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(54) **MULTI-SIDED CULVERT**

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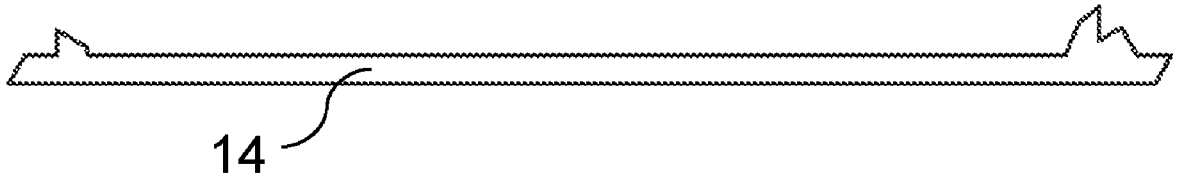
(57) **ABSTRACT**

There is provided a multi-sided culvert having a base section, a first side body, and a second side body. The first and second side bodies are engaged at the top of the culvert by a top engagement and supported by the base section. The base section engages the first side body by a first bottom engagement and the second side body by a second bottom engagement. The first part of the first bottom engagement has a first guide section and a first interlocking section, and the second part of the first bottom engagement has a second guide section and a second interlocking section. During installation the first and second guide sections guide the first and second interlocking sections into engagement, the first and second interlocking sections having tapered surfaces that, when engaged, permit upward and outward movement of the second part relative to the base.



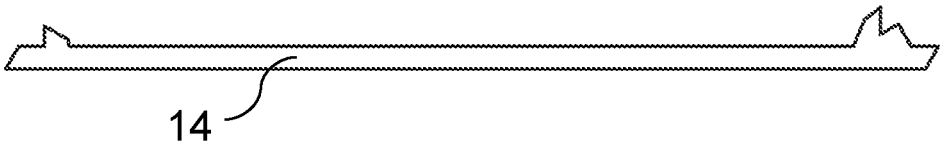


FIG. 1

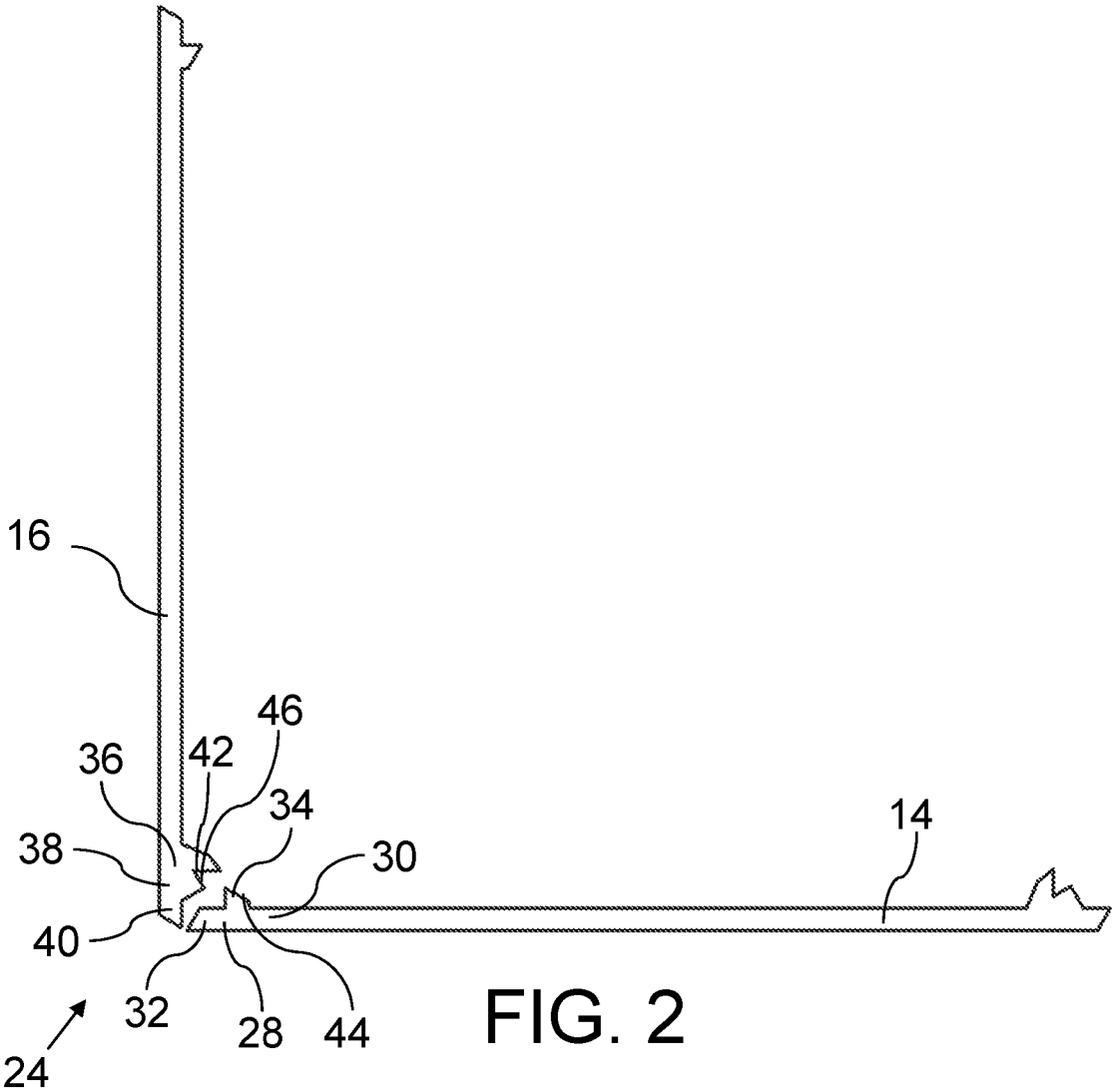


FIG. 2

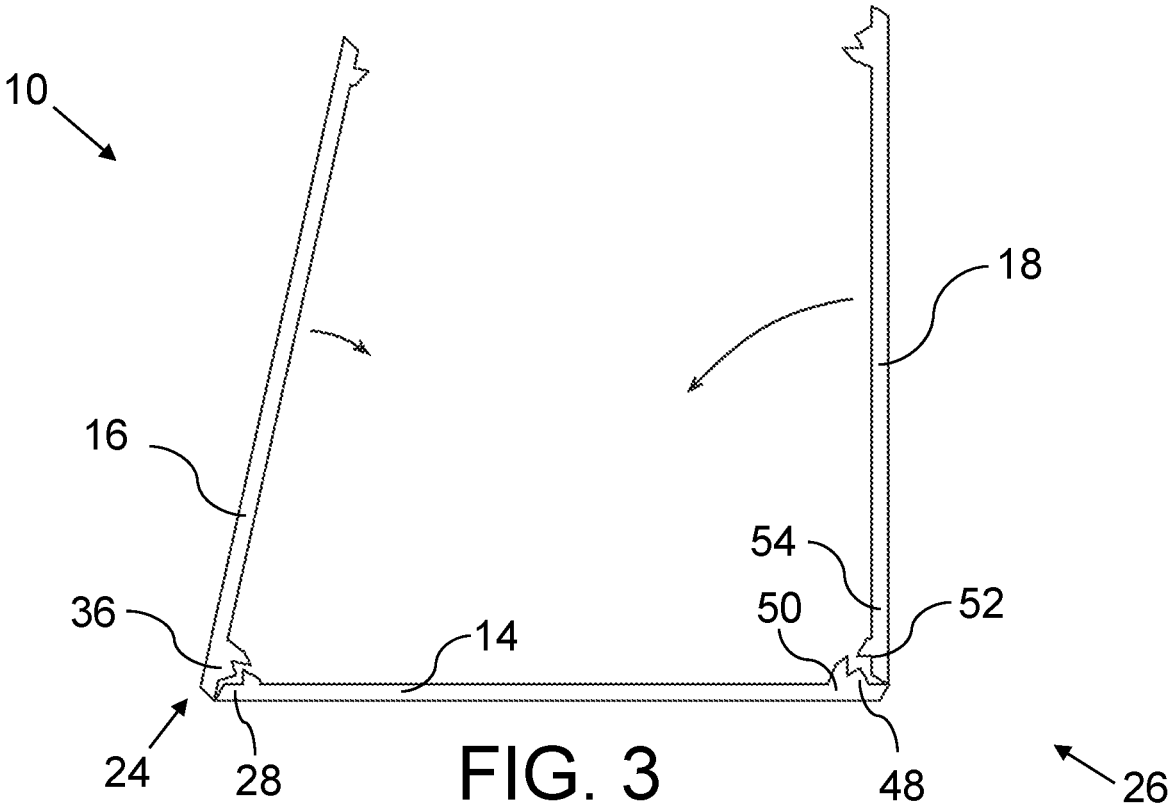


FIG. 3

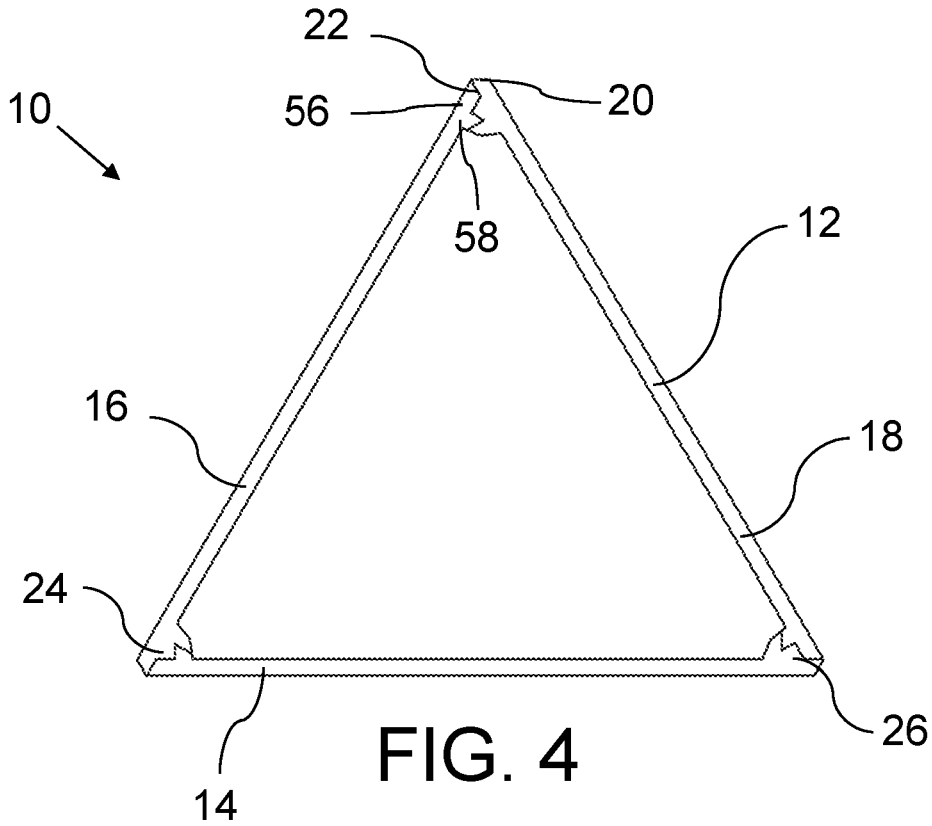


FIG. 4

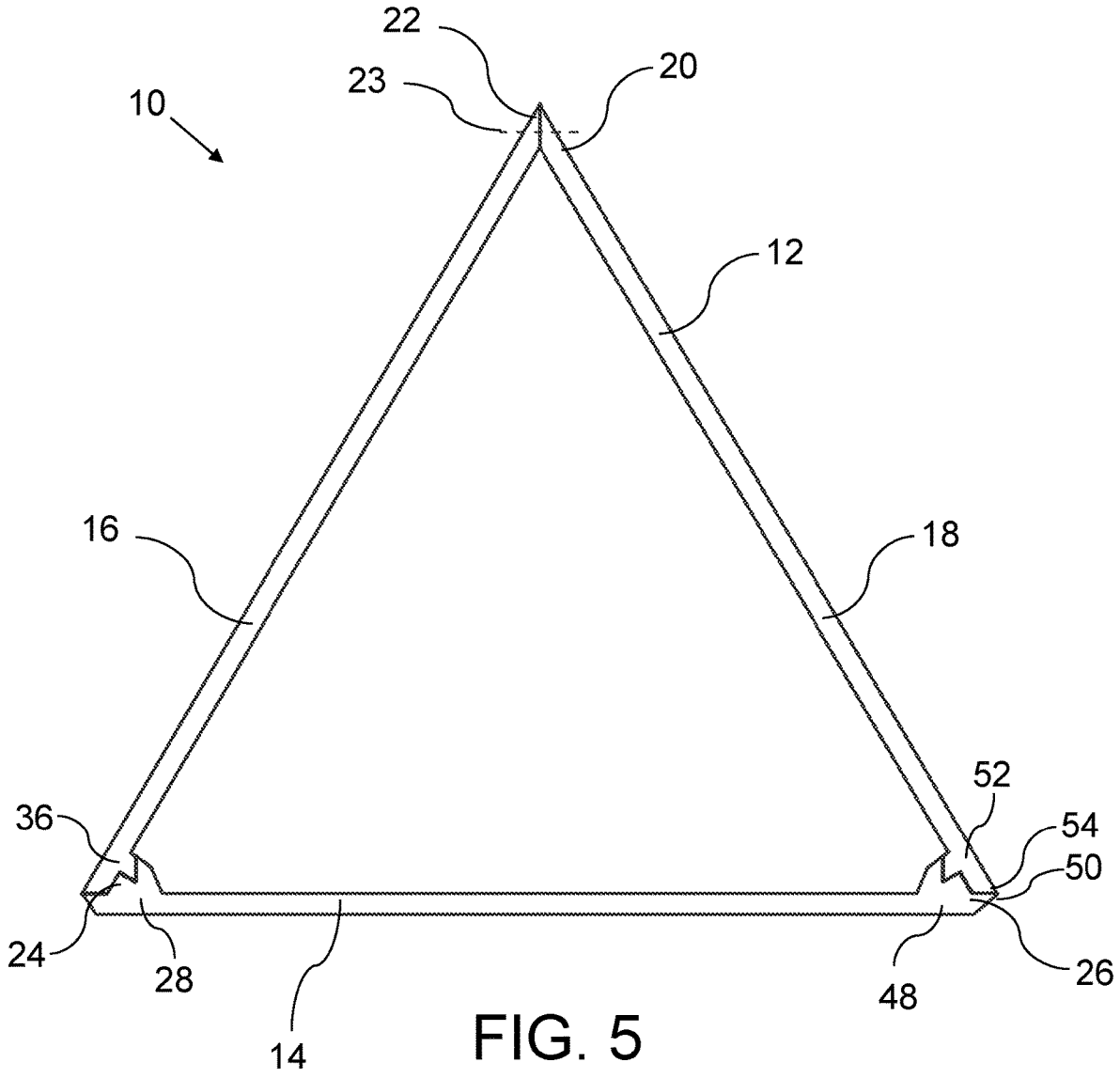


FIG. 5

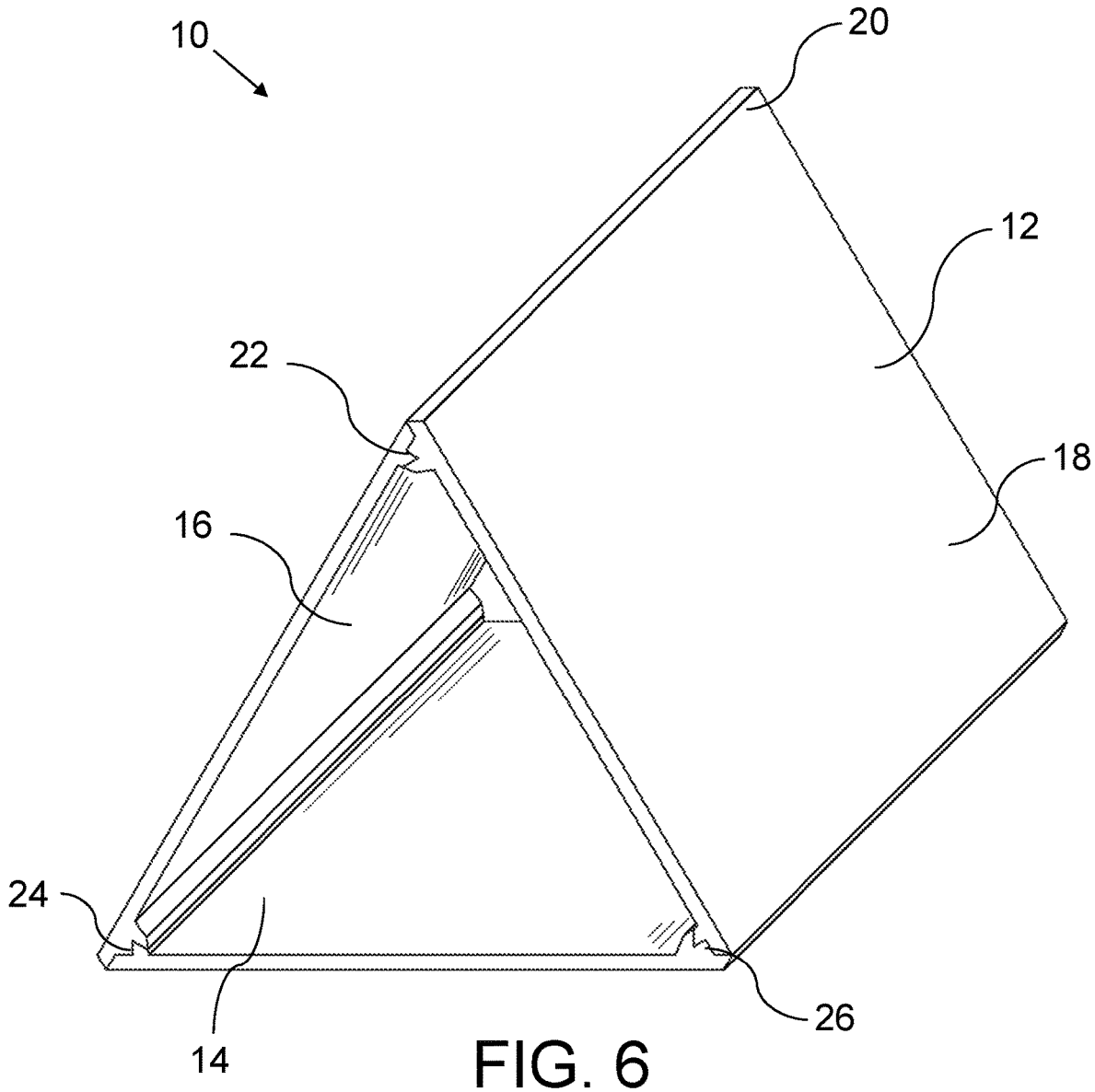


FIG. 6

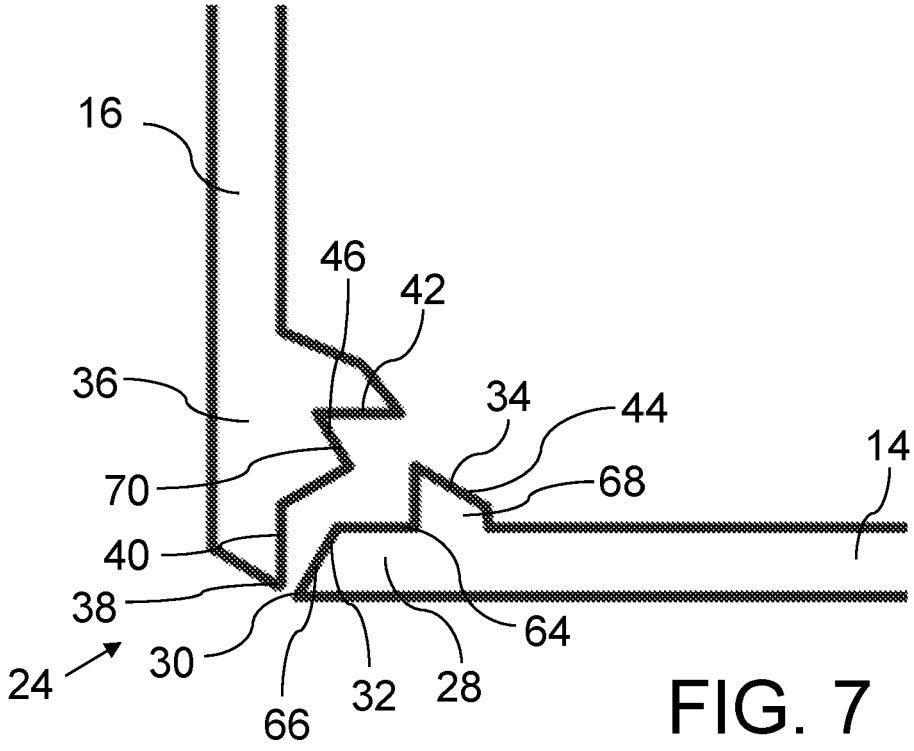

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FIG. 7

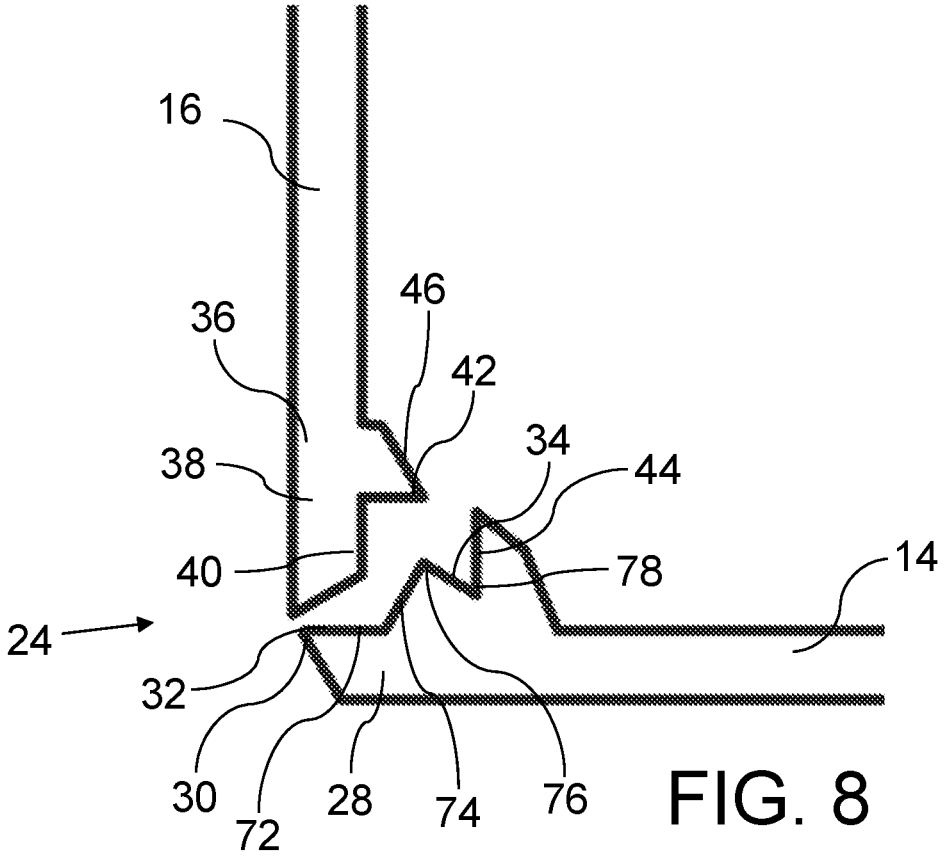
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FIG. 8

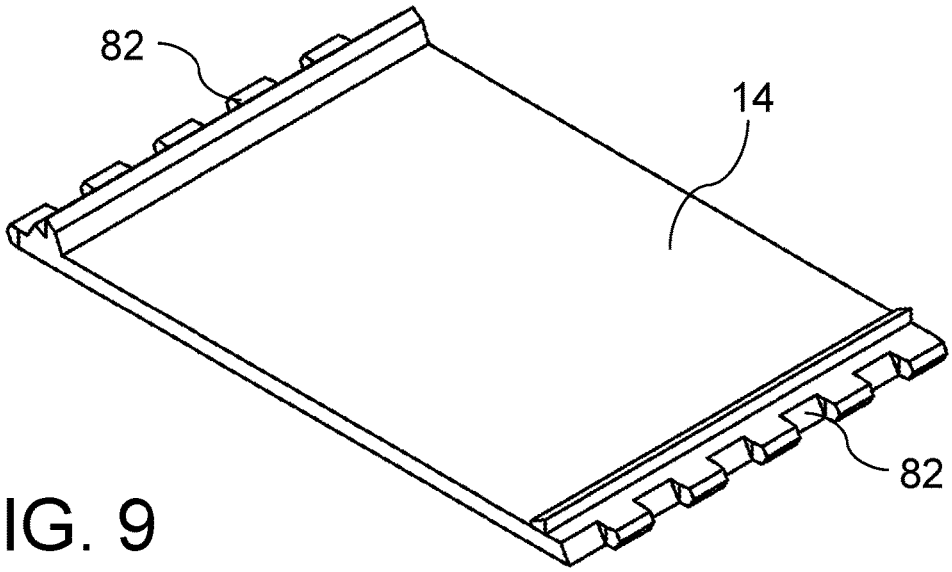

FIG. 9

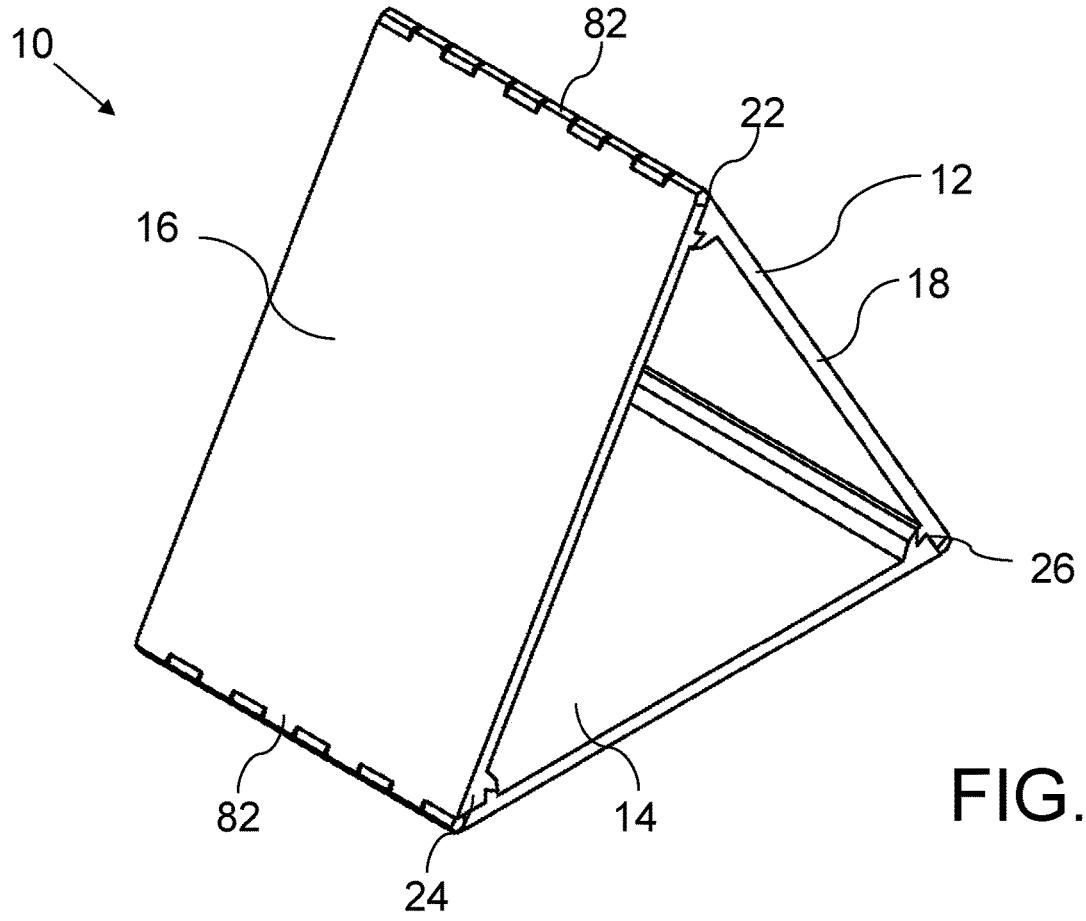

FIG. 10

MULTI-SIDED CULVERT

TECHNICAL FIELD

[0001] This relates to a three-sided culvert having a unique corner engagement.

BACKGROUND

[0002] Culverts are often used in order to either control or allow for water flow, such as under roadways and bridges. While the most common type of culvert is a round culvert, other types of culverts are also possible. Examples of other types of culverts can be found in U.S. Pat. No. 1,334,484 (Charliss) entitled "Culvert", U.S. Pat. No. 4,011,726 (Cooper, Jr. entitled "Delta Culvert" and U.S. Pat. No. 9,228,312 (Smith) entitled "Method of Building a Structure in the Presence of Water".

SUMMARY

[0003] According to an aspect, there is provided a multi-sided culvert comprising a culvert body comprising a base section, a first side body, and a second side body, the first and second side bodies being engaged at a top of the culvert body by a top engagement and being supported by the base section, the base section engaging the first side body by a first bottom engagement and the second side body by a second bottom engagement, wherein the first bottom engagement comprises a first part at a first side edge of the base, the first part having a first guide section and a first interlocking section and a second part at a first side edge of the first side, the second part having a second guide section and a second interlocking section, wherein, during installation, the first and second guide sections interact to guide the first and second interlocking sections into interlocking engagement, the first and second interlocking sections comprising tapered surfaces that, when engaged, permit upward and outward movement of the second part relative to the base.

[0004] According to another aspect, the first and second bottom engagements may be symmetric.

[0005] According to another aspect, the second bottom engagement may comprises a first part at a second side edge of the base that is shaped the same as the second part of the first bottom engagement, and a second part at a first side edge of the second side body that is shaped the same as the first part of the first bottom engagement.

[0006] According to another aspect, the top engagement may comprise a first part at a second side edge of the first side body that is shaped the same as the first part of the first bottom engagement and a second part at a second side edge of the second side body that is shaped the same as the second part of the first bottom engagement.

[0007] According to another aspect, each of the base, the first side body, and the second side body may have a common size and shape.

[0008] According to another aspect, the first guide section of the first part may comprise a flat surface adjacent to a tapered surface that descends from the flat surface toward the first side edge of the base, the first interlocking section of the first part may comprise a protrusion that extends upward from the flat surface of the first guide section, the second guide section of the second part may be complementary to the first guide section, and the second interlocking section may comprise a recess that receives the protrusion of the first interlocking section.

[0009] According to another aspect, the first guide section of the first part may comprise a flat surface adjacent to the first side edge of the base and a tapered surface that extends upward and away from the flat surface relative to the first side edge of the base, the first interlocking section of the first part may comprise a recess that is recessed from a top of the tapered surface, the second guide section of the second part may be complementary to the first guide section, and the second interlocking section may comprise a protrusion that is received by the recess of the first interlocking section.

[0010] According to another aspect, the second bottom engagement may comprise a first part at a second side edge of the base that is shaped the same as the first part of the first bottom engagement, and a second part at a first side edge of the second side body that is shaped the same as the second part of the first bottom engagement.

[0011] According to another aspect, the top engagement may comprise a first part at a second side edge of the second side body that is shaped the same as the first part of the first bottom engagement and a second part at a second side edge of the first side body that is shaped the same as the second part of the first bottom engagement.

[0012] According to another aspect, the first part and the second part of the first bottom engagement, when engaged, may define a labyrinth seal.

[0013] According to another aspect, the first part and the second part of the bottom engagement each may comprise an engagement profile that extends along a length of the first side edges of the base and the first side body.

[0014] According to an aspect, there is provided a multi-sided culvert, comprising first, second and third side bodies, each side body comprising a first end having a first part of a two-part engagement, the first part comprising a first guide section and a first interlocking section, and a second end having a second part of the two-part engagement, the second part comprising a second guide section and a second interlocking section, wherein, during installation, the first, second and third side bodies are engaged to form a three-sided culvert such that respective first and second guide sections of adjacent side bodies interact to guide the respective first and second interlocking sections into interlocking engagement, the first and second interlocking sections comprising tapered surfaces that, when engaged, permit upward and outward movement of the second part relative to the base.

[0015] According to another aspect, for each of the first, second and third side bodies the first guide section of the first part may comprise a flat surface adjacent to the first side edge of the base and a tapered surface that extends upward and away from the flat surface relative to the first side edge of the base, the first interlocking section of the first part may comprise a recess that is recessed from a top of the tapered surface, the second guide section of the second part may be complementary to the first guide section, and the second interlocking section comprises a protrusion that is received by the recess of the first interlocking section.

[0016] According to another aspect, the first end and the second end of each of the first, second and third side bodies may comprise an engagement profile that extends along a length of the first side edges of the base and the first side body.

[0017] In other aspects, the features described above may be combined together in any reasonable combination as will be recognized by those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] These and other features will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to be in any way limiting, wherein:

[0019] FIG. **1** is a front elevation view of a component of a multi-sided culvert.

[0020] FIG. **2** is a front elevation view of two components of a multi-sided culvert being assembled.

[0021] FIG. **3** is a front elevation view of a multi-sided culvert being assembled.

[0022] FIG. **4** is a front elevation view of the assembled multi-sided culvert of FIG. **3**.

[0023] FIG. **5** is a front elevation view of an assembled alternate embodiment of a multi-sided culvert.

[0024] FIG. **6** is a perspective view of an assembled multi-sided culvert.

[0025] FIG. **7** is a detail front elevation view of a connection being formed between two components.

[0026] FIG. **8** is a detail front elevation view of an alternate connection being formed between two components.

[0027] FIG. **9** is a perspective view of an alternate embodiment of a component of a multi-sided culvert.

[0028] FIG. **10** is a perspective view of an assembled multi-sided culvert having the component shown in FIG. **9**.

DETAILED DESCRIPTION

[0029] A multi-sided culvert generally identified by reference numeral **10**, will now be described with reference to FIG. **1** through **10**.

[0030] Referring to FIG. **6**, multi-sided culvert **10** has a culvert body **12** formed from three separate bodies, used as a base section **14**, a first side body **16** and a second side body **18**. It will be understood that the designation as a base, first or second body relates primarily to the function of the component. As will be discussed below, the design or shape of the bodies may be interchangeable or the same. Furthermore, while the bodies are all shown as being planar, it will be understood that some or all may have different shapes, such as a curved section to increase the volume. On the other hand, it may be preferable to provide base section **14** and possibly others with a flat surface, such as to simplify installation.

[0031] First side body **16** and second side body **18** are supported by base section **14**, which engages first side body **16** with a first bottom engagement **24**, and second side body **18** with a second bottom engagement **26**. First side body **16** and second side body **18** are engaged at a top **20** of culvert body **12** by a top engagement **22**. As shown in FIG. **6**, each of the first, second and top engagements **24**, **26** and **22** may use a similar shape to form the engagement and each of the three side bodies **14**, **16**, and **18** carry one part of a two-part connection at either end, allowing for connections to be formed at the corners when assembled, as shown in FIG. **6**. However, it will be understood that alternate engagements may be used, some of which are described below. In one example, referring to FIG. **5** and with respect to top engagement **22**, first side body **16** and second side body **18** may have flat top engagement surfaces, and use a secondary connector **23**, such as a pin connection or clamp, to form top engagement **22**.

[0032] Referring to FIG. **2**, first bottom engagement **24** is depicted as having a first part **28** at a first side edge **30** of base **14** and a second part **36** at a first side edge **38** of first side **16**, and is formed by engaging first and second parts **28** and **36**. First part **28** has a first guide section **32** and a first interlocking section **34**. Second part **36** has a second guide section **40** and a second interlocking section **42**, each of which are shown as being complementary to first guide section **32** and first interlocking section **34**, respectively. When first bottom engagement **24** is being formed, first and second guide sections **32** and **40** interact to guide first and second interlocking sections **34** and **42** into interlocking engagement, as shown in FIG. **3**. First and second interlocking sections **34** and **42** have tapered surfaces **44** and **46** that, when engaged, permit upward and outward movement of second part **36** relative to base **14**. Referring to FIGS. **7** and **8**, first bottom engagement **24** may have either arrangement of components.

[0033] The engagement described above is preferably used as the basis for the other engagements used in culvert body **12**, although it may be used in different ways. For example, as shown in FIG. **5**, first bottom engagement **24** and second bottom engagement **26** may be symmetric, with having the arrangement shown in FIG. **7**, such that second bottom engagement **26** has a first part **48** at a second side edge **50** of base **14** that is shaped the same as first part **28** of first bottom engagement **24** and a second part **52** at a first side edge **30** of second side body **18** that is shaped the same as second part **36** of first bottom engagement **24**. Alternatively, referring to FIG. **2**, second bottom engagement **26** may have a first part **48** at a second side edge **50** of base **14** that is shaped the same as second part **36** of first bottom engagement **24** and a second part **52** at a first side edge **54** of second side body **18** that is shaped the same as first part **28** of first bottom engagement **24**.

[0034] Referring to FIG. **4**, top engagement **22** may have a first part **56** at a second side edge **58** of first side body **16** that is shaped the same as first part **28** of first bottom engagement **24** and a second part **60** at a second side edge **62** of second side body **18** that is shaped the same as second part **36** of first bottom engagement **24**. As shown in FIG. **4**, when top engagement **22** is provided as described, each of base **14**, first side body **16**, and second side body **18** have a common size and shape, which may be used to simplify manufacturing and handling procedures. In another example, top engagement **22** may have a first part **56** at second side edge **62** of second side body **18** that is shaped the same as first part **28** of first bottom engagement **24** and a second part **60** at a second side edge **58** of first side body **16** that is shaped the same as second part **36** of first bottom engagement **24**. For example, first side body **16** and second side body **18** may each be symmetrical, assuming base **14** has a different engagement profile at either side edge.

[0035] Referring to FIG. **7**, in the depicted example, first guide section **32** of first part **28** has a flat surface **64** adjacent to a tapered surface **66** that descends from flat surface **64** toward first side edge **30** of base **14**, first interlocking section **34** of first part **28** has a protrusion **68** that extends upward from flat surface **64** of first guide section **32**. Second guide section **40** of second part **36** is complementary to first guide

section **32**, and second interlocking section **42** has a recess **70** that receives protrusion **68** of first interlocking section **34**. Alternatively, referring to FIG. **8**, first guide section **32** of first part **28** has a flat surface **72** adjacent to first side edge **30** of base **14** and a tapered surface **74** that extends upward and away from flat surface **72** relative to first side edge **30** of base **14**, and first interlocking section **34** of first part **28** has a recess **76** that is recessed from a top **78** of tapered surface **74**. Second guide section **40** of second part **36** is complementary to first guide section **32**, and second interlocking section **42** has a protrusion **80** that is received by recess **76** of first interlocking section **34**. When engaged, the respective engagements may act as a labyrinth seal, or a mechanical seal that provides a tortuous path to help prevent leakage, through the corners of the culvert, thus ensuring that as much water as possible is diverted through the culvert, and does not leak into the surrounding area.

[0036] The angles of the various surfaces of the first and second parts of the engagements are selected such that the joints remain engaged and are biased toward engagement, but also permit some expansion when pressure is applied from within. For example, in the winter, water may freeze within culvert **12**. The depicted engagements permit some movement to allow the freezing water to expand without damaging the culvert. As can be seen, there are surfaces at either end of the various bodies that are generally perpendicular to the respective body, or in other words, which are generally tangential to an arc that would be followed if the body were to pivot about its other end. These surfaces allow each body to slide outward in response to a force applied to the inner surface of culvert **12**, while still being urged by gravity and the slope of that and other surfaces toward engagement.

[0037] The assembly of multi-sided culvert **10** will now be described. Referring to FIG. **1**, a base **14**, is placed in an installation location. The installation location may be prepared by levelling or packing a material, such as road crush or gravel. Referring to FIGS. **2** and **3**, first and second side bodies **16** and **18** are then guided into place. As bodies **14**, **16** and **18** may be quite heavy, they are preferably outfitted with lifting rings or apertures (not shown), such that they can be manipulated by a lifting crane, hoist, or other device. If bodies **14**, **16** and **18** are cast from concrete, lifting cables or rings may be embedded as part of the casting process. As shown with first engagement **24**, where base body **14** has a convex guide surface **32**, it may be easier to slide surface toward the edge of base body **14**, such that second guide section engages first guide section **32** and causes first body **16** to pivot and form first engagement **24**. As shown with second engagement **26**, where base body **14** has a concave shape and second body **18** has a convex shape, the edge of second body **18** may be placed directly on first part **48** of base body **14**, and the respective shapes will allow second engagement **26** to be engaged as second body **18** pivots about the bottom edge. It will be understood that the order of installation of first side body **16** and second side body **18** will depend on the type of top engagement **22** provided. For example, each side may be lowered simultaneously, or one may be lowered first and the second installed afterwards. Alternatively, it may be necessary to suspend one or both of first and second bodies **16** and **18** in a partially open position, and move them to a fully installed position either simultaneously, or in a coordinated manner, to ensure the respective engagement profiles are properly mated. Once the three bodies **14**, **16**, and **18** have been installed, the tapered surfaces of the connections will permit relative movement of the side panels while maintaining engagement, allowing for the multi-sided culvert to expand and contract, such as in response to freezing of water within the culvert.

[0038] Referring to FIG. **9** and FIG. **10**, multi-sided culvert **10** may optionally have an engaging profile **82** along the edge of each of the side bodies **14**, **16**, and **18**. As depicted, engaging profile **82** is provided along the length of the engagements **22**, **24**, and **26**, and has alternating protrusions and recesses that engage during installation of multi-sided culvert **10**. Engaging profile **82** may aid in the installation process by aligning the side bodies for forming connections. As well, engaging profile **82** may serve to prevent shifting of the side bodies along the engagements **22**, **24**, or **26**. It will be understood that engaging profile **82** may take other forms that engage the respective edges and limit sliding movement of the side bodies, such as having different numbers of protrusions and recesses, having shaped profiles, or having a series of notches and recesses.

[0039] Base **14**, side body **16**, and side body **18** may be formed from any suitable material, as will be understood by those skilled in the art. For example, the three panels may be cast from cement, concrete, or any other material suitable for use as a culvert. In the configuration shown in FIG. **3**, first side body **16** and second side body **18** have a top engagement **22** that also forms an interlocking connection. In other embodiments, such as the one in FIG. **5**, after first side body **16** and second side body **18** are installed, top engagement **22** is formed with an additional connector, such as a bolt or clamp, although this is preferably a loose connection that still allows for some expansion, for the reasons as discussed above.

[0040] In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the elements is present, unless the context clearly requires that there be one and only one of the elements.

[0041] The scope of the following claims should not be limited by the preferred embodiments set forth in the examples above and in the drawings, but should be given the broadest interpretation consistent with the description as a whole.

What is claimed is:

1. A multi-sided culvert comprising:

a culvert body comprising a base section, a first side body, and a second side body, the first and second side bodies being engaged at a top of the culvert body by a top engagement and being supported by the base section, the base section engaging the first side body by a first bottom engagement and the second side body by a second bottom engagement, wherein the first bottom engagement comprises:

a first part at a first side edge of the base, the first part having a first guide section and a first interlocking section; and

a second part at a first side edge of the first side, the second part having a second guide section and a second interlocking section, wherein, during installation, the first and second guide sections interact to guide the first and second interlocking sections into interlocking engagement, the first and second inter-

locking sections comprising tapered surfaces that, when engaged, permit upward and outward movement of the second part relative to the base.

2. The multi-sided culvert of claim **1**, wherein the first and second bottom engagements are symmetric.

3. The multi-sided culvert of claim **1**, wherein the second bottom engagement comprises:

a first part at a second side edge of the base that is shaped the same as the second part of the first bottom engagement; and

a second part at a first side edge of the second side body that is shaped the same as the first part of the first bottom engagement.

4. The multi-sided culvert of claim **3**, wherein the top engagement comprises:

a first part at a second side edge of the first side body that is shaped the same as the first part of the first bottom engagement; and

a second part at a second side edge of the second side body that is shaped the same as the second part of the first bottom engagement.

5. The multi-sided culvert of claim **1**, wherein each of the base, the first side body, and the second side body have a common size and shape.

6. The multi-sided culvert of claim **1**, wherein:

the first guide section of the first part comprises a flat surface adjacent to a tapered surface that descends from the flat surface toward the first side edge of the base;

the first interlocking section of the first part comprises a protrusion that extends upward from the flat surface of the first guide section;

the second guide section of the second part is complementary to the first guide section; and

the second interlocking section comprises a recess that receives the protrusion of the first interlocking section.

7. The multi-sided culvert of claim **1**, wherein:

the first guide section of the first part comprises a flat surface adjacent to the first side edge of the base and a tapered surface that extends upward and away from the flat surface relative to the first side edge of the base;

the first interlocking section of the first part comprises a recess that is recessed from a top of the tapered surface;

the second guide section of the second part is complementary to the first guide section; and

the second interlocking section comprises a protrusion that is received by the recess of the first interlocking section.

8. The multi-sided culvert of claim **7**, wherein the second bottom engagement comprises:

a first part at a second side edge of the base that is shaped the same as the first part of the first bottom engagement; and

a second part at a first side edge of the second side body that is shaped the same as the second part of the first bottom engagement.

9. The multi-sided culvert of claim **8**, wherein the top engagement comprises:

a first part at a second side edge of the second side body that is shaped the same as the first part of the first bottom engagement; and

a second part at a second side edge of the first side body that is shaped the same as the second part of the first bottom engagement.

10. The multi-sided culvert of claim **1**, wherein the first part and the second part of the first bottom engagement, when engaged, define a labyrinth seal.

11. The multi-sided culvert of claim **1**, wherein the first part and the second part of the bottom engagement each comprise an engagement profile that extends along a length of the first side edges of the base and the first side body.

12. A multi-sided culvert, comprising:

first, second and third side bodies, each side body comprising:

a first end having a first part of a two-part engagement, the first part comprising a first guide section and a first interlocking section; and

a second end having a second part of the two-part engagement, the second part comprising a second guide section and a second interlocking section;

wherein, during installation, the first, second and third side bodies are engaged to form a three-sided culvert such that respective first and second guide sections of adjacent side bodies interact to guide the respective first and second interlocking sections into interlocking engagement, the first and second interlocking sections comprising tapered surfaces that, when engaged, permit upward and outward movement of the second part relative to the base.

13. The multi-sided culvert of claim **12**, wherein, for each of the first, second and third side bodies:

the first guide section of the first part comprises a flat surface adjacent to the first side edge of the base and a tapered surface that extends upward and away from the flat surface relative to the first side edge of the base;

the first interlocking section of the first part comprises a recess that is recessed from a top of the tapered surface;

the second guide section of the second part is complementary to the first guide section; and

the second interlocking section comprises a protrusion that is received by the recess of the first interlocking section.

14. The multi-sided culvert of claim **12**, wherein the first end and the second end of each of the first, second and third side bodies comprise an engagement profile that extends along a length of the first side edges of the base and the first side body.

* * * * *