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Dielectric foreign object debris protection cover with integral washer

Abstract

A foreign object debris (FOD) protection cover includes a dielectric barrier assembly having an integrated washer. The dielectric barrier assembly includes a base and one or more barrier walls integrally formed with the base. The washer is integrally formed in the base and includes a hole extending radially about a center axis of the washer. The base and the barrier wall of the dielectric barrier assembly are formed from a dielectric material, and the washer is formed from an electrically conductive material.

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Background/Summary

BACKGROUND

(1) Embodiments of the present disclosure relate generally to power distribution networks, and more particularly, to a foreign object debris protection cover.

(2) The design approaches for foreign object debris (FOD) fault prevention and protection within electrical products are a combination of physical spacing and insulation materials added. As

voltages increase and spacing constraints are increased the addition of secondary insulation materials or parts takes up room and has risk of not being used correctly in assembly or re-assembly. Power distribution equipment with large gauge wires and bus bars requires the bolted joints be properly assembled and easily accessed for installation, which is complicated if there are requirements to add additional pieces of installation or dielectric barriers in the assembly.

BRIEF DESCRIPTION

- (3) According to a non-limiting embodiment, a foreign object debris (FOD) protection cover comprises a dielectric barrier assembly and one or more integrated washers. The dielectric barrier assembly comprises an upper surface, a lower surface, and one or more upper barrier walls. The upper surface is located opposite the lower surface opposite the upper surface such that each of the upper and lower surfaces extend along a first axis and a second axis orthogonal to the first axis to define a base dielectric barrier assembly. The upper barrier walls are integrally formed with the base. Each of the upper barrier walls includes an upper-surface end extending from the base in a first direction along a third axis that is orthogonal to the first and second axes to a top end located above the lower surface and the upper surface. Each washer extends radially about a center axis and is integrally formed in the base such that it is fixed thereto. Each washer includes a hole that is formed therethrough the washer and that extends radially from the center axis. Each washer includes an inner surface and an outer surface located opposite the inner surface and separated therefrom by the washer. The inner surface is directly exposed to the hole and the outer surface directly contacting the base and integrally formed therewith. The base and each barrier wall comprises a dielectric material, and the each washer comprises an electrically conductive material.
- (4) Additionally or alternatively, in this or other embodiments the at least one washer includes an inner surface and an outer surface located opposite the inner surface and is separated therefrom by the at least one washer, the inner surface directly exposed to the hole and the outer surface directly contacting the base and integrally formed therewith.
- (5) Additionally or alternatively, in this or other embodiments the at least one upper barrier wall extends along a full length of the base.
- (6) Additionally or alternatively, in this or other embodiments the at least one upper barrier wall includes a plurality of upper barrier walls. A first upper barrier wall and a second upper barrier wall among the plurality of upper barrier walls define an upper access opening to provide access to the hole.
- (7) Additionally or alternatively, in this or other embodiments a first upper barrier wall and a second upper barrier wall among the plurality of upper barrier walls are integrally formed together to define an upper barrier corner.
- (8) Additionally or alternatively, in this or other embodiments at least one lower barrier wall is integrally formed with the base. The at least one lower barrier wall includes a lower-surface base end extending along the third axis in a second direction opposite the first direction from the base to a lower end located below the upper surface and the lower surface.
- (9) Additionally or alternatively, in this or other embodiments the at least one lower barrier wall extends along the full length of the base.
- (10) Additionally or alternatively, in this or other embodiments the at least one lower barrier wall includes a plurality of lower barrier walls. A first lower barrier wall and a second lower barrier wall among the plurality of lower barrier walls defines a lower access opening therebetween to provide access to the hole.
- (11) Additionally or alternatively, in this or other embodiments a first lower barrier wall and a second lower barrier wall among the plurality of lower barrier walls are integrally formed together to define a lower barrier corner.
- (12) Additionally or alternatively, in this or other embodiments the at least one barrier wall is configured to block a line-of-sight to one or more electrical conductors located adjacent to the dielectric barrier assembly.

(13) According to another non-limiting embodiment, a power distribution assembly comprises an electrical conductor and a foreign object debris (FOD) protection cover including a dielectric barrier assembly having at least one integrated washer. The electrical conductor includes an opening configured to conduct electrical current therethrough. The dielectric barrier assembly comprises an upper surface and a lower surface opposite the upper surface. The upper and lower surfaces extend along a first axis and a second axis orthogonal to the first axis to define a base that is disposed on the electrical conductor. At least one upper barrier wall is integrally formed with the base. The at least one upper barrier wall includes an upper-surface end extending from the base in a first direction along a third axis that is orthogonal to the first and second axes to a top end located above the lower surface and the upper surface. The at least one washer is integrally formed in the base such that the washer is fixed thereto. The at least one washer contacts the electrical conductor and includes a hole that extends radially from a center axis and that is aligned with respect to the opening of the electrical conductor. A fastener extends through the hole and the opening, and is configured to couple the dielectric barrier assembly together with the electrical conductor.

(14) Additionally or alternatively, in this or other embodiments a second electrical conductor is configured to conduct electrical current therethrough and is disposed on the first electrical conductor to establish physical contact therewith. The second electrical conductor includes a second opening that is vertically aligned with the opening of the first conductor.

(15) Additionally or alternatively, in this or other embodiments an electrically conductive path is established from the first electrical conductor to the second electrical conductor.

(16) According to yet another non-limiting embodiment, a power distribution network comprises a first power distribution assembly and a second power distribution assembly located adjacent the first power distribution assembly. The first power distribution assembly comprises a first electrical conductor configured to conduct electrical current therethrough and a first foreign object debris (FOD) protection cover first that includes first dielectric barrier assembly. The first dielectric barrier assembly comprises a first base, at least one first upper barrier wall integrally formed with the first base, and a first washer extending radially about a first center axis and integrally formed in the first base such that the first washer is fixed thereto. The first washer includes a first hole formed therethrough and extending radially from the first center axis. The second power distribution assembly comprises a second electrical conductor configured to conduct electrical current therethrough, and a second foreign object debris (FOD) protection cover that includes a second dielectric barrier assembly. The second dielectric barrier assembly is located a distance away from the first dielectric barrier assembly to define a line-of-sight between the first and second dielectric barrier assemblies. The second dielectric barrier assembly comprises a second base, at least one second upper barrier wall integrally formed with the second base, and a second washer extending radially about a second center axis and integrally formed in the second base such that the second washer is fixed thereto. The second washer includes a second hole formed therethrough and extending radially from the second center axis.

(17) Additionally or alternatively, in this or other embodiments the at least one second upper barrier wall extends into the line-of-sight and is located between the first base of the first dielectric barrier assembly and the second base of the second dielectric barrier assembly.

(18) Additionally or alternatively, in this or other embodiments each the first and second power distribution assemblies further comprises an upper surface and a lower surface opposite the upper surface. The upper and lower surfaces extend along a first axis and a second axis orthogonal to the first axis to define a base that is disposed on the first and electrical conductors, respectively.

(19) Additionally or alternatively, in this or other embodiments each of the at least one first upper barrier wall and the at least one second upper barrier wall further includes an upper-surface end. The upper surface end extends from the first and second base, respectively, in a first direction along a third axis that is orthogonal to the first and second axes to a top end located above the lower surface and the upper surface.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

- (1) The following descriptions should not be considered limiting in any way. With reference to the accompanying drawings, like elements are numbered alike:
- (2) FIG. 1 is a perspective view of a dielectric foreign object debris object protection cover with an integral electrically conductive washer according to a non-limiting embodiment of the present disclosure;
- (3) FIG. 2 is a perspective view of the dielectric foreign object debris object protection cover with an integral electrically conductive washer shown in FIG. 1 including a fastener disposed therein according to a non-limiting embodiment of the present disclosure;
- (4) FIG. 3 is a top view of the dielectric foreign object debris object protection cover with an integral electrically conductive washer shown in FIG. 2 according to a non-limiting embodiment of the present disclosure;
- (5) FIG. 4 is a cross-sectional view of the dielectric foreign object debris object protection cover with an integral electrically conductive washer shown in FIG. 3 taken along line A-A according to a non-limiting embodiment of the present disclosure;
- (6) FIG. 5 is a side view of a power distribution assembly including a dielectric foreign object debris object protection cover with an integral electrically conductive washer according to a non-limiting embodiment of the present disclosure; and
- (7) FIG. 6 is a perspective view of a power distribution assembly including a plurality of dielectric foreign object debris object protection covers including an integral electrically conductive washer according to a non-limiting embodiment of the present disclosure.

DETAILED DESCRIPTION

- (8) A detailed description of one or more embodiments of the disclosed apparatus and method are presented herein by way of exemplification and not limitation with reference to the Figures.
- (9) Referring to FIGS. 1-4, a foreign object debris (FOD) protection cover **100** is illustrated according to a non-limiting embodiment. The FOD protection cover **100** includes a dielectric barrier assembly **102** and a metallic (load bearing) washer **200** integrally formed (retained) with the dielectric barrier assembly **102**. Although the FOD protection cover **100** is illustrated as having a single washer **200**, it should be appreciated that the FOD protection cover **100** can include two or more washers **200** without departing from the scope of the invention.
- (10) The dielectric barrier assembly **102** includes a base **104** and one or more upper barrier walls **106**. Although two upper barrier walls **106** are illustrated, the dielectric barrier assembly **102** can include more or less upper barrier walls **106** without departing from the invention. The base **104** and each upper barrier wall **106** are formed from a dielectric material. The dielectric material can be any electrically non-conductive material or electrically isolating material. In one or more non-limiting embodiments, the dielectric material includes various plastics, polymers, or electrically non-conductive ceramics.
- (11) The base **104** has an upper surface **108** and a lower surface **110** opposite the upper surface **108**. The base **104** extends along a first axis (e.g., an X-axis) to define a first side (e.g., side **111**) of the base **104** and a second axis (e.g., a Y-axis) orthogonal to the first axis to define a second side of the base **104**.
- (12) Each upper barrier wall **106** is integrally formed with the base **104**. In one or more non-limiting embodiments, the base **104** and the upper barrier walls **106** could be formed using various additive manufacturing techniques such as, for example, three-dimensional (3D) printing. In this manner, the base **104** and upper barrier walls **106** can be seamlessly and integrally formed together with one another.
- (13) Each upper barrier wall **106** includes an upper-surface end **112** and a top end **114**. The upper-

surface end **112** extends from the base **104** in a first direction along a third axis (e.g., a Z-axis) that is orthogonal to the first and second axes to the top end **114**, which is located above the lower surface **110** and the upper surface **108**. In one or more non-limiting embodiments, one or more of the upper barrier walls **106** extends along the entire side (e.g., a full length) of the base **104**.

(14) The washer **200** is integrally formed in the base **104** and is fixed thereto. As described herein although one washer **200** is shown, it should be appreciated that a plurality of washers **200** can be formed in the base **104** and spaced apart from one another by a portion of the base **104**. In one or more non-limiting embodiments, the base **104** and the washer **200** are formed using various additive manufacturing techniques such as, for example, three-dimensional (3D) printing. In this manner, the base **104** and washer **200** can be seamlessly and integrally formed together with one another.

(15) The washer **200** extends radially about a center axis (C-C) and includes a hole **202** formed therethrough that extends radially from the center axis (C-C). Although the hole **202** is illustrated as having a circular profile with a circumference, it should be appreciated that the hole **202** can have any shape or profile without departing from the scope of the invention.

(16) The washer **200** can be formed from various materials including, but not limited to, an electrically conductive material. The electrically conductive material can include, but is not limited to, steel, brass, aluminum, and copper. The washer **200** includes a top surface **204** and bottom surface **210** that extends between an inner edge **206** and an outer edge **208** opposite the inner edge **206**. In one or more non-limiting embodiments, the outer edge **208**, top surface **204** and/or bottom surface **210** directly contacts the base **104** and is integrally formed therewith.

(17) As illustrated in the non-limiting embodiment illustrated in FIG. 1, for example, the FOD protection cover **100** can include a dielectric barrier assembly **102** with a plurality of upper barrier walls **106** that define one or more upper access openings **116**. The upper access opening **116** provides access to the internal area of the FOD protection cover **100**. In this manner, a maintenance technician can access components located within the internal area and/or a fastener **150** that is disposed in the hole **202**. In one or more non-limiting embodiments, a first upper barrier wall **106** and a second upper barrier wall **106** are integrally formed together to define an upper barrier corner **107**.

(18) As illustrated in the non-limiting embodiment illustrated in FIG. 1, for example, the FOD protection cover **100** can further include one or more lower barrier walls **118** integrally formed with the base **104**. Each lower barrier wall **118** is integrally formed with the base **104**. In one or more non-limiting embodiments, the base **104** and the upper barrier walls **118** could be formed using various additive manufacturing techniques such as, for example, three-dimensional (3D) printing. In this manner, the base **104** and lower barrier walls **118** can be seamlessly and integrally formed together with one another.

(19) Each lower barrier wall **118** includes a lower-surface end **120** and a lower end **122**. The lower-surface end **120** extends from the base **104** in a second direction (opposite the direction of the upper-surface walls **106**) along the third axis (e.g., a Z-axis) to the lower end **122**, which is located below the upper surface **108** and the lower surface **110**. In one or more non-limiting embodiments, one or more of the lower barrier walls **106** extends along the entire side (e.g., a full length) of the base **104**.

(20) As illustrated in the non-limiting embodiment illustrated in FIG. 1, for example, the dielectric barrier assembly **102** can include a plurality of lower barrier walls **118** that define one or more lower access openings **124**. The lower access opening **124** provides access to a lower internal area of the FOD protection cover **100**. In this manner, a maintenance technician can access components located within the lower internal area and/or the fastener **150** that is disposed in the hole **202**.

(21) Although FIG. 1 shows a first lower barrier wall **118** separate from a second lower barrier wall **118**, it should be appreciated that first and second barrier walls **118** can be integrally formed together to define a lower barrier corner

(22) With continued reference to FIG. 1 along with additional reference to FIG. 2, the washer **200** is configured to receive a fastener **150** having a portion that extends through the hole **202**. The fastener **150** can include, but is not limited to, a screw, a bolt, a pin. The fastener **150** includes a body **152** (see FIG. 1) extending from a lower fastener end **154** to an upper fastener end **156** see FIG. 1). A fastener head **158** is formed on the upper fastener end **156** and extends laterally therefrom. Accordingly, the fastener can be disposed through the hole **202** such that a lower surface **160** of the fastener head **158** sits on the washer **200**. In one or more non-limiting embodiment, the lower surface **160** directly contacts the washer **200**. In other embodiments, an additional washer (e.g. a locking washer or a spring washer) **162** can be disposed between the fastener head **158** and the washer **200**.

(23) In one or more non-limiting embodiments, one or more of the upper barrier walls **106** extends above the fastener head **158**. In this manner, one or more of the upper barrier walls **106** can prevent a foreign object from falling into internal area of the FOD protection cover **100** and contacting the fastener **150**. The upper barrier walls **106** can therefore prevent an electrically short from occurring when the foreign object and the fastener **150** are formed from an electrically conductive material and the fastener **150** is in contact with an electrical conductor such as for example, a bus bar or electrically conductive wire.

(24) In one or more non-limiting embodiments, one or more of the lower barrier walls **118** extend below the lower fastener end **154**. In this manner, one or more of the lower barrier walls **118** can prevent a foreign object from entering into the internal area of the FOD protection cover **100** and contacting the fastener **150**. The lower barrier walls **118** can therefore prevent an electrical short from occurring when a foreign object and the fastener **150** are formed from an electrically conductive material and the fastener **150** is in contact with an electrical conductor such as for example, a bus bar or electrically conductive wire.

(25) Turning now to FIG. 5, a power distribution assembly **500** is illustrated according to a non-limiting embodiment. The power distribution assembly **500** includes a FOD protection cover **100** with a dielectric barrier assembly **102** configured to cover more electrical conductors **502** and **504**. The dielectric barrier assembly **102** is constructed according to the dielectric barrier assembly **102** described above. Therefore, details of the dielectric barrier assembly **102** will not be repeated for the sake of brevity.

(26) The electrical conductors **502** and **504** can include, but are not limited to, a bus bar, an electrical wire, an electrical cable, or any other electrical component configured to conduct electrical current. Although two electrical conductors **502** and **504** are illustrated, it should be appreciated that more or less electrical conductors can be included in the **500** without departing from the scope of the invention.

(27) The first electrical conductor includes a first opening that is aligned with the hole **202** of the washer **200** and is configured to receive the body **152** of the fastener **150**. The second electrical conductor **504** is disposed on the first electrical conductor **502** and establishes physical contact therewith. In this manner, an electrically conductive path is established from the first electrical conductor to the second electrical conductor. The second electrical conductor **504** includes a second opening that is vertically aligned with the first opening of the first conductor and the washer hole **202** to receive the body **152** that is fitted through the washer hole **202**. Accordingly, the fastener **150** extends through the washer hole **202**, the first electrical conductor opening, and the second electrical conductor opening to couple the dielectric barrier assembly **102** together with the first and second electrical conductors **502** and **504**.

(28) As described herein, one or more of the upper barrier walls **106** extends above the fastener head **158** to prevent foreign objects from falling into internal area of the FOD protection cover **100** and contacting the fastener **150**. Similarly, one or more of the lower barrier walls **118** extend below the lower fastener end **154** and may also cover the second electrical conductor **504** and/or the first electrical conductor **502**. In this manner, one or more of the lower barrier walls **118** can prevent

accidental contact with an exposed live, hot, or active portion of the second electrical conductor **504** and/or the first electrical conductor **502**.

(29) Turning now to FIG. **6**, a power distribution network **600** is illustrated according to a non-limiting embodiment. The power distribution network **600** includes a first power distribution assembly **500a** and a second power distribution assembly **500b**. The first power distribution assembly **500a** includes a first FOD protection cover **100a** and the second power distribution assembly **500b** includes a second FOD protection cover **100b**. The first FOD protection cover **100a** includes a first dielectric barrier assembly **102a** with a first integrated washer and the second FOD protection cover **100b** includes a second dielectric barrier assembly **102b** with a second integrated washer. The first and second power distribution assemblies **500a** and **500b** are constructed similarly to the power distribution assembly **500** shown in FIG. **5** described above. Likewise, the first and second FOD protection covers **100a** and **100b** are constructed similar to the FOD protection cover **100** shown in FIGS. **1-5** described above. Therefore, details of the first and second FOD protection covers **100a** and **100b** will not be repeated for the sake of brevity.

(30) According to a non-limiting embodiment, the first power distribution assembly **500a** is located a distance away from the second power distribution assembly **500b**. Accordingly, a line-of-sight **602** is established between the first and second power distribution assemblies **500a** and **500b**. As shown in FIG. **6**, at least one of the upper barrier walls **106b** included with the second FOD protection **100b** extends into the line-of-sight **602** and is located between the base **104a** of the first FOD protection **100a** (i.e., the first dielectric barrier assembly) and the base **104b** of the second FOD protection **100b** (i.e., the second dielectric barrier assembly). The power distribution network **600** provides an advantage in that if a foreign object falls on top of the power distribution network **600**, the upper barrier wall **106b** of the second FOD protection **100b** can prevent the foreign object physically contacting both the first fastener **150a** and the second **150a**, thereby preventing a short circuit between the first and second power distribution assemblies **500a** and **500b**.

(31) The term “about” is intended to include the degree of error associated with measurement of the particular quantity based upon the equipment available at the time of filing the application.

(32) The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the present disclosure. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises” and/or “comprising,” when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, element components, and/or groups thereof.

(33) While the present disclosure has been described with reference to an exemplary embodiment or embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the present disclosure. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from the essential scope thereof. Therefore, it is intended that the present disclosure not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out this present disclosure, but that the present disclosure will include all embodiments falling within the scope of the claims.

Claims

1. A foreign object debris (FOD) protection cover comprising: a dielectric barrier assembly comprising: an upper surface and a lower surface opposite the upper surface, the upper and lower surfaces extending along a first axis and a second axis orthogonal to the first axis to define a base; and at least one upper barrier wall integrally formed and seamless with the base, the at least one upper barrier wall including an upper-surface end extending from the base in a first direction along

a third axis that is orthogonal to the first and second axes to a top end located above the lower surface and the upper surface; at least one lower barrier wall integrally formed and seamless with the base, the at least one lower barrier wall including a lower-surface base end extending along the third axis in a second direction opposite the first direction from the base to a lower end located below the upper surface and the lower surface; and at least one washer extending radially about a center axis and integrally formed and seamless in the base such that the washer is fixed thereto, the at least one washer including a hole formed therethrough and extending radially from the center axis, wherein the base, the at least one upper barrier wall, and the at least one lower barrier wall each comprises a dielectric material and the at least one washer comprises an electrically conductive material.

2. The FOD protection cover of claim 1, wherein the at least one washer including an inner surface and an outer surface located opposite the inner surface and separated therefrom by the at least one washer, the inner surface directly exposed to the hole and the outer surface directly contacting the base and integrally formed therewith.

3. The FOD protection cover of claim 1, wherein the at least one upper barrier wall extends along a full length of the base.

4. The FOD protection cover of claim 1, wherein the at least one upper barrier wall includes a plurality of upper barrier walls, a first upper barrier wall and a second upper barrier wall among the plurality of upper barrier walls defining an upper access opening to provide access to the hole.

5. The FOD protection cover of claim 1, wherein the at least one lower barrier wall includes a plurality of lower barrier walls, a first lower barrier wall and a second lower barrier wall among the plurality of lower barrier walls defining a lower access opening therebetween to provide access to the hole.

6. The FOD protection cover of claim 1, wherein the at least one barrier wall is configured to block a line-of-sight to one or more electrical conductors located adjacent to the dielectric barrier assembly.

7. The FOD protection cover of claim 3, wherein a first upper barrier wall and a second upper barrier wall among a plurality of upper barrier walls are integrally formed and seamless together to define an upper barrier corner.

8. The FOD protection cover of claim 4, wherein the at least one lower barrier wall extends along the full length of the base.

9. The FOD protection cover of claim 5, wherein the first lower barrier wall and the second lower barrier wall among the plurality of lower barrier walls are integrally formed and seamless together to define a lower barrier corner.

10. A power distribution assembly comprises: an electrical conductor including an opening and configured to conduct electrical current therethrough; and a foreign object debris (FOD) protection cover including a dielectric barrier assembly comprising: an upper surface and a lower surface opposite the upper surface, the upper and lower surfaces extending along a first axis and a second axis orthogonal to the first axis to define a base that is disposed on the electrical conductor; and at least one upper barrier wall integrally formed and seamless with the base, the at least one upper barrier wall including an upper-surface end extending from the base in a first direction along a third axis that is orthogonal to the first and second axes to a top end located above the lower surface and the upper surface; at least one lower barrier wall integrally formed and seamless with the base, the at least one lower barrier wall including a lower-surface base end extending along the third axis in a second direction opposite the first direction from the base to a lower end located below the upper surface and the lower surface; and at least one washer integrally formed and seamless with the base such that the washer is fixed thereto, the at least one washer contacting the electrical conductor and including a hole that extends radially from a center axis and that is aligned with respect to the opening of the electrical conductor; and a fastener extending through the hole and the opening and configured to couple the dielectric barrier assembly together with the electrical conductor.

11. The power distribution assembly of claim 10, further comprising a second electrical conductor configured to conduct electrical current therethrough, the second electrical conductor disposed on the first electrical conductor to establish physical contact therewith and including a second opening that is vertically aligned with the opening of the first conductor.

12. The power distribution assembly of claim 11, wherein the physical contact establishes an electrically conductive path from the first electrical conductor to the second electrical conductor.

13. A power distribution network comprises: a first power distribution assembly comprising: a first electrical conductor configured to conduct electrical current therethrough; and a first foreign object debris (FOD) protection cover including a first dielectric barrier assembly comprising: a first base; at least one first upper barrier wall integrally formed and seamless with the first base; and a first washer extending radially about a first center axis and integrally formed and seamless with the first base such that the first washer is fixed thereto, the first washer including a first hole formed therethrough and extending radially from the first center axis; a second power distribution assembly adjacent the first power distribution assembly, the second power distribution assembly comprising: a second electrical conductor configured to conduct electrical current therethrough; and a second foreign object debris (FOD) protection cover including a second dielectric barrier assembly a distance away from the first dielectric barrier assembly to define a line-of-sight between the first and second dielectric barrier assemblies, the second dielectric barrier assembly comprising: a second base; at least one second upper barrier wall integrally formed and seamless with the second base; and a second washer extending radially about a second center axis and integrally formed and seamless with the second base such that the second washer is fixed thereto, the second washer including a second hole formed therethrough and extending radially from the second center axis.

14. The power distribution network of claim 13, wherein the at least one second upper barrier wall extends into the line-of-sight and is located between the first base of the first dielectric barrier assembly and the second base of the second dielectric barrier assembly.

15. The power distribution network of claim 14, wherein each the first and second power distribution assemblies further comprises an upper surface and a lower surface opposite the upper surface, the upper and lower surfaces extending along a first axis and a second axis orthogonal to the first axis to define a base that is disposed on the first and electrical conductors, respectively.

16. The power distribution network of claim 15, wherein each of the at least one first upper barrier wall and the at least one second upper barrier wall further includes an upper-surface end extending from the first and second base, respectively, in a first direction along a third axis that is orthogonal to the first and second axes to a top end located above the lower surface and the upper surface.
