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SHROUD ASSEMBLY

Abstract

A shroud assembly is disclosed. The shroud assembly may include a shroud configured to enclose equipment. The shroud assembly may further include a support structure configured to provide support to the shroud. The shroud assembly may additionally include one or more alignment channels disposed at a periphery of the support structure. Furthermore, the shroud assembly may include a slide block configured to slide vertically inside the alignment channels. The slide block may be further configured to engage with the shroud, and move the shroud vertically between a first position and a second position.

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Background/Summary

RELATED APPLICATIONS [0001] The present application is a continuation of U.S. patent application Ser. No. 18/443,127 filed Feb. 15, 2024, which claims the benefit of U.S. Provisional Patent Application No. 63/485,456 filed Feb. 16, 2023. Each application is incorporated by reference in its entirety as if fully set forth herein.

TECHNICAL FIELD
[0002] The present disclosure relates to a shroud assembly, and more particularly, to a shroud assembly for cellular infrastructure.
BACKGROUND INFORMATION
[0003] With the advances in cellular technology, the need to service and maintain the infrastructure becomes even more critical to provide the ubiquitous wireless service that is such a vital part of everyday life in the modern world.
[0004] The backbone of that cellular infrastructure is the system of towers that provide cellular coverage around the world. Maintaining that system of towers involves not only software, but servicing and maintaining the hardware and physical structure.
[0005] However, with the ever-growing need for densification of the current wireless networks, more cellular towers will be required along with their corresponding maintenance. Many jurisdictions further require the concealment from view of the radios now at the top of the tower and antenna systems, in order to provide better visual aesthetics.
[0006] One such method of concealment is the use of a shroud. Shrouds cover and conceal the equipment, but that comes at a cost: access to the underlying equipment becomes difficult and expensive.
[0007] There exist various approaches to access the equipment including making panels of the shroud removable, hinge open, accordion open, rotate, having the entire shroud removed via a crane.
[0008] Each of these approaches creates other problems for maintenance or limit the shroud's underlying efficacy. For example, cellular towers are often exposed to high wind and the large size of these shroud panels can be difficult to maneuver high above the ground. Panels that are removed or swing open could be very difficult to control in high winds and create a dangerous situation for the maintenance workers. It is often not feasible to simply delay maintenance until calmer conditions because of the time sensitive nature of many repairs. In bad weather or wind conditions, panels or doors could be dropped or damaged during maintenance.
[0009] Another challenge with these large panels or shrouds is what to do with them when removed during maintenance. Often, they can deform and make it difficult to re-install.
[0010] Cranes are costly and likewise not an ideal solution because not all locations are easily accessed by a crane and high winds also pose a hazard to crane operations. Further, in crowded urban environments, bringing in a crane could also require traffic control or be otherwise difficult to maneuver a crane into position.
[0011] In light of the above, a system is needed that facilities users to handle a shroud and conveniently access the equipment during maintenance.
[0012] It is with respect to these and other considerations that the disclosure made herein is presented.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The detailed description is set forth with reference to the accompanying drawings. The use of the same reference numerals may indicate similar or identical items. Various embodiments may utilize elements and/or components other than those illustrated in the drawings, and some elements and/or components may not be present in various embodiments. Elements and/or components in the figures are not necessarily drawn to scale. Throughout this disclosure, depending on the context, singular and plural terminology may be used interchangeably.

[0014] FIG. **1** depicts an example environment in which techniques and structures for providing the systems and methods disclosed herein may be implemented.

[0015] FIG. **2** depicts an example portion of a shroud assembly and equipment in accordance with the present disclosure.

[0016] FIG. **3** depicts a first example detailed view of a part of the shroud assembly in accordance with the present disclosure.

[0017] FIG. **4** depicts a second example detailed view of a part of the shroud assembly in accordance with the present disclosure.

[0018] FIG. **5** depicts a top view of a part of the shroud assembly in accordance with the present disclosure.

[0019] FIG. **6** depicts an example pulling mechanism in accordance with the present disclosure.

OVERVIEW

[0020] The present disclosure describes a shroud assembly for wireless communication equipment (such as a cellular tower). The shroud assembly may include a shroud configured to enclose the equipment. The shroud assembly may further include a support structure configured to provide support to the shroud. The shroud assembly may further include one or more alignment channels disposed at a periphery of the support structure. The shroud assembly may further include a slide block configured to slide vertically inside the alignment channels. The slide block may be further configured to engage with the shroud, and move the shroud vertically between a first position and a second position.

[0021] In some aspects, the shroud assembly may further include a cable configured to engage the slide block with a counter weight. The cable may be disposed inside the alignment channels.

[0022] In some aspects, the shroud may include a protrusion, and the slide block may include a cavity. The protrusion may be configured to engage with the cavity to engage the shroud with the slide block. The shroud may be configured to enclose the support structure and the alignment channels.

[0023] The shroud may be a one-piece shroud, and may have a hollow body. The shroud assembly may further include a float plate configured to connect the alignment channels with the support structure. In some aspects, the support structure may include one or more circular plates.

[0024] The present disclosure discloses a system that enables a user to handle the shroud and access the equipment conveniently during maintenance. The disclosed embodiments simplify access to the pole top equipment and eliminate the need to fully remove the shroud to gain access for maintenance and servicing. The present disclosure describes a one-piece shroud that is beneficial in high wind areas. The present disclosure describes an aerodynamic shape that reduces drag, thus also reducing forces exerted on the shroud and reduces the structural requirements of the base and foundation of the pole structure. This also reduces overall cost. This is also advantageous because it eliminates seams. The elimination of seams presents less weak points in the shroud assembly where it could more easily become damaged or break.

[0025] Disclosed embodiments may be used to provide access to certain internal equipment while keeping the shroud partially in place by having the shroud lifted, but not fully removed. Instead, the shroud is lifted enough to provide access to underlying equipment, and then is simply lowered back into place, maintaining the integrity of the shroud and done without the need of tools, heavy

equipment, or specialized equipment. Specifically, the present disclosure enables the raising and lowering of the shroud by a single maintenance worker positioned in a man lift, without other heavy equipment. This in turn saves both time and money involved in servicing the equipment.
[0026] Embodiments may also be implemented without the need for electric motors, gas springs, torsion springs, extension springs, linkages, or gearing. All of which would involve increased cost and additional points of failure that are not optimal for operation and maintenance. In addition, the disclosed embodiments may be implemented through material that has minimal RF interference.
[0027] These and other advantages of the present disclosure are provided in detail herein.
Illustrative Embodiments
[0028] The disclosure will be described more fully hereinafter with reference to the accompanying drawings, in which example embodiments of the disclosure are shown, and not intended to be limiting.
[0029] FIG. **1** depicts an example environment **100** in which techniques and structures for providing the systems and methods disclosed herein may be implemented.
[0030] The environment **100** includes a shroud assembly configured to enclose or cover an equipment **102**. In some aspects, the shroud assembly may be configured to completely enclose the equipment **102**. In an embodiment, the equipment **102** may be a cellular tower that is configured to provide cellular coverage. A skilled person may appreciate that cellular towers may be standalone structures, or may be equipment installed or placed on pre-existing structures, such as buildings, streetlights or collocating with other radio or antenna equipment for other services. A cellular tower may include a plurality of components including, but not limited to, antennas, transmitters, receivers, and/or the like.
[0031] In some aspects, the shroud assembly may include a shroud **104** that may completely enclose (as an example) the equipment **102**. The shroud **104** may be of any size and any shape, which facilitates the shroud **104** to cover the equipment **102**. For example, the shroud **104** may have a hollow cylindrical, or any other shape, body that may be configured to receive and surround the equipment **102**. In some aspects, the ends (e.g., the top end and the bottom end) of the shroud **104** may be open. In further aspects, the length of the shroud **104** may be equivalent or slightly greater than the length of the equipment **102** (e.g., 20-30 inches). In addition, the shroud **104** may have any diameter, e.g., in a range of 30-42 inches. The shroud **104** may be made of any lightweight, ultraviolet (UV) resistant, and RF transparent material such as plastic, thermoplastic (e.g., acrylonitrile butadiene styrene, thermoplastic polyolefin, acrylic polyvinyl chloride alloy), and vinyl foam core sandwich panels. In further aspects, the shroud **104** may be a one-piece shroud, and may not have any seam. In other aspects, the shroud **104** may include more than one piece/panel.
[0032] The shroud assembly may further include a support structure **106** and alignment channel(s) **108** that may be configured to provide support to the shroud **104**. The shroud **104** may be configured to enclose the equipment **102** via the support structure **106** and the alignment channel(s) **108**. The support structure **106** and the alignment channel(s) **108** may facilitate the shroud **104** to move/slide vertically over the alignment channel(s) **108** (e.g., between a first position (or a closed position) and a second position (or an open position)), without removing/detaching the shroud **104** completely.
[0033] In the first position, the shroud **104** may be configured to completely enclose the equipment **102** (and the support structure **106** and the alignment channel(s) **108**), as shown in a view **110** of FIG. **1**. In the second position, the shroud **104** may be configured to expose (e.g., partially expose) the equipment **102**. A partial open position of the shroud **104** is shown in a view **112** of FIG. **1**. A user may move the shroud **104** from the first position to the second position during maintenance/service. For example, the user may move the shroud **104** upwards to any height based on the user's requirement so that the user may perform the maintenance work easily, without completely removing the shroud **104**.

[0034] Further details of the support structure **106** and the alignment channel(s) **108** may be understood in conjunction with FIGS. **2**-**5**.

[0035] FIG. **2** depicts an example portion of a shroud assembly and an equipment in accordance with the present disclosure. Specifically, FIG. **2** depicts one or more support structures **202***a*, **202***b*, **202***c* (collectively referred as support structure **202**) and alignment channel(s) **204** of the shroud assembly, and the equipment **206** (without the shroud **104**). The support structure **202** may be same as the support structure **106**, the alignment channels **204** may be same as the alignment channels **108**, and the equipment **206** may be same as the equipment **102**, described above in conjunction with FIG. **1**.

[0036] In some aspects, the support structure **202** may include one or more circular plates that may be configured to provide support to the equipment **206** and the shroud **104**. The support structure **202** may be positioned at different positions. For example, the support structure **202***a* may be disposed in proximity to a top end of the equipment **206**, the support structure **202***b* may be disposed in proximity to a bottom end of the equipment **206**, and the support structure **202***c* may be disposed in proximity to a middle portion of the equipment **206** (e.g., between the top end and the bottom end of the equipment **206**). In some aspects, the distance between the support structure **202***c* and the support structure **202***a* may be same as the distance between the support structure **202***c* and the support structure **202***b*. In other aspects, the distance between the support structure **202***c* and the support structure **202***a* may be different from the distance between the support structure **202***c* and the support structure **202***b*. For example, the support structure **202***c* may be disposed in proximity to or closer to the support structure **202***a*, relative to the support structure **202***b*.

[0037] In some aspects, the support structure **202***a*, **202***b*, and **202***c* may have same structure, dimensions and may be made of same material. For example, the support structure **202***a*, **202***b*, and **202***c* may have the same diameter. The diameter of the support structure **202** may correspond to the diameter of the shroud **104**. For example, the diameter of the support structure **202** may be equivalent to or slightly less than the diameter of the shroud **104**. In further aspects, each of the support structure **202***a*, **202***b*, and **202***c* may include a plurality of holes/openings to facilitate positioning of components of the equipment **206** (and may support such components). For example, the components may pass through the holes/openings, as shown in FIG. **2**. The plurality of holes/openings may be present in a predetermined pattern. In some aspects, the pattern of the plurality of holes/openings may be different in different support structures, which may be based on the components of the equipment **206**.

[0038] The alignment channel(s) **204** of the shroud assembly may be disposed at a periphery of the support structure **202**. The alignment channels **204** may be vertical channels that may be connected between the support structure **202***a* and the support structure **202***b*. In some aspects, the length of the alignment channels **204** may be equivalent to the length of the equipment **206**. In some aspects, each alignment channel **204** may contact the support structures **202***a*, **202***b*, and **202***c*. The alignment channel **204** may be a U-shaped channel (i.e., may have a U-shaped cross-section) that may facilitate the shroud **104** to move/slide vertically via the alignment channels **204**. The alignment channels **204** may include an open end that may face opposite/away from the equipment **206** (i.e., away from the shroud **104**). A detailed view of an alignment channel is shown in FIG. **3**. In an embodiment, the shroud assembly may include three alignment channels which may be disposed at an equal distance from adjacent alignment channels. In other aspects, the shroud assembly may include more or less number of alignment channels. In some aspects, the alignment channels **204** may be made of any material such as non-metallic material, and may be disposed around a shroud perimeter, and works in conjunction with counterweight (e.g., counterweight **602**).

[0039] In some aspects, the support structure **202** may include an opening/recess that may be configured to engage with/hold the alignment channels **204**. Each alignment channel **204** may be connected to the support structure **202** via a float plate **302**. For example, each alignment channel

may be bolted to the support structure **202** via one or more bolts to provide stability to the shroud assembly. The float plates **302** may be used to minimize frictional drag and binding of the shroud walls and the alignment channel **204** due to the manufacturing of the support structure **202** and shroud **104**. Float plate **302** may also assist the alignment of the shroud **104** to the inner support structure to eliminate binding during the movement of the shroud **104**.

[0040] In some aspects, the shroud assembly may further include a slide block **304** that may be disposed inside each alignment channel **204**, and may be configured to move/slide up and down vertically. The slide block **304** may be configured to engage/interface with the shroud **104** and move the shroud vertically between the first position and the second position. In some aspects, the slide block **304** may be partially disposed inside the alignment channel **204**. In other aspects, the slide block **304** may be completely disposed inside the alignment channel **204**.

[0041] In some aspects, the slide block **304** may be a rectangular block that may include a cavity/recess **402** (as shown in FIG. **4**) at a top portion (or a side portion) of the slide block **304**. The cavity/recess **402** may be configured to receive the shroud **104**. In some aspects, the shroud **104** may include a protrusion **404**. The shape of the protrusion **404** may correspond to the shape of the cavity/recess **402**. In some aspects, the protrusion **404** and the cavity/recess **402** may form a "French cleat" which enables the shroud **104** to engage with the slide block **304** in a secure manner. In some aspects, the shroud **104** may include a plurality of protrusions that may be disposed at a bottom portion of the shroud **104**. The count of protrusions may correspond to the count of the alignment channels **204**, and the positions of the protrusions may align with the positions of the alignment channels **204**. In some aspects, the width of the slide block **304** may be slightly less than the width of the alignment channel **204**, so that the slide block **304** may fit inside the alignment channel **204**. In some aspects, the length of the slide block **304** may be any percentage (e.g., 1-10%) of the height of the alignment channel **204**. In some aspects, the slide block **304** may be made of any material such as low-friction materials, and may have chamfered edges to minimize catching on any joints. This allows the slide block to function without need for lubrication. In another embodiment, if needed, the slide block could be fabricated with different material or a different shape, but lubricant may then be used to enable smooth and easy movement within the alignment channel **204**.

[0042] As shown in FIG. **5**, the shroud protrusion **404** fits with in and extends into the opening of strut **204**. The slide block rides in the strut and contacts shroud protrusion **404** in a manner shown in FIG. **4**. Using the counterweights, cable **306** exerts force on the on slide block which is transferred to the shroud. For the purposes of this disclosure cable includes ropes, straps, lines, cords, twine, or any other linkage material.

[0043] The shroud assembly may further include a cable/cord **306** that may be configured to engage the slide block **304** with a counterweight **602** (as shown in FIG. **6**). The counterweight **602** may be made of any material (such as steel or lead), which may not interfere with the equipment **206**. The cable **306** may also be made from material that has RF transparent properties, such as UV resistant polymers. In some aspects, each alignment channel **204** may have its own counterweight. In some aspects, multiple alignment channels may use a single counterweight, as long as the cord length is properly controlled for uniform engagement of that counterweight from multiple alignment channels.

[0044] In one aspect, the cable **306** may engage the slide block **304** with the counterweight **602** via a pulley **604** (to move the shroud vertically between the first position and the second position). In some aspects, the slide block **304** may include a cavity **406** (or a through-hole) that may allow the cable **306** to pass through. One end of the cable **306** may be connected to the slide block **304** and the other end may be connected to the counterweight **602**, via the pulley **604**, as shown in FIG. **6**. In some aspects, the cable **306** may include a positive stop **408** that may prevent the cable **306** from disengaging with the slide block **304**. The positive stop **408** may be disposed in proximity to a bottom end of the slide block **304**. In one aspect, the diameter of the positive stop **408** may be

greater the size of the opening, which prevents the cable **306** from disengaging with the slide block **304**. In some aspects, the cable **306** may be positioned inside each of the alignment channel **204**, and may be configured to the move the slide block **304** vertically in the alignment channel **204** when the counterweight **602** may be attached to the other end of the cable **306**. In some aspects, the mass of the counterweight **602** may be adjusted according to the mass of the shroud **104**, to allow it to overcome the mass of the shroud plus frictional force along with the added force from the user moving the shroud **104** up or down.

[0045] In the down position, the shroud **104** may be mechanically secured to the support structure **202** via securing components. In some aspects, the securing components may include pins, latches, clamps, or screws. In this embodiment, the user would open the mechanical fastener before lifting the shroud **104**.

[0046] In some aspects, the shroud **104** may not be mechanically secured to the support structure **202** and is only held in place by the alignment channels **204** and the shroud **104** resting in the slide block **304**. In the open position, gravity holds the shroud **104** on the slide block **304**. If there is a need to fully remove the shroud **104**, it may be done by completely vertically lifting the shroud **104** without removal of any additional hardware. This may be done using lightweight equipment.

[0047] In some aspects, the alignment channels **204** may keep the shroud **104** from rotating as the user lifts or lowers the shroud **104**. This helps to keep the shroud **104** stable and to prevent any features of the shroud **104**, such as handgrips, from interfering with the equipment enclosed by the shroud **104**. The alignment channels **204** may also ensure that the slide blocks **304** stay in alignment to keep the counterweight system functioning correctly.

[0048] Although the present disclosure describes a shroud for a cellular tower, the scope of the present disclosure is not limited to cellular towers. The shroud may be used with any other equipment, without modifying the scope of the present disclosure. The present disclosure provides an effective and efficient way of protecting and concealing any such infrastructure.

[0049] In the above disclosure, reference has been made to the accompanying drawings, which form a part hereof, which illustrate specific implementations in which the present disclosure may be practiced. It is understood that other implementations may be utilized, and structural changes may be made without departing from the scope of the present disclosure. References in the specification to “one embodiment,” “an embodiment,” “an example embodiment,” etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a feature, structure, or characteristic is described in connection with an embodiment, one skilled in the art will recognize such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0050] It should also be understood that the word “example” as used herein is intended to be non-exclusionary and non-limiting in nature. More particularly, the word “example” as used herein indicates one among several examples, and it should be understood that no undue emphasis or preference is being directed to the particular example being described.

[0051] With regard to the processes, systems, methods, heuristics, etc. described herein, it should be understood that, although the steps of such processes, etc. have been described as occurring according to a certain ordered sequence, such processes could be practiced with the described steps performed in an order other than the order described herein. It further should be understood that certain steps could be performed simultaneously, that other steps could be added, or that certain steps described herein could be omitted. In other words, the descriptions of processes herein are provided for the purpose of illustrating various embodiments and should in no way be construed so as to limit the claims.

[0052] Accordingly, it is to be understood that the above description is intended to be illustrative and not restrictive. Many embodiments and applications other than the examples provided would

be apparent upon reading the above description. The scope should be determined, not with reference to the above description, but should instead be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. It is anticipated and intended that future developments will occur in the technologies discussed herein, and that the disclosed systems and methods will be incorporated into such future embodiments. In sum, it should be understood that the application is capable of modification and variation.

[0053] All terms used in the claims are intended to be given their ordinary meanings as understood by those knowledgeable in the technologies described herein unless an explicit indication to the contrary is made herein. In particular, use of the singular articles such as “a,” “the,” “said,” etc. should be read to recite one or more of the indicated elements unless a claim recites an explicit limitation to the contrary. Conditional language, such as, among others, “can,” “could,” “might,” or “may,” unless specifically stated otherwise, or otherwise understood within the context as used, is generally intended to convey that certain embodiments could include, while other embodiments may not include, certain features, elements, and/or steps. Thus, such conditional language is not generally intended to imply that features, elements, and/or steps are in any way required for one or more embodiments.

Claims

1-20. (canceled)

21. A method of assembling a shroud assembly to conceal equipment on a cellular tower while permitting unobstructed access for maintenance of the equipment, the method comprising: providing a support structure that supports at least a portion of the equipment; disposing an alignment channel at a periphery of the support structure; positioning a slide block to slide vertically within the alignment channel; and coupling a shroud to the slide block such that movement of the slide block within the alignment channel transitions the shroud between a lowered position and a raised position relative to the equipment.

22. The method of claim 21, further comprising raising the shroud from the lowered position to the raised position while the shroud remains engaged with the slide block to expose at least part of the equipment.

23. The method of claim 22, further comprising performing maintenance on the equipment when the shroud is in its raised position.

24. The method of claim 23, further comprising lowering the shroud to its lowered position after maintenance is completed and mechanically securing the shroud in the lowered position with at least one fastener.

25. The method of claim 21, further comprising routing a cable inside the alignment channel such that the cable engages the slide block with a counterweight to facilitate raising and lowering the shroud.

26. The method of claim 25, further comprising adjusting a mass of the counterweight to balance or slightly exceed a mass of the shroud, thereby enabling single-person vertical movement of the shroud.

27. The method of claim 25, further comprising providing a positive stop on the cable to prevent the cable from disengaging from the slide block during movement of the shroud.

28. The method of claim 21, further comprising forming a protrusion on the shroud and a corresponding cavity in the slide block, wherein the protrusion fits within the cavity to secure the shroud to the slide block during vertical movement.

29. The method of claim 21, wherein the shroud is a one-piece, hollow body that is substantially free of seams.

30. The method of claim 21, further comprising providing a float plate for the support structure that aligns the alignment channel with the shroud to reduce friction and binding as the shroud moves.

31. The method of claim 21, further comprising completely removing the shroud by raising it above the support structure once it is disengaged from the slide block or the alignment channel.
32. The method of claim 21, wherein the support structure comprises a plurality of circular plates, and the alignment channel is connected to the circular plates at an outer periphery thereof.
33. The method of claim 21, wherein the shroud is made from an RF-transparent material selected from the group consisting of plastic, thermoplastic, and vinyl foam core sandwich panels.
34. The method of claim 21, wherein the alignment channel has a U-shaped cross section, and the slide block is dimensioned to slide within the U-shaped cross section.
35. The method of claim 21, further comprising disposing multiple alignment channels around the periphery of the support structure, each alignment channel configured to receive a corresponding slide block.