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(54) **EXPANSION FOAM CAVITY FILLER AND METHOD**

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(57) **ABSTRACT**

A plastic or elastomeric foam cavity filler, useable for filling of cavities such as are found in vehicles, ships, boats, mobile or modular homes, buildings, machinery, and equipment comprises a flexible pouch containing at least one material suitable for chemical or thermal activation which, upon activation of the material, the flexible pouch is placed in a cavity. The material expands the pouch to fit the cavity in which it was placed, restricting the entrance of, or transmission through, of noise, vibration, or fumes. When more than one foam component material is used, the component materials are separated within the flexible pouch. Among the means of separation are a pouch within the flexible pouch or barriers forming separate compartments in the pouch.

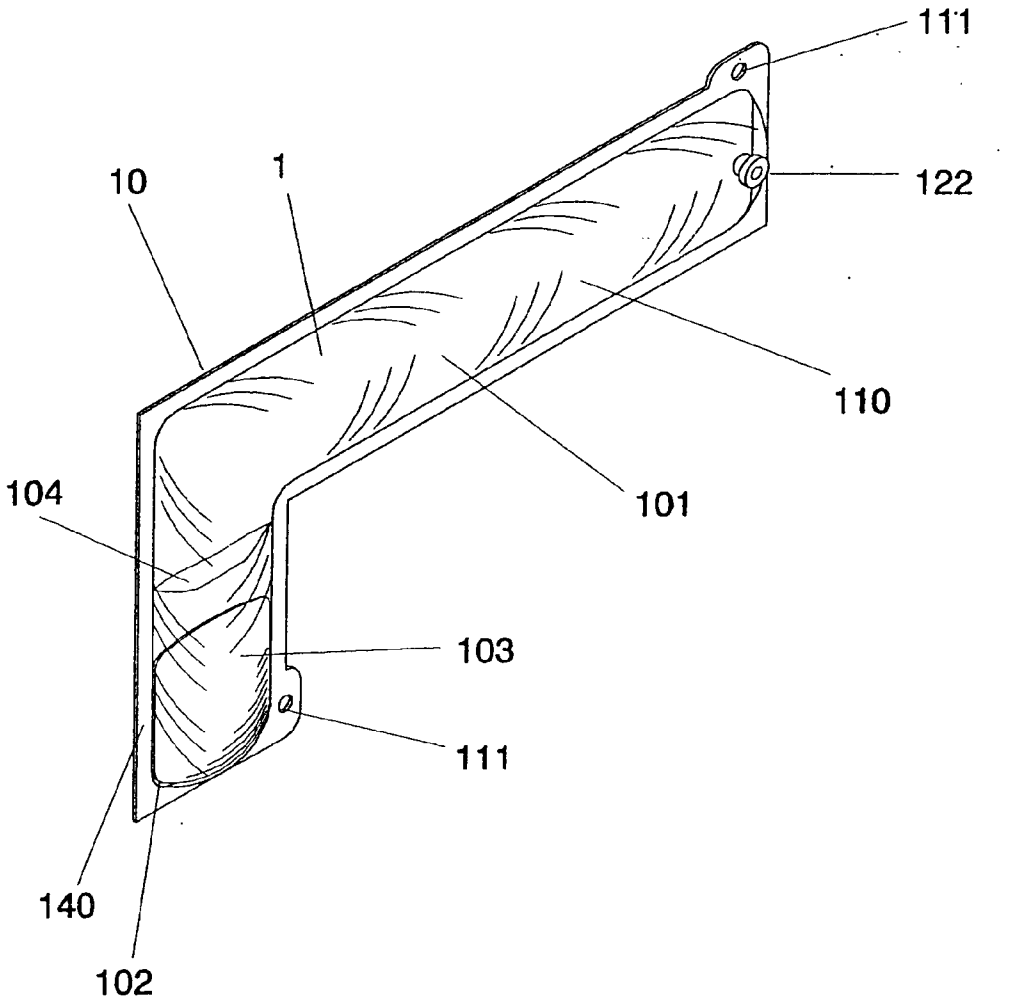


FIG. 1

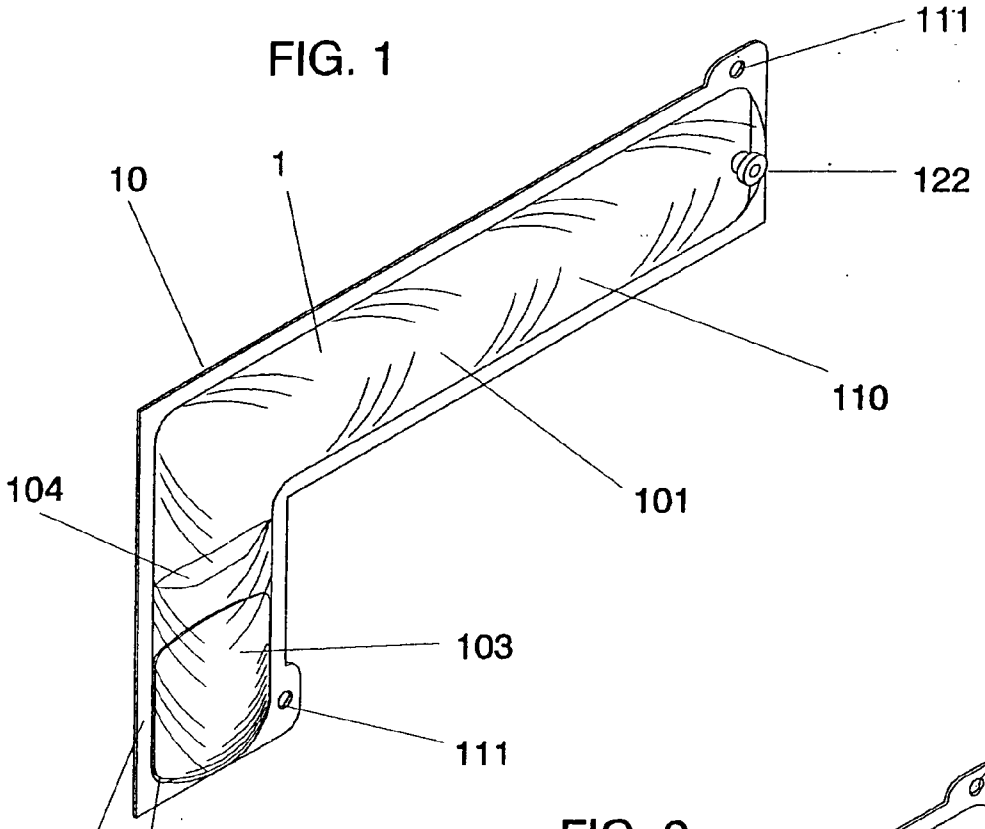

111
122
10
1
110
101
104
103
111
140
102

FIG. 2

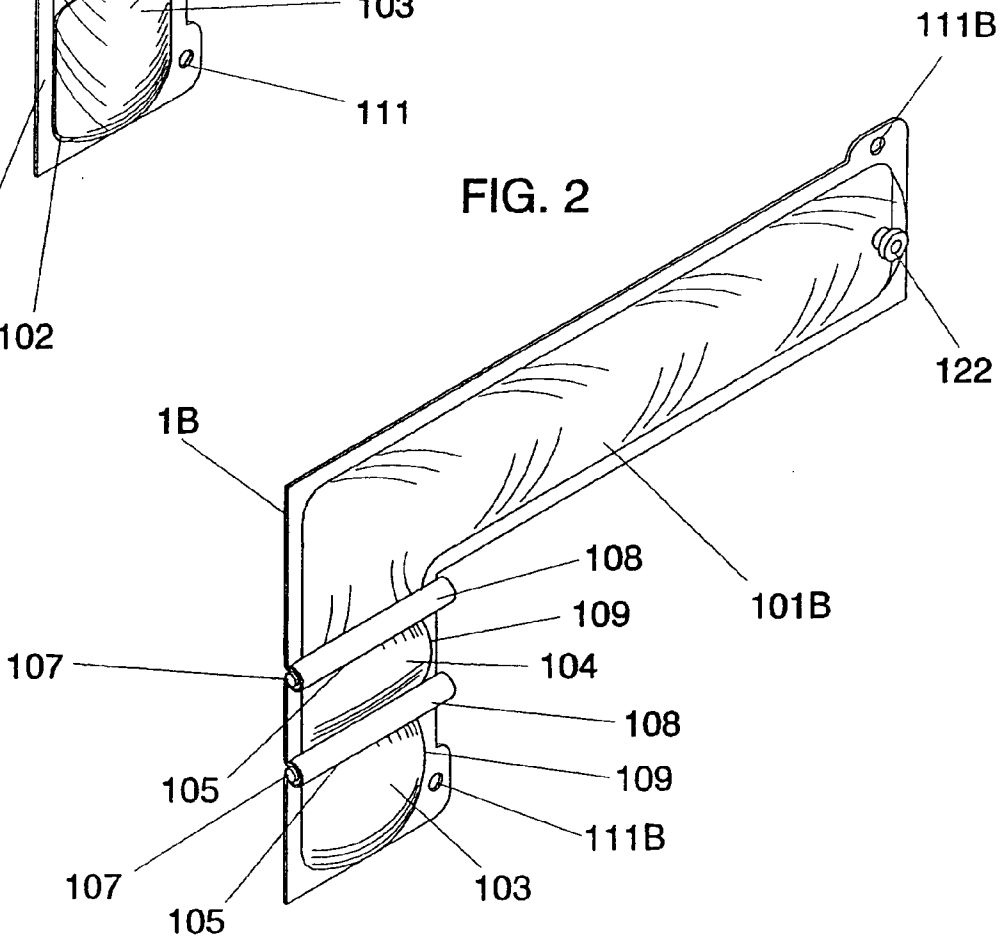

111B
122
1B
108
101B
109
107
104
108
105
109
111B
107
103
105

FIG. 3

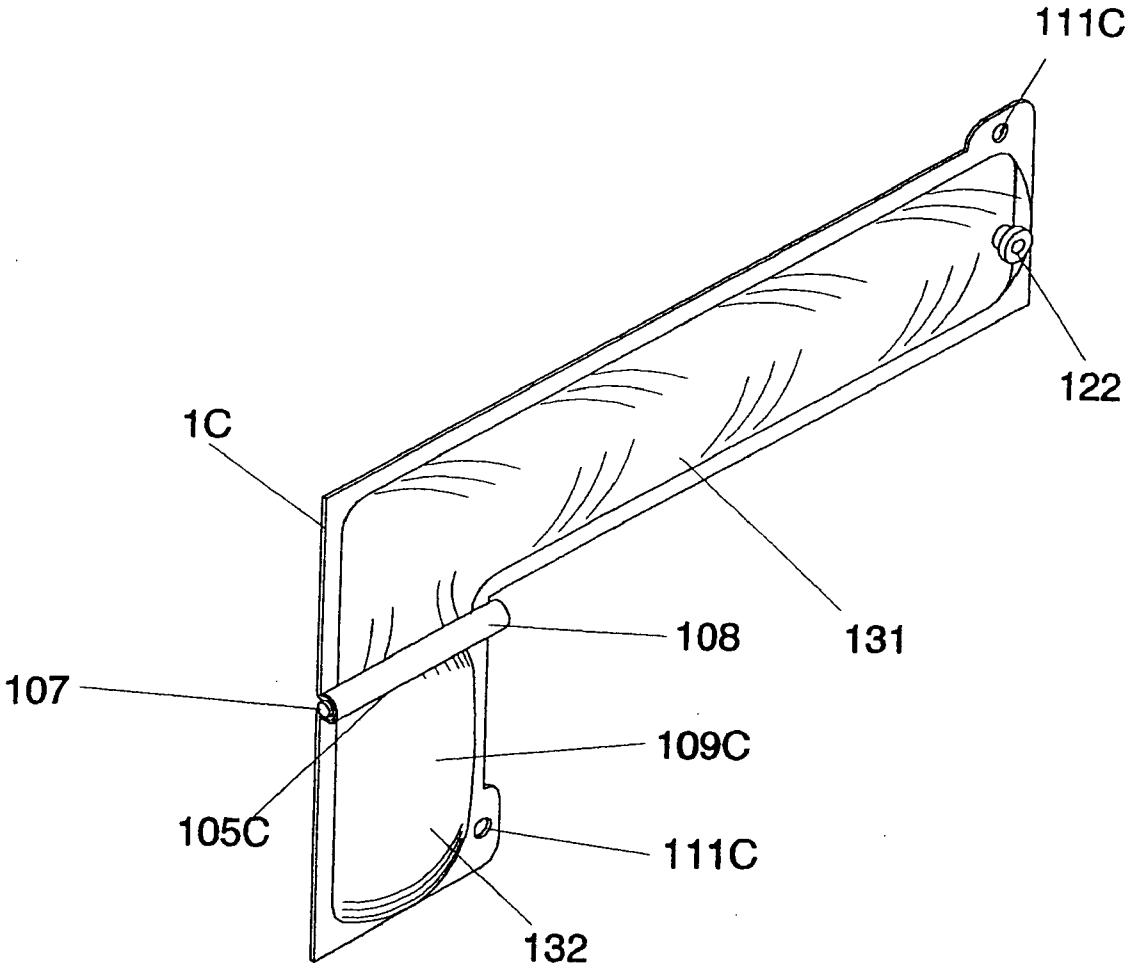


FIG. 4

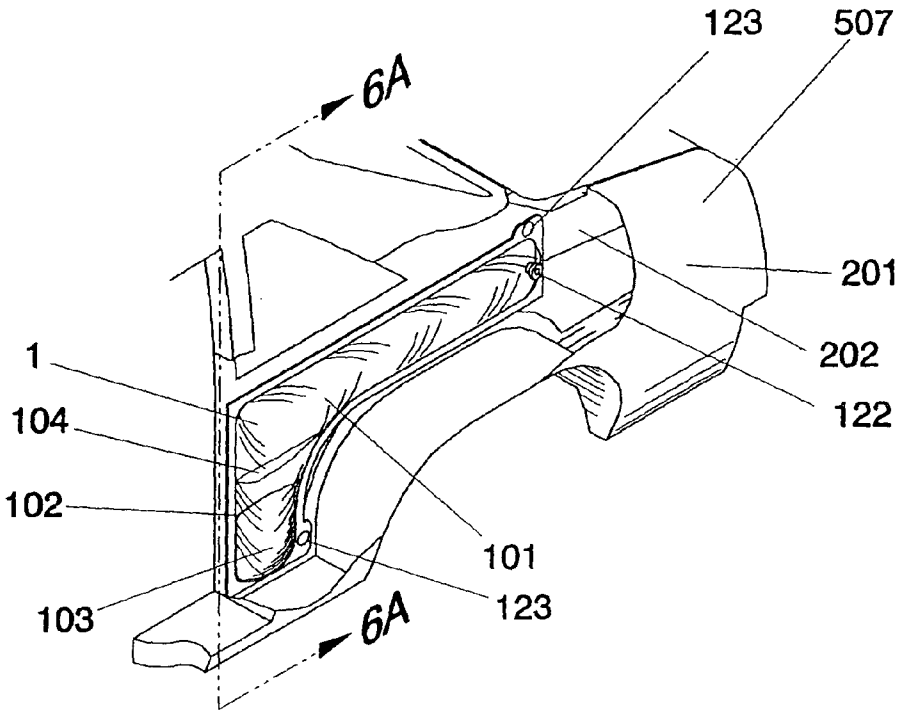

123
507
6A
201
202
1
104
122
102
101
123
103
6A

FIG. 5

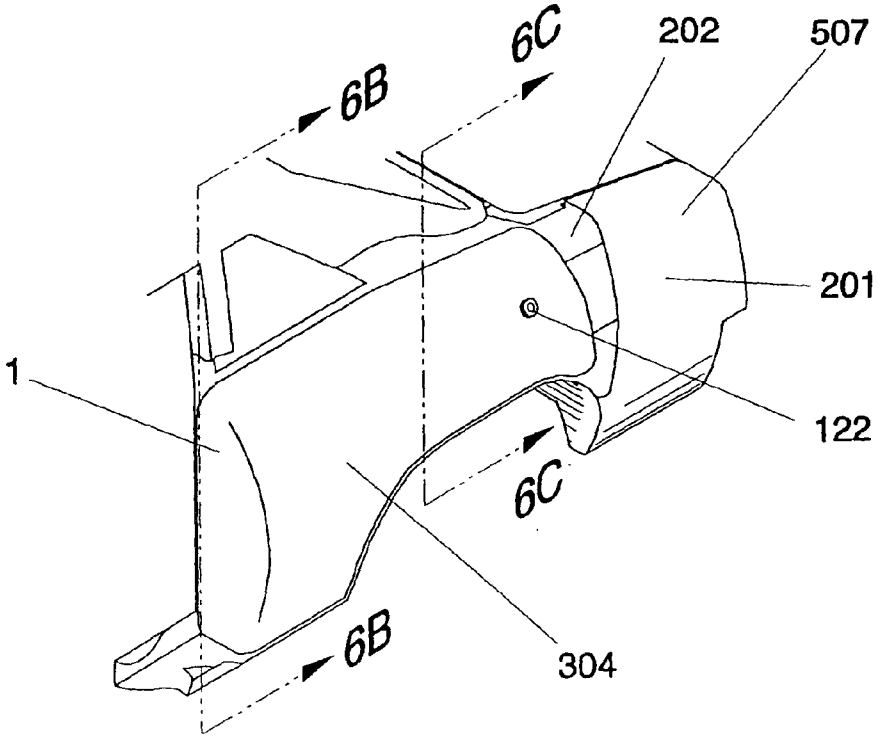

6C
202
507
6B
201
1
122
6C
304
6B

FIG. 6A

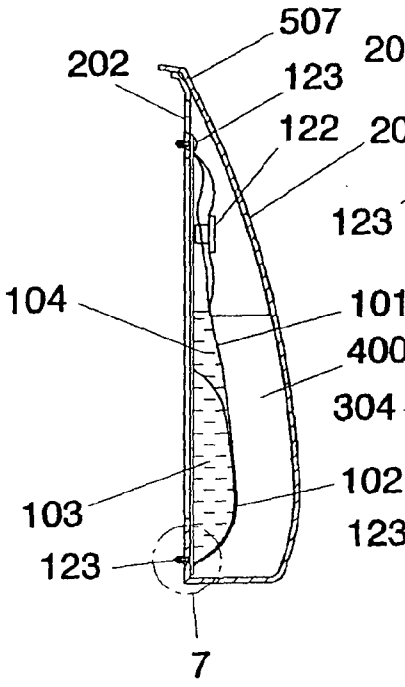


FIG. 6B

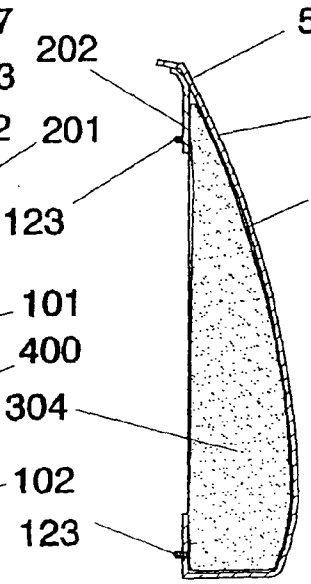


FIG. 6C

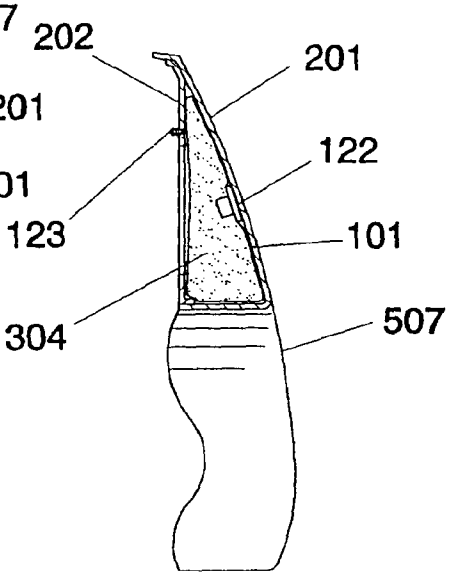
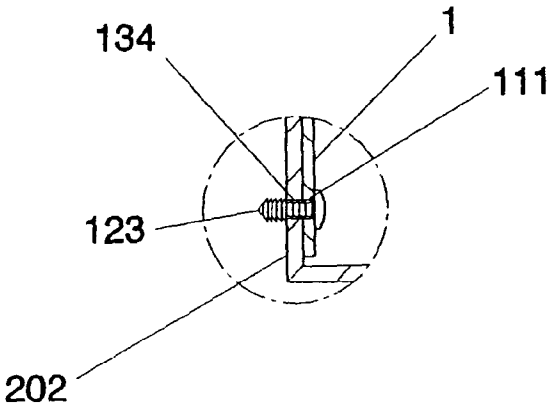


FIG. 7



EXPANSION FOAM CAVITY FILLER AND METHOD

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] None

STATEMENT AS TO RIGHTS TO INVENTION MADE UNDER FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

[0002] Not Applicable

BACKGROUND OD THE INVENTION

[0003] 1. Field of the Invention

[0004] This invention relates to the use of a chemically or heat activated high expansion foam within a pouch to fill a cavity in motor vehicles, boats, ships, campers, mobile or modular homes, home appliances, buildings, machinery, and equipment. The pouch is a containment pouch that may be composed of a suitable material, or coated, so it adheres to a surface adjacent to the cavity.

[0005] 2. Background Information

[0006] The construction of an automobile body results in many cavities of various sizes and shapes. Some of these cavities are currently filled with a material, such as a foam plastic, to prevent noise or fumes from entering into the passenger compartment or from one compartment to another. Foam plastic materials, as a filler, are also used to reduce vibrations within the vehicle. Prior art includes the use of a free flowing chemically activated urethane foam or a heat activated elastomeric rubber/plastic foam.

[0007] Current art has various problems and limitations.

[0008] Elastomeric rubber/plastic foam is limited to an expansion ratio of 8 to 10 times original volume and require special equipment and techniques for heat activation which are not feasible outside an automotive assembly plant. This is a limitation that precludes the use of elastomeric rubber/plastic foam for auto body repair shops, for example.

[0009] Urethane Foam:

- [0010] 1. Can only be applied after painting as it does not adhere to oily surfaces.
- [0011] 2. Requires special bulkheads or dams to contain the foam and prevent it from foaming into other regions.
- [0012] 3. As a liquid is not available in preformed shapes and as a solid is not usable for the intended purpose.
- [0013] 4. In a liquid state, prior to setting, can seep through weld seams.
- [0014] 5. Has an attendant exposure risk to isocyanates.

[0015] There is a need to control the flow of a high expansion urethane foam in body cavities of automobiles during assembly or repair. The method needs to be safe, easy to use, and have a minimal employee contact. As will be seen from the subsequent description, the present invention overcomes these and other disadvantages of current practises of filling cavities in motor vehicles such as automobiles or trucks, boats, campers, mobile or modular homes, appliances, buildings, machinery and equipment.

[0016] There is a prior art U.S. Pat. No. 5,497,829 by Rajkovich, Mar. 12, 1996. It relates to using a two component foam in a pouch to form plugs in boreholes for drilling and blasting operations for construction or mining purposes. This however is a different application than the present invention. The present invention, as will be seen in the subsequent description, is used for entirely different purposes in applications not foreseen or taught by Rajkovich.

[0017] U.S. Pat. No. 5,699,902 discloses a pouch used as packaging material. A two part foaming agent is contained within a bag and a mechanical seal that can be ruptured to begin the mix of material. While useful as a packing material, the device disclosed has limitations. The use of high density polyethylene film as well as metal foil is disclosed. While this may be fine in a closed box for packing, it is undesirable for a cavity filler in a vehicle. Specifically, such a film material is very noisy when exposed to wind, vibration, sound and movement. Sheet polyethylene, metal foil, paper, and other plastics crinkle and pop when exposed to movement and as such are unacceptable for use in automotive applications where reducing body panel noise is of extreme importance.

SUMMARY OF THE INVENTION

[0018] The present invention provides for a cavity filler created by self-expanding plastic or elastomer foam contained in a flexible pouch. The pouch is placed into a cavity where it expands to fill up the cavity so as to reduce vibrations, noise, or fumes from entering or being transmitted through a vehicle, a vessel such as a ship or boat, a mobile or modular home, a building, machinery, or equipment. In the preferred embodiment of the present invention, the plastic or elastomeric foam is self curing so the cavity filler sets in the shape constrained by the pouch which is contained and constrained within the cavity.

[0019] Latex, vinyl, various rubber compounds, and urethane can be elastomeric, and as such, thin sheets made from these materials generate almost no noise when exposed to wind, movement, vibration, sound, or other mechanical actions. Prior art pouches were made of relatively noisy material such as high density polyethylene. A cavity filling pouch that does not generate noise is very desirable for applications in vehicles particularly in the automotive field as noise reduction in body panels is a critical goal. A thin pouch, made of elastic sheet material less than 10 thousandths of an inch thick will conform to required shapes within a panel. An elastomeric pouch will allow for expansion to fill around obstructions such as corners as the pouch can stretch. Prior art pouches of polyethylene were flexible, but the material polyethylene has almost no stretch, therefore has limitations in applications where complete filling of a cavity having irregular shapes and tight corners is desired.

[0020] The pouch can be modified for the application, including shape of cavity, direction of flow, flexibility of pouch required, or for adhering or attaching to a wall of the cavity into which the pouch is placed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] **FIG. 1** shows a preferred embodiment of the present invention, a cavity filler.

[0022] **FIG. 2** shows an alternate embodiment of the present invention, an alternate cavity filler **1**B.

[0023] **FIG. 3** is a view of a second alternate embodiment of the present invention, a second alternate cavity filler IC.

[0024] **FIG. 4** shows the present invention installed in an automobile body cavity.

[0025] **FIG. 5** shows the present invention after foam expansion.

[0026] **FIGS. 6A, 6B**, and 6C elaborate on **FIGS. 4 and 5**, showing the cavity filler as it is being expanded by foam resulting from the combining of components contained within an outer pouch of the cavity filler.

[0027] **FIG. 7** shows a means of securing the cavity filler in a position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Referring to **FIG. 1**, in the preferred embodiment of the present invention, a cavity filler, an outer pouch **101**, which is a flexible pouch, is fabricated in a given shape as desired for an intended application. The outer pouch **101** contains a first foam component **104**. The outer pouch **101** may be composed of different types of material which affects characteristics such as, but not limited to, flexibility, stretch, density, toughness, strength, and adhesion of contents within the outer pouch **101** to the outer pouch **101**.

[0029] The outer pouch **101** can be made from sheets of urethane in a thickness range from **1** thousandth to 10 thousands of an inch. Urethane provides a material that is very quiet in applications where the outer pouch **101** can be exposed to wind or other movement. This characteristic is particularly advantageous in vehicle applications and is ideal for automotive applications. A thickness of 3-4 thousandths of an inch appears to be ideal. **FIGS. 6B and 6C** show how the elasticity of the pouch **101** alllows the material to more completely fill the fender cavity **400**. An elastic pouch **101** can stretch around obstructions such as valve **122** and can stretch to completely fill corners within the cavity **400**. A pouch such as of prior art polyethylene that was just flexible, but not elastic will not fill the cavity **400** as completely. At the same time an outer pouch **101** of urethane provides a pouch that is tough and that will resist wear over time as a vehicle application requires. Additionally, urethane is a material that can be heat sealed and this is important in forming and closing of the pouch **101**. An inner pouch **102** could be of urethane or could be of a different material and the outer pouch **101** would still give rood performance.

[0030] The outer pouch **101** may also be treated or coated with release agents, hotmelts, elastomeric compounds, or other special materials comprising a means of bonding the outer pouch **101** to a wall or walls of a particular cavity. An inner pouch **102** contains a second foam component **103**. The inner pouch **102** is sealed to prevent premature mixing of the first foam component **104** and the second foam component **103**. An optional outer coating **110** may be added to bond the outer pouch **101** to a wall of a particular cavity such as a cavity **400** in **FIG. 6A**. The outer coating **110** can be one of a number of pressure sensitive adhesives such as are well known to the trade or a heat activated material such as a hot melt glue. Or, as opposed to an outer coating **110**, the outer pouch **101** could be composed of a heat-activated material such as an expanding elastomeric compound that would bond to a cavity wall **202** in **FIG. 4**.

[0031] The inner pouch **102** and the outer pouch **101** are typically made from a liquid impervious, substantially clear, tubular urethane film to a desired form and are heat sealed as required. The inner pouch **102** is constructed of a thinner material than the outer pouch **101** in the preferred embodiment of the present invention. By using a substantially clear film an operator can observe the contents of the inner pouch **102** and the outer pouch **101**. A seal **140** joins the inner pouch **102** in a fixed position within the outer pouch **101**. The inner pouch **102** serves as a means of separating the first foam component **104** from the second foam component **103**. Rupturing the inner pouch **102** within the outer pouch **101** serves as a means of eliminating the means of separating the first foam component **104** from the second foam component **103** so the first foam component **104** can combine with the second foam component **103** to result in a cured foam cavity filler.

[0032] The cavity filler **1** also comprises, as an option, in the preferred embodiment of the present invention, a means of venting air and fumes emmitted by the combining of the foam components **103** and **104**. In the preferred embodiment of the present invention, the venting means is a vent **122** which is a one-way valve that permits the air and fumes to escape, but does not allow moisture or air to enter. Such one-way valves are common to the inflatable plastic toy trade. The one-way valves typically have a little flap in them that permits one to inflate a toy because the air is held within the toy sufficiently by the flap until one caps the valve. Such a valve, reversed, uncapped, serves as the vent **122**. As an alternate embodiment, in some circumstances, a simple vent comprising an opening in the outer pouch **101** would suffice.

[0033] A means of holding the inner pouch **102** in a position within the outer pouch **101**, if desired, would be sealing the inner pouch **102** within the outer pouch **101** by a seal **140**. This could be a heat seal or staple.

[0034] **FIG. 2** is a view of an alternate embodiment of the present invention, an alternate cavity filler **1**B an alternate outer pouch **101**B is separated into a compartment **109** using a means of separation of a first foam component **104** from a second foam component **103**. The preferred means of separation is a barrier **105**. A second barrier **105** is usable as a convenience for containing the first foam component **104** within a compartment **109** as a convenience for shipping and storing. The barriers **105** are used to isolate and contain the first foam component **104** and the second foam component **103** within the alternate outer pouch **101**B in compartments **109** formed by the barriers **105**. The barrier **105** between the first foam component **104** and the second foam component **103** prevents premixing of those components. The barriers **105** containing the first foam component **104** within the outer pouch **101** in a compartment **109** prevents the spread of the first foam component **104** throughout the outer pouch **101**.

[0035] Each of the barriers **105** comprise a rod **107** and a clip **108** wherein the clip **108** secures the alternate outer pouch **101**B between the rod **107** and the clip **108**, forming the barrier **105** so material contined within the alternate outer pouch **101**B, which is a flexible pouch, cannot flow past the barrier **105** so created, which in turn form the

compartments **109**. The barriers **105** are removed to permit mixing and allow expansion of the resulting mixture of the first component **104** and the second component **103**.

[**0036**] Also shown in **FIG. 2** is a push pin clearance **111**B and the valve **122**.

[**0037**] **FIG. 3** illustrates a second alternate embodiment of the invention, a single component cavity filler **1**C comprising a pouch **131**, which is flexible in the preferred embodiment of the present invention, containing a pre-mixed compound **132** contained in a compartment **109**C formed by the barrier **105**C. Said barrier **105**C is formed by the clip **108** securing the pouch **131** against the rod the rod **107**. Push pin apertures **111** are shown as options.

[**0038**] The pre-mixed compound **132** is typically a heat activateable latex foam, available in liquid form, sometimes called liquid rubber. A number of such suitable compounds are known to the trade.

[**0039**] The pouch **131** is shown with a vent **122**.

[**0040**] **FIGS. 4, 5**, 6A, 6B, 6C, and **7** illustrate a typical application of the cavity filler **1**, inserted in the cavity **400** (Ref. **FIG. 6A**) within an inner wall **202** and an outer wall **201** in an automobile chasis **507**. The cavity filler **1** is held in position in the cavity **400** by means of push pins **123**, each through a push pin clearance **134** in the inner wall **202** (Ref. **FIG. 7**). Push pins **123** are well known in the trade. A source for such push pins is Engineered Fastener Co., 1940 Craigshire, St. Louis, Mo. 63146.

[**0041**] **FIG. 6A** is a cross section view of the cavity filler **1** as installed in the cavity **400**.

[**0042**] **FIG. 6B** is a cross section view of the cavity filler **1** after expansion.

[**0043**] **FIG. 6C** is an additional cross section view of the cavity filler **1** after expansion.

[**0044**] A third containment pouch may be required by a customer for specific requirements as it allows more flexibility for the addition of the outer coating **110** (Ref. **FIG. 1**), or other coatings, or special materials for special characteristics such as flexibility, stretch, density, toughness, strength, and adhesion.

[**0045**] In the preferred embodiment of the present invention, the foam components would typically be an isocyanate (A) component and a polyol resin (B) component. The first foam component **103** could be either the A or the B component, and the second foam component could be the other of the A or the B component. The polyol resin (B) component typically contains other additives such as blowing agents, catalysts, and surfactants. Water is a common chemical blowing agent. When reacted with isocyanate, it generates carbon dioxide, which becomes trapped within the closed cells. Catalysts are chemical additives typically used to control the speed of the polyurethane reaction and influence polymer structure. Surfactants are used to reduce surface tension. The preferred embodiment of the present invention uses foam from MultiSeal, Inc., an Evansville, Ind. plastics company, but it will be recognized that other expansion foams may be substituted without loss of generality.

[**0046**] The isocyanate (A) component acts as a catalyst and typically has a density of approximately 10.3 pounds per gallon (ppg). The polyol resin (B) component may be of many different types of polyol resin blends, and typically has a density of approximately 10.2 ppg. The isocyanate (A) component is typically visually dark in color, while the polyol resin (B) component is typically more clear. It will be recognized that any number of chemically inert coloring agents may be added to either the A or B component in order to provide a stronger or different visual cue to aid an operator in mixing the components.

[**0047**] When combined, the A and B components typically expand to approximately 33 times the volume of their liquid state, resulting in a foam with a density of approximately 1.8 to 3.0 pounds per cubic foot (pcf) and a compression strength of approximately 23 pounds per square inch (psi). This 33 times expansion factor assumes a pouch in a cavity sufficiently large to permit this much expansion. Proper formulation of the A and B componenets will provide 2-5 minutes for the rise time. This will allow placement of a pouch with mixed A and B components into a cavity before the foam rises. Temperature will affect the final time for rise, gel, and tack free. On average, a usable, sufficiently cured foam cavity filler is formed in 3 to 6 minutes after mixing the A and B components. The foam cavity filler adapts to the pouch as constrained by a cavity into which said pouch is placed.

[**0048**] It will be recognized that the foam density and reaction times are dependent on mix efficiency, temperature, and resultant foam thickness, and that the present invention accomodates a wide variation in these factors without loss of functionality. The chemistry of the foam may be adjusted for optimum performance, but a typical ratio of component A to component B of the foam is approximately 4 to 3. The amount of component A may be increased or decreased depending on the applicaiton. Increasing the proportion of component A to component B results in a harder foam, but generates more heat during the expansion phase of the foam. Decreasing the proportion of component A to component B normally results in a softer foam but with less heat generated. The ratio of component A to component B may be increased to substantially 3 to 2 on the upper range or decreased to substantially 3 to 7 on the lower range.

[**0049**] Cavity volume ranging from 1 to 5000 or more cubic inches may be accommodated by proportionally increasing or decreasing the amount of the foam components and pouch sizes as appropriate.

[**0050**] During the expansion phase, the foam typically remains warm to the touch externally, but may reach temperatures as high as 300 degrees Fahrenheit internally. This level of heating is usually not a problem during the manufacturing stages of an autombile. The heat generated could activate the outer coating **110** or an external heat source could be supplied.

[0051] To fill a cavity with the preferred embodiment of the present invention, an operator's first step is to allow the first foam component **103** to mix with the second foam component **104**.

[0052] In the construction shown in **FIG. 1** this is done by rupture of the inner pouch **102** within the outer pouch **101** which allows the first foam component **103** contained in the inner pouch **102** to combine with the second foam component **104** within the outer pouch **101**. The operator can cause the rupture of the inner pouch within the outer pouch **101** by manual squeeze, or with his foot, or with some mechanical means. As previously stated, in the preferred embodiment, the inner pouch **102** is held in position by the seal **140** and is constructed of a thinner material than the outer pouch **101**.

[0053] In the construction shown in **FIG. 2**, the operator removes the barriers **105** by removing the clips **108** which permits the first foam component **103** to combine with the second foam component **104**.

[0054] The operator then kneads the outer pouch **101** to mix the foam components. In a production operation, such as an automobile assembly plant, the kneading operation might best be done by an appropriate automatic mechanical device. In the preferred embodiment of the present invention, the first foam component **103** and the second foam component **104** are of different colors and the outer pouch **101** is made of a substantially clear flexible plastic so the operator can determine visually when first foam component **103** and the second foam component **104** are properly mixed. When the color of a resulting mixture matches what is considered an appropriate standard, usually by a quality control authority, the mixture is considered properly mixed.

[0055] When the first foam component **103** and the second foam component **104** are properly mixed, the operator places the outer pouch **101** in a desired cavity such as cavity **400**. The foam will expand and form a cured foam cavity filler **304** which, properly designed, forms a positive seal to the walls **201** and **202**. A properly designed cavity filler **1** for this intended purpose contains appropriate quantities of the foam components **103** and **104** in an outer pouch of a proper size and shape to fill the cavity **203** so that there is a positive seal formed between the walls **201** and **202** by the cavity filler **1**.

[0056] If the outer coating **110** is used, the heat generated by the mixture will activate the outer coating **110** and cause the outer pouch **101** to adhere to a wall **201** or **202** of the cavity.

[0057] The second altermate embodiment of the present invention is a single component expansion foam **132** comprising a liquid or paste latex material with a blowing agent that is heat activated. Such a material is available from MultiSeal, Inc., Evansville, Ind. but other expansion foams, both polyurethane and non-polyurethane based are known to the trade. The means of heat activation can be a hot air blower or an oven, both of which are known to the trade.

[0058] Although the description above contains many specificities, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. For example, the drawings and descriptions are directed towards the filling of cavities in automobile bodies. However the invention is intended for the filling of cavities in, but not restricted to, vehicles of all sorts, ships, boats, mobile or modular homes, buildings, machinery, and equipment. Among the object and advantages of the invention is the reduction of vibrations, noise, and fumes entering or being transmitted through the above mentioned cavities.

[0059] Thus the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

I claim:

1. A device for filling cavities to reduce vibrations, noise and fumes from entering or being transmitted through said cavities, said device being a cavity filler comprising:

a) a flexible pouch containing at least one material wherein said material can be activated chemically or thermally so the material expands and cures to a shape conforming to the flexible pouch as contained in said cavity, becoming a cured foam cavity filler.

2. The flexible pouch of claim 1 wherein the flexible pouch is separated into compartments each containing a foam component that can be mixed to produce a cured foam cavity filler.

3. The flexible pouch of claim 1 wherein the flexible pouch comprises:

a) a first foam component,

b) a second foam component,

c) a means of separation of the first foam component from the second foam component wherein the means of separation can be eliminated, allowing the first foam component material to be combined with the second foam component material to result in a cured foam cavity filler.

4. The flexible pouch of claim 3 wherein the means of separation of the first foam component from the second foam component is a pouch within the flexible pouch, said pouch within the flexible pouch containing one of the foam components.

5. The flexible pouch of claim 4 wherein the pouch within the flexible pouch is of a thinner material than the flexible pouch.

6. The flexible pouch of claim 4 wherein the pouch within the flexible pouch is held in position within the flexible pouch by means of a seal between the pouch within the flexible pouch and the flexible pouch.

7. The flexible pouch of claim 3 wherein the means of separation of the first foam component material from the second foam component material is a barrier.

8. The flexible pouch of claim 7 wherein the barrier comprises:

a) a rod and

b) a clip that secures the flexible pouch between the rod and the clip so material contained within the flexible pouch cannot flow past the barrier.

9. The cavity filler of claim 1 for filling cavities wherein the device is used for filling cavities in vehicles, ships, boats, mobile or modular homes, buildings, machinery, and equipment.

10. The cavity filler of claim 1 further comprising a means of adhering the flexible pouch to a cavity wall in which the flexible pouch will be placed.

11. The cavity filler of claim 10 wherein the means of adhering the flexible pouch to the cavity wall comprises a pressure sensitive adhesive added as a coating to the flexible pouch.

12. The cavity filler of claim 10 wherein the means of adhering the flexible pouch to the cavity wall comprises a heat activated material added as a coating to the flexible pouch.

13. The cavity filler of claim 11 wherein the heat activated material is a hot melt glue.

14. The cavity filler of claim 10 wherein the means of adhering the flexible pouch to the cavity wall is using a flexible pouch composed of a heat-activateable material.

13. The cavity filler of claim 10 wherein the means of adhering the flexible pouch to the cavity wall is at least one push pin through an aperture in the flexible pouch and a clearance in the cavity wall.

15. A method of filling cavities in vehicles, ships, boats, mobile or modular homes, buildings, machinery and equipment where an operator:

a) takes the flexible pouch of claim 1,

b) activates material contained within the flexible pouch either chemically or thermally as dictated by the nature of the material contained within the flexible pouch, and

c) places the flexible pouch in a cavity to be filled.

16. A method of filling cavities where an operator:

a) takes the flexible pouch of claim 2,

b) allows the foam components to mix, and

c) places the flexible pouch in a cavity to be filled.

* * * * *