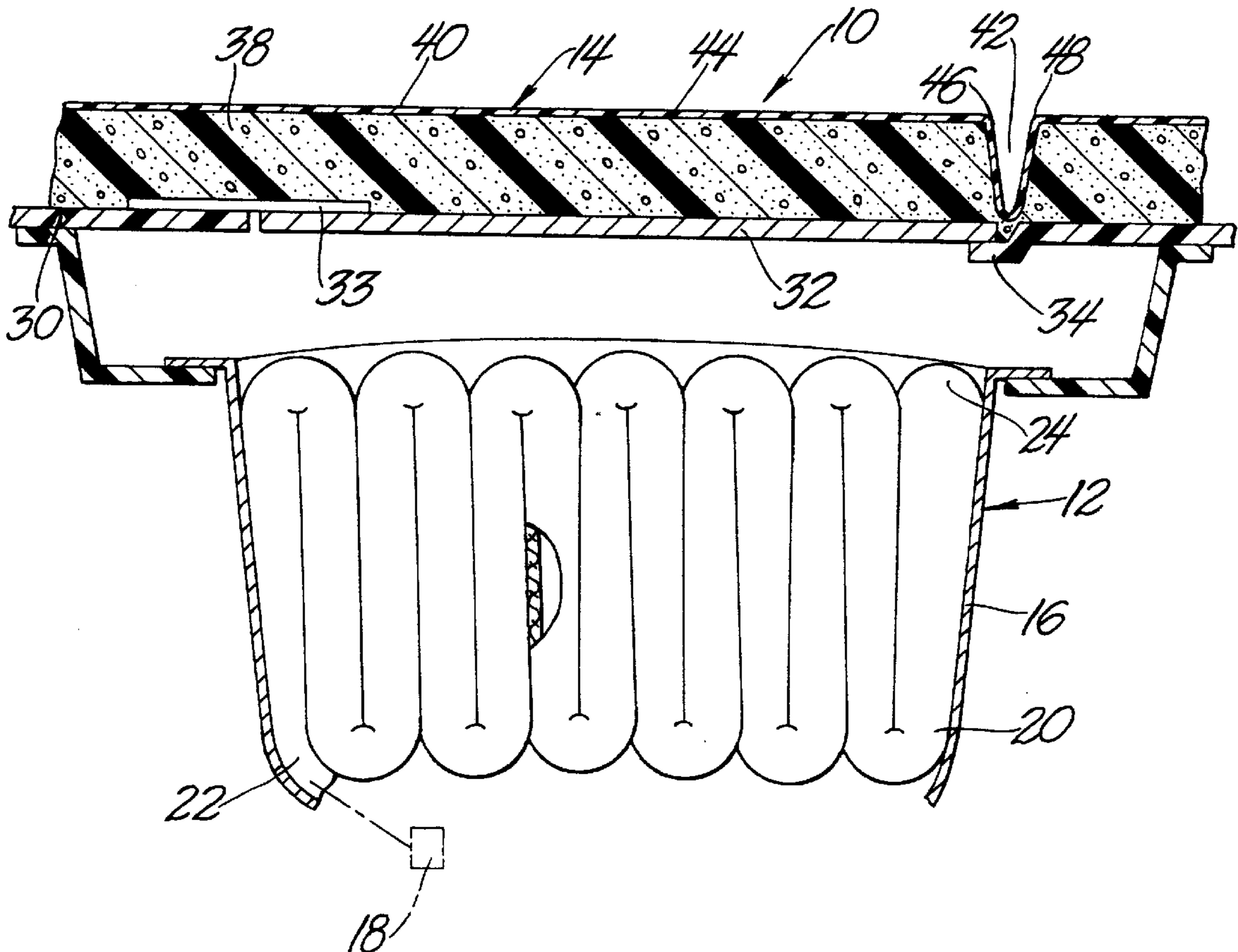
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(57) **ABSTRACT**

An instrument panel has an integral door cover for concealing a supplemental inflatable restraint system in a vehicle passenger compartment. The door cover includes a flap that is an integral part of a flexible plastic skin of the instrument panel. The plastic skin is cast in a special mold with a raised apexed rib that forms grooves outlining the flap that have a thin tear seam at their bottom.

15 Claims, 3 Drawing Sheets



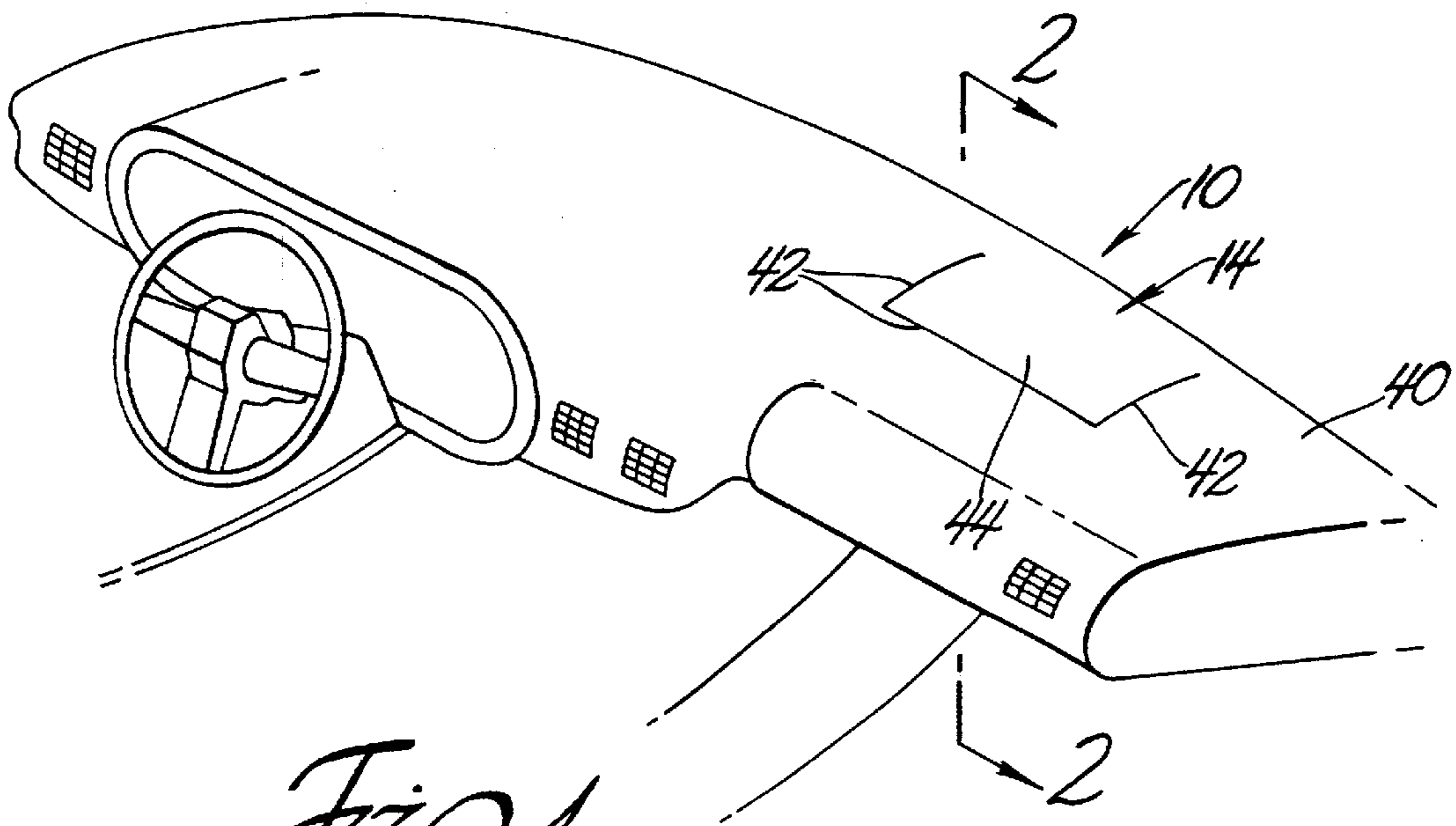


Fig. 1

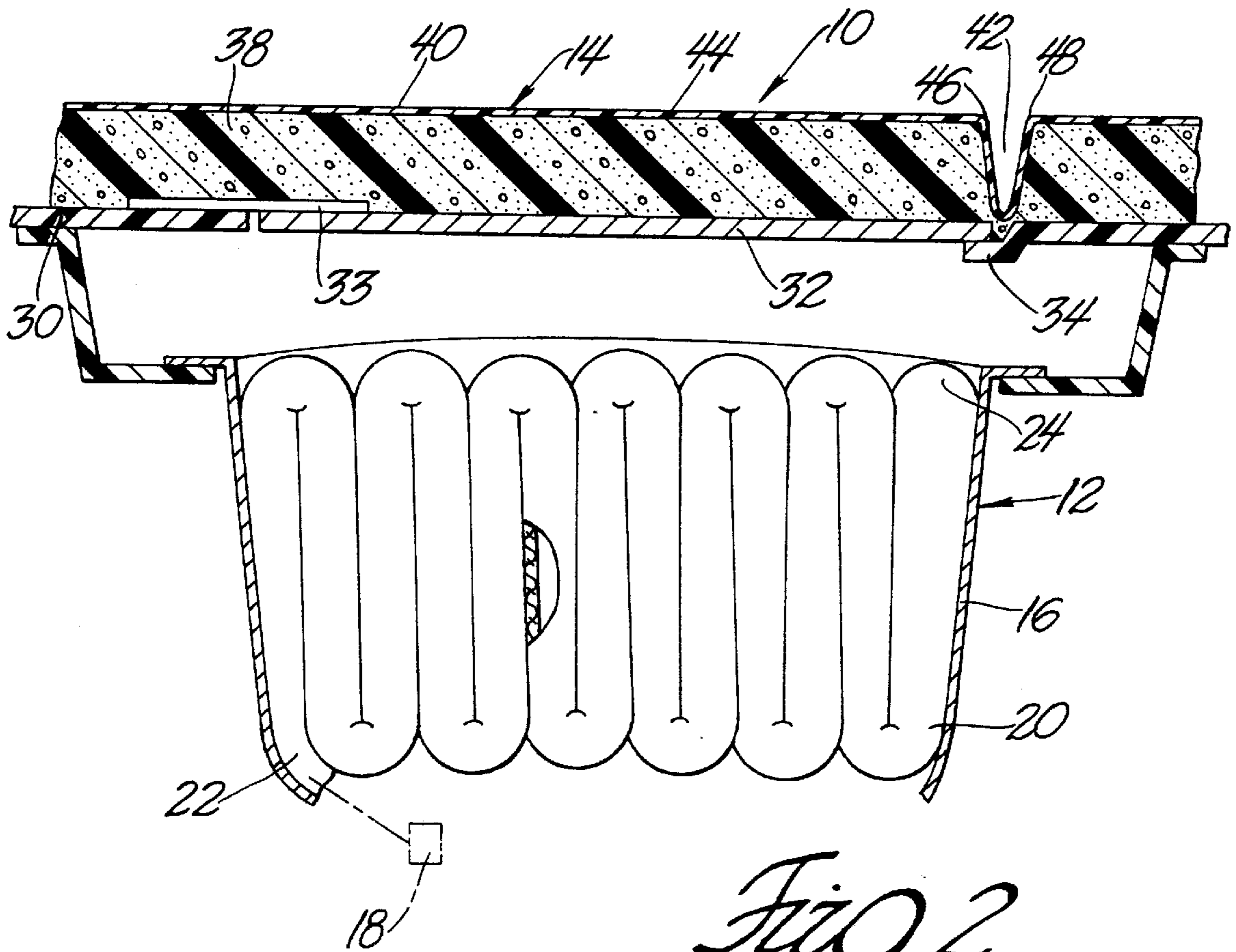


Fig. 2

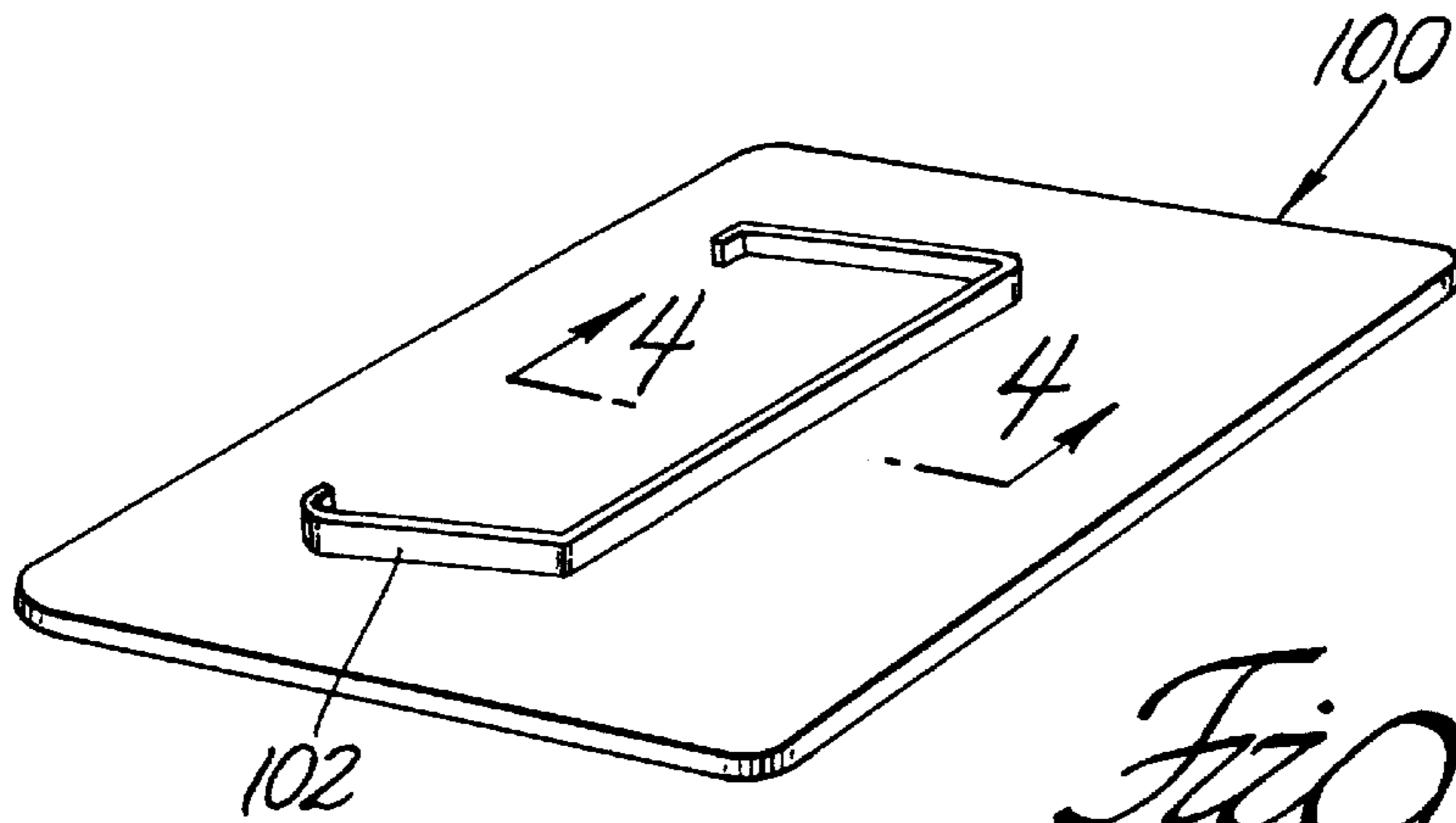


Fig. 3

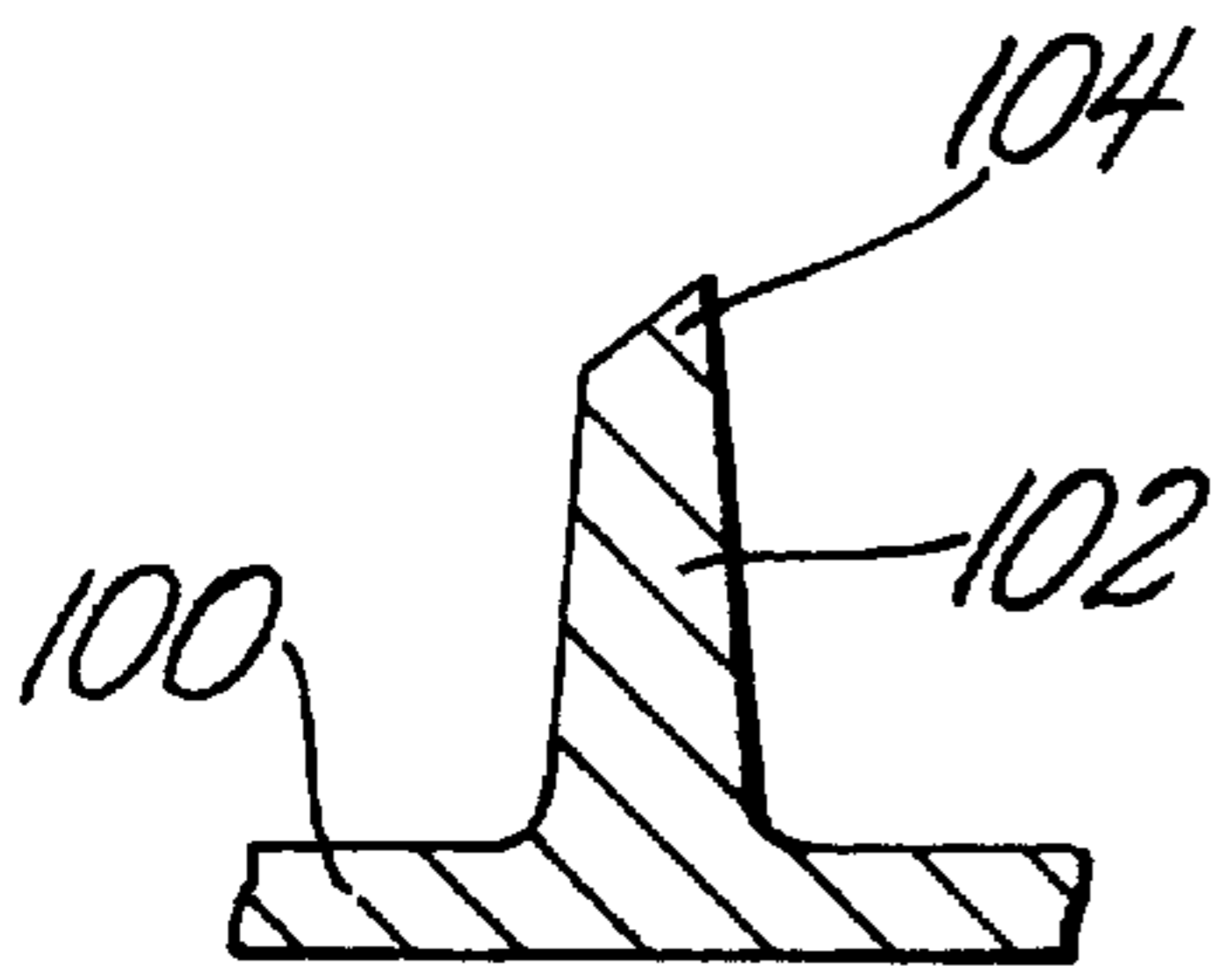


Fig. 4

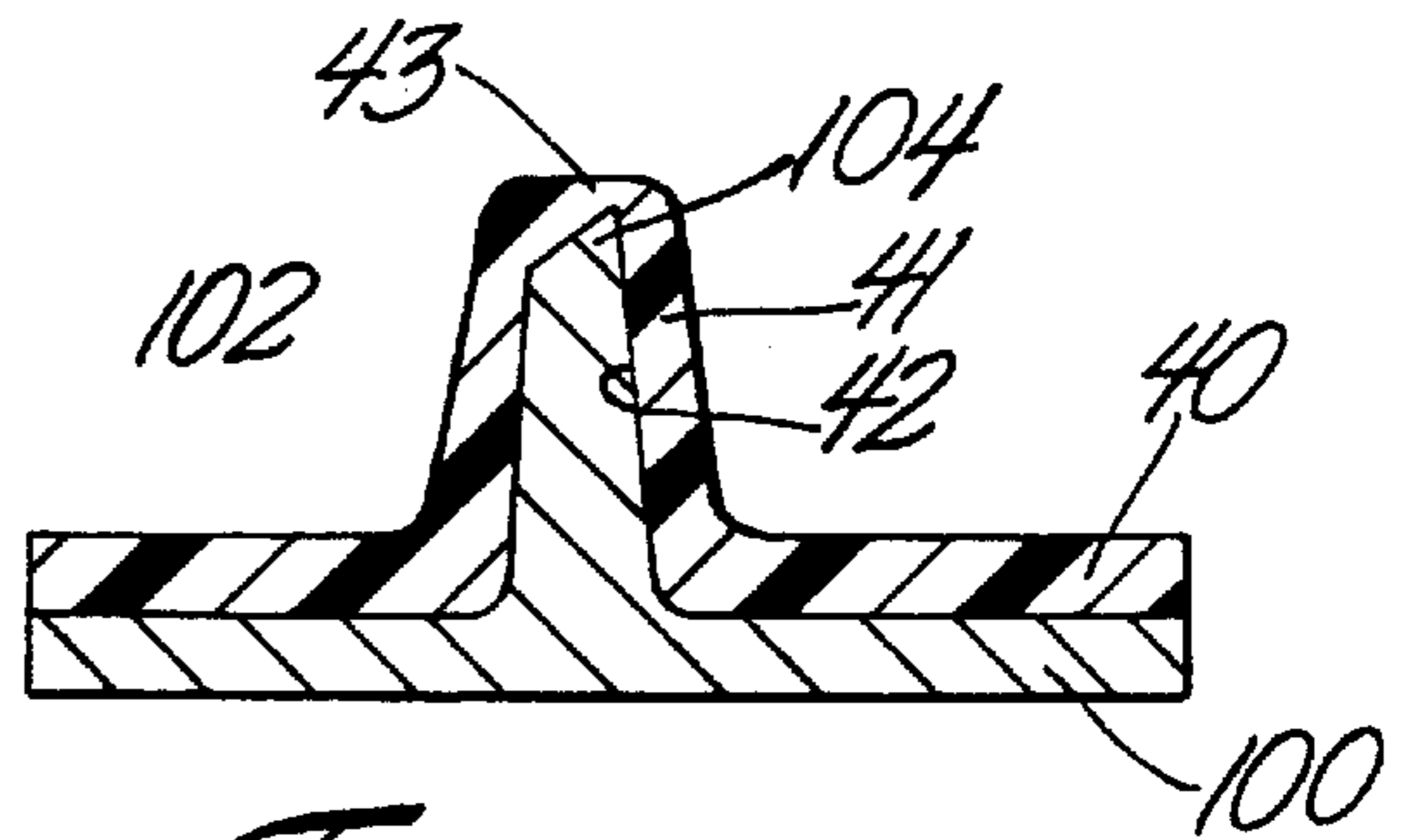


Fig. 6

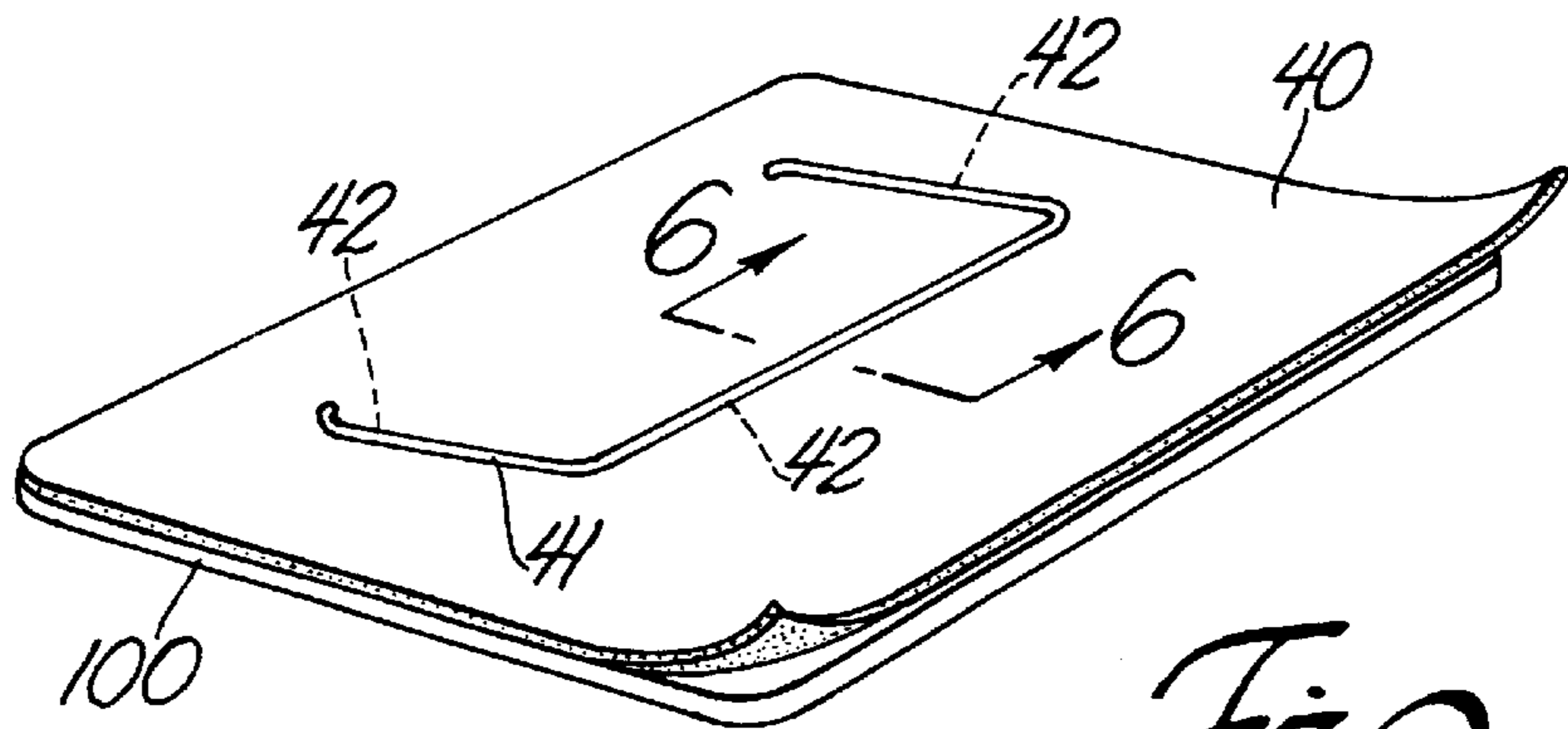


Fig. 5

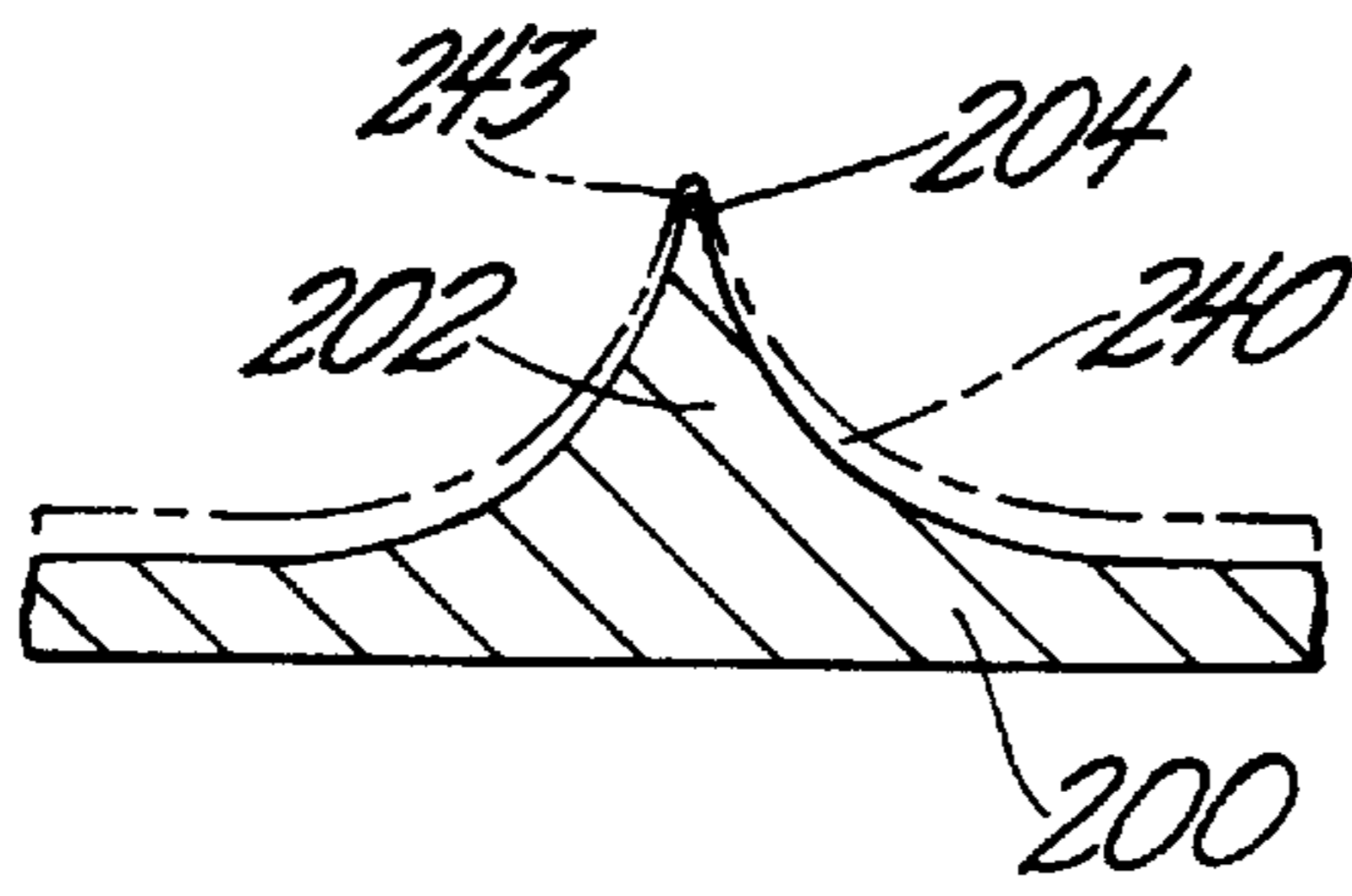


Fig. 7

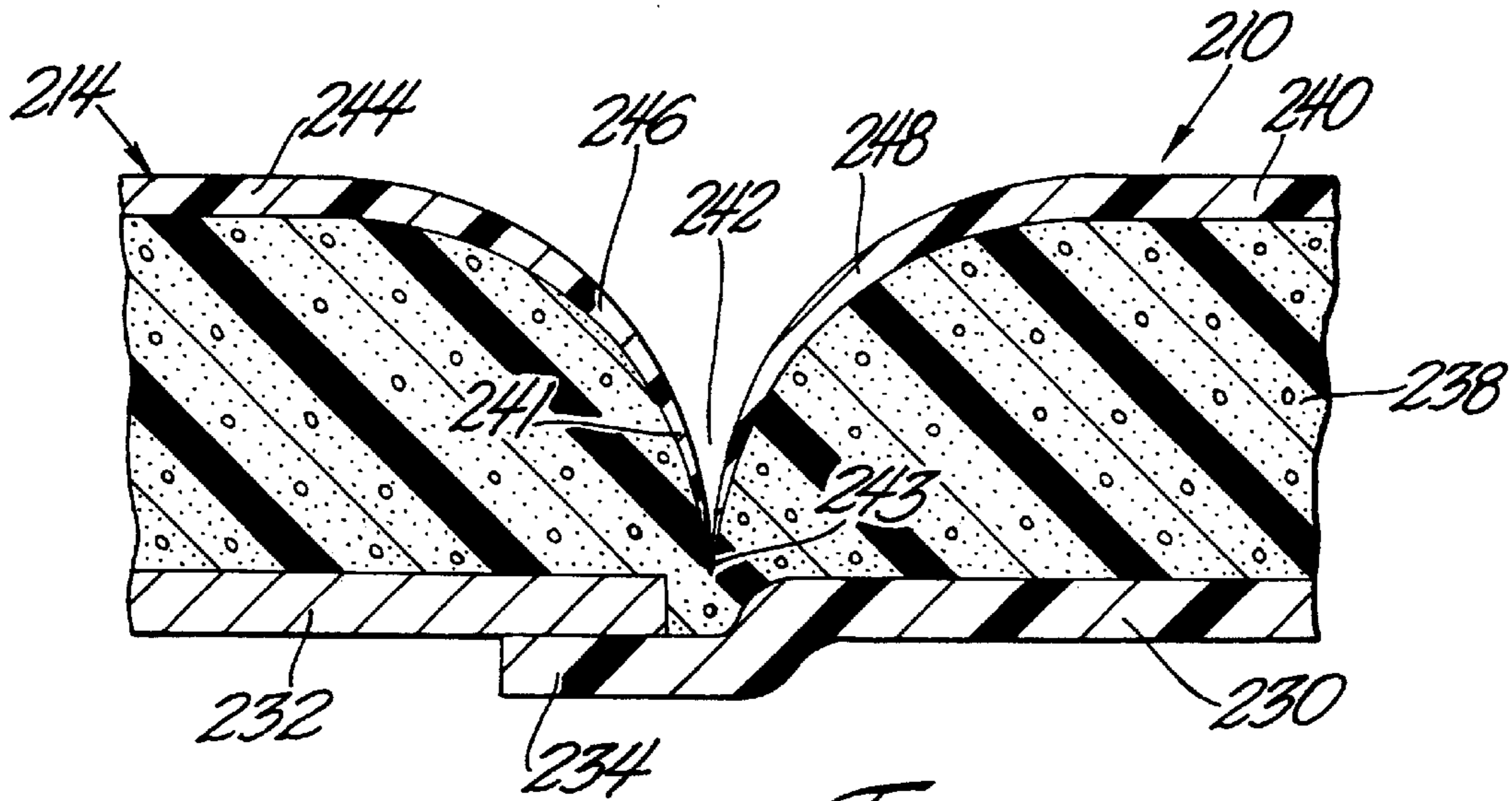


Fig. 8

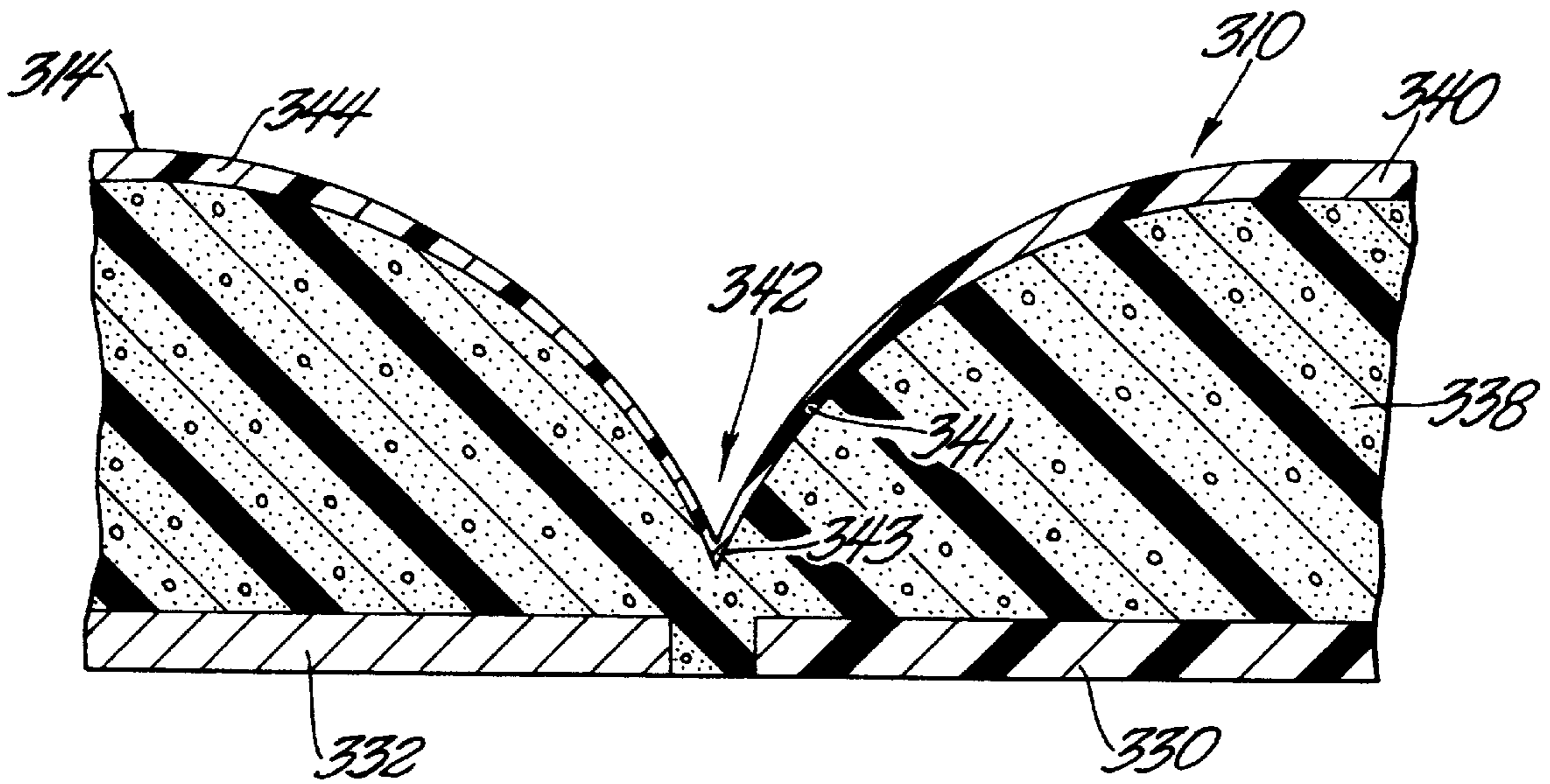


Fig. 9

TRIM PANEL HAVING INTEGRAL DOOR COVER

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

This invention relates generally to supplemental inflatable restraint systems often referred to as airbag systems. More particularly, this invention relates to a trim panel such as an instrument panel, having an integral door cover for concealing the airbag system in a vehicle passenger compartment.

SUMMARY OF THE INVENTION

U.S. Pat. No. 5,131,678 granted to John A. Gardner, Richard D. Rhodes, Jr. and Everett Hastings Jul. 21, 1992 discloses an air bag door cover that is an integral part of a decorative panel for a steering wheel. The panel comprises an aluminum backing plate, an outer flexible vinyl skin and an intermediate elastomeric urethane foam layer. The vinyl skin is cast with a rectangular groove that defines a door. The cast vinyl skin is then placed in a mold in a spaced relationship with the backing plate after which the intermediate layer is foamed in place. The bottom of the rectangular groove is then cut at least part way through on three sides to provide a weakened section in the panel that includes an U-shaped cut line in the backing plate.

While the decorative panel of the above patent is well suited for its intended purpose, it has a drawback in that the bottom of the groove is cut at least part way through on three sides after the vinyl skin is cast and assembled into the decorative panel. This cutting in turn requires deep and narrow grooves to hide the cut. These grooves limit aesthetic design choices and may be difficult to form.

The object of this invention is to provide a trim panel that has an integral door cover for an airbag system that does not require cutting the bottom of the grooves.

Another object of this invention is to provide a trim panel that has a shaped plastic skin that includes a flap for an integral door cover for a SIR system that is partially outlined by a groove that does not require any cutting after the skin is cast to provide a weakened tear seam.

Still another object of this invention is to provide a trim panel that has an integral door cover for an airbag system that includes a shaped plastic skin having a flap partially outlined by a groove that is cast in an aesthetically pleasing manner to include a weakened tear seam at its bottom that does not require any cutting after the skin is cast.

Still yet another object of this invention is to provide a method for making such a trim panel and a mold for use in practicing the method.

A feature and advantage of the trim panel of this invention is that the trim panel has a cast plastic skin which includes a flap for an integral door cover that is cast in a special mold that produces a weakened tear seam in the bottom of an aesthetically pleasing groove that does not require any cutting after the skin is cast.

Still another feature and advantage of the invention is that trim panel is cast in a mold that has a raised rib for forming a groove that partially outlines a flap in a cast plastic skin and that includes a tear seam that can be ruptured by a deploying airbag without any need for cutting the tear seam after the plastic skin is cast.

Yet still another feature and advantage of the invention is that it provides a special mold having a uniquely shaped rib for casting a flexible plastic skin so that the cast plastic skin is formed with a groove that partially outlines a flap and that includes a tear seam that can be ruptured by a deploying air bag without any need for cutting the groove.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the invention will become more apparent from the following description taken in conjunction with the accompanying drawings wherein like references refer to like parts and wherein:

FIG. 1 is a perspective view of an automotive instrument panel that includes an integral door cover made in accordance with this invention;

FIG. 2 is a fragmentary sectional view of a first embodiment of the invention taken substantially along the line 2—2 of FIG. 1 looking in the direction of the arrows;

FIG. 3 is a fragmentary perspective view of a special mold for making a cast skin for the automotive instrument panel of FIG. 1 that is made in accordance with this invention;

FIG. 4 is a section of the mold taken substantially along the line 4—4 of FIG. 3 looking in the direction of the arrows;

FIG. 5 is a fragmentary perspective view of the mold of FIG. 3 showing the skin cast in place on the mold;

FIG. 6 is a section taken substantially along the line 6—6 of FIG. 5 looking in the direction of the arrows;

FIG. 7 is a section of an alternative mold for making a cast skin for an alternative automotive instrument panel that is made in accordance with this invention and showing the skin cast in place on the mold in phantom;

FIG. 8 is an enlarged fragmentary sectional view similar to FIG. 2 showing the cast skin of FIG. 7 incorporated in the alternative automotive instrument panel;

FIG. 9 is an enlarged fragmentary sectional view similar to FIG. 2 showing another alternative automotive instrument panel.

DESCRIPTION OF THE INVENTION

Referring now to the drawing, FIG. 1 shows an instrument panel 10 having an airbag system 12 located beneath an integral door cover 14 constructed in accordance with this invention. In this particular instance, the airbag restraint system 12 is located beneath the top of the instrument panel on the passenger side of the vehicle. However the integrated door cover of this invention can be used on the driver side as part of a trim panel for the steering wheel; on either side as part of the front or facing portion of the instrument panel; or as part of any other trim panel that is strategically positioned in the passenger compartment.

The airbag system 12 includes an airbag housing 16 that encloses a gas generator 18 for supplying an inflatant to an airbag 20 that is collapsed, folded and packed in the housing 16. The folded airbag 20 includes an inlet end 22 connected to a passage for flow of the inflatant from the gas generator 18 into the airbag. The airbag also includes a nose end 24 at the opposite end of the folds that is positioned to open the door 14 when the airbag 20 inflates.

The instrument panel 10 comprises a substrate or support 30 of structural plastic material such as ABS/Polycarbonate, Polypropylene, Polyphylene Oxide (PPO)/HIPS or Styrene Malaeic Anhydrid (SMA). The substrate 30 has a rectangular opening for deployment of the air bag 20 that is closed

by a door back plate or reinforcement **32** of aluminum or other light weight metal. The door back plate **32** is connected to the substrate **30** by a hinge **33** at a back end. The opposite or front end of the door back plate **32** is supported on a depressed lip **34** of the substrate **30** at the front edge of the rectangular opening for the door **14** when the door **14** is in the closed position as shown in FIG. 2.

The airbag housing **16** is supported beneath the door **14** by a depending rectangular plastic bracket that is welded or otherwise suitably secured to the bottom of the substrate **30**.

The outer surface of the substrate **30** and the hinged door back plate **32** is bonded to a layer of a suitable energy absorbing elastomeric foam, such as urethane foam that forms a cushion **38** in an underlying relationship to a polymeric skin or shell **40** of vinyl or other suitable flexible plastic material such as thermoplastic urethane (TPU), thermoplastic olefin (TPO) or polyester that forms an outer decorative surface of the instrument panel **10**.

The skin **40** has three grooves **42** in a U-shaped pattern that outline a flap **44** that is aligned with front and side edges of the hinged door back plate **32**. The grooves **42** are formed to provide tear lines or weakened sections for separating the skin flap **44** as explained below. The grooves **42** are also formed so that there are not any cuts needed in the bottom of the grooves. Consequently, the uncut grooves **42** also improve the aesthetic appearance of the instrument panel **10** as explained below.

Referring now to FIGS. 3 through 6, the polymeric skin **40** may be made for example by a drysol casting process such as that disclosed in U.S. Pat. Nos. 4,562,025 and 4,610,620 granted to John D. Gray Dec. 31, 1985 and Sep. 9, 1986 respectively. These patents are hereby incorporated in this patent specification by reference. Other examples of processes or methods for shaping the polymeric skin include rotational casting, liquid casting, blow molding and vacuum forming. In any event, the vinyl skin **40** is cast using a special mold **100** that produces the three grooves **42** in the U-shaped pattern that defines the skin flap **44** for the door cover **14** that opens when the airbag **20** is deployed.

FIG. 4 shows a portion of the special mold **100** for casting the vinyl skin **40** which is preferably cast using a drysol casting process such as that described in the two U.S. Patents that are identified above and that are incorporated in this patent specification by reference. More particularly, FIG. 4 shows the portion of the mold **100** for casting the portion of the vinyl skin **40** that includes the integral flap **44**. This portion of the mold **100** has a raised narrow rib **102** in a U-shaped pattern. The top of the narrow rib **102** is slanted to provide a V-like apex **104** as shown in FIG. 4. When the skin **40** is cast in the mold **100** in a drysol casting operation, the casting material thins out over the top of the raised narrow rib **102** of the mold **100** and a very thin section is formed at the apex **104** of the rib **102**. FIGS. 5 and 6 show a fragmentary portion of the vinyl skin **40** after it has been cast in the mold **100**. The cast vinyl skin **40** has a depending portion **41** in a U-shaped pattern that is formed by the raised rib **102** of the mold **100** and that contains the groove **42**. The groove **42** has a bottom which includes a very thin section **43** that forms over the apex **104** of the raised rib **102** as shown in FIG. 6. The thin section **43** is considerably thinner than the rest of the cast skin **40** and can have a thickness that is as little as 25% of the predominate or nominal thickness of the cast skin **40**.

This thin section provides a tear seam in the bottom of the groove **42** without any need for cutting after the skin **40** is cast. Since there is no need to hide the bottom of the groove

42, the groove may be relatively shallow as shown in FIG. 2 where the depth to width ratio is about 2 to 1. The possibility of shallower grooves provides the designer with a wider range for style lines and the manufacturer with an easier manufacturing job.

A general criterion for a tear seam is that the tear seam should have a tensile strength of no more than about 50% of the tensile strength of the rest of the skin. Consequently, a suitable tear seam can be provided with a thin section at the bottom of the groove **42** that has a thickness that is as much as about 50% of that of the rest of the skin. Of course the precise thickness required will vary somewhat with the skin material selected and customer requirements for the tensile strength of the tear seam. However, the formulation of the selected skin material and the shape of the groove **42** and the raised rib **102** can be varied to produce the desired thickness of the tear seam by the thinning of the skin material on the raised rib **102** during the casting process.

To manufacture instrument panel **10**, the vinyl skin **40** with the flap **44** outlined by the groove **42** shown in FIGS. 5 and 6 is demolded and placed in the cavity of a conventional closeable mold that has a cavity that is shaped to correspond to the desired shape of the instrument panel **10**. The substrate **30** and hinged door reinforcement **32** are then placed in a spaced relationship in the closed mold and the intermediate elastomeric layer **38** is then foamed in place in a conventional manner to provide the instrument panel **10** that is partially shown in section in FIG. 2.

Referring now to FIGS. 7 and 8, FIG. 7 shows a section of an alternative mold **200** for making a cast skin **240** for an alternative automotive instrument panel **210** that is partially shown in FIG. 8 and that is also made in accordance with this invention. More particularly, FIG. 7 shows the section of the mold **200** for casting the portion of the vinyl skin **240** that contains a U-shaped groove **242** that outlines an integral flap **244** of the door cover **214**. This portion of the mold **200** has a raised narrow rib **202** in a U-shaped pattern. The narrow rib **202** has concave side walls to provide a cusp-like apex **204** at the top of the rib **202**. When the skin **240** is cast in the mold **200** in a drysol casting operation, the casting material progressively thins out over raised narrow rib **202** of the mold **200** and a very thin section is formed at the cusp-like apex **204** of the rib **202**. FIG. 7 shows a fragmentary portion of the vinyl skin **240** in phantom after it has been cast in the mold **200**. The cast vinyl skin **240** has a depending portion **241** in a U-shaped pattern that is formed by the raised rib **202** of the tool **200** and that contains the groove **242**. The groove **242** has a bottom which includes a very thin section **243** that forms over the cusp-like apex **204** of the raised rib **202** as shown in FIG. 7.

To manufacture instrument panel **210**, the vinyl skin **240** with the flap **244** outlined by the groove **242** shown in FIG. 7 is demolded and placed in the cavity of a conventional closeable mold that has a cavity that is shaped to correspond to the desired shape of the instrument panel **210**. The substrate **230** and hinged door reinforcement **232** are then placed in a spaced relationship in the closed mold and the intermediate elastomeric layer **238** is then foamed in place in a conventional manner to provide the instrument panel **210** that is partially shown in section in FIG. 8. The groove **242** is in the nature of a "gull wing" shaped style line that is formed with a converging gap between rounded edges **246** of the integral flap and adjacent rounded edges **248** of the vinyl skin **240** at the surface of the instrument panel **210**. However, the groove **242** is still formed with a very thin section **243** at the bottom that provides a tear line or weakened section for separating the flap **244** that eliminates

any need for cutting the skin **240** after it is cast. Thus the invention provides a wide range of aesthetic alternatives for the designer.

Aside from the differences noted above, the instrument panel **210** is otherwise the same as the instrument panel **10** and corresponding parts are identified by adding **200** to the identifying numerals for the parts of instrument panel **10**.

Another alternative instrument panel **310** is shown in FIG. **9**. This instrument panel **310** is characterized by a groove **342** that provides a wider "gull wing" style line that outlines the flap **344** of the door cover **314** in the skin **340**. The skin **340** is cast in a mold similar to that shown in FIG. **7** so that the depending portion **341** of the skin **340** that defines the groove **342** progressively thins out to a very thin section **343** at the bottom that provides a weakened section or tear line without any need for cutting. The substrate **330** also does not have a support lip for the front end of the door back plate **332** which is characteristic of small doors or dual door arrangements. The instrument panel **310** is otherwise the same as the instrument panel **210**.

An advantage of these "gull wing" style lines is that they are generally regarded as more aesthetically pleasing and easier to tool.

All of the foregoing instrument panels operate in the same manner. When the gas generator **18** is triggered due to a predetermined vehicle deceleration, the airbag **20** inflates at the nose end **24** first and then progressively back toward the inlet end **22**. Consequently the nose end **24** engages the metal door reinforcement **32**, **232** or **332** and pivots it outwardly about hinge **32**. As the door pivots outwardly, the foam layer **38**, **238** or **338** and then the skin **40**, **240** or **340** is fractured at the weakened sections or tear lines to create a separated flap **44**, **244** or **344** and an opening for deployment of the airbag **20** that corresponds with the rectangular opening in the substrate **30**, **230** or **330**.

While a U-shaped pattern of three grooves has been described for purposes of illustration, other arrangements are possible. For instance, four grooves or an H-shaped or X-shaped pattern may be used. In other words, the invention has been described in an illustrative manner, and it is to be understood that the terminology which has been used is intended to be in the nature of words of description rather than of limitation.

Obviously, many modifications and variations of the present invention in light of the above teachings may be made. It is, therefore, to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A trim panel having a door cover for concealing an airbag system in a vehicle passenger compartment and a flexible plastic skin that includes a flap that is an integral part of the door cover comprising:

the flexible plastic skin having a depending portion that contains a groove for providing a tear seam between the flap and the remaining part of the polymeric skin,
a layer of energy absorbing elastomeric foam underlying the plastic skin, and
the groove being formed so that it has a weakened section in the layer of energy absorbing elastomeric foam that can be fractured by deployment of an airbag without any need for cutting the groove.

2. The trim panel as defined in claim **1** wherein the flexible plastic skin is cast in a mold having a raised rib that forms the groove so that it has a thinner section at its bottom.

3. The trim panel as defined in claim **2** wherein the flexible plastic skin is cast in a mold having a raised rib that forms the groove so that the groove is gull wing shaped.

4. The trim panel as defined in claim **1** wherein the flexible plastic skin is cast in a mold with a raised rib so that the groove has a bottom that includes a thin section that provides a tear seam that can be fractured by deployment of an air bag without any need for cutting the plastic skin after it is cast.

5. The trim panel as defined in claim **1** wherein the thin section has a thickness that is in the range of about 25% to 50% of the nominal thickness of the remainder of the skin.

6. A method for making a trim panel having a door cover for concealing an airbag system in a vehicle passenger compartment and a flexible plastic skin that includes a flap that is an integral part of the door cover comprising:

casting a flexible plastic skin in a mold that has a raised rib so that the skin has a depending portion that contains a groove that conforms to the shape of the raised rib, and

the raised rib having a top that has an apex so that the groove is formed with a bottom that is cast with a thin section that forms over the apex to provide a tear seam for the skin flap that can be fractured by deployment of an airbag without any need for cutting the bottom of the groove.

7. The method for making a trim panel as defined in claim **6** further comprising:

placing the cast skin in a closeable mold, and
foaming an elastomeric layer in place beneath the polymeric skin so that the depending portion is disposed in the layer generated in the foaming process.

8. The method for making a trim panel as defined in claim **6** wherein the top of the raised rib has a V-like apex.

9. The method for making a trim panel as defined in claim **6** wherein the raised rib has concave sides that provide a cusp-like apex at the top of the raised rib.

10. A mold for casting a flexible plastic skin for a trim panel having a door cover for concealing an airbag system in a vehicle passenger compartment wherein the flexible plastic skin includes a flap that is an integral part of the door cover, the mold comprising:

a raised rib that forms a depending portion in the flexible plastic skin that contains a groove that conforms to the shape of the raised rib when the flexible plastic skin is cast in the mold, and

the raised rib having a top that has an apex so that the groove is formed with a bottom that is cast with a thin section that forms over the apex to provide a tear seam for the flap that can be fractured by deployment of an airbag without any need for cutting the bottom of the groove.

11. The mold for making a trim panel as defined in claim **10** wherein the raised rib has a height to width ratio of about 2 to 1.

12. The mold for making a trim panel as defined in claim **10** wherein the top of the raised rib has a V-like apex.

13. The mold for making a trim panel as defined in claim **10** wherein the raised rib has concave sides that provide a cusp-like apex at the top of the raised rib.

14. A method for making a trim panel having a door cover for concealing an airbag system in a vehicle passenger compartment and a flexible plastic skin that includes a flap that is an integral part of the door cover comprising:

casting a flexible plastic skin in a mold that has a raised rib so that the skin contains a groove that conforms to the shape of the raised rib,

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the raised rib having a top so that the groove is formed with a bottom with a thin section to provide a tear seam for the skin flap that can be fractured by deployment of an airbag without any need for weakening the bottom of the groove;

*placing the cast skin in a closable mold; and
foaming an elastomeric layer in place beneath the plastic skin.*

15. *A method for making a trim panel having a door cover for concealing an airbag system in a vehicle passenger compartment and a flexible plastic skin that includes a flap that is an integral part of the door cover comprising:*

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forming a flexible plastic skin in a mold that has a raised rib so that the skin contains a groove that conforms to the shape of the raised rib,

the raised rib having a top so that the groove is formed with a bottom with a thin section to provide a tear seam for the skin flap that can be fractured by deployment of an airbag without any need for weakening the bottom of the groove; and

forming a foam layer beneath the plastic skin.

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