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(54) **STRUCTURAL REINFORCEMENT MEMBER AND METHOD OF UTILIZING THE SAME TO REINFORCE A LONGITUDINAL SECTION OF AN ANTENNA SUPPORT TOWER**

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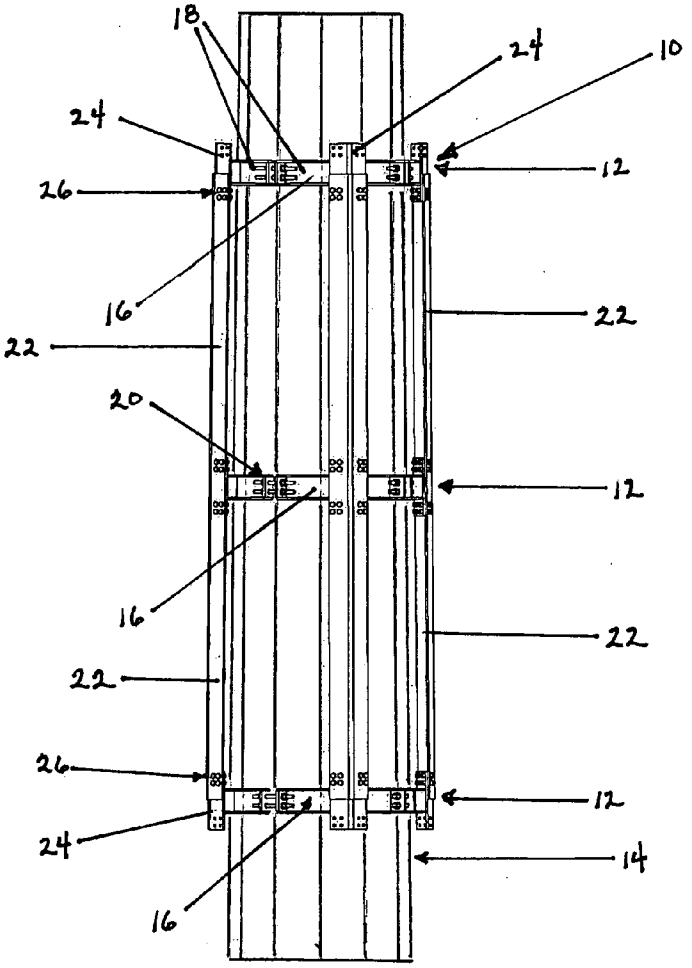
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(57) **ABSTRACT**

An assembly for reinforcing a longitudinal section of a pole, includes at least two load transfer rings formed by sleeve segments having radically opposed mating ends. The rings are adapted to fit onto the outer surface of the pole so as to circumferentially encompass the pole. The sleeve segments are connected at their ends by a nut and bolt assembly, wherein tightening of the nut and bolt assembly creates a radial clamping force to squeeze the load transfer rings onto the outer surface of the pole for holding the rings in fixed relation thereon. Elongated stiffener members are fixedly attached to the load transfer rings by a nut and bolt assembly or by welding. The load transfer rings may also be partially welded to the exterior of the pole if structural load bearing demands require additional capacity.



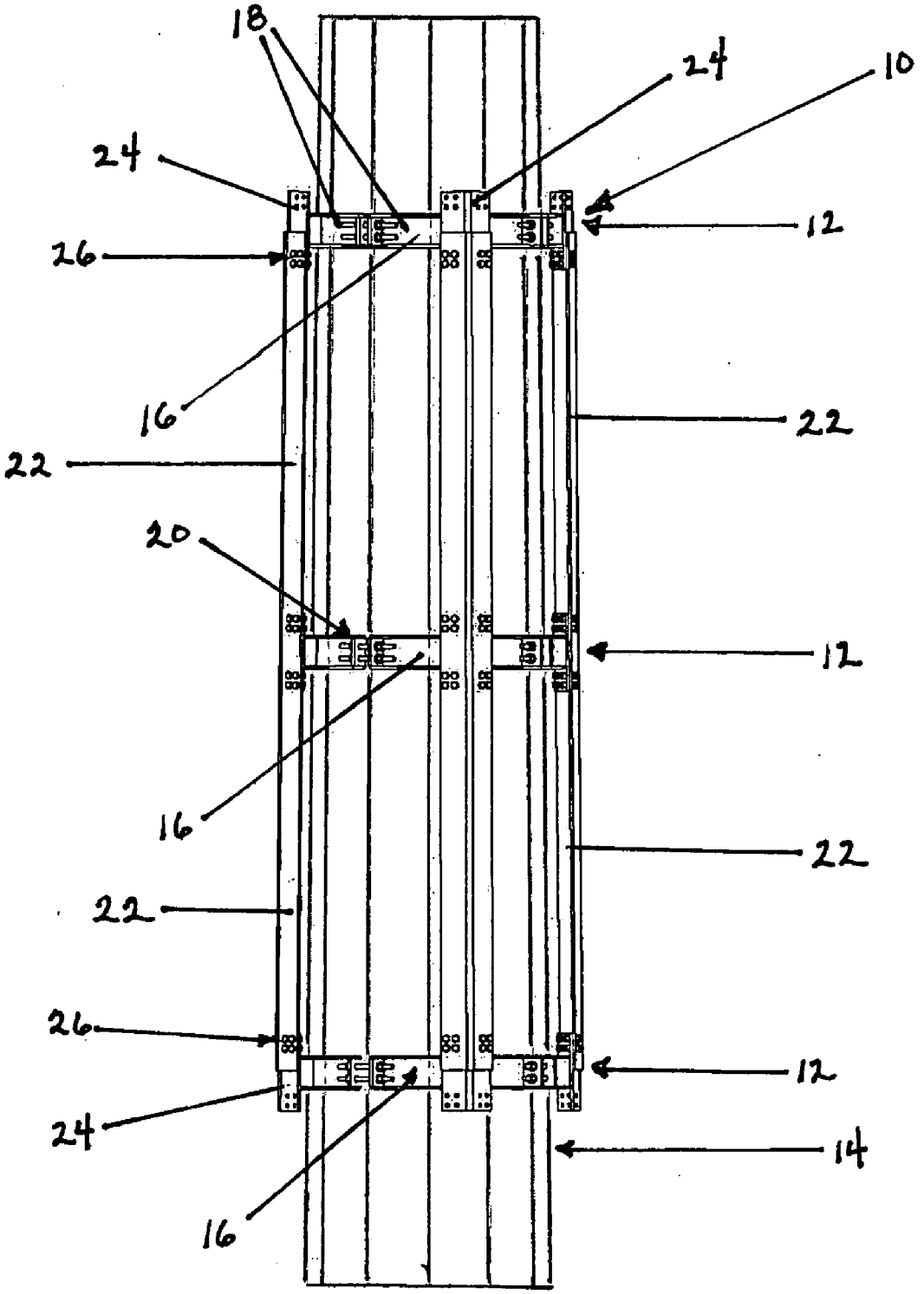


Fig. 1

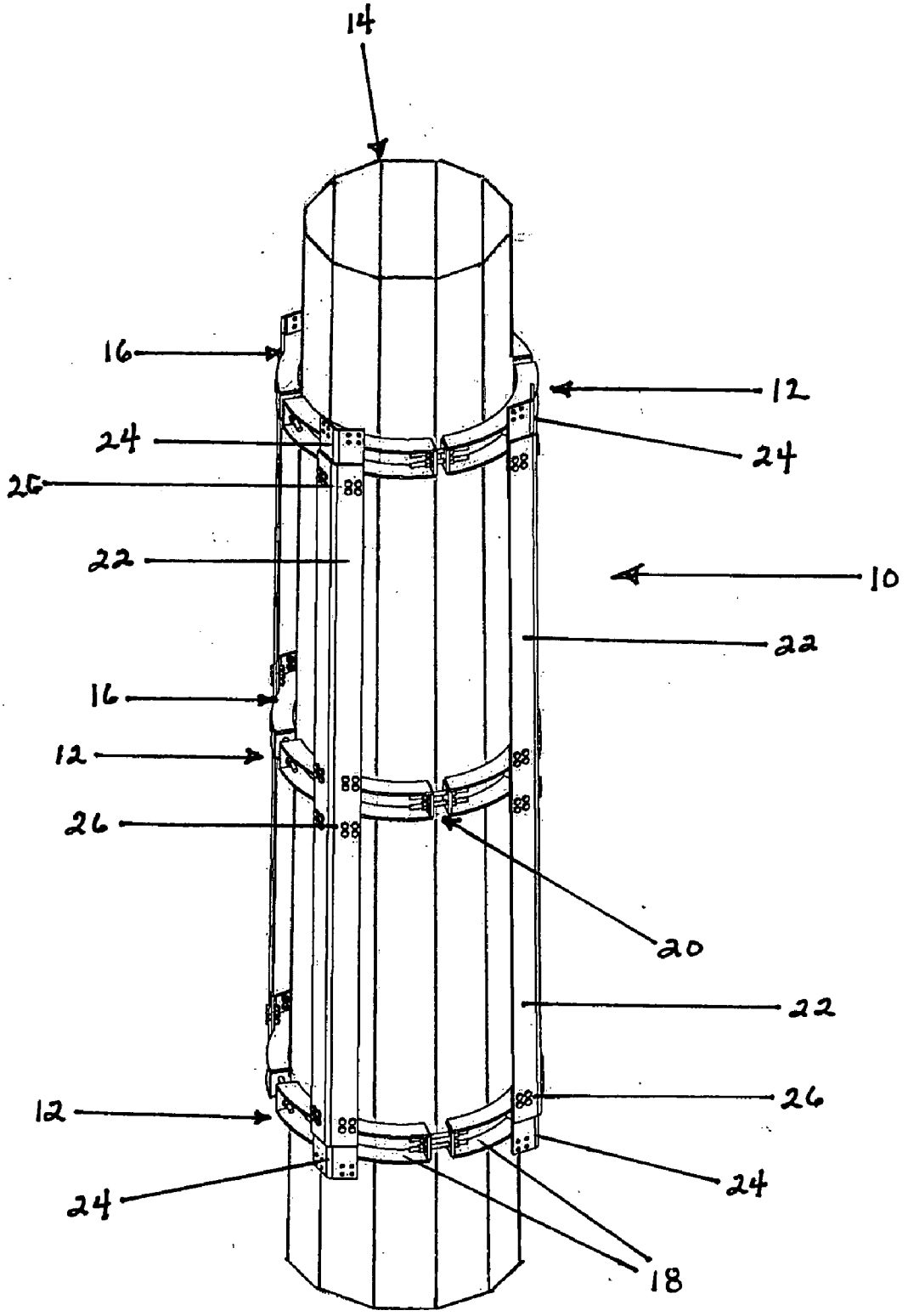


Fig. 2

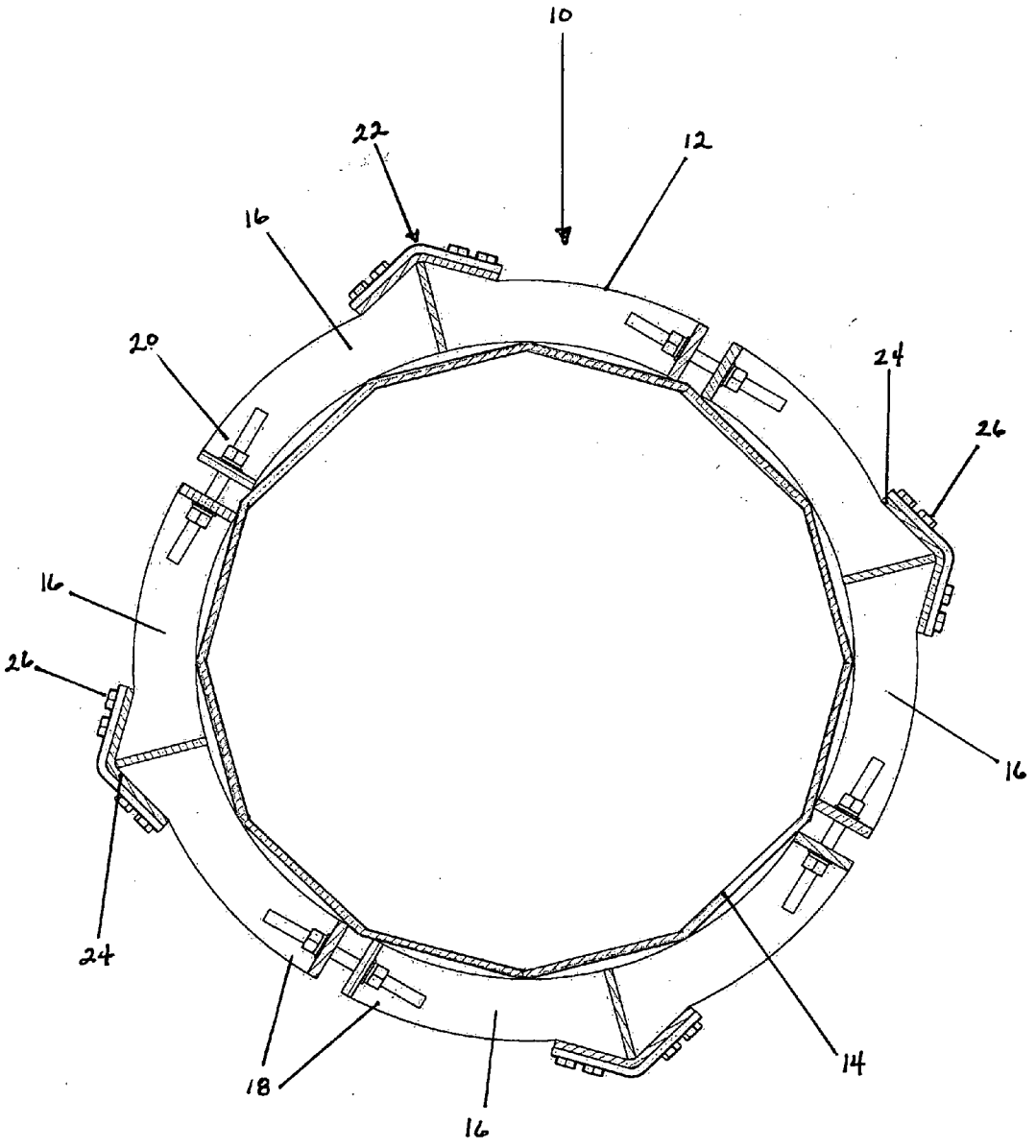


Fig. 3

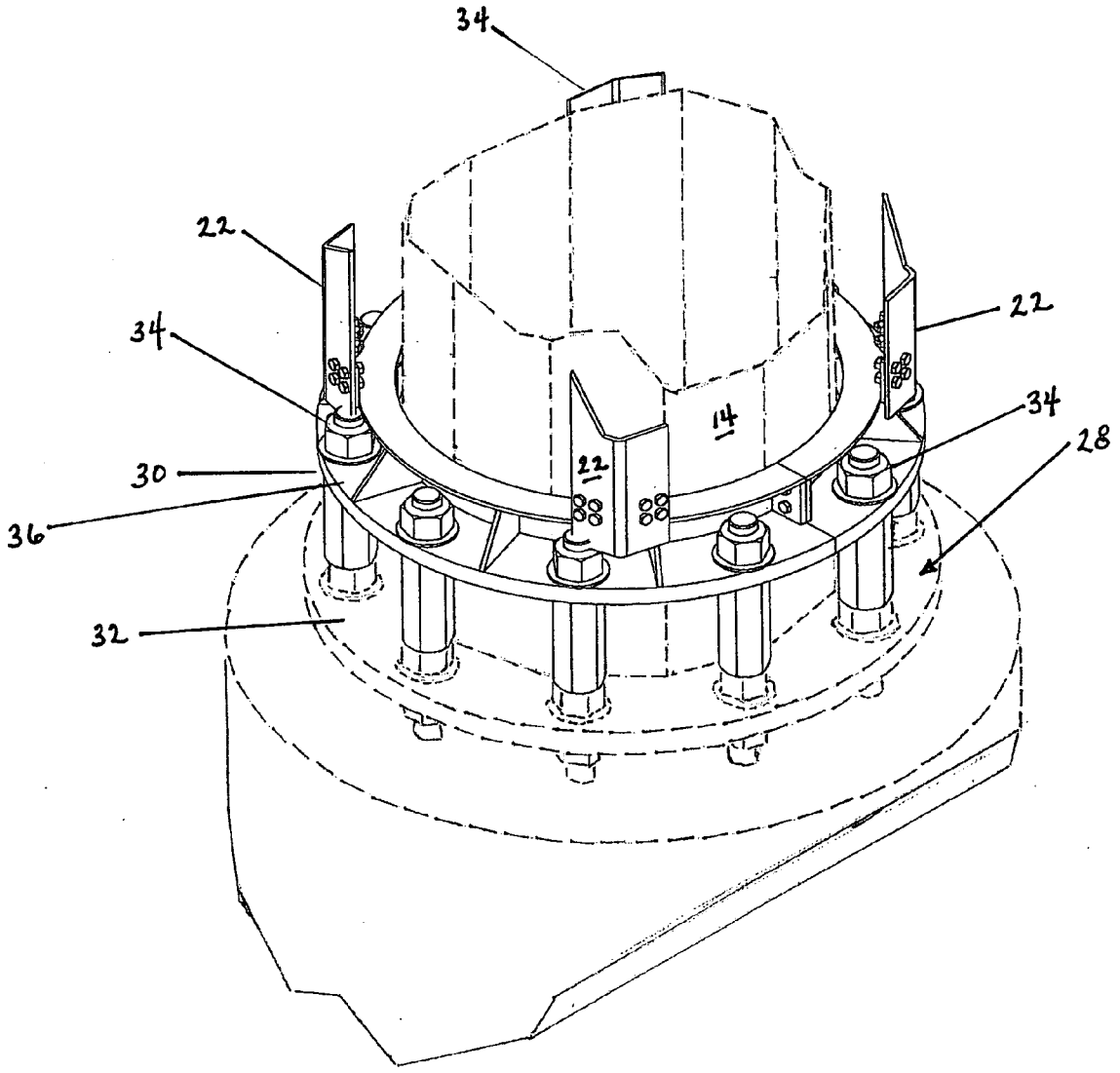


Fig. 4

STRUCTURAL REINFORCEMENT MEMBER AND METHOD OF UTILIZING THE SAME TO REINFORCE A LONGITUDINAL SECTION OF AN ANTENNA SUPPORT TOWER

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to the field of structural reinforcing and strengthening systems and more particularly to a novel and improved structural reinforcement assembly and method of utilizing the same to reinforce structures such as communication poles, cellphone and antenna towers on which antennas are mounted to allow more tenants to be added thus increasing tower efficiency and usage.

[0003] 2. Description of the Prior Art

[0004] Current known structural reinforcing and strengthening systems and methods fall into four main categories. The first general category includes the use of welded stiffener plates. This design uses stiffener plates that are welded continuously directly to the exterior surface of the communications pole. This technique is very time consuming and risky as the heat caused by welding the stiffener plates to the exterior of the pole sometimes causes a fire on the inside of the communications pole by igniting the plastic covering the cables which are normally run through the hollow interior of the pole.

[0005] A second category is similar to that described immediately above where stiffener rods are welded to the communications pole. This design uses solid steel round reinforcing bars normally in twenty foot lengths that are bolted together and welded to the communications pole in five foot increments where spacers are located. This process is very time and labor consuming, but is less risky than reinforcing methods in category one discussed above, as the welding only occurs every five feet or so along the communications pole where the spacers are located. Thus while the overall opportunity for damage due to heating is lessened, the danger still exists at those spacer locations along the pole.

[0006] A third category uses bolted on stiffener plates. In this design, the reinforcing plates are bolted directly to the exterior surface of the communications pole. This technique is very time and labor consuming as the communications pole needs to be drilled at the site location by skilled workers in numerous locations to match the bolt pattern of the stiffener plate. Errors made at the site are not easily remedied. The benefit of this system is that there is no welding on the communications pole resulting in a less risky procedure, i.e., less likely to cause damage to the interior cabling due to weld heating, but it also creates the potential for environmental damage to the cabling in the pole interior due to the holes being drilled into the pole for attachment of the stiffener plates.

[0007] The fourth known category for reinforcing communication poles is also the most recent. It uses fiberglass plates that are epoxy glued to the surface of the pole. This recent technique has not been proven with the test of time. While this technique eliminates the heating danger, there are serious concerns about the "fiberglass glued to steel construction" weathering several freeze-thaw cycles, especially in areas such as the Northeast and Midwest where such freeze-thaw cycles can be extreme and numerous in a single season. This is, however, probably the fastest of the known systems to install.

[0008] The present invention deals with and solves the problems noted above in existing known reinforcing systems that arise in attempting to design and manufacture a structural reinforcing system for communication poles, or for any elongated structural element that eliminates or lessens the fire danger to cabling in the interior of the poles.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a structural reinforcing system and method that is useful for structures such as communication poles that eliminates or lessens the fire danger to cabling run through the interior of such poles from welding.

[0010] It is an additional object of the present invention to provide a structural reinforcing system and method that is useful for structures such as communication poles to increase the tenant carrying capacity of the pole.

[0011] It is a further object of the present invention to provide a structural reinforcing system and method that is useful for structures such as communication poles that requires little to no welding.

[0012] It is an object of the present invention to provide a structural reinforcing system and method that is useful for structures such as communication poles that is modular in construction, easily upgraded, downgraded, relocated on the pole to meet changing needs, or even removed from the pole with little effort.

[0013] It is an additional object of the present invention to provide a structural reinforcing system and method that is useful for structures such as communication poles that is modular, provides standardized assembly elements for design ease, that is quickly shipped to pole sites and is economic in manufacture and purchase cost.

[0014] In general, the invention is embodied in an assembly for reinforcing a longitudinal section of a pole, such as a communication tower or antenna tower, by employing a plurality of load transfer rings mounted on the tower by either welding, epoxy gluing, or compressive forces. Each ring has a series of sleeve segments with radically opposed mating ends that are joined to form the ring. The load transfer rings are adapted to fit onto the outer surface of the pole so as to circumferentially encompass the pole.

[0015] The sleeve segments are connected at their radically opposed mating ends by a nut and bolt assembly, where tightening the nut and bolt assembly creates a radial clamping force to squeeze the load transfer rings onto the outer surface of communications pole for holding the load transfer rings in fixed relation thereon.

[0016] Connecting the rings are elongated stiffener members that are fixedly attached to the load transfer rings mounted on the outer surface of the pole which act to create an exoskeletal frame for reinforcing the pole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** is a side plan view of a reinforcing assembly mounted on a pole section embodying the present invention;

[0018] FIG. **2** is a side elevational view of a reinforcing assembly mounted on a pole section embodying the present invention similar to that illustrated in FIG. **1**;

[0019] FIG. **3** is a top plan view of a reinforcing assembly mounted on a pole section embodying the present invention similar to that illustrated in FIG. **1**; and, FIG. **4** is a side elevational view of one preferred method of attaching the base load transfer ring attachment to the pole base plate assembly.

DETAILED DESCRIPTION OF THE INVENTION

[0020] The present invention is directed to an assembly for reinforcing a longitudinal section of a pole segment, for non-limiting example, such as those found in communication poles, antenna or cellular towers.

[0021] It is preferred that the reinforcing assembly **10** include a plurality of annular, load transfer rings **12** mounted along the longitudinal length of the pole **14** that is to be strengthened, as illustrated in FIGS. **1** and **2** of the accompanying drawings. These load transfer rings are placed along the longitudinal length of the communication pole in a spaced apart relationship. For ease in installing the rings onto the pole, it is preferred that the rings be formed from a plurality of individual, standardized sleeve segments **16** having radically opposed mating ends **18** best seen in FIG. **3**. Once the segments **16** are joined at ends **18**, they form the load transfer ring **12** and are adapted to fit onto the outer surface of the pole **14** so as to circumferentially encompass the pole as shown in the FIGS. By using standardized, modular sleeve segments to form the load transfer rings, the rings can be quickly installed on existing poles where needed with a minimum of installation difficultly. Also the use of standardized, modular design elements allows for ease in engineering design, manufacture and installation of the assembly at the tower site. While FIG. **3** illustrates four sleeve segments **16** forming the load transfer ring **12**, it must be understood that any number of sleeve segments may be utilized to form the load transfer ring depending on the ease of manufacture, cross-sectional profile of the pole section to be strengthened, or the installation desired. Likewise, the exterior shape of the load transfer ring may be adapted to provide additional capabilities, such as mounting sites for additional antenna systems or a ladder or guying posts while the interior portion of the load transfer ring is shaped to mate generally around the pole's cross-sectional shape in the location that the reinforcing assembly **10** is to be attached.

[0022] One preferred method of connecting the sleeve segments together to form the load transfer rings, is to connect each sleeve segment **16** at its radically opposed mating ends **18** to adjacent sleeve segments by a nut and bolt assembly **20** as shown in the FIGS. When nut and bolt assembly **20** is tightened, it creates a radial clamping force to squeeze the load transfer rings onto the outer surface of the pole for holding the load transfer rings in fixed relation thereon. As shown in FIG. **3**, the interior shape of the load transfer ring need not fully mirror that of the cross-sectional shape of the pole for a secure and snug fit.

[0023] Additionally, where the pole cross-sectional diameter varies along its longitudinal axis, gravity may also be used to hold the ring in place in a frictional, downward engagement of the interior of the load transfer ring with an enlarging pole cross-section.

[0024] For additional reinforcing strength, the load transfer rings may also be at least partially welded to the outer surface of the pole either continuously or by spot welding around the ring's interior circumference.

[0025] Elongated stiffener members **22** are fixedly attached to the load transfer rings **12** as illustrated in the FIGS. Preferred stiffener members are steel reinforcing rods, angle irons, and plates. Also more exotic stiffener elements such as cabling and fiberglass plates and sheets are within the scope of the present invention as viable alternatives that may be used for stiffener members.

[0026] Stiffener members **22** may be attached to each one of the load transfer rings **12**, to adjacent load transfer rings, or to alternate load transfer rings to form an overlapping network of interlocked stiffener members and load transfer rings as seen in FIGS. **1** and **2**. Stiffener members may also be attached to one another to create a stiffener member with a greater length.

[0027] Likewise the number of stiffener members attached to the load transfer rings may vary from a single stiffener member to eight members or more depending on the degree of reinforcing sought or demanded for the particular pole.

[0028] One preferred method of attaching the stiffener members to the load transfer rings is by a nut and bolt assembly **20** as shown in the FIGS. As illustrated most clearly in FIG. **3**, one preferred method of attachment using the nut and bolt assembly is by having the sleeve segments **16** formed with a flange or protuberance **24** for mating with a corresponding flange or hole assembly **26** formed on the elongated stiffener member **22** to provide a reinforced and enlarged mounting base for the nut and bolt assembly to hold the stiffener member to the sleeve segments forming the load transfer rings. By extending the flange configuration on either or both the stiffener member or the sleeve segments along the longitudinal axis of the pole, additional strengthening support can be created for the overall assembly by distributing the attaching forces between the reinforcing member and the load transfer ring over a larger area.

[0029] It is also preferred that the various elements constituting the reinforcing assembly, that is the sleeve segments, load transfer rings and stiffener members be standardized and made modular. By standardizing and making these elements modular, the assembly may be easily upgraded, downgraded, installed or removed with little effort and tools at the pole site. The stiffener members can be easily removed and replaced with larger or smaller ones or the load transfer rings can be moved along the longitudinal axis of the pole, moving the reinforcing assembly higher or lower long the length of the pole to meet the needs of the users. Also, such standardization leads to economies not only in manufacturing time, but in manufacturing costs and shipping times as it can be manufactured in volume and customized for an individual site installation using such modular building blocks.

[0030] As illustrated in FIG. **4**, to provide additional strengthening, an assembly **10** embodying the present invention preferably attaches directly to the fixed base plate assembly **28** from which pole **14** generally extends.

[0031] One of the load transfer rings, designated as base load transfer ring **30** is fixedly attached to the pole base plate **32** as illustrated in FIG. **4**. Base load transfer ring **30** may be

additionally strengthened by providing in it extending circumferential reinforcement flanges **36** through which nut and bolt assemblies **34** may be installed as described below in greater detail.

[**0032**] One preferred method of attaching base load transfer ring **30** to pole base plate **32**, is shown in FIG. **4** as nut and bolt assemblies **34** which incorporate reinforcing flanges **36** in base load transfer ring **30** to create a secure bond between base load transfer ring **30** and pole base plate **32**. Likewise, base load transfer ring **30** may be welded to pole base plate **32**, or held in place by an adhesive epoxy bonding compound intermediate base load transfer ring **30** and pole base plate **32**. The preferred method of attaching base load transfer ring **30** to pole base plate **32** depends upon the specific factors of the installation, including weather conditions, size of the pole, location, economies of installation, desired speed of installation, etc.

[**0033**] Elongated stiffener members **22** are fixedly attached to base load transfer ring **30** and at least one other load transfer ring **12** to add rigidity to the structure.

[**0034**] The present invention is also embodied in a method of reinforcing a longitudinal section of a pole that would include the steps of:

[**0035**] Providing a plurality of load transfer rings at least partially along the longitudinal axis of the pole that is to be reinforced in a spaced apart relationship. Each of the load transfer rings is formed by a plurality of sleeve segments having radically opposed mating ends, and is adapted to fit onto the outer surface of the pole so as to circumferentially encompass the pole.

[**0036**] Connecting the sleeve segments at their radically opposed mating ends by a nut and bolt assembly, where tightening of the nut and bolt assembly creates a radial clamping force to squeeze the load transfer rings onto the outer surface of the pole for holding the load transfer rings in fixed relation thereon.

[**0037**] Providing a plurality of stiffener members, such as steel or fiberglass stiffening plates, reinforcing bars, angle irons fixedly attached to the load transfer rings by a nut and bolt assembly.

[**0038**] Further, to provide for a greater reinforcing strength if needed, the method also includes welding, or adhering with an epoxy, at least partially, at least one of the load transfer rings to the outer surface of the pole for holding the transfer ring in fixed relation thereto.

[**0039**] Likewise, the method of the present invention also includes a step of forming on the sleeve segments a flange for mating with a flange formed on the elongated stiffener member to provide a reinforced mounting base for the nut and bolt assembly to hold the stiffener member to the load transfer rings.

[**0040**] Alternatively, the method of the present invention includes a step of forming on the sleeve segments a protrusion for mating with the elongated stiffener member to provide a reinforced mounting base for the nut and bolt assembly to hold the stiffener member to the load transfer rings.

[**0041**] Certain modifications and improvements will occur to those skilled in the art upon a reading of the foregoing description. It should be understood that the present invention is not limited to any particular type of design or arrangement of the individually claimed elements. One of ordinary skill in the art will recognize that there are different manners in which these elements described above can provide to accomplish the present invention. The present invention is intended to cover what is claimed and any equivalents. The specific embodiments used herein are to aid in the understanding of the present invention, and should not be used to limit the scope of the invention in a manner narrower than the claims and their equivalents.

What is claimed is:

1. An assembly for reinforcing a longitudinal section of a pole, the pole extending generally from a fixed base plate, comprising:

At least two load transfer rings, each being formed by at least two sleeve segments having radically opposed mating ends, said load transfer rings adapted to fit onto the outer surface of said pole so as to circumferentially encompass said pole;

Means for holding said load transfer rings in fixed relation to the outer surface and longitudinal axis of the pole;

At least one stiffener member fixedly attached to at least two of said load transfer rings.

2. A reinforcing assembly as in claim 1, wherein one of said load transfer rings is fixedly attached to the pole base plate.

3. An assembly for reinforcing a longitudinal section of a pole, the pole extending generally from a fixed base plate, comprising:

At least two load transfer rings, each being formed by at least two sleeve segments having radically opposed mating ends, said load transfer rings adapted to fit onto the outer surface of said pole so as to circumferentially encompass said pole,

Said sleeve segments connected at said radically opposed mating ends by a nut and bolt assembly, wherein tightening of said nut and bolt assembly creates a radial clamping force to squeeze said load transfer rings onto said outer surface of said pole for holding said load transfer rings in fixed relation thereon and prevent movement along the longitudinal axis of the pole;

At least one elongated stiffener member fixedly attached to at least two of said load transfer rings being held in fixed spaced apart relation to one another on said outer surface of the pole.

4. A reinforcing assembly as in claim 3, further comprising:

one of said load transfer rings being a base load transfer ring that is fixedly attached to the pole base plate, and,

at least one of said elongated stiffener members being fixedly attached to said base load transfer ring and to at least one other of said load transfer rings held in fixed spaced apart relation to said base load transfer ring on said outer surface of the pole.

5. A reinforcing assembly as in claim 4, wherein said base load transfer ring is fixedly attached to the pole base plate by a nut and bolt assembly.

6. A reinforcing assembly as in claim 4, wherein said base load transfer ring is fixedly attached to the pole base plate by welding said base load transfer ring to the pole base plate.

7. A reinforcing assembly as in claim 4, wherein said base load transfer ring is fixedly attached to the pole base plate by an adhesive epoxy bonding compound intermediate said base load transfer ring and the pole base plate.

8. A reinforcing assembly as in claim 4, wherein said at least one elongated stiffener member is fixedly attached to said sleeve segments forming said load transfer rings by a nut and bolt assembly.

9. A reinforcing assembly as in claim 4, wherein said at least one elongated stiffener member is fixedly attached to said load transfer rings by welding said stiffener member to said sleeve segments.

10. A reinforcing assembly as in claim 4, wherein said at least one elongated stiffener member is fixedly attached to said load transfer rings by an adhesive epoxy bonding compound intermediate said stiffener member and said sleeve segments.

11. A reinforcing assembly as in claim 4, wherein at least one of said load transfer rings is at least partially welded to said outer surface of the pole for holding said transfer ring in fixed relation thereto.

12. A reinforcing assembly as in claim 4, wherein said at least one elongated stiffener member is a reinforcing rod.

13. A reinforcing assembly as in claim 4, wherein said at least one elongated stiffener member is an angle iron.

14. A reinforcing assembly as in claim 4 wherein said sleeve segments have a flange formed thereon for mating with a flange formed on said elongated stiffener member to provide a reinforced mounting base for said nut and bolt assembly to hold said stiffener member to said load transfer rings.

15. A reinforcing assembly as in claim 4 wherein said sleeve segments have a protrusion formed thereon for mating with said elongated stiffener member to provide a reinforced mounting base for said nut and bolt assembly to hold said stiffener member to said load transfer rings.

16. A method of reinforcing a longitudinal section of a pole comprising:

providing at least two load transfer rings, each being formed by at least two sleeve segments having radically opposed mating ends, said load transfer rings adapted to fit onto the outer surface of said pole so as to circumferentially encompass said pole;

connecting said sleeve segments at said radically opposed mating ends by a nut and bolt assembly, wherein tightening of said nut and bolt assembly creates a radial clamping force to squeeze said load transfer rings onto said outer surface of said pole for holding said load transfer rings in fixed relation thereon;

providing at least one elongated stiffener member fixedly attached to at least two of said load transfer rings by a nut and bolt assembly.

17. A method for reinforcing a longitudinal section of a pole as in claim 16, further comprising:

Welding, at least partially, at least one of said load transfer rings to said outer surface of said pole for holding said transfer ring in fixed relation thereto.

18. A assembly method for reinforcing a longitudinal section of a pole as in claim 16, further comprising:

providing a reinforcing rod for said at least one elongated stiffener member.

19. A assembly method for reinforcing a longitudinal section of a pole as in claim 16, further comprising:

providing an angle iron for said at least one elongated stiffener member.

20. A assembly method for reinforcing a longitudinal section of a pole as in claim 16, further comprising:

forming on said sleeve segments a flange for mating with a flange formed on said elongated stiffener member to provide a reinforced mounting base for said nut and bolt assembly to hold said stiffener member to said load transfer rings.

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