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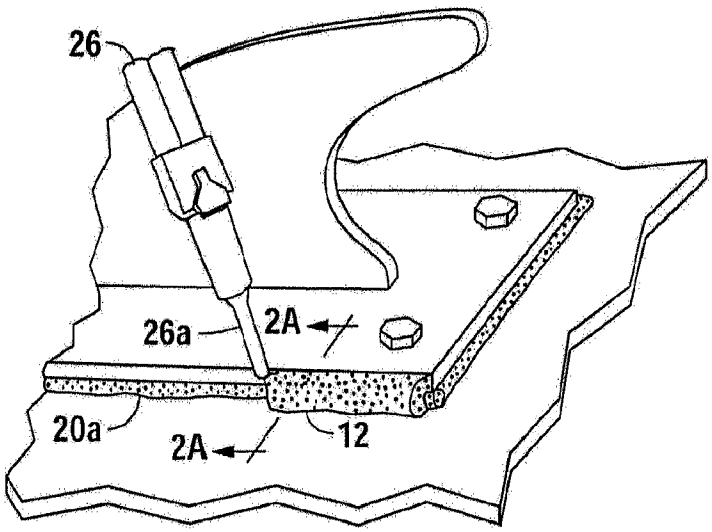
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(54) **Titre : JOINT PERIPHERIQUE DE POLYUREE POUR UNE ANTENNE D'AVION OU UNE AUTRE PARTIE D'AERONEF**
(54) **Title: POLYUREA PERIMETER SEAL FOR AN AIRCRAFT ANTENNA OR OTHER AIRCRAFT PART**



(57) **Abrégé/Abstract:**
A sealant is provided for use on an aircraft or other vehicle. The sealant may be used with a gasket. The sealant is a perimeter seal that comprises a polyurea member. The polyurea member is a self-curing, two-component mix. It may cure to a hardness in the range of about 40 to 100 (Shore A). It may maintain an adequate peel strength to withstand multiple thermal and pressure cycling, and may have a working life, wherein it may be shaped, of less than about eleven minutes.

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(54) Title: POLYUREA PERIMETER SEAL FOR AN AIRCRAFT ANTENNA OR OTHER AIRCRAFT PART

(57) Abstract: A sealant is provided for use on an aircraft or other vehicle. The sealant may be used with a gasket. The sealant is a perimeter seal that comprises a polyurea member. The polyurea member is a self-curing, two-component mix. It may cure to a hardness in the range of about 40 to 100 (Shore A). It may maintain an adequate peel strength to withstand multiple thermal and pressure cycling, and may have a working life, wherein it may be shaped, of less than about eleven minutes.

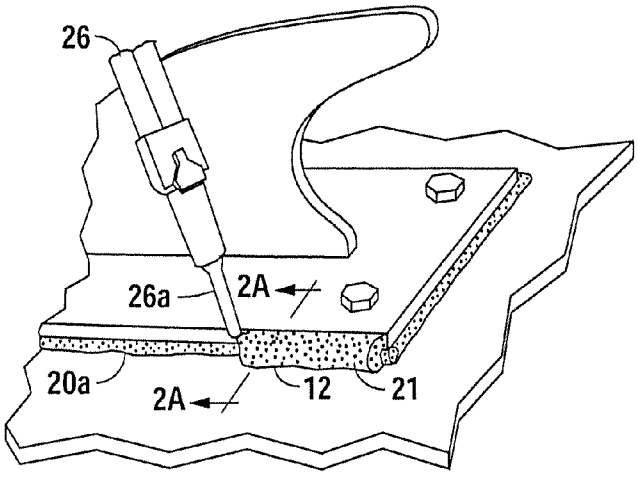


Fig. 2

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POLYUREA PERIMETER SEAL FOR AN AIRCRAFT ANTENNA OR OTHER AIRCRAFT PART

FIELD OF THE INVENTION

[01] A seal and a method for sealing for a perimeter of an aircraft or marine vehicle workpiece or part which, in one example, may be an aircraft antenna, which is bolted to an aircraft base, which may be a fuselage. A pliable polyurethane gasket or other gasket may be under compression between the aircraft part (workpiece) and base, for example, a fuselage of an aircraft. To this or other vehicle parts combination, a polyurea perimeter seal may be applied.

BACKGROUND OF THE INVENTION

[02] Aircraft parts are typically fastened to aircraft structure or base with fasteners. Often gaskets, including pliable, sticky polyurethane gaskets, such as those found in US Patent Nos. 6,530,577; 6,695,320; and 7,229,516, are used. During compression of the gasket as the workpiece is fastened down with torque applied to fasteners, there is sometimes squeeze out laterally at or near a perimeter edge of the gasket. Sometimes the perimeter edge of the gasket generally conforms in shape to the perimeter of the part that is being fastened to the base. However, once the workpiece is fastened, there is sometimes further squeeze out or sometimes there is actually an indentation where there was not sufficient gasket material (in an undercut gasket) to carry out to the edge of the perimeter of the workpiece, leaving the indentation. Sometimes the

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tightening or torque down on the fasteners, which generates squeeze out of a pliable gasket body, brings the deformable gasket body right up to the workpiece perimeter, but usually squeeze out extends beyond the perimeter.

[03] It may be advantageous, for aesthetic and functional reasons (as in providing a good environmental seal and limiting squeeze out), to provide a perimeter seal, that may be shaped, that contacts and surrounds substantially all of the perimeter of the part, the gasket body that may or may not have been squeezed out past the perimeter of the part or the workpiece, and the base upon which the workpiece is to be fastened.

SUMMARY OF THE INVENTION

[04] In one particular embodiment, a perimeter seal is a two component polyurea and the gasket under compression is cured polyurethane gel. In this particular embodiment, the polyurea perimeter seal may be pliable and sticky polyurea (in uncured condition) that is allowed to cure after the two components are mixed and applied with an applicator that mixes the two components while it flows the perimeter mix out a nozzle onto the perimeter. One such applicator is Part UG981108-01 available from Aviation Devices & Electronic Components, L.L.C., 3215 W Loop 820 S, Fort Worth, TX 76116. A suitable two-part polyurea is part no. TG3212 from KBS, Fort Worth, Texas.

[05] In another embodiment, the perimeter seal is two-component polyurea material with the two components being an isocyanate prepolymer component and a resin blend, such as a polyamine, with amine terminated members. The polyurea is applied with an applicator that has a body for each component and a double compartment syringe-like forcing element. The forcing element is pushed by the user's hand while his second hand holds and directs the body of the applicator. The system does not depend upon pressurized gas to dispense the mix. In one embodiment, the isocyanate is a diisocyanate between about 13 and 30% mixed with about 25-45% resin blend or hardener. A mixing tip or mixing nozzle on the applicator allows the two components to mix as they are being applied, typically as a bead, along the workpiece/gasket/fuselage perimeter after the workpiece has been torqued down. After being shaped, the two-component mix will quickly cure in place.

[06] In one embodiment, after application of an uncured polyurea bead, it is manually formed into a concave, convex or shaped profile by either the use of one's hand or a handheld tool. The perimeter, in one embodiment, will cure in a low profile concave, convex

or flat shape that will join and spread across a gap along the perimeter edge of the part where it joins the base.

[07] Applicant's two-component polyurea systems are typically silicone and polysulfide free and may have a very rapid cure time achieved without the use of a catalyst as in the two-component polyurethane systems. This rapid cure time is typically very consistent and uniform over a very broad temperature range. The two components are free of VOC's and solvents.

[08] The Polyurea Development Association defines polyurea as follows:

> "A polyurea coating/elastomer is that derived from the reaction product of an isocyanate component and a resin blend component. The isocyanate can be aromatic or aliphatic in nature. It can be monomer, polymer, or any variant reaction of isocyanates, quasi-prepolymer or a prepolymer. The prepolymer, or quasi-prepolymer, can be made of an amine-terminated polymer resin, or a hydroxyl-terminated polymer resin. The resin blend must be made up of amine-terminated polymer resins, and/or amine-terminated chain extenders. The amine-terminated polymer resins will not have any intentional hydroxyl moieties. Any hydroxyls are the result of incomplete conversion to the amine-terminated polymer resins. The resin blend may also contain additives, or non-primary components. These additives may contain hydroxyls, such as pre-dispersed pigments in a polyol carrier. Normally, the resin blend will not contain a catalyst(s)."

[09] The two-component polyurea system reaction may take place between a polyisocyanate component and the resin component. The action generates polymerization and curing.

[10] Polyurea technology typically differs from polyurethane, in that amine terminated (-NH_2) resins are used rather than hydroxyl terminated (-OH) resins commonly referred to as polyols. The reaction of the amine terminated resins with the isocyanate component results in the formation of a polyurea linkage. The resin blend of the two-component polyurea systems may be aliphatic or aromatic.

[11] In one particular embodiment, the two-component cure-in-place polyurea perimeter material has a working life (more viscous than gel, but not too hard, for shaping) of less than about four minutes, and a gel time (too hard to shape, but still deformable) of more than about four minutes (preferably between 4 and 8 minutes), and a full cure (substantially

complete hardening) of less than about two hours at room temperature (about 24°C to 26°C). In another embodiment, the working life of the two-component mix is about 2-4 minutes after leaving the mix nozzle at about room temperature. In another embodiment, the working life is up to about 11 minutes; in another embodiment, up to about 7 minutes; and in another embodiment, up to about 4 minutes from the time it is mixed and applied. At the end of the working life, the mix starts to gel, and will gel in about one to two minutes. Substantially full cure is typically about an hour, allowing the parts to return to service quickly. The working life may be at room temperature or temperatures between about 15°C and 40°C. In a preferred embodiment, the perimeter seal has a two-component polyurea mix that has a UV inhibiting agent, such as carbon black, that renders it substantially black in color and improves UV resistance, a hardness after full cure between about 70 to 90 (shore A at 25°C), and a peel strength of greater than about 25 pounds/inch width, in another embodiment, peel strength from about 10 to 40 pounds per inch width.

[12] In one embodiment, the invention may include an assembly comprising an aircraft base and an aircraft workpiece having an outer perimeter and optionally a polyurethane gasket (or other elastomeric gasket) under compression between the two. The gasket has an outer perimeter. A perimeter seal around the outer perimeter has, in one embodiment, a substantially continuous linear polyurea member (complete or partly encircling the workpiece) of cure in place polyurea. The perimeter seal typically contacts the base, the workpiece, and the body of the gasket if a gasket is used.

[13] A "seal" or "sealant" means any composition that can be used to form a connecting bond between two or more objects, articles or bodies or to fill at least a portion of any type of opening, junction or other space in, on or between one or more objects, articles or bodies (e.g., grooves, pits, cracks, joints, spaces between adjacent or overlapping members, pores, rivet holes and seams). Some sealants are used, for example, to fill a space defined by two or more overlapping or adjacent members of a structure, such as a joint around a window, a joint connecting or between parts of an aircraft or watercraft. In some embodiments, for example, sealants can be used to smooth a surface or to act as a caulk-like material to slow or stop movement of moisture, chemicals, gasses, debris, and other materials through or across an opening, junction or space, although the foregoing functions are not required properties of the sealant.

[14] Seal or sealant materials may cure (i.e., solidify and harden) upon or after application through chemical or physical behavior of one or more components in the

sealant. In some embodiments, the sealant is a self-curing sealant. A "self-curing sealant" is a sealant that cures upon application at room temperature (about 24°C to 26°C) or, in another embodiment, between about 15°C and 40°C, without further administration of heat or irradiation. Some examples include emulsions of one or more polymers (e.g., acrylic polymers) in water or another solvent that cure through physical coalescence upon drying through evaporation; prepolymers that polymerize through reaction with atmospheric moisture or ambient water (e.g., isocyanate-cured polyurethane or polyurea prepolymers); compositions containing two or more compounds that are combined to react with each other to cause the composition to cure (e.g., two-component polyurethane or polyurea sealants); and sealant compounds that react with materials in the substrates to which they are applied to bond to such materials (e.g., silane-terminated sealants having alkoxy groups that react with hydroxyl groups on substrates).

[15] The term "polymer" as used herein means a molecule that is the reaction product of polymerizing at least one type of monomer and, in the case where the polymer includes two or more types of monomers, the monomers may be arranged in any order and polymerized concurrently or sequentially. The polymers of the perimeter seal of the present invention may be a two-component polyurea, the components of which are VOC and solvent-free.

[16] In one embodiment, the invention comprises an assembly comprising an aircraft base and an aircraft workpiece having an outer perimeter with a polyurethane bodied gasket between the base and workpiece, the polyurethane gasket body deformable under compression and with an outer perimeter, the polyurethane gasket under compression. A perimeter seal may comprise a shaped, discontinuous or substantially continuous, linear polyurea member formed from a fast curing two-component cured in place polyurea mix. The perimeter seal may contact the base, the workpiece, and optionally the body of the gasket.

[17] In one embodiment, Applicant provides a method of assembling marine vehicle or aircraft parts, in one embodiment, comprising an aircraft workpiece and an aircraft base, the method comprising the steps of: acquiring an aircraft base and an aircraft workpiece, the workpiece having a workpiece outer perimeter and adapted to engage the aircraft base along opposed mating surfaces; acquiring an applicator having a two-component polyurea and a nozzle for mixing the two components; acquiring a pre-cured, die cut gasket comprising a skeleton and a tacky, soft, viscoelastic polymeric gel body, the gasket having a gasket perimeter that is shaped to conform to the workpiece outer perimeter; placing the

gasket between the base and the workpiece; and, fastening the workpiece to the base with the gasket under sufficient compression to cause some lateral (outward) movement of the polymeric gel body such that the perimeter of the gel. "Acquiring" when used in the specification and claims means to come into possession or control of, by any means.

[18] A sealant is disclosed for use on an aircraft having an aircraft base and an aircraft workpiece, with a gasket having a gasket body, the gasket for compression between the aircraft base and the workpiece so as to deform the gasket body. The sealant may comprise: a perimeter seal comprising a linear polyurea member formed from a self-curing two-component mix of cured in place polyurea, the perimeter seal contacting at least the base and the workpiece. The cured polyurea, in one embodiment, has a hardness in the range of about 40 to 100 (Shore A) and a working life of less than about 4 minutes at about 24°C to 26°C; and wherein the linear polyurea member is capable of withstanding multiple thermal and pressure cycling while maintaining a peel strength of between about 20 to 40 pounds/inch width in one embodiment.

[19] The perimeter seal may contact an outer perimeter of the gasket.

[20] The gasket may comprise cured polyurethane gel.

[21] The perimeter seal may be substantially continuous about the perimeter of the workpiece.

[22] The linear polyurea member may further include a UV inhibiting component.

[23] The two components before mixing, may have a viscosity of between about 18,000 and 42,000 cps, in one preferred embodiment, between about 500 and 90,000 cps in another.

[24] The perimeter seal may be painted upon curing.

[25] An assembly for use on an aircraft or other vehicle is disclosed, the assembly comprising: an aircraft or other vehicle base and an aircraft or other vehicle workpiece having an outer perimeter; and a perimeter seal comprising a shaped linear polyurea member formed from a self-curing two-component mix of cured in place polyurea, the perimeter seal contacting the base and the workpiece; wherein the cured polyurea has a hardness in the range of about 40 to 100 (Shore A) and a working life of less than about 11 minutes at about 24°C to 26°C; and wherein the polyurea member is capable of withstanding multiple thermal and pressure cycling while maintaining a peel strength of between about 10 to 40 pounds/inch width.

[26] A gasket may be placed between the base and the workpiece.

[27] The perimeter seal may contact an outer perimeter of the gasket. The gasket may be comprised of cured polyurethane.

[28] The perimeter seal is typically continuous about the perimeter of the workpiece.

[29] A method of putting together a body assembly comprising a base and a workpiece, the workpiece having a workpiece outer perimeter and adapted to engage the base along opposed mating surfaces, the method comprising the steps of: placing between the base and the workpiece a pre-cured, die cut gasket comprising a skeleton and a tacky, soft visco elastic polymeric gel body, the gasket having a gasket perimeter that is shaped to conform to the workpiece outer perimeter; fastening the workpiece to the base with the gasket under sufficient compression to cause some lateral (outward) movement of the polymeric gel body such that the perimeter of the body, the outer perimeter of the workpiece and the base define a junction; with an applicator having a forcing element and a pair of compartments for containing a self-curing two-component polyurea sealant and a nozzle for mixing the two components, applying a linear bead of the uncured sealant mix from the applicator to the junction such that the junction is at least partly covered, and the mix contacts the base and outer perimeter of the workpiece and contacts and covers the outer perimeter of the gasket; and allowing the mix to cure.

[30] The method of the preceding paragraph wherein the workpiece and base are parts of an aircraft window assembly.

[31] The workpiece and base may be part of an aircraft antenna and an aircraft fuselage. In other embodiments, the workpiece and base are parts of aircraft rib joints, floor boards, cargo bays, and door tracks.

[32] The step of shaping the linear bead prior to curing may be included.

[33] The shape of the shaping step may be one of: concave, convex or linear.

[34] The polymer is selected to cure to a hardness of between about 40 to 100 (Shore A) and a peel strength of between about 10 and about 40 pounds per inch width.

[35] The polymer is selected to have a working life of less than about 4 minutes.

[36] A sealant for use on a body having a base and a workpiece, the sealant comprising: a perimeter seal comprising a linear polyurea member formed from a self-curing two-component mix of cured in place polyurea, the perimeter seal contacting the base and the workpiece; wherein the cured polyurea has a hardness in the range of about 40 to 100 (Shore A) and a working lfie of less than about 4 minutes at about 24°C to 26°C; and

wherein the polyurea member is capable of withstanding multiple thermal and pressure cycling while maintaining a peel strength of between about 10 to 40 pounds/inch width.

[37] The body may be an aircraft vehicle, a marine vehicle, a spacecraft vehicle and the like, the vehicle subject to temperature and pressure cycling.

[38] The outer perimeter of a workpiece and the base may define a junction. A linear bead of the uncured mix from the applicator may be applied to the junction such that the junction is at least partly covered, and the mix contacts the base and outer perimeter of the workpiece and contacts and substantially covers the outer perimeter of a gasket. The mix may be allowed to cure. The workpiece and base may be, in one embodiment, an aircraft antenna and an aircraft fuselage.

[39] Applicant's method may further include, optionally, the step of shaping the linear bead prior to curing. The shape of the shaping step may be one of: concave, convex or linear.

BRIEF DESCRIPTION OF THE DRAWINGS

[40] Fig. 1 is a cutaway cross-sectional view of an aircraft antenna engaged to an aircraft fuselage with a gasket having a pliable body therebetween, the Figure illustrate a condition of antenna/fuselage/gasket prior to the application of Applicant's perimeter seal.

[41] Fig. 2 illustrates a method of forming a polyurea bead or perimeter seal on the external surface of an aircraft fuselage.

[42] Fig. 2A is a cross-sectional view of the uncured polyurea bead after application and prior to shaping.

[43] Fig. 3 illustrates the optional shaping step, in cross-section, wherein the uncured polyurea bead is shaped using a shaping tool.

[44] Figs. 3A, 3B, and 3C illustrate, in cross-sectional view, the profile of the cured polyurea bead on an aircraft workpiece with a gasket between the workpiece and the base.

[45] Fig. 4 illustrates an aircraft assembly comprising an aircraft (or other vehicle) workpiece and aircraft base with a gasket between the workpiece and the base and a shaped polyurea bead on the perimeter of the workpiece.

[46] Fig. 4A illustrates a kit for use with applying a perimeter seal to an aircraft workpiece.

[47] Fig. 5 illustrates the use of polyurea seal with an aircraft window.

[48] Figs. 6A, 6B, and 6C illustrate the use of Applicant's perimeter seal on adjacent panels of an aircraft or other vehicle.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[49] Figs. 1-4A illustrate an assembly comprising an aircraft base, such as a fuselage 18, and an aircraft workpiece, such as an aircraft antenna 16, having an outer perimeter 16a and optionally an elastomeric gasket. In one case, the gasket is a polyurethane gasket 20 having a gasket body of cured polyurethane (such as disclosed in the patents referenced herein, for example) with an outer perimeter 20a. The gasket may be under compression between the base and the workpiece, such as compression generated by a multiplicity of fasteners 24. The figures also illustrate a method of making the assembly and the method of use of the assembly. A kit for use when applying the perimeter seal is also illustrated.

[50] Sometimes the gasket, having a gel, gel-like or pliable body, when compressed, may spread laterally outward at its perimeter 20a as the workpiece is being torqued down towards the base. Upon compression, perimeter 20a of the gasket body may reach or not reach (undercut), or extend beyond, the perimeter 16a of antenna 16.

[51] In one embodiment, Applicant provides a shaped polyurea perimeter seal 10, the shaped perimeter seal created by applying a mixed, uncured (when applied) fast-curing polyurea rope, bead or linear member from an applicator 26 having a mixing nozzle 26a thereon. The uncured mix is typically applied to the perimeter 16a of the workpiece in such a fashion that the uncured polyurea will contact and cure while in contact with perimeter 20a of gasket 20 (if one is present), perimeter 16a of antenna 16 (or other workpiece) and the fuselage 18 or base upon which the workpiece is attached. In this application, the uncured polyurea will both form and (optionally) be shaped before curing "in place" and then cure in place as shaped. In one embodiment, the bead mix 12 (unshaped) will conform to the shape it takes coming out of the nozzle and contacting the three parts (gasket, if used, workpiece, base) when applied and, in another embodiment, the perimeter seal will be shaped 10 prior to curing, such as with a shaping tool 14 (compare Fig. 2 to Fig. 3A) or manually.

[52] In one embodiment, the perimeter seal may be formed and cured in place as a linear member, such as that coming out of nozzle of the applicator as the applicator is moved with the tip of the nozzle just adjacent the workpiece/base perimeter joint. In one particular embodiment, the two-component form and cure in place polyurea has a working life (during which it can be shaped) of less than about 11 minutes and a full cure time (substantially

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complete hardness) of less than 2 hours (optimally less than about 1 hour) at room temperature. In a preferred embodiment, the perimeter seal is a polyurea comprised of one part isocyanate and one part resin, the two components forming a polymer with multiple urea links. In one embodiment, the polyurea is substantially opaque, in one embodiment, black with tiny particles of carbon black mixed therein for helping make the mix more ultraviolet tolerant. A hardness after full cure in one embodiment is between about 70 and about 90 (shore A at 25°C) (about 40 to 100 in another preferred embodiment) with a peel strength of greater than about 25 pounds/inch width or in the range of about 10 to 40. Peel strength was (force normal) measured using a 1" wide, 6" long aluminum "trough" about .045" in depth, full of fully cured polyurea and containing an embedded pulling material, and measured with a spring scale or other accurate force measuring device.

[53] A method of making the perimeter seal may comprise a step of placing a gasket having, in part, a polyurethane (or other elastomeric) body and an outer perimeter between an aircraft antenna having an outer perimeter and a fuselage, and providing fasteners to torque down the antenna to the fuselage. The aircraft antenna and the gasket may have a similarly configured outer perimeter and, in the process of clamping or torqueing down, there may be some squeeze out laterally of the pliable polyurethane of the gasket body.

[54] An applicator 26 containing a resin blend in one chamber and an isocyanate in another and a mixing nozzle 26a for the mixing of the two components may be used to apply a bead or linear member adjacent the squeeze out in the outer perimeter of the gasket and the workpiece such that, in one embodiment, a linear bead is formed substantially around (surrounding) the outer perimeter of the antenna or other workpiece (see Fig. 2). Typically, the bead contacts the three elements of the assembly and may be shaped (see Fig. 3) before it cures. It may be shaped using a shaping tool 14, which may remove excess uncured perimeter polyurea and provide a shape to the bead, which shape may be flat in one embodiment or slightly concave or slightly convex in other embodiments (see Figs. 3A, 3B, and 3C).

[55] The shaping tool may have a straight, convex or concave edge, or a combination of these shapes, and may be flexible and made of a rubber or rubber-like material. To help ensure no air gaps at the junction, the flow out of nozzle 26a should be sufficient, in combination with the speed of movement of the applicator, such that the junction preferably be fully coated. The tool can be held at an acute angle to the direction of travel along the bead, with the tool contacting both the base and the workpiece and the bead simultaneously

surrounding the workpiece in a preferred embodiment. The shaped perimeter bead may have the following characteristics: it is somewhat flexible (but typically harder than the body of the gasket used) , strong, waterproof, easy to install, adhesive to the aluminum and the body of any gasket, eliminates the need for solvents and scraping, and help provides a good environmental seal and effective moisture barrier and is U.V. tolerant.

[56] Fig. 4A shows a kit 32 for use in making the perimeter seal, the kit with some or all of the following components: applicator 26 (containing the two-part polyurea system), a tabular, flexible, rubber or rubber-like applicator tool 14, which may be rectangular, about 3 to 5 inches along a side with a thickness of about ¼ inch and a curved corner as seen with a curvature of about ¼ to ½ inch, and at about ¼ in another and a curvature less than a ¼ inch at another corner (for sizing the bead during shaping). The tool may be used as illustrated herein to shape the polyurea before it cures. Optionally, a small container of paint 28 may be used along with a brush 30 to paint the perimeter seal following curing. Paint, such as a polyurethane or mil-spec paint, applied to the perimeter seal after it has cured may provide additional environmental and UV protection.

[57] Fig. 5 illustrates another environment in which Applicant's polyurea bead or linear member may be used. Fig. 5 illustrates an aircraft window or windscreen 36 attached to an aircraft's skin 38 with a center windscreen frame 40 or other frame structure. An outer retainer 42 may be provided, which engages the aircraft skin and the windscreen frame and the window edge, an inner frame 42 typically holding the aircraft window or windscreen element, the inner frame engaging the outer retainer, the outer retainer also engaging the outer surface of the windscreen as illustrated. Applicant's perimeter seal 10 may be used at any of the places indicated where a durable somewhat flexible environmental seal is provided. Three of these locations are illustrated. "A" shows the use of Applicant's seal between the aircraft skin and inner frame on one side and the window element on the other, with the outer retainer on the outer surface providing an outer boundary to the perimeter seal. The perimeter seal may also be used where the outer retainer meets the aircraft skin or where the outer retainer meets or is adjacent to the outer surface of the windscreen as seen in "C" and "B" above.

[58] The perimeter seal may be used even when there is no gasket between the base and the workpiece. It will provide, in many instances, an effective seal even without a gasket between the base and the workpiece. Moreover, while specific environments are mentioned in the specifications, such as on aircraft, it may be used in any suitable setting

where an environmental seal is needed on any assembly. Moreover, it may be halogen-free and silicone-free. Moreover, in a preferred embodiment, no catalyst is required.

[59] Figures 6A, B and C illustrate the use of Applicant's polyurea seal with adjacent panels 34. Panels 34 may be any structural panels on any assembly, but in one embodiment may be aluminum or aluminum alloy panels of an aircraft exterior or interior. For example, Fig. 6A shows to a pair of panels 34 in a lap joint configuration at the exterior lap joint and the interior or inner lap joint where a polyurea bead or perimeter seal 10 may be applied. Note that in this embodiment, as in others, the use of the gasket between the faying surfaces is optional. Figs. 6B and 6C illustrate the use of Applicant's polyurea seal 10 between the faces of adjacent, but spaced apart, panels 34. Here, as in other locations, Applicant's perimeter seal provides an effective environmental seal protecting the joints from corrosive elements.

[60] Applicants have found that the cure in place polyurea described herein, including the mix having a cure time in the ranges set forth herein and a hardness set forth herein, maintains a good environmental seal over repeated thermal and pressure cycling. An aircraft as it climbs to altitude and descends, undergoes repeated thermal and pressure cycling. It is sometimes difficult to find an easy to apply environmental seal that will maintain its favorable physical characteristics in such a harsh environment. Temperatures may range between about -65°C and 85°C, and pressures between atmosphere or slightly above (to about 2 atmospheres) down to about 5 inches of mercury. Moreover, a proper seal needs some degree of UV tolerance, as well as tolerance to a variety of humid to dry conditions.

[61] In preferred embodiments of the perimeter seal, both the gasket body and the perimeter are free of polysulfides, chromate, and silicone. The body of the gasket may be a nonconductive gel polymer, including two component polyurethane. The polyurea perimeter seal is typically not a gel and may be used as a pack and gap void seal. It is capable of multiple temperature pressure cycling. In one embodiment, the viscosity of a resin component is between 18,000 and 28,000 cps, 25°C, and the viscosity of a hardener component is about 25,000 to 42,000 cps, 25°C. In one embodiment, the color of the hardener is black through the use of carbon black. Applicant's perimeter seal may be used as a replacement for polysulfide seals wherever the polysulfide perimeter seals are used.

[62] Although the invention has been described with reference to a specific embodiment, this description is not meant to be construed in a limiting sense. On the contrary, various

modifications of the disclosed embodiments will become apparent to those skilled in the art upon reference to the description of the invention. Applicant's various embodiments of its perimeter seal may be used on other devices, such as ships and other marine transport vehicles. It is therefore contemplated that the appended claims will cover such modifications, alternatives, and equivalents that fall within the true spirit and scope of the invention.

CLAIMS:

1. A sealant for use on an aircraft having an aircraft base and an aircraft workpiece, with a gasket having a gasket body, the gasket for compression between the aircraft base and the workpiece so as to deform the gasket body, the sealant comprising:

a perimeter seal comprising a linear polyurea member formed from a self-curing two-component mix of cured in place polyurea, the perimeter seal contacting the base and the workpiece;

wherein the cured polyurea has a hardness in the range of about 40 to about 100 Shore A; and

wherein the linear polyurea member is adapted to withstand multiple thermal and pressure cycling while maintaining a peel strength of about 10 to about 40 pounds/inch width.

2. The sealant of Claim 1, wherein the perimeter seal contacts an outer perimeter of the gasket.

3. The sealant of Claim 2, wherein the gasket body is comprised of cured polyurethane gel.

4. The sealant of Claim 3, wherein the perimeter seal is substantially continuous about the perimeter of the workpiece.

5. The sealant of Claim 1, wherein the linear polyurea member further comprises an ultraviolet inhibiting or absorbing component.

6. The sealant of Claim 1, wherein the two components before mixing, have a viscosity of about 18,000 to about 42,000 cps.

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7. The sealant of Claim 1, wherein the perimeter seal is painted upon curing.

8. The sealant of Claim 1, wherein the polyurea has a working life of 11 minutes or less at a temperature of about 15°C to about 40°C.

9. An assembly for use on an aircraft, the assembly comprising:

an aircraft base and an aircraft workpiece having an outer perimeter; and

a perimeter seal comprising a shaped linear polyurea member formed from a self-curing two-component mix of cured in place polyurea, the perimeter seal contacting the base and the workpiece;

wherein the cured polyurea has a hardness in the range of about 40 to about 100 Shore A and a working life of 11 minutes or less at a temperature of about 24°C to about 26°C; and

wherein the linear polyurea member is adapted to withstand multiple thermal and pressure cycling while maintaining a peel strength of about 10 to about 40 pounds/inch width;

further comprising a gasket between the base and the workpiece;

wherein the perimeter seal contacts an outer perimeter of the gasket;

wherein the gasket is comprised of cured polyurethane; and

wherein the perimeter seal is substantially continuous about the perimeter of the workpiece.

10. A sealant for use on a body having a base and a workpiece, the sealant comprising:

a perimeter seal comprising a linear polyurea member formed from a self-curing two-component mix of cured in place polyurea, the perimeter seal contacting the base and the workpiece;

wherein the cured polyurea has a hardness in the range of about 40 to about 100 Shore A and a working life of 4 minutes or less at about 24°C to about 26°C;

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wherein the polyurea member is adapted to withstand multiple thermal and pressure cycling while maintaining a peel strength of about 10 to about 40 pounds/inch width; and

wherein the body is an aircraft vehicle, a marine vehicle, or a spacecraft vehicle, wherein the vehicle is subject to temperature and pressure cycling.

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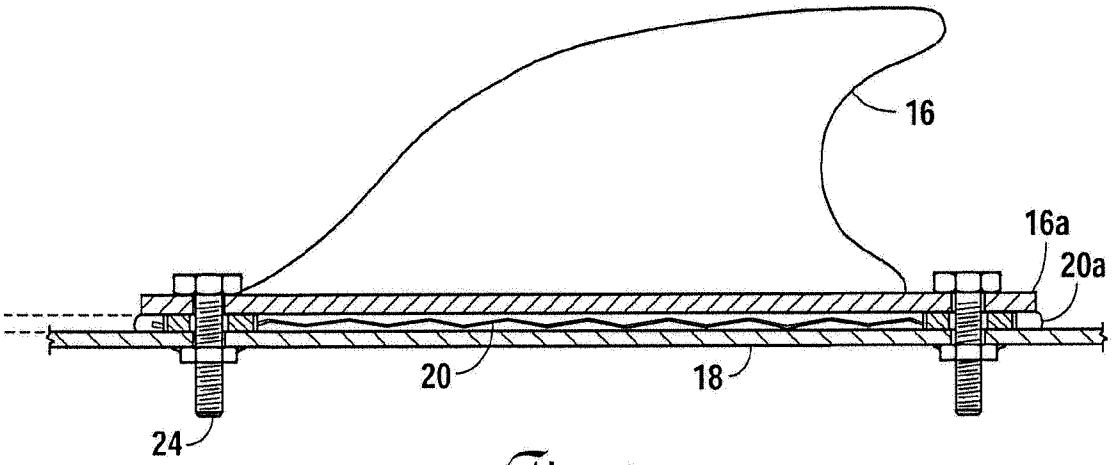


Fig. 1

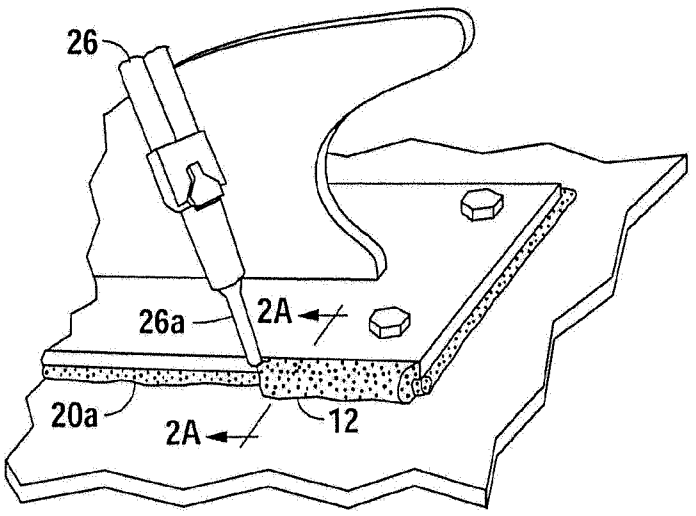


Fig. 2

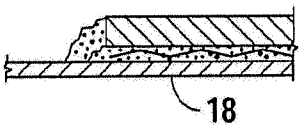


Fig. 2A

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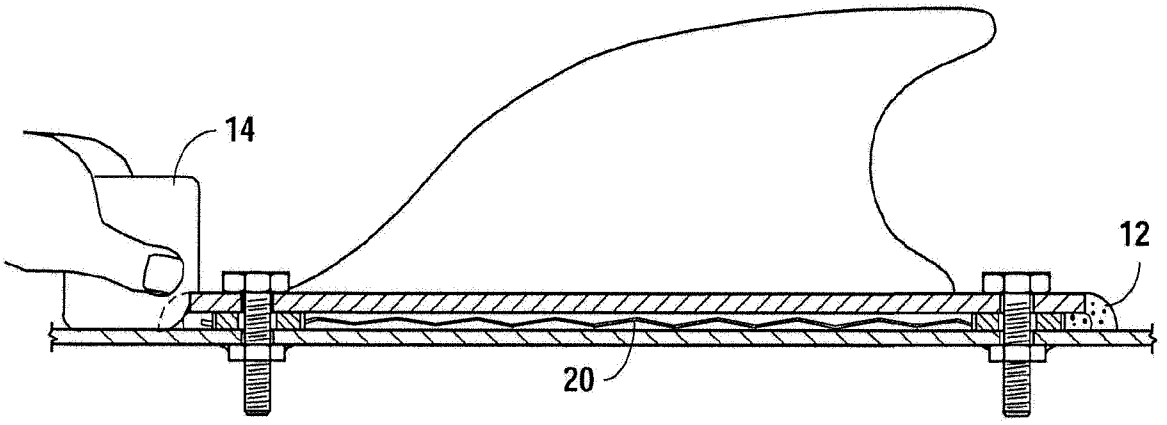


Fig. 3

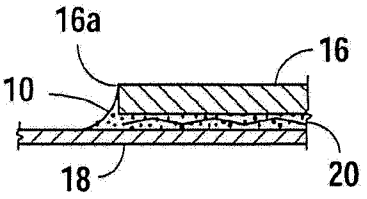


Fig. 3A

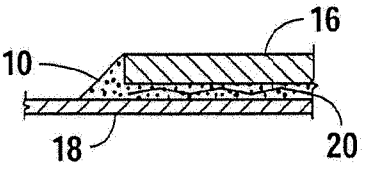


Fig. 3B

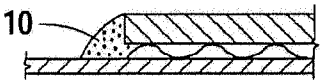


Fig. 3C

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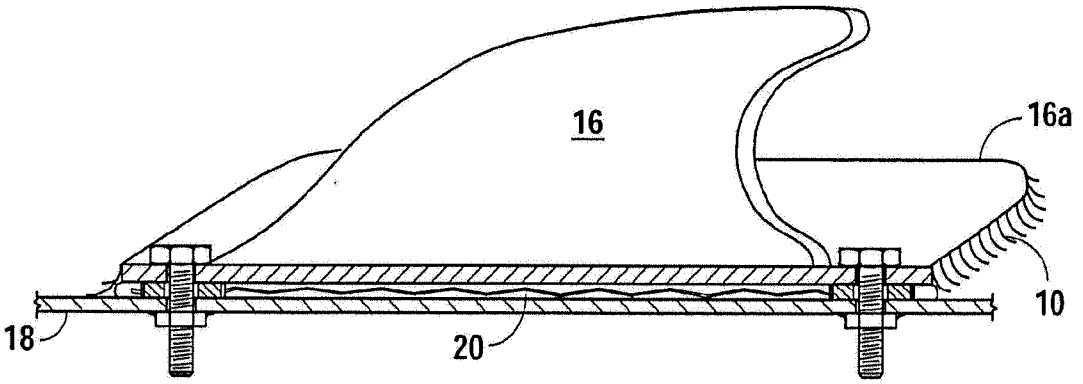


Fig. 4

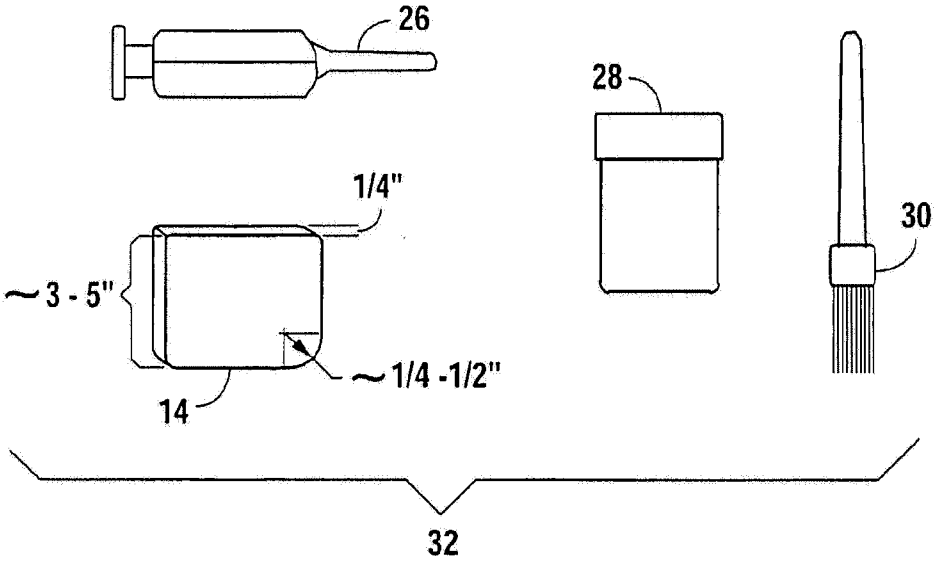


Fig. 4A

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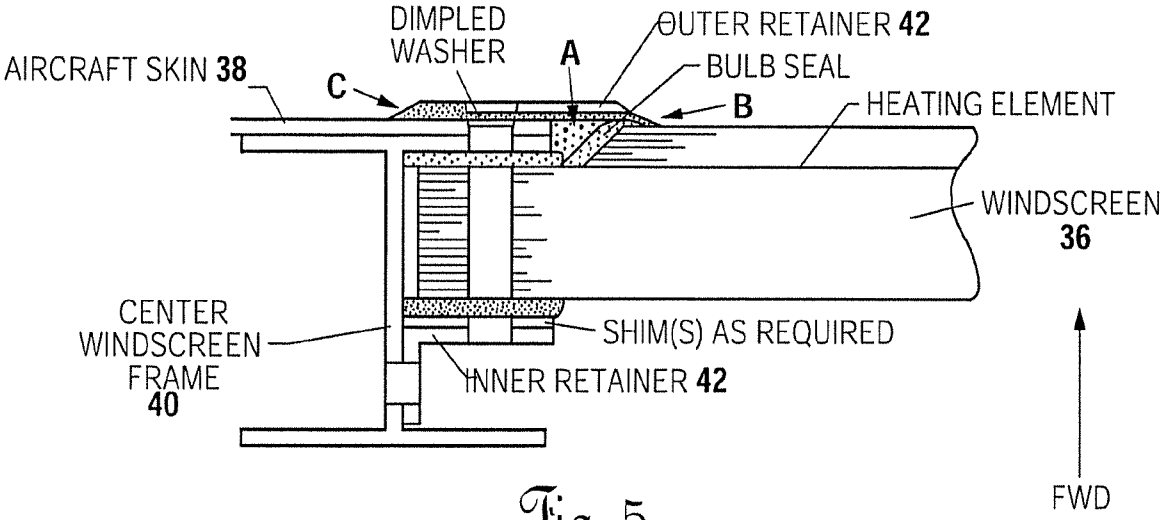


Fig. 5

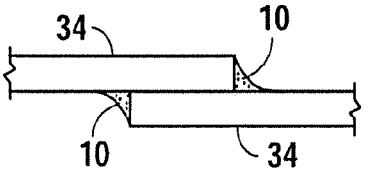


Fig. 6A

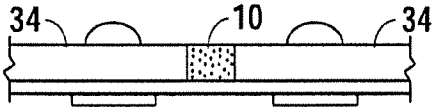


Fig. 6B

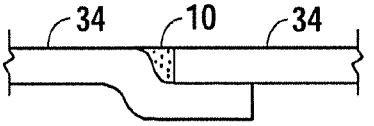
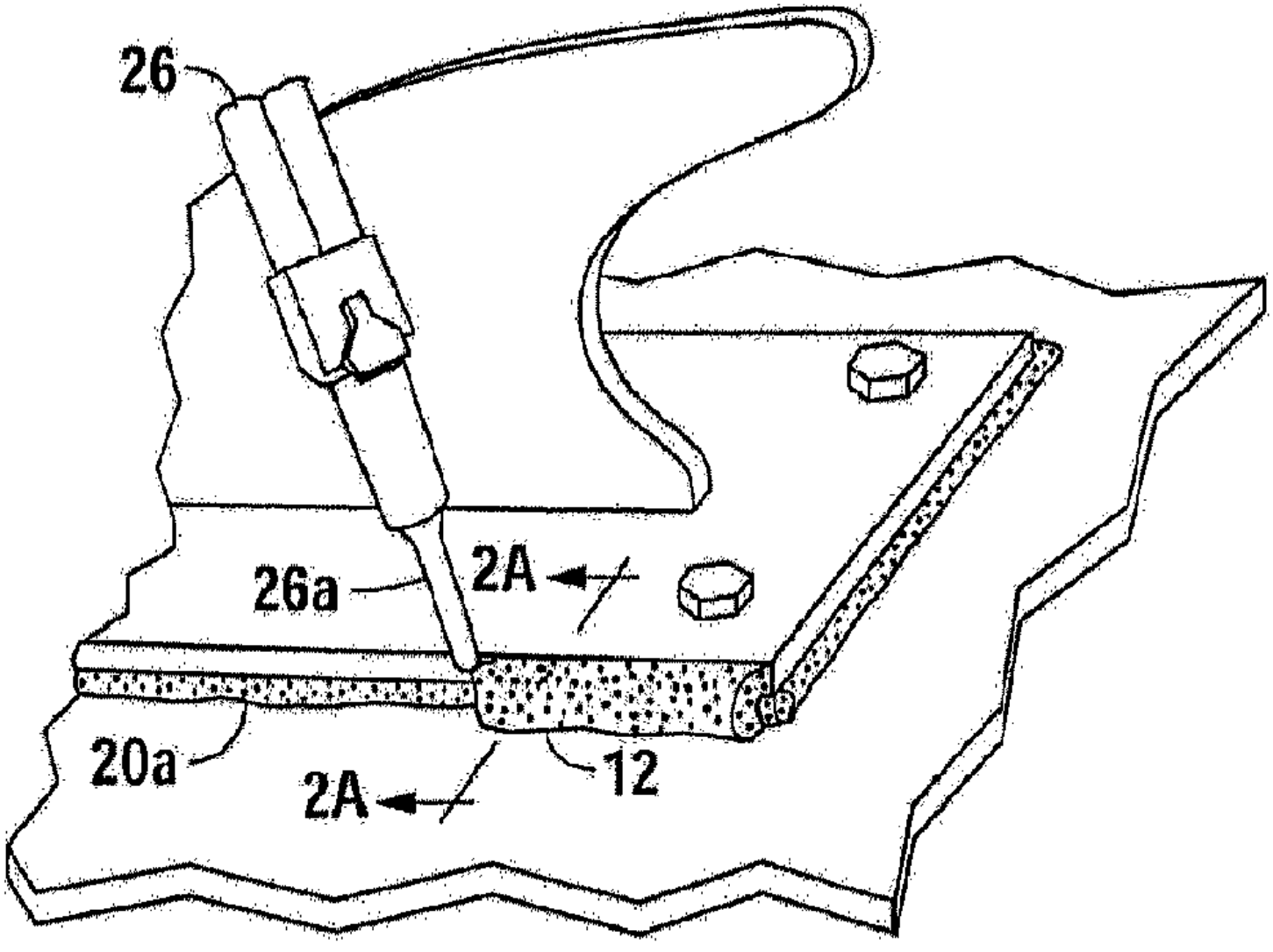


Fig. 6C


26
26a
2A
2A
20a
12