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Tooling for manufacturing a vehicle panel and method of manufacture

Abstract

Tooling for manufacturing a vehicle panel having a substrate, a foam layer, and a decorative covering. The tooling includes a tool base having a tool aperture, and an insert having a sealing projection. The insert is located at least partially in the tool aperture. The sealing projection is configured to create a seal between the substrate and the decorative covering at least partially around a substrate aperture in the substrate. The substrate aperture is at least partially smaller than the tool aperture so as to form an overlapping seal area between the sealing projection of insert and the substrate. A manufacturing method can create a foam-less region between the decorative covering and the substrate.

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Background/Summary

TECHNICAL FIELD
(1) The invention relates to vehicle interior panels, and more particularly, to tooling and methods for manufacturing vehicle interior panels having a foam layer.
BACKGROUND
(2) In vehicle panels having a substrate, a decorative covering, and a foam layer between the substrate and the decorative covering, it is oftentimes preferred to injection mold locator holes in the substrate prior to foaming. In some instances, this is preferred due to post processing tolerances. For example, it may be prohibitive to mill a locator hole in the substrate after foaming.

Accordingly, during foaming, the locator holes need to be sealed off to prevent foam leakage. There are some references that use inserts or slots in the tooling for seam or edge retention and the like, such as U.S. Pat. No. 7,205,044 to Ortelt et al. or U.S. Pat. No. 6,708,462 to Pokorynski et al.; however, these references do not address the problem of sealing locator holes in the substrate during foaming.

SUMMARY

(3) In accordance with an embodiment, there is provided tooling for manufacturing a vehicle panel having a substrate, a foam layer, and a decorative covering. The tooling comprises a tool base having a tool aperture, and an insert having a sealing projection. The insert is located at least partially in the tool aperture. The sealing projection is configured to create a seal between the substrate and the decorative covering at least partially around a substrate aperture in the substrate. The substrate aperture is at least partially smaller than the tool aperture so as to form an overlapping seal area between the sealing projection of the insert and the substrate.

(4) In some embodiments, the insert is removable with respect to the tool aperture.

(5) In some embodiments, a foam-less region is created between the substrate and the decorative covering at the overlapping seal area.

(6) In some embodiments, the sealing projection has a planar top surface configured to create the foam-less region.

(7) In some embodiments, the foam-less region is a 1.5-5 mm perimeter, inclusive, around the substrate aperture.

(8) In some embodiments, the sealing projection comprises a raised perimeter region, the raised perimeter region corresponding at least partially to a perimeter of the substrate aperture.

(9) In some embodiments, the insert has an underside and an opposite part side, and wherein a shim is located on the underside.

(10) In some embodiments, a plurality of shims is located on the underside of the insert.

(11) In some embodiments, the substrate aperture is a locator hole for attaching a vehicle panel subcomponent.

(12) In some embodiments, the substrate aperture has a tapered edge and the overlapping seal area is located at a planar inboard edge of the substrate aperture.

(13) In accordance with another embodiment, there is a method of manufacturing a vehicle interior panel having a substrate, a foam layer, and a decorative covering. The method includes situating a decorative covering in tooling having a tool base and an insert located at least partially in a tool aperture in the tool base; situating a substrate over the decorative covering such that a substrate aperture of the substrate is positioned over the tool aperture in the tool base, wherein the substrate aperture is at least partially smaller than the tool aperture; forming a seal between the decorative covering and substrate around the substrate aperture by applying pressure between the substrate and the insert; and foaming between the substrate and the decorative covering.

(14) In various embodiments, the method includes the step of adjusting the insert with one or more shims to manage the applied pressure.

(15) In various embodiments, the seal creates a foam-less region in an overlapping seal area between the substrate and decorative covering, and the forming step further comprises creating the seal using a sealing projection on the insert that forces the decorative covering into engagement with the substrate around the substrate aperture.

(16) In various embodiments, the method includes the step of maintaining an offset between the substrate and the decorative covering before the foaming step.

(17) In various embodiments, a height of the offset is equal to half of a height of a seal projection on the insert.

(18) Various aspects, embodiments, examples, features and alternatives set forth in the preceding paragraphs, in the claims, and/or in the following description and drawings may be taken

independently or in any combination thereof. For example, features disclosed in connection with one embodiment are applicable to all embodiments in the absence of incompatibility of features.

Description

DESCRIPTION OF THE DRAWINGS

(1) One or more embodiments will hereinafter be described in conjunction with the appended drawings, wherein like designations denote like elements, and wherein:

(2) FIG. **1** is a schematic, cross-sectional view of tooling, an insert in the tooling, along with a substrate and decorative covering prior to foaming;

(3) FIG. **2** is a schematic, cross-sectional view of the components in FIG. **2** after foaming;

(4) FIG. **3** is a partial view of tooling, such as the tooling illustrated in FIGS. **1** and **2**, having a plurality of inserts;

(5) FIG. **4** is another schematic, cross-sectional view of tooling, an insert in the tooling, along with a substrate and decorative covering prior to foaming; and

(6) FIG. **5** is a schematic, cross-sectional view of the components in FIG. **4** after foaming.

DETAILED DESCRIPTION OF EMBODIMENTS

(7) Described herein is tooling to manufacture a vehicle panel, as well as related manufacturing methods. The tooling can be used to manufacture a vehicle panel having a substrate, a decorative covering, and a foam layer between the substrate and the decorative covering. It is desirable to have locator holes or apertures that are injection molded or otherwise formed in the substrate prior to foaming. This may be at least partially due to post processing tolerances. Accordingly, during the foaming process, these locator holes in the substrate need to be sealed to prevent foam leakage. One method that has been used to seal these holes involves taping over each hole prior to foaming. This can be quite time consuming, however, and tape is often missed or applied incorrectly causing foam to leak onto the foaming lid. This can then cause a large amount of downtime for the tooling to get cleaned. Moreover, on larger panels such as instrument panels, there are often upwards of 50-60 locator holes that need to be sealed. This can make a taping process quite time consuming and more prone to error. As an alternative to the taping process, the tooling and methods described herein use an insert in a tool base to help create a seal between the decorative covering and the substrate.

(8) FIGS. **1** and **2** illustrate tooling **10** and a schematic vehicle panel **12** before foaming and after foaming, respectively. In the illustrated embodiment, the vehicle panel **12** is a multi-layer vehicle instrument panel having a decorative covering **14**, a substrate **16**, and an intermediate layer **18**. The panel **12** may be any type of panel having a visible outer side **20** exposed to the interior of a vehicle passenger cabin when installed in the vehicle, such as an instrument panel, door panel, console lid, arm rest, pillar cover, steering wheel panel, seat covering, etc. Other vehicle panel types and structures are certainly possible, particularly those requiring an intermediate layer **18**.

(9) The decorative covering **14** is the outermost layer of the panel **12** and includes the visible outer side **20** of the panel with an opposite inner side **22** facing toward the substrate **16**. The decorative covering **14** can have a multi-layer structure (e.g., in some embodiments, one or more intermediate layers **18** may be part of the decorative covering itself), or may just comprise a single skin layer **24**. The primary function of the decorative covering **14** is to provide a resilient, long-lasting exposed surface within the vehicle with aesthetic appeal to occupants of the passenger cabin, including desirable visual characteristics such as color, shape, and texture. The decorative covering **14** may thus include design features visible at the outer side **20**, such as an embossed pattern or a paint film in the desired color. The decorative covering **14** may also at least partly provide the panel **12** with desired tactile characteristics in the likeness of furniture upholstery, such as a soft-touch or smooth feel. In some cases, the decorative covering **14** is formed with synthetic materials configured with

aesthetic characteristics imitating other more expensive materials such as leather. In other implementations, the decorative covering **14** and/or skin layer **24** is a natural material such as leather. Other materials for the decorative covering **14** and/or skin layer **24** are certainly possible. Further, other interlayers or components may be included at or near the skin layer **24**, depending on the desired implementation.

(10) The substrate **16** is typically the most rigid of the illustrated panel layers and thereby provides structural support for the overlying layers at desired locations within the vehicle via attachment to other vehicle structures. Fiberglass-reinforced polypropylene having a thickness of 2 mm to 4 mm is one example of a suitable substrate **16**, but various other types of materials and material combinations and/or different thickness ranges can be employed in a similar manner. The substrate **16** includes a skin facing side **26** that faces directly toward the decorative covering **14** and intermediate layer **18**, and an opposite outer side **28**.

(11) The substrate **16** includes one or more substrate apertures **30**. In the illustrated embodiment, the substrate aperture **30** is a locator hole **32** used to attach a vehicle panel subcomponent **34**. The substrate aperture **30** and locator hole **32** extend entirely through a thickness of the substrate **16** between the substrate sides **26**, **28**, and they generally correspond to a desired location of the vehicle panel subcomponent **34**. In the illustrated embodiment where the panel **12** is an instrument panel, the vehicle panel subcomponent **34** could be a heads-up display unit, or any other panel-related or structural-related component. For example, the substrate aperture **30** and the locator hole **32** could be used for attaching the panel **12** to the body-in-white or another structural component of the vehicle. Or, the substrate aperture **30** and the locator hole **32** could be used for other panel-related features such as air vents, infotainment devices, handles, etc., depending on the desired implementation for the vehicle panel **12**. The substrate apertures **30** and locator holes **32** are advantageously injection molded into the substrate **16** when the substrate is initially formed, which can help streamline post-processing efforts.

(12) The intermediate layer **18** can assist the decorative covering **14** in providing desired tactile characteristics to the panel **12** in the form of cushioning that compresses when a force is applied to the skin outer side **20** of the panel **12** and decompresses when the force is removed to return the skin layer to its original position. The intermediate layer **18** is a foam layer **36**, and may also include other layers, such as fabric or scrim layers, adhesive layers, etc. The intermediate layer **18** can also provide sound deadening and/or have a non-uniform thickness to fill space between the decorative covering **14** and the substrate **16** when the respective contours of the decorative covering and substrate are different from each other. In the illustrated examples, the foam layer **36** is a backfilled or a closed pour, foam-in-place material layer formed by introducing a foam material, such as a liquid foam precursor, into a space between the decorative covering **14** and the substrate **16**, with at least the decorative covering constrained in the desired final shape in a foam molding tool, such as tooling **10**. The foam material expands to fill and take the shape of the space and cures to form the foam layer **36**. One suitable foam layer material is polyurethane foam formed from a liquid precursor material comprising a polyol and a diisocyanate. Other foam materials (e.g., polyolefin-based) are possible, as are other foaming processes (e.g., use of a heat-activated foaming agent). The foam layer **36** may range in thickness from 1 mm to 10 mm, can be separately provided and adhered with adjacent material layers. Other materials for the intermediate layer **18** besides the explicitly described foam layer and fabric may be possible.

(13) With reference to FIGS. **1-3**, the tooling **10** is advantageously an in-mold foaming tool **38** that is used to introduce the foam layer **36** between the decorative covering **14** and the substrate **16**. The tooling **10** includes a tool base **40** having a number of tool apertures **42**, **44**, **46**. The discussion herein focuses on the tool aperture **42**, but teachings relating to the tool aperture **42** may be applicable to other apertures, such as apertures **44**, **46** or other configured apertures that are not particularly illustrated. The tool apertures **42**, **44**, **46** correspond to locations in the panel **12** where there are substrate apertures **30**. Instead of needing to tape the substrate apertures **30** to prevent

foam leakage onto the tooling **10**, inserts **48**, **50**, **52** are located in each respective tool aperture **42**, **44**, **46**. Again, the discussion herein will focus on insert **48**, but teachings relating to the insert **48** may be applicable to other inserts, such as inserts **50**, **52** or other configured inserts that are not particularly illustrated.

(14) Instead of comprising features directly on or integral with the tool base **40**, the insert **48** is removable with respect to the tool aperture **42**. This can be particularly advantageous, as it allows for more precise tuning to create the seal between the decorative covering **14** and the substrate **16**. Additionally, this arrangement can facilitate maintenance and adaptation without reconfiguring the entirety of the tooling **10**, which could be prohibitively expensive. A small handle **54** or the like may be included (shown in FIG. **3** but not in the remaining FIGS.) to help facilitate removal of each insert **48**. Since the decorative covering **14** is later punched or cut away from the substrate aperture **30**, including one or more handles **54** on the insert **48** will likely not impact the final structure of the panel **12**.

(15) The insert **48** includes a sealing projection **56** that is a portion or a top surface of the insert that extends above the inboard surface of the tool base **40** and into the cavity of the tooling **10**. In the illustrated embodiment, the sealing projection **56** extends up from a part side **58** of the insert **48**. The sealing projection **56** in the illustrated embodiments extends straight up from an outer perimeter **60** of the insert **48**; however, it is possible for the sealing projection **56** to be located inboard of the outer perimeter **60**. Accordingly, in this embodiment, the sealing projection **56** comprises a raised perimeter region **62** having an annular shape. The raised perimeter region **62** corresponds in shape to a perimeter **64** of the substrate aperture **30**, which helps create an overlapping seal area **66** between the decorative covering **14** and the substrate **16**. The raised perimeter region **62** also creates an indented interior area **68** which accommodates the decorative covering **14** when pressure is applied. The indented interior area **68** corresponds in size and shape to the substrate aperture **30**. However, it is possible in some embodiments for the insert **48** and the sealing projection **56** to have other configurations, such as a larger raised interior area instead of an indented interior area, or other shapes for the projection or perimeter, to cite a few examples.

(16) As shown more particularly in FIG. **2**, the overlapping seal area **66** is an area adjacent the substrate aperture perimeter **64** where there is direct contact between the insert **48**, the decorative covering **14**, and the substrate **16**. The overlapping seal area **66** corresponds to a location of the sealing projection **56**, which includes an annular top planar surface **70** to help facilitate proper sealing. The overlapping seal area **66** creates a foam-less region **72** between the substrate **16** and the decorative covering **14**. “Foam-less” as used herein does not necessarily mean that the region **72** is completely devoid of foam, but instead, means that a small amount of foam may be present, but not enough to leak into the substrate aperture **30**. The planar top surface **70** at the foam-less region **72** helps facilitate better pressure distribution to create an improved overlapping seal area **66**. A width W.sub.S of the overlapping seal area **66** equals a width W.sub.P of the projection **56**, and in an advantageous embodiment, the widths W.sub.S, W.sub.P are about 2-3 mm each, inclusive. Having the size between about 1.5 and 5 mm, or more particularly, 2-3 mm, can provide an improved amount of sealing while not overly interfering with the foam layer **36**. Accordingly, in the illustrated embodiments, the foam-less region **72** around each aperture **30** is about a 2-3 mm perimeter.

(17) During manufacture, as schematically illustrated in FIGS. **1** and **2**, the decorative covering **14** and the substrate **16** are put into a cavity area **74** of the tooling **10**. The substrate **16** is oriented so as to align the substrate aperture **30** over the insert **48** in the tool aperture **42**. An offset **76** is maintained between the decorative covering **14** and the substrate **16**. This offset **76** is sized to be about half the size of a height H of the sealing projection **56**, or the amount in which the insert **48** extends into the cavity **74** above the tool base **40**. This configuration can help provide adequate space for the foam layer **36** while creating a sufficient seal at the overlapping seal area **66**. The seal between the decorative covering **14** and substrate **16** is formed by an applied pressure between the

tool base **40** and substrate **16** such as can be created by closing an upper mold or tooling member (not shown). This pressure forces decorative covering **14** against the substrate at the overlapping seal area **66** around the substrate aperture **30** due to the annular sealing projection **56** of the insert **48**. This annular projection **56** extends above the surface of the tool base **40** and therefore holds the decorative covering **14** at an elevated location about the substrate aperture **30**, as shown in FIGS. **2** and **5**. The offset **76** between the decorative covering **14** and the substrate **16** can be maintained during the applied pressure in any suitable manner, such as by using a partial vacuum applied through the tool base, or by spacers, or can be created by the foaming pressuring during injection to push the decorative covering **14** against the tool base. The applied pressure during manufacture can be tuned using a shim **78** on an underside **80** of the insert **48**. The shim **78** is advantageously made of an elastomeric material to provide more of a cushion than the likely metal material used for the insert **48**. The shim **78** allows for adjustment in the Z-height or direction, which can impact the creation of the overlapping seal area **66**.

(18) In the embodiment illustrated in FIGS. **4** and **5**, there is a second shim **82** in addition to the shim **78**, both of which being located on the underside of the insert **48**. Having multiple shims **78**, **82** allows for further tuning and adjustability of the manufacturing process. Additionally, in this illustrated embodiment, the substrate aperture **30** has an alternate configuration. It is possible for the substrate aperture **30** and the locator hole **32** to have other shapes, such as the shown tapered edge **84**. Since the tapered edge **84** has an angle or slope, it may be less desirable for forming the overlapping seal area **66**. Accordingly, in this implementation, the insert **48** and the sealing projection **65** are sized to contact a planar inboard edge **86** so there is contact between the planar inboard edge and the top planar surface **70** of the sealing projection **65**. This arrangement can be more likely to produce the foam-less region **72**. In another example, the profile or angle of the sealing projection **56** is configured to match the profile or angle of the tapered edge **84**.

(19) It is to be understood that the foregoing is a description of one or more preferred example embodiments of the invention. The invention is not limited to the particular embodiment(s) disclosed herein, but rather is defined solely by the claims below. Furthermore, the statements contained in the foregoing description relate to particular embodiments and are not to be construed as limitations on the scope of the invention or on the definition of terms used in the claims, except where a term or phrase is expressly defined above. Various other embodiments and various changes and modifications to the disclosed embodiment(s) will become apparent to those skilled in the art. All such other embodiments, changes, and modifications are intended to come within the scope of the appended claims.

(20) As used in this specification and claims, the terms “for example,” “for instance,” “such as,” and “like,” and the verbs “comprising,” “having,” “including,” and their other verb forms, when used in conjunction with a listing of one or more components or other items, are each to be construed as open-ended, meaning that the listing is not to be considered as excluding other, additional components or items. Other terms are to be construed using their broadest reasonable meaning unless they are used in a context that requires a different interpretation. In addition, the term “and/or” is to be construed as an inclusive OR. Therefore, for example, the phrase “A, B, and/or C” is to be interpreted as covering all the following: “A”; “B”; “C”; “A and B”; “A and C”; “B and C”; and “A, B, and C.”

Claims

1. Tooling for manufacturing a vehicle panel having a substrate, a foam layer, and a decorative covering, comprising: a tool base having a tool aperture; and an insert having a sealing projection, the insert being located at least partially in the tool aperture, wherein the sealing projection is configured to create a seal between the substrate and the decorative covering at least partially around a substrate aperture in the substrate, wherein the substrate aperture is at least partially

smaller than the tool aperture so as to form an overlapping seal area between the sealing projection of the insert and the substrate, wherein the substrate aperture is a locator hole for attaching a vehicle panel subcomponent, wherein the insert is a separate component from the decorative covering and the substrate.

2. The tooling of claim 1, wherein the insert is removable with respect to the tool aperture.

3. The tooling of claim 1, wherein a foam-less region is created between the substrate and the decorative covering at the overlapping seal area.

4. The tooling of claim 1, wherein the sealing projection comprises a raised perimeter region, the raised perimeter region corresponding at least partially to a perimeter of the substrate aperture.

5. The tooling of claim 1, wherein the insert has an underside and an opposite part side, and wherein a shim is located on the underside.

6. The tooling of claim 1, wherein the substrate aperture has a tapered edge and the overlapping seal area is located at a planar inboard edge of the substrate aperture.

7. The tooling of claim 3, wherein the sealing projection has a planar top surface configured to create the foam-less region.

8. The tooling of claim 3, wherein the foam-less region is a 1.5-5 mm perimeter, inclusive, around the substrate aperture.

9. The tooling of claim 5, wherein a plurality of shims is located on the underside of the insert.

10. A method of manufacturing a vehicle panel having a substrate, a foam layer, and a decorative covering, comprising the steps of: situating the decorative covering in tooling comprising: a tool base having a tool aperture; and an insert having a sealing projection, the insert being located at least partially in the tool aperture, wherein the sealing projection is configured to create a seal between the substrate and the decorative covering at least partially around a substrate aperture in the substrate, wherein the substrate aperture is at least partially smaller than the tool aperture so as to form an overlapping seal area between the sealing projection of the insert and the substrate, wherein the substrate aperture is a locator hole for attaching a vehicle panel subcomponent, wherein the insert is a separate component from the decorative covering and the substrate; situating the substrate over the decorative covering such that the substrate aperture of the substrate is positioned over the tool aperture in the tool base; forming the seal between the decorative covering and the substrate around the substrate aperture by applied pressure between the substrate and the insert; and foaming between the substrate and the decorative covering.

11. The method of claim 10, further comprising the step of adjusting the insert with one or more shims to manage the applied pressure.

12. The method of claim 10, wherein the seal creates a foam-less region in an overlapping seal area between the substrate and decorative covering, and wherein the forming step further comprises creating the seal using the sealing projection on the insert that forces the decorative covering into engagement with the substrate around the substrate aperture.

13. The method of claim 10, further comprising the step of maintaining an offset between the substrate and the decorative covering before the foaming step.

14. The method of claim 13, wherein a height of the offset is equal to half of a height of the sealing projection on the insert.