EXPANSION FOAM CAVITY FILLER AND METHOD

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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.
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CROSS REFERENCE TO RELATED APPLICATIONS

[0001] None

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

[0002] Not Applicable

BACKGROUND OF 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.


[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 practices 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 boresholes 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 packaging 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, 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.
FIG. 2 shows an alternate embodiment of the present invention, an alternate cavity filler 1B.

FIG. 3 is a view of a second alternate embodiment of the present invention, a second alternate cavity filler 1C.

FIG. 4 shows the present invention installed in an automobile body cavity.

FIG. 5 shows the present invention after foam expansion.

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.

FIG. 7 shows a means of securing the cavity filler in a position.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

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.

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 allows the material to more completely fill the inner 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 road performance.

The outer pouch 101 may also be treated or coated with release agents, hotmelt, 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.

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.

The cavity filler 1 also comprises, as an option, in the preferred embodiment of the present invention, a means of venting air and fumes emitted 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.

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.

FIG. 2 is a view of an alternate embodiment of the present invention. An alternate cavity filler 1B includes an outer pouch 101B, 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 101B 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 101B in a compartment 109 prevents the spread of the first foam component 104 throughout the outer pouch 101.

Each of the barriers 105 comprise a rod 107 and a clip 108 wherein the clip 108 secures the alternate outer pouch 101B between the rod 107 and the clip 108, forming the barrier 105 so material contained within the alternate outer pouch 101B, which is a flexible pouch, cannot flow past the barrier 105 so created, which in turn forms 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 111B and the valve 122.

[0037] FIG. 3 illustrates a second alternate embodiment of the invention, a single component cavity filler 1C 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 109C formed by the barrier 105C. Said barrier 105C is formed by the clip 108 securing the pouch 131 against 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 chassis 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 components 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 accommodates 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 application. 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 automobile. The heat generated could activate the outer coating 110 or an external heat source could be supplied.
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.

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.

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.

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.

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.

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.

The second alternate 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.

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.

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.

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.