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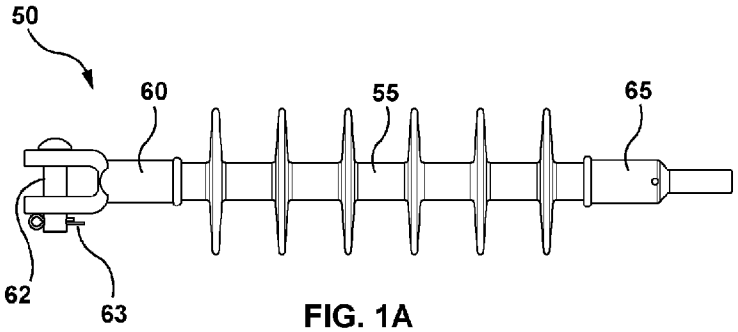

FIG. 1A

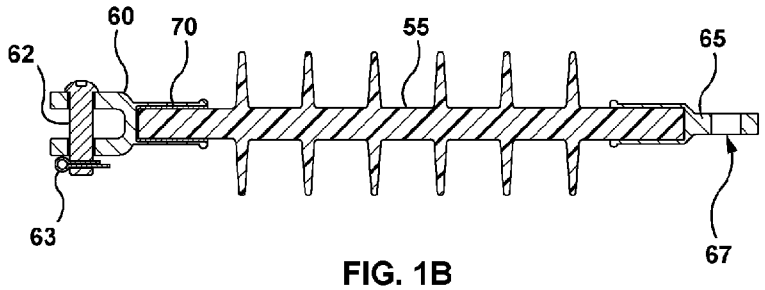

FIG. 1B

(57) **Abstract:** An example of an apparatus is provided. The apparatus includes an insulating material to stop a flow of current. The apparatus further includes a first connector secured to a first end of the insulating material. The first connector includes a hole to receive the first end of the insulating material. In addition, the apparatus includes a second connector secured to a second end of the insulating material. The second end is opposite the first end of the insulating material. Furthermore, the apparatus includes a coating deposited on an inner surface of the hole of the first connector to reduce corrosion at an interface between the insulating material and the first connector.

[Continued on next page]

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GALVANIZED LINE INSULATORS

BACKGROUND

[0001] Electricity is delivered across long distance from a power generation station to local power grids using high-voltage power lines. The high-voltage power lines are typically overhead conductors that may be bare and insulated by separation from each other using the surrounding air. In order for the conductors to be supported overhead across distances, supports are used at points along the conductor to mount the conductors to transmission and distribution towers. Since the transmission and distribution towers are typically made of a conducting metal, insulators are used to mount the conductor to a transmission and distribution tower and to avoid current flowing to the transmission and distribution tower from the conductor.

[0002] Insulators used for high-voltage transmission and distribution applications may be made from a wide variety of materials such as glass, porcelain, or composite polymer materials. Porcelain insulators may be made from clay, quartz, or alumina and feldspar, and are covered with a smooth glaze to resist debris and water. The electrical properties of a porcelain insulator may vary depending on the type of porcelain used and may have a dielectric strength of about 4-10 kV/mm. Glass may have a higher dielectric strength than porcelain which may be advantageous. However, glass often forms condensation, which may result in shorting across the insulator. Furthermore, thick irregular shapes used for insulator are difficult to cast without internal strains. Recently, polymer composite materials for some types of insulators have been used. These insulators may be composed of a central rod made of reinforced plastic and an outer material made of a rubber material, such as silicone. Composite insulators are less costly, lighter in weight, and have excellent hydrophobic capability. This combination makes them ideal for service in polluted areas.

[0003] Dirt, pollution, salt, and particularly water on the surface of a high voltage insulator can create a conductive path across the surface, causing leakage currents and arcing conditions, such as a flashover. The flashover voltage may be reduced by more than about half when the insulator is wet. High voltage insulators for outdoor use are shaped to increase the length of a leakage path along the surface from one end to the other of the insulator to reduce leakage currents and arcing. A common design to increase the length of a leakage path is to mold the insulator into a series of corrugations or concentric disc shapes. In addition, each disc shape may be a downward facing cup-shaped surface that acts as an umbrella to provide a dry underside that may act to break the leakage path.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Reference will now be made, by way of example only, to the accompanying drawings in which:

[0005] Figure 1A is a schematic representation of an example of an apparatus to support a conducting cable;

[0006] Figure 1B is a cross section view of the apparatus shown in figure 1A;

[0007] Figure 2 is a schematic representation of an example of a portion of a electricity delivery system;

[0008] Figure 3A is a schematic representation of an example of a connector compatible with the apparatus shown in figure 1A;

[0009] Figure 3B is a cross section view of the connector shown in figure 3A;

[0010] Figure 4A is a schematic representation of an example of another connector compatible with the apparatus shown in figure 1A;

[0011] Figure 4B is a cross section view of the connector shown in figure 4A;

[0012] Figure 5A is a schematic representation of another example of a connector compatible with the apparatus shown in figure 1A;

[0013] Figure 5B is a cross section view of the connector shown in figure 5A;

[0014] Figure 6A is a schematic representation of another example of a connector compatible with the apparatus shown in figure 1A;

[0015] Figure 6B is a cross section view of the connector shown in figure 6A;

and

[0016] Figure 7 is a flowchart of an example of a method of supporting a conducting cable.

DETAILED DESCRIPTION

[0017] Conducting cables are commonly used to deliver electricity across larger distances by carrying a current at high voltages. The conducting cables are generally placed high above the reach of most things at ground level for safety purposes. In order for the conducting cables to be supported overhead the conducting cables are physically mounted to fixtures, such as transmission and distribution towers or other structures capable of supporting the weight of the conducting cables. Since the fixtures are typically made of a conducting metal, insulators are used to mount the conducting cables to the fixture, such as a transmission and distribution tower, to avoid shorting the transmission circuit or losing current flowing through the conducting cables to the transmission and distribution tower.

[0018] As the conducting cables are generally placed in an outdoor setting and exposed to weather and elements, deposits of material may form on the surfaces of the entire delivery system. This includes the conducting cables, fixtures and structures supporting the conducting cables, as well as the insulators that mount the conducting cables to the fixtures. Over time, dirt, pollution, salt, and other contaminants may collect on the surface of the insulator. Once the contaminants are exposed to water, a conductive solution may form across the surface to create a conductive path across the insulator from the conducting cable to the fixture, which may cause leakage currents and arcing, such as a flashover. In some examples, the flashover voltage may be reduced by more than about half when a contaminated insulator is wet.

[0019] In addition to surface contaminants, corrosion of metal parts may further reduce the flashover voltage. It is to be appreciated with the benefit of this description that insulators used to mount conducting cables are typically secured to the conducting cables with a metallic connector. Similarly, a connector at the other end of the insulator is used to secure the insulator to the fixture, such as a transmission and distribution tower. The connectors are disposed at opposite ends of the insulating material and may

be crimped or otherwise secured to the insulating material. Accordingly, there exists a metal and insulator interface at each of these connectors. The surfaces at the interface may be exposed to moisture and other contaminants such as salt which can enhance the corrosion of the connectors, which are typically made of steel for its physical properties. As the metallic interface surface corrodes, it may promote arcing at the interface to further reduce the flashover voltage, which increases the likelihood of a flashover event.

[0020] An apparatus and method to insulate a conducting cable from a fixture or structure is provided. In the present example, the apparatus is a dead-end insulator to support a conducting cable via tension or suspension with one end secured to a cross arm, pole, or other fixture and the other end connected to the conducting cable. The apparatus is not particularly limited. It is to be appreciated by a person of skill with the benefit of this description that in other examples, the apparatus may also be a suspension insulator, a post insulator, a line post insulator, a cut-out switch, a transformer bushing, and other similar components in a transmission and distribution system. The apparatus includes connecting ends that have been treated to resist corrosion to improve performance and enhance service life.

[0021] Referring to figures 1A and 1B, an apparatus to support a conducting cable is generally shown at 50. The apparatus 50 may include additional components, such as additional connectors, fasteners, and other features for specific applications. In addition, it is to be appreciated by a person of skill with the benefit of this description that the design may be varied for different applications as discussed in greater detail below. In the present example, the apparatus 50 includes an insulating material 55, a first connector 60, a second connector 65, and a coating 70 disposed on the first connector 60.

[0022] The insulating material 55 is to stop current from flowing to the between the conducting cable and the fixture supporting the conducting cable. Accordingly the insulating material 55 includes a dielectric component that separates the conducting cable from the fixture at a distance that is sufficient to prevent arcing. In addition, the insulating material 55 is to have sufficient mechanical properties to support the weight of the conducting cable. It is to be appreciated by a person of skill with the benefit of this

description that the exact size and design as well as the type of material is not particularly limited and may be varied.

[0023] In the present example, the insulating material 55 is a composite material and in particular, a rubber material, such as silicone is used. In other examples, the insulating material 55 may be a plastic polymer composite, ethylene propylene diene terpolymer, or ethylene propylene diene, or other similar materials. The rubber material may also be designed to include self-cleaning properties to reduce the buildup contaminants, such as dust and salt, in polluted or saline environments. In other examples, the insulating material 55 may be made from different dielectric materials, such as glass or porcelain since both materials can have mechanical and electrical properties suitable to mount and to support a conducting cable to a fixture.

[0024] Furthermore, the specific design of the insulating material 55 is not particularly limited. In the present example, the insulating material 55 has a ribbed design. The ribbed design is to increase the surface area of the insulating material 55 which in turns increase the surface path length from one end of the apparatus 50 to the opposite end. By increasing the surface path length, it is to be appreciated by a person of skill that the flashover voltage is increased to reduce the likelihood of arcing across the apparatus 50. In other examples, the design of the insulating material 55 may be modified to have different shapes or designs. For example, the ribs may include a curvature to repel moisture while keeping an underside dry when the apparatus 50 is oriented in a substantially vertical orientation. In other designs, the insulating material 55 may have a substantially elongated shape, such as a cylinder or rectangular prism.

[0025] The first connector 60 is to be secured to an end of the insulating material 55. The manner by which the first connector 60 is secured to the insulating material 55 is not particularly limited. In the present example, the first connector 60 includes a hole which is dimensioned to receive an end of the insulating material 55. In particular, the first connector 60 may include a circular hole into which a cylindrical end of the insulating material 55 slides. The insulating material 55 may be secured via a friction fit in the hole. In some examples, an adhesive may be used to secure the insulating material 55. In further examples, the insulating material 55 may be secured with a fastener, such as a clamp, bolt, screw, or the first connector 60 may be crimped to hold

the insulating material 55. Furthermore, the insulating material 55 may also be sealed in the hole of the first connector 60 to reduce the amount of moisture and other contaminants entering the interface between the insulating material 55 and the first connector 60.

[0026] The first connector 60 is to connect the apparatus 50 to another component from which a conducting cable is to be electrically insulated. For example, the first connector 60 may be to connect the apparatus 50 to a fixture. Referring to figure 2, a portion of an electricity delivery system 100 is generally shown at 100. In the present example, the electricity delivery system 100 includes the apparatus 50, a transmission tower 105, and a conducting cable 110. Accordingly the first connector 60 is to mount to the transmission tower 105 to allow the apparatus 50 to suspend the conducting cable 110 above the ground. The manner by which the first connector 60 connects to the transmission tower 105 is not particularly limited. In the present example, the first connector 60 is a clevis connector with a clevis pin 62 and a cotter pin 63. The clevis pin 62 is to mate with a corresponding connection point on the transmission tower 105 and the cotter pin 63 is to hold the clevis pin 62 in place. It is to be appreciated by a person of skill that the first connector 60 may rotate freely about the clevis pin 62 to allow for some movement and expansion of the conducting cable 110 to reduce mechanical stress on the electricity delivery system 100. In other examples, the first connector 60 may use other mechanisms to mount to the transmission tower 105, such as a bolt or rivet connection. It is to be appreciated by a person of skill with the benefit of this description that although the present example is described with a transmission tower 105, the apparatus 50 may also be used or modified to be used on distribution towers.

[0027] In the present example, the first connector 60 is made from a steel, such as a cast or forged steel alloy. The first connector 60 may be molded into a unitary body. In other examples, the first connector 60 may be made from different materials, such as aluminum, with sufficient mechanical properties to support the conducting cable 110.

[0028] The second connector 65 is to be secured to the opposite end of the insulating material 55. The manner by which the second connector 65 is secured to the insulating material 55 is not particularly limited. Similar to the first connector, the

second connector 65 may include a hole which is dimensioned to receive an end of the insulating material 55. In particular, the second connector 65 may include a circular hole into which a second and opposite cylindrical end of the insulating material 55 slides. The insulating material 55 may be secured via a friction fit in the hole of the second connector 65. In other examples, the insulating material 55 may be secured with a fastener, such as a clamp, bolt, screw, or the second connector 65 may be crimped to hold the insulating material 55. Furthermore, the insulating material 55 may also be sealed in the hole of the second connector 65 to reduce the amount of moisture and other contaminants entering the interface between the insulating material 55 and the second connector 65.

[0029] The second connector 65 is to connect the apparatus 50 to the conducting cable 110. The manner by which the second connector 65 connects to the conducting cable 105 is not particularly limited. In the present example, the second connector 65 includes a hole 67 through which the conducting cable 110 can pass. It is to be appreciated by a person of skill that the conducting cable 110 may slide freely through the hole 67 to allow for some movement and expansion of the conducting cable 110 to reduce mechanical stress on the electricity delivery system 100 while supporting the connecting cable 110 above the ground. In other examples, the second connector 65 may use other mechanisms to connect to the conducting cable 110, such as a welded joint.

[0030] In the present example, the second connector 65 is made from a steel, such as a cast or forged steel alloy. The second connector 65 may be molded into a unitary body. In other examples, the second connector 65 may be made from different materials with sufficient mechanical properties to support the conducting cable 110. In further examples, the second connector 65 may be identical to the first connector 60 such that the apparatus 50 is symmetrical.

[0031] The coating 70 deposited on the first connector 60 is to be deposited at least on the inner surface of the hole into which the insulating material 55 is to be received. In the present example, the coating 70 is an anticorrosion coating to reduce corrosion of the first connector 60 under the coating. In particular, the coating 70 forms a layer of protection to prevent moisture, salt, and other contaminants from interacting with the

first connector 60. Continuing with the present example where the first connector 60 is made from steel, the coating 70 reduces the ability for the surface to form oxides, such as rust. Accordingly, by coating the inner surface of the hole of the first connector 60, corrosion at the interface between the insulating material 55 and the first connector 60 may be reduced to improve the service life of the apparatus 50. In particular, by reducing corrosion, the seal between the insulating material 55 and the first connector 60 may be more stable over time and the seal that prevents moisture and contaminants from entering the interface is maintained.

[0032] The coating 70 is not particularly limited and may be any protective layer that can be applied to the first connector 60. It is to be appreciated by a person of skill with the benefit of this description that the material from which the coating 70 is made as well as the method of application may vary depending on the application, such as the environment in which the apparatus 50 is deployed, as well as the materials from which the first connector 60 is made. In the present example, the coating 70 is a zinc coating used to galvanize the surface of the first connector 60. In particular, the coating 70 may be applied using a thermal diffusion galvanization process. The use of a thermal diffusion galvanization process was found to improve the performance of the coating 70 as the zinc bonds better to the surface of the first connector 60 when deposited via thermal diffusion compared with other methods. In other examples, the coating 70 may also be applied using a hot dip process. In further examples, alternative coatings other than a zinc coating may be applied to provide improved anticorrosion performance, such as various paints.

[0033] Referring to figures 3A and 3B, the first connector 60 is shown in greater detail. In the present example, the first connector 60 includes a unitary body 61, a connecting mechanism 200, a hole 210, and a coating 70 disposed at least within the hole 210.

[0034] In the present example, the connecting mechanism 200 is disposed on an end of the body 61. In the present example, the connecting mechanism 200 is a clevis connector with a clevis pin 62 and a cotter pin 63. The clevis pin 62 is to mate with a corresponding connection point on the transmission tower 105 and the cotter pin 63 is to hold the clevis pin 62 in place. In other examples, the connecting mechanism 200

may use other mechanisms to mount to the transmission tower 105, such as a bolt or rivet connection. The hole 210 is formed at the opposite end of the body 61 from the connection mechanism 200. The hole 210 is dimensioned to receive an end of the insulating material 55. In particular, the hole 210 may be circular to mate with a cylindrical end of the insulating material 55. The hole 210 may be dimensioned to secure an end of the insulating material 55 via a friction fit in the hole 210. In some examples, the insulating material 55 may be secured with a fastener, such as a clamp, bolt, screw, after the insulating material 55 is received in the hole 210. Alternatively, the hole 210 may be crimped into the insulating material 55.

[0035] Referring to figures 4A and 4B, the second connector 65 is shown in greater detail. In the present example, the second connector 65 includes a unitary body 66, a connecting mechanism 220, a hole 230, and a coating 72 disposed at least within the hole 230.

[0036] In the present example, the connecting mechanism 220 is disposed on an end of the body 66. In the present example, the connecting mechanism 220 is a hole 67 through which a conducting cable 110 can pass. It is to be appreciated by a person of skill that the conducting cable 110 may slide freely through the hole 67 to allow for some movement and expansion of the conducting cable 110 to reduce mechanical stress. In other examples, the connecting mechanism may use other mechanisms to connect to the conducting cable 110, such as an opening that may be opened and closed or welded joint.

[0037] The hole 230 is formed at the opposite end of the body 66 from the connection mechanism 220. The hole 230 is dimensioned to receive an end of the insulating material 55. In particular, the hole 230 may be circular to mate with a cylindrical end of the insulating material 55. The hole 230 may be dimensioned to secure an end of the insulating material 55 via a friction fit in the hole 230. In some examples, the insulating material 55 may be secured with a fastener, such as a clamp, bolt, screw, after the insulating material 55 is received in the hole 230. Alternatively, the hole 230 may be crimped into the insulating material 55.

[0038] Referring to figures 5A and 5B, another example of a first connector 60a is shown in greater detail. Like components of the first connector 60a bear like reference

to their counterparts in the first connector 60, except followed by the suffix “a”. In the present example, the first connector 60a includes a unitary body 61a, a connecting mechanism 200a, a hole 210a, and a coating 70a.

[0039] In the present example, the coating 70a is deposited on all external surfaces of the body 61a. The coating 70a is an anticorrosion coating to reduce corrosion of the first connector 60a. In particular, the coating 70a forms a layer of protection to prevent moisture, salt, and other contaminants from interacting with the first connector 60a. In the present example, the first connector 60a is made from steel and the coating 70 reduces the ability for the surface to form oxides, such as rust. Accordingly, by coating the entire body 61a, corrosion of the body 61a may be reduced to improve the service life of the figure connector 60a.

[0040] The coating 70a is not particularly limited and may be any protective layer that can be applied to the body 61a. It is to be appreciated by a person of skill with the benefit of this description that the material from which the coating 70a is made as well as the method of application may vary depending on the application, such as the environment in which the first connector 60a is deployed. In the present example, the coating is a zinc coating use to galvanize the surface of the first connector 60a. In particular, the coating 70a may be applied using a thermal diffusion galvanization process.

[0041] Referring to figures 6A and 6B, another example of a first connector 60b is shown in greater detail. Like components of the first connector 60a bear like reference to their counterparts in the first connector 60, except followed by the suffix “b”. In the present example, the first connector 60b includes a unitary body 61b, a connecting mechanism 200b, a hole 210b, a coating 70b, a seal 250b, and a corona ring 255b.

[0042] In the present example, the seal 250b to reduce moisture and contaminants from infiltrating the interface between the insulating material 55 and the body 61b. The seal 250b is not particularly limited. For example, the seal 250b may be an O-ring or other hermetic seal. In addition, it is to be appreciate by a person of skill with the benefit of this description that the seal 250b may be multiple sealing mechanisms, such as additional O-rings.

[0043] The corona ring 255b is disposed about the body 61b to reduce leakage of

electric current at the first connector 60b. The design of the corona ring 255b is not particularly limited and may vary depending on the application and the voltages carried by the conducting cable.

[0044] Referring to figure 7, a flowchart of a method 700 of supporting a conducting cable is generally shown. In order to assist in the explanation of method 700, it will be assumed that method 700 may be performed with the apparatus 50. Indeed, the method 700 may be one way in which apparatus 50 may be used. Furthermore, the following discussion of method 700 may lead to a further understanding of the apparatus 50 and its various components.

[0045] Block 710 involves applying a protective coating 70 to a surface of the body 61. In the present example, the protective coating 70 is an anticorrosion coating to reduce corrosion of the body 61 under the coating. In particular, the coating 70 forms a layer of protection to prevent moisture, salt, and other contaminants from interacting with the inner surface in the hole 210 formed in the body 61. By coating the inner surface of the hole 210, corrosion at the interface between the insulating material 55 and the body 61 may be reduced to improve the service life of the apparatus 50. In the present example, the protective coating 70 is a zinc coating used to galvanize the surface of the body 61. In particular, the protective coating 70 may be applied using a thermal diffusion galvanization process.

[0046] Next, block 720 involves the body 61 receiving the insulating material 55 in the hole 210. The insulating material 55 is then secured in the hole 210 at block 730. The manner by which the insulating material 55 is secured in the hole 210 is not particularly limited. For example, the insulating material 55 may be secured via a friction fit in the hole 210. In other examples, an adhesive may be used to secure the insulating material 55 in the hole 210. In further examples, the insulating material 55 may be secured with a fastener, such as a clamp, bolt, screw, or the hole 210 may be crimped to hold the insulating material 55.

[0047] At block 740, the body 61 is connected to a fixture to support the weight of the conducting cable. The manner by which the body 61 connects to the fixture is not particularly limited. In the present example, the body 61 includes a clevis connector with a clevis pin 62 and a cotter pin 63. The clevis pin 62 is to mate with a

corresponding connection point on the fixture and the cotter pin 63 is to hold the clevis pin 62 in place.

[0048] A conducting cable is then connected to the opposite end of the insulating material 55 at block 750. In the present example, a second connector 65 is attached to the opposite end of the insulating material 55. The second connector 65 may include a hole through which the conducting cable can pass and by which the apparatus 50 can support the weight of the conducting cable.

[0049] Various advantages will now be apparent to a person of skill in the art with the benefit of the present description. In particular, the apparatus 50 and its variations provide a way to support a conducting cable for extended periods of time while being exposed to the elements. In particular, by applying a protective coating in the hole of the body of the connect, the service life of the apparatus 50 may be increased substantially.

[0050] It should be recognized that features and aspects of the various examples provided above may be combined into further examples that also fall within the scope of the present disclosure.

What is claimed is:

1. An apparatus comprising:

an insulating material to stop a flow of current;

a first connector secured to a first end of the insulating material, wherein the first connector includes a hole to receive the first end of the insulating material;

a second connector secured to a second end of the insulating material, wherein the second end is opposite the first end of the insulating material; and

a coating deposited on an inner surface of the hole of the first connector to reduce corrosion at an interface between the insulating material and the first connector.

2. The apparatus of claim 1, wherein the first connector is made from a steel.

3. The apparatus of claim 2, wherein the coating is a zinc coating.

4. The apparatus of claim 3, wherein the zinc coating is deposited via a thermal diffusion galvanization process.

5. The apparatus of claim 4, wherein the zinc coating coats the first connector entirely.

6. The apparatus of any one of claims 1 to 5, wherein the insulating material has a ribbed design.

7. The apparatus of any one of claims 1 to 6, wherein the insulating material is a composite material.

8. The apparatus of claim 7, wherein the composite material is silicone.

9. The apparatus of claim 7, wherein the composite material is ethylene propylene diene terpolymer.

10. The apparatus of any one of claims 1 to 9, wherein the first connector is to connect to a fixture.

11. The apparatus of claim 10, wherein the second connector is to connect to a conducting cable for supporting the conducting cable.

12. An apparatus comprising:

a body having a first end and a second end, wherein the first end is opposite the second end;

a connecting mechanism disposed at the first end to connect the body to a fixture;

a hole formed at the second end, wherein the hole is to receive an insulating material to be secured to the body; and

a coating deposited on an inner surface of the hole to reduce corrosion at an interface between the insulating material and the body.

13. The apparatus of claim 12, wherein the body is formed as a unitary piece.

14. The apparatus of claim 12 or 13, wherein the body is made from a steel.

15. The apparatus of claim 14, wherein the coating is a zinc coating.

16. The apparatus of claim 15, wherein the zinc coating is deposited via a thermal diffusion galvanization process.

17. The apparatus of claim 16, wherein the zinc coating coats the body entirely.

18. A method comprising:

applying a protective coating to a surface of a body, wherein the body includes a connecting mechanism to connect the body to a fixture, and wherein the protective coating is deposited on an inner surface of a hole in the body;

receiving, in the hole, an insulating material;

securing the insulating material to the hole;

connecting the body to the fixture;

securing a cable connector to the insulating material at an opposite end from the body; and

connecting a conducting cable to the cable connector, wherein the conducting cable is to be supported by the fixture.

19. The method of claim 18, wherein applying the protective coating comprises applying a zinc coating.

20. The method of claim 18, wherein applying the protective coating comprises using a thermal diffusion galvanization process.

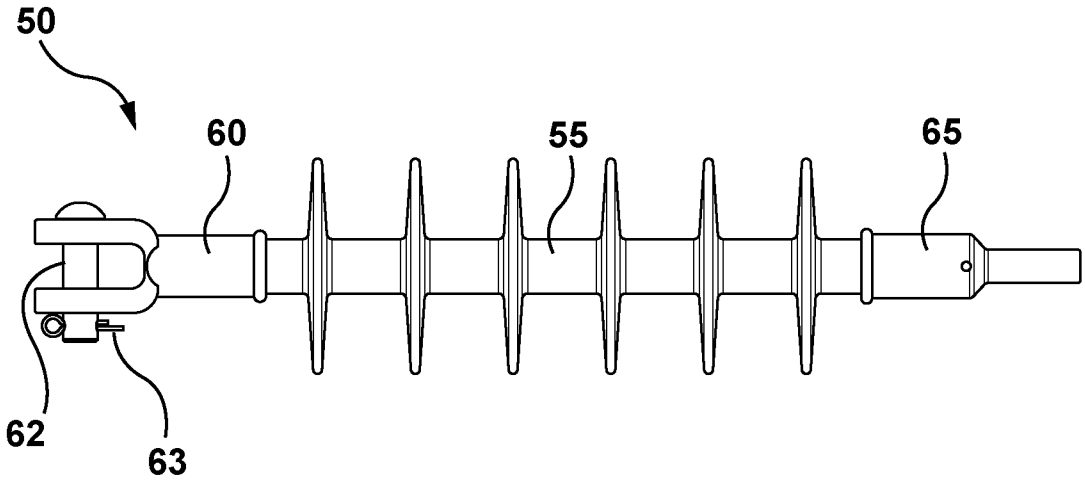

FIG. 1A

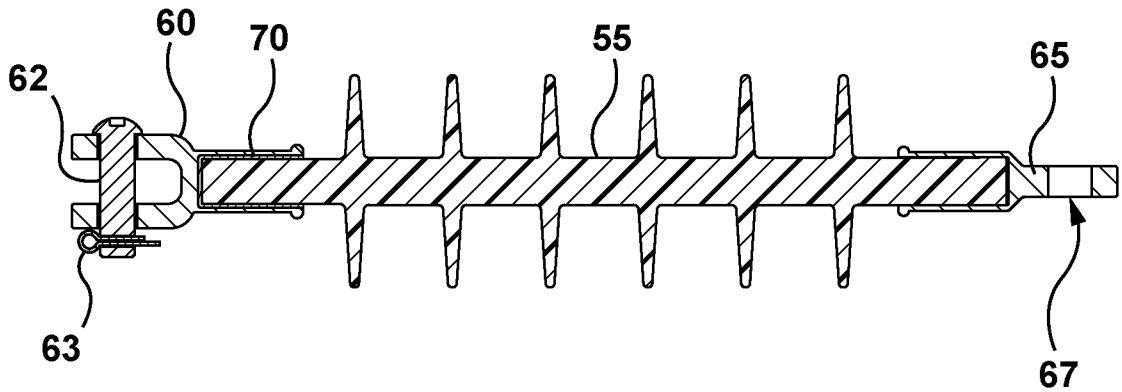

FIG. 1B

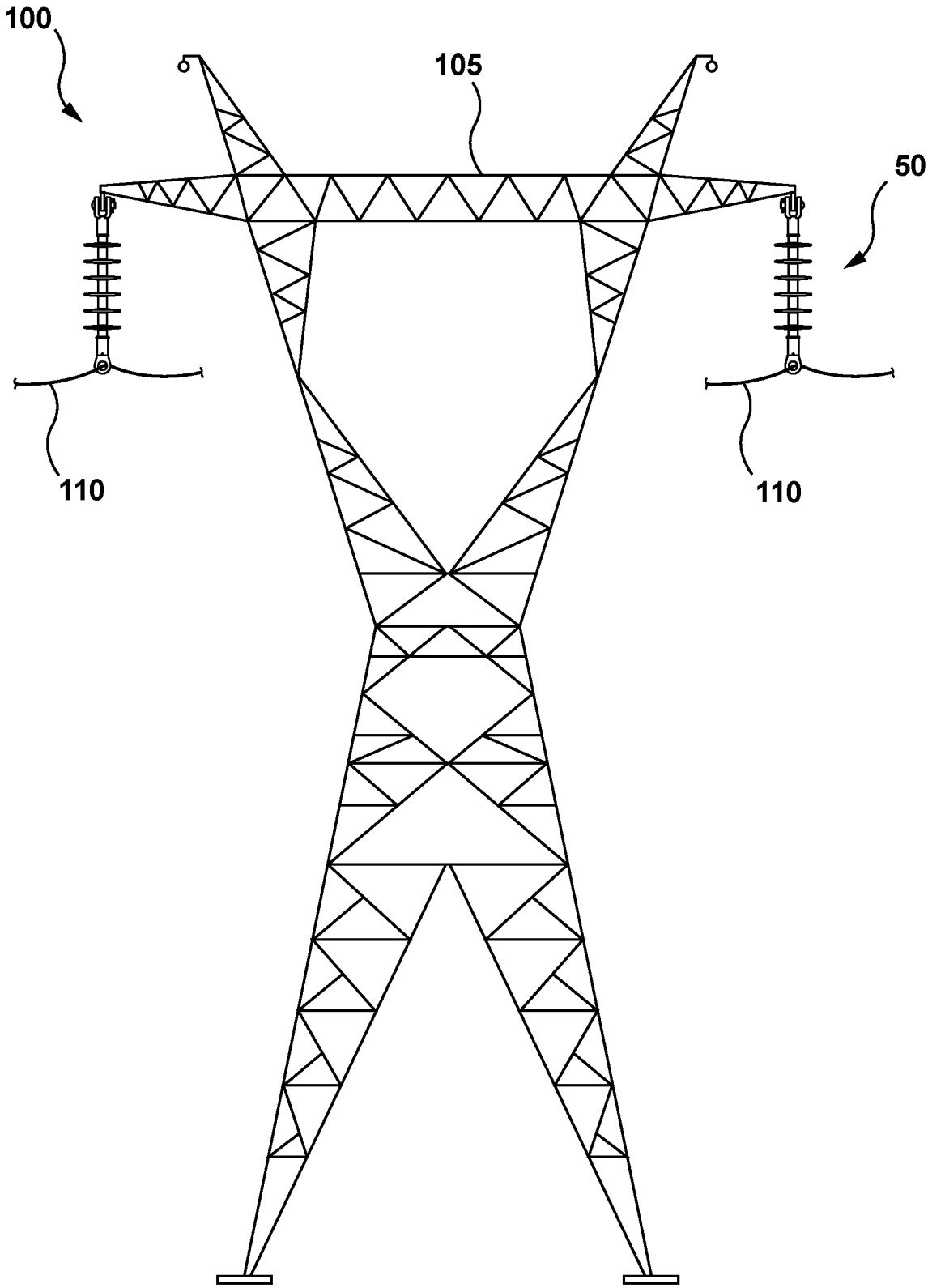

FIG. 2

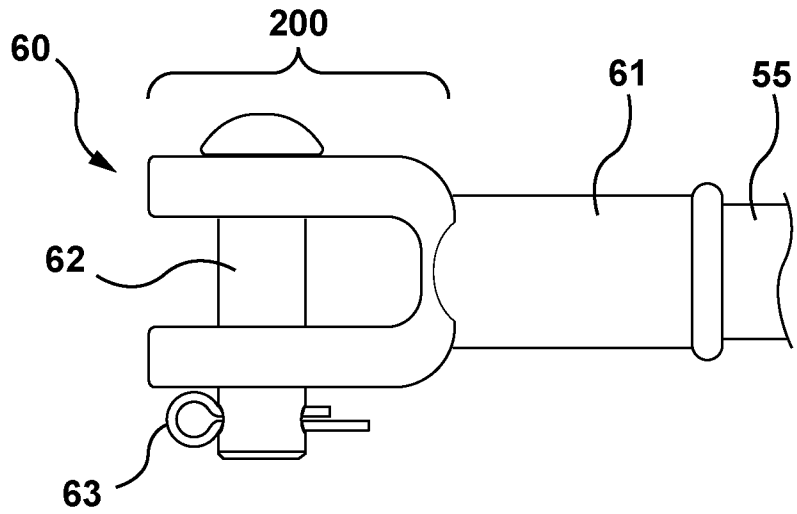

FIG. 3A

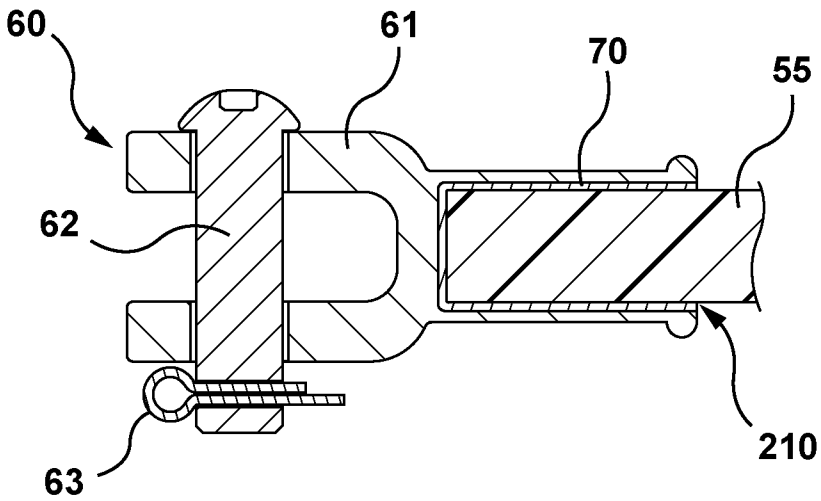

FIG. 3B

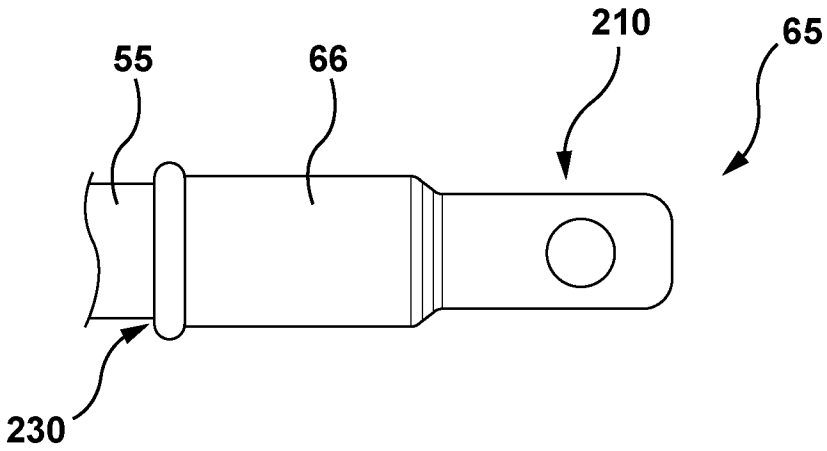

FIG. 4A

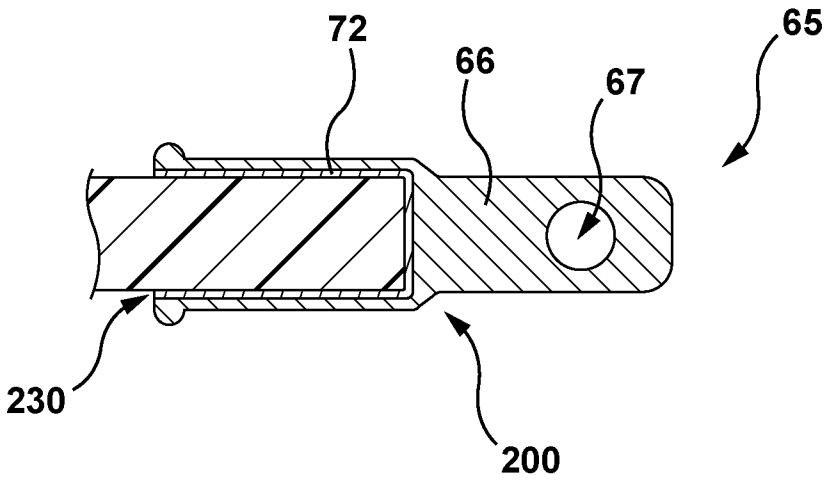

FIG. 4B

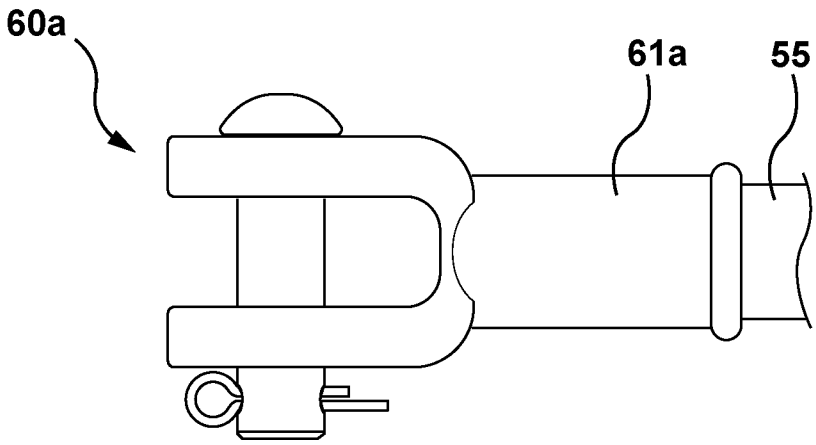

FIG. 5A

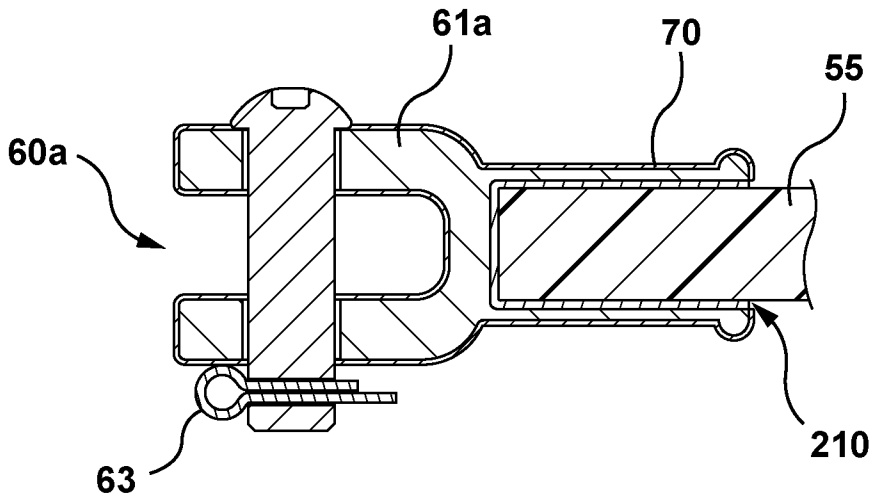

FIG. 5B

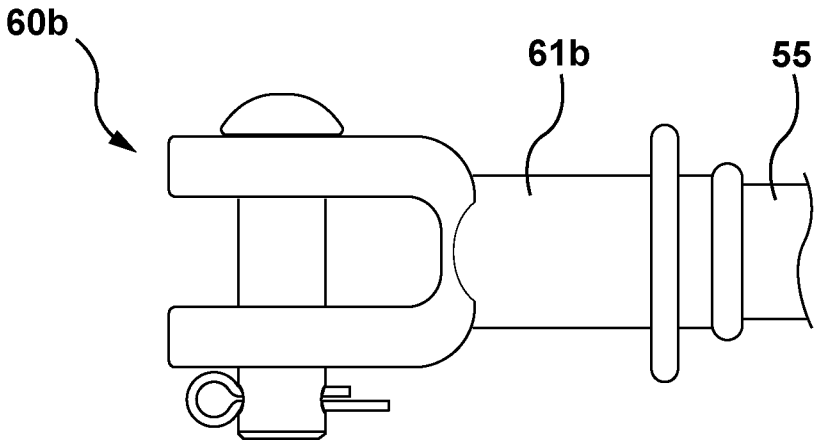

FIG. 6A

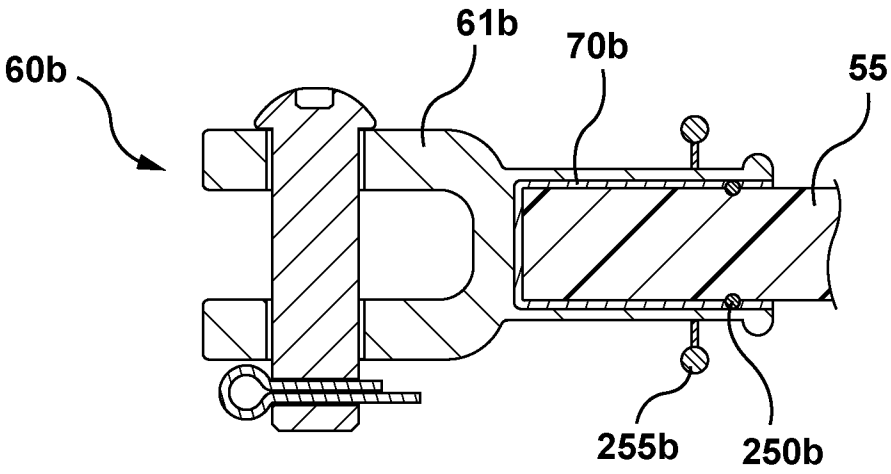

FIG. 6B

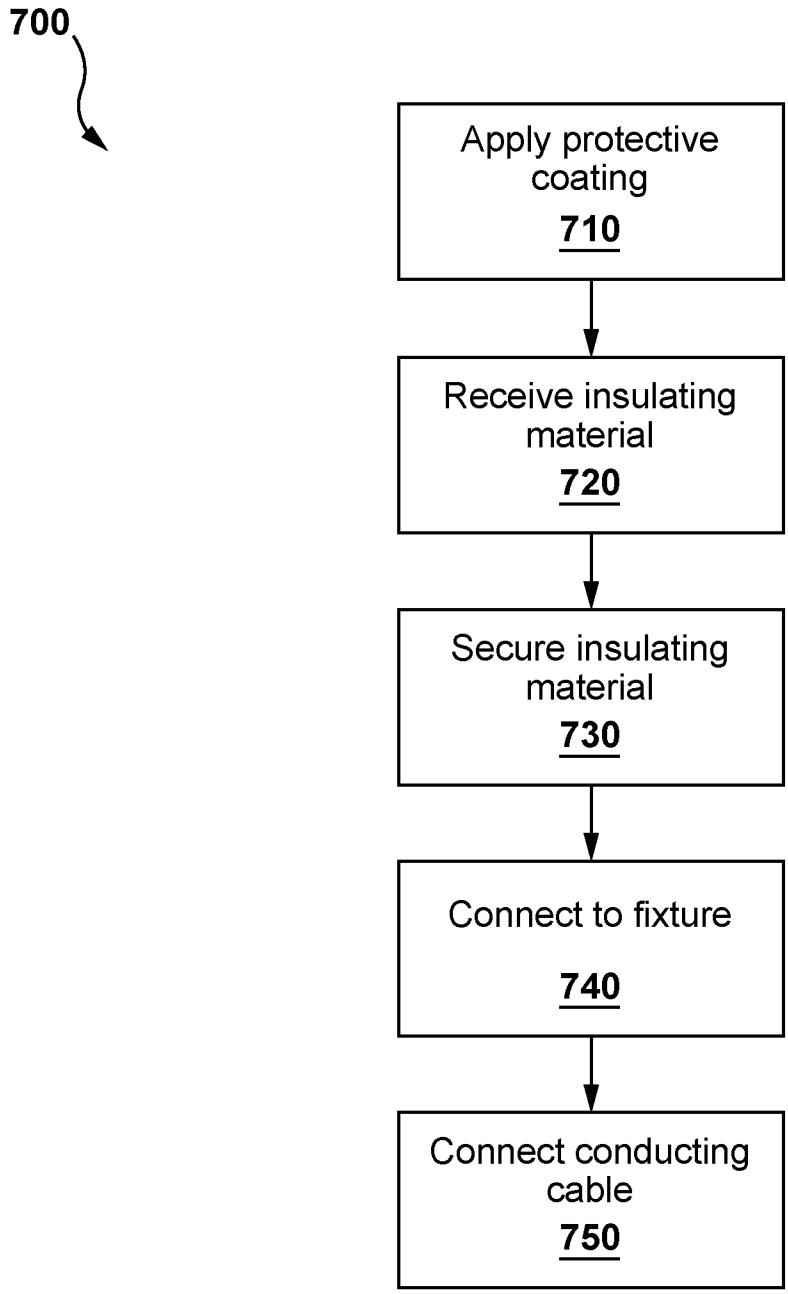
700
Apply protective coating
710
Receive insulating material
720
Secure insulating material
730
Connect to fixture
740
Connect conducting cable
750

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2023/059647

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***H01B 17/02*** (2006.01) , ***H01B 17/50*** (2006.01)

CPC: **H01B 17/02** (2020.01) , H01B 17/50 (2020.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: *H01B*

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
IPC: *all*

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Google; Google Patents; Questel-Orbit; IEEE Xplore; Canadian Patent Database. Terms used : insulator, coating, connector, fitting, transmission, distrubtion.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CA2152029A1 Khul 18 December 1995 (18-12-1995) * figures 1, 4; claim 9; page 3, lines 22-25; page 6, lines 32-33 *	1-20
Y	US5796048A Suzuki et al. 18 August 1998 (18-08-1998) * para. 0052 *	1-20
Y	KR102336645B1 Choi et al. 08 December 2021 (08-12-2021) * whole document *	1-20

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
"D"	document cited by the applicant in the international application
"E"	earlier application or patent but published on or after the international filing date
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O"	document referring to an oral disclosure, use, exhibition or other means
"P"	document published prior to the international filing date but later than the priority date claimed
"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&"	document member of the same patent family

Date of the actual completion of the international search 31 May 2014 (31-05-2024)	Date of mailing of the international search report 11 June 2024 (11-06-2024)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Andrew O'Malley (819) 635-4706

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2023/059647

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		BR9502815A	06 February 1996 (06-02-1996)
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		KR102336645B1	08 December 2021 (08-12-2021)
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		KR102413511B1	28 June 2022 (28-06-2022)

IPC: all

CPC: all