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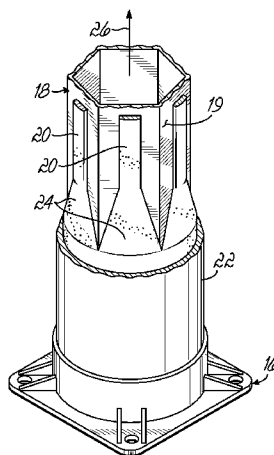


FIG. 2

(57) **Abstract:** A pole (10) for supporting another structure comprising at least one interior skin layer (18), at least one structural filler layer (24), and at least one exterior skin layer (22). The structural filler layer (24) is positioned around the outer surface (19) of the interior skin layer (18), and may be coupled with the at least one interior skin layer (18). The exterior skin layer (22) is positioned around an outer surface (19) of the structural filler layer. The exterior skin layer (22) may be coupled with at least one of the structural filler layers (24). The exterior skin layer (22) being formed from a continuous sheet of material to be continuous along the length of the pole. The layers may be manufactured on site to minimize shipping and installation costs.

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SUPPORT POLE STRUCTURE AND METHOD OF MANUFACTURE**Related Applications**

[0001] This Application claims the benefit of the priority of U.S. Provisional Patent Application Serial Number 60/958,736, entitled LAMINATED POLE DESIGN filed July 9, 2007, which priority application is incorporated herein by reference in its entirety.

Field of the Invention

[0002] This invention relates generally to a pole structure and the construction and manufacture thereof, such as poles utilized to support lights, flags and signage.

Background of the Invention

[0003] Support pole structures are utilized for a variety of different purposes. For example, support pole structures are utilized to support light fixtures, cellular communication components, such as cell phone antennas mounted at an elevated position, flags, or various different signage components.

[0004] Because of the elevated heights at which such fixtures and components are mounted, as well as the weight of such, fixtures and components, support poles generally need to be of a robust construction. While various pole designs exist, which adequately satisfy the strength requirements for the noted lighting, signage, and/or communication components, generally there are various drawbacks in utilizing existing poles.

[0005] First, these pole structures are generally long, and existing poles are heavy and bulky, and thus are difficult and expensive to transport. Similarly, their installation is also difficult and expensive due to their weight and size. Furthermore, existing pole structures are expensive to manufacture, as they require significant amounts of material, such as metal wood or composites, for their fabrication.

[0006] First, these In addition, because of the thick wall sections used during the manufacturing process associated with making existing pole structures, these products must be manufactured at one site, and then shipped when completed to the final site for installation. If the installation site requires any modification of the pole, or if the wrong pole is shipped, the pole structure has to be returned to the manufacturer. Given the rising cost of fuel and increasingly limited availability of tractor trailers, such unnecessary or wasted transportation costs are not insignificant with respect to the overall cost of utilizing existing pole structures.

[0007] Consequently, there is still a need in the field for a support pole structure, which is robust, but which might be readily and easily transported and installed. Furthermore, there is a need for a pole structure which may be manufactured in a cost-effective manner, and which is easily adapted to the conditions at the site where the pole is to be utilized.

Brief Description of the Drawings

[0008] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given below, serve to explain the principles of the invention.

[0009] Figure 1 is a perspective view of a pole in accordance with the present invention.

[0010] Figure 2 is a cutaway section of one embodiment of the invention.

[0011] Figure 3 is a sectional view of a portion of an assembly station for manufacturing the present invention as depicted in Figure 2.

[0012] Figure 3A is a perspective view of a portion of an embodiment of the present invention.

[0013] Figure 4 is a cutaway section of one embodiment of the invention.

[0014] Figure 5 is a cutaway section of one embodiment of the invention.

[0015] Figure 6 is a cross-sectional view of one embodiment of the invention shown in Figure 5.

[0016] Figure 7 is a cross-sectional view of one embodiment of the invention.

[0017] Figure 8 is a cross-sectional view of one embodiment of the invention.

[0018] Figure 9 is a cross-sectional view of one embodiment of the invention.

[0019] Figure 10A and 10B are prospective views of a roll forming station for manufacturing the invention.

[0020] Figure 11 is a prospective view of a fabrication site for manufacturing the invention.

[0021] Figure 12 is an exploded view of a base structure in accordance with the principles of the invention.

[0022] Figure 13 is an exploded view of a cap structure in accordance with the principles of the invention.

[0023] Figure 14 is a cross-sectional view of the cap structure of Figure 13 as installed on a pole.

Detailed Description of the Invention

[00024] Figure 1 illustrates one embodiment of a structural support pole, or utility pole 10 in accordance with one aspect of the invention. The pole 10, as shown in Figure 1 supporting a typical light structure 12, may support other structures, such as flags, cellular communication antenna, signage, etc. As such, the structural support pole of the present invention is not limited to the specific structure being supported.

[00025] In accordance with one aspect of the present invention, the pole may be fabricated, and then topped off by a top cap, or cap structure 14, and held in place at the ground level by a suitable base or base structure 16, as discussed further hereinbelow.

[00026] As shown in figure 2 and in accordance with one aspect of the invention, the pole 10 includes a plurality of layers or structures, including at least one interior skin layer or structure 18, and a structural filler layer or structure 20 that is fixedly attached to the interior skin layer 18, and positioned around an outer surface 19 of that interior skin layer 18. An exterior skin layer or structure 22 is positioned around the outside of the pole 10, and is fixedly attached to the structural filler layer 20 and/or the interior skin layer 18 to complete the pole construction.

[00027] In accordance with one aspect of the present invention, the exterior skin layer 22 is continuous along the length of the pole. More specifically, the interior and exterior skin layers 18, 22 are fabricated in a portable, continuous fabrication process starting with rolled sheet material. In this way, the pole structure of the present invention may be fabricated to practically any desired length, on site,

i.e. at the location where the pole is to be installed. Therefore, a finished pole does not have to be shipped to the site, but rather can be fabricated on site to the desired length.

[00028] Various cross-sectional and cutaway sections of alternate embodiments of the invention are illustrated in Figures 2-5. For example, as illustrated in Figure 2, the interior skin layer 18 is formed of a thin metallic sheet material as an elongated tubular structure having one of various different shapes. In this example, a hexagonal shape is shown. Likewise, the tubular structure that makes interior skin layer 18 may include a round, square, polygonal or fluted cross-sectional shape. Of course, it would be understood by a person of ordinary skill in the art, that the cross-sectional shape of the tubular structure that forms the interior skin layer 18 is not limited. Generally, the form or shape of the interior skin layer will be dependent upon the required strength of the pole and/or its particular use. Furthermore, the desired cross sectional shape and taper of an exterior skin layer 22 and required strength of the pole structure may dictate the shape of the interior skin layer 18.

[00029] As illustrated in Figure 2, the exterior skin layer 22 is configured in the form of a tubular structure as well. The exterior skin layer 22 forms the outside aesthetic surface of the pole 10. That tubular structure that forms the exterior skin layer 22 may have a cross-section that is circular, as shown in Figure 2, or may take any other desired cross-sectional shapes, such as a square, polygonal, or fluted, etc.

[00030] In one embodiment of the invention, the interior and exterior skin layers 18, 22 are thin layers with a wall thickness in the range of 0.010 to 0.250 inches. Due to the relatively thin thicknesses of the metal, the skin layers might be

formed on site or may be rolled on a coil, as discussed further hereinbelow. A suitable metal material might be selected from the group of: aluminum, steel, brass, copper, and stainless steel. When the skin layers are formed from a continuous sheet of material, those skin layers are generally continuous along the length of the pole, or at least along the length of that particular skin layer. It is noted that in some embodiments, certain of the interior skin layers may not extend along the entire length of the pole, as discussed hereinbelow.

[00031] In an alternative embodiment of the invention, one or more of the skin layers might be made of a composite pultruded material rather than thin sheets of metal. Again, it is envisioned that the pultruded material would be fabricated on site.

[00032] In accordance with another aspect of the invention, the interior and exterior skin layers 18, 22 are physically separated by a structural filler layer 20. Therefore the interior and exterior skin layers 18, 22 may be made of different materials without concern for adverse galvanic reaction between two dissimilar metal materials. For example, the interior skin layer 18 may be made of high strength steel while the exterior skin layer 22 is made of corrosion resistant aluminum alloy. In this way, the present invention allows use a combination of materials to enhance strength without compromising durability or appearance.

[00033] In one aspect of the invention, at least one structural filler layer 20 is positioned between and coupled to the interior skin layer 18 and/or the exterior skin layer 22. The structural filler layer may take a variety of different forms, as illustrated in the Figures, and may be applied and coupled to the interior skin layer 18, and exterior skin layer in a number of different fashions. Preferably, the structural filler layer 20 is applied in a continuous fashion on either the interior skin layer or the exterior skin layer as the skin layers are being formed. As discussed

further hereinbelow, the unique construction of the pole 10 utilizing continuous layers and continuous fabrication method, provides for unique benefits to the present invention over the poles utilized in the prior art.

[00034] Referring to Figure 2, in one embodiment of the invention, the structural filler layer may comprise a plurality of rigid elements 24 that surround the interior skin layer 18, and extend generally along an axis 26 of the pole. Those rigid elements 24 may take a variety of forms, or be made from various materials. In one embodiment, the filler elements 24 might be made of rigid foam that may be positioned along the outside of the interior skin layer 18. The structural filler element layer 20 might be fixedly attached or secured to one or more of the interior and exterior skin layers 18, 22, such as by an adhesive. The rigid foam elements 24 are illustrated as elongated elements that extend in the generally parallel fashion along the height of the pole 10.

[00035] In one embodiment, as illustrated in Figure 3, during a continuous fabrication process, a foam applicator 25 might be utilized to spray a foam structural filler layer onto the interior skin layer 18 so that the filler layer expands and hardens to form rigid foam elements 24.

[00036] As further shown in Figure 3, each of the rigid filler elements 24 might be sprayed onto the interior skin layer by individual spray heads 90. Alternatively, a continuous structural foam filler layer might be utilized. For an embodiment using a structural foam filler layer 20, a layer of a rigid foam material might be sprayed onto the interior skin layer 18 so as to completely encircle the skin layer.

[00037] The structural filler layer 20 is positioned between the interior and exterior skin layers 18,22, and is coupled to one or more of the skin layers. For example, the structural filler layer 20 might be fixed to at least one of the interior skin layer or the exterior skin layer utilizing an adhesive. Of course, the structural filler layer might be affixed to both of those skin layers utilizing an adhesive. In embodiments utilizing sprayed structural foam to form the structural filler layer 20, the foam may incorporate an adhesive, which adheres it to the skin layer on which it contacts.

[00038] In an alternative embodiment of the invention, small metal tubes or rods 28 might be utilized for filler elements, as shown in Figure 4. Such rods or tubes 28 might also be positioned around the interior skin layer 18 to extend along the axis 26 of the pole. Generally, the defined filler elements 24, 28, will extend along most of the length of pole 10 to provide increased structural strength to the pole.

[00039] In an alternative embodiment of the invention, the structural filler layer might be fixed to at least one of the skin layers utilizing mechanical means. For example, welding, screws, bolts, or other fasteners might be utilized to affix the structural filler layer to one or more of the skin layers.

[00040] In still another alternative embodiment of the invention, a structural filler layer might be composed of a combination of metal structures 28 with foam filler elements 24 therebetween. For example, elongated rigid foam elements 24 might alternate with the metal elements 28, around the outside of the interior skin layer 18. Alternatively, metal structures 28 might be embedded in a foam layer 20 that generally encircles the interior skin layer 18.

[00041] Figure 5 and 6 illustrate an alternative embodiment of the invention, wherein the structural filler layer might be in the form of a continuous sheet structure, such as a continuous corrugated metal sheet 20A. The corrugated filler sheet 20a includes flutes or corrugations 30 formed therein. The flutes/corrugations space the interior and exterior skin layers 18, 22 apart from each other, and provide a significant wall thickness without significant additional cost or weight. A fluted or corrugated sheet or skin might be applied around the interior skin layer 18 in a number of different ways. In the embodiment illustrated in Figure 5, the corrugated filler sheet 20a is spirally wrapped around the pole 10 along the length of the inner tubular structure formed by interior skin layer 18. Other ways of positioning the corrugated filler sheet 20a between the interior and exterior skin layers 18, 22 might also be utilized.

[00042] In an alternative embodiment illustrated in Figure 7, the structural filler layer might be formed of individual corrugations or flutes of material 20b, rather than a skin or sheet of material. An individual continuous corrugation 20b might be spirally wrapped around interior skin layer 18 to form the structural filler layer of the invention. Furthermore, the pitch of the spirally wrapped individual continuous corrugation 20b might be varied along the height of the pole. For example, a smaller pitch might be utilized at the base of the pole for greater strength, whereas the pitch of the spiral toward the top of the pole might be increased such that each of the wraps is further apart from the previous wrap to decrease material where strength is not needed. Similarly, the pitch of the spiral wrapped corrugated filler sheet shown in Figure 5 might vary such that there would be space between the spirals.

[00043] While the embodiment of the present invention illustrated in Figures 2-7 incorporates a single interior skin layer 18, a single exterior skin layer 22, and structural filler layer 20, multiple skin and filler layers may also be utilized in practicing the present invention. For example, additional layers may be necessary for particularly tall or high strength poles. With such additional layers, a very tall or very stiff pole can be constructed in accordance with the principles of the invention, without needing to increase the wall thickness of the individual layers. Referring to Figure 8, a pole 10a is shown having an exterior skin layer 22 and multiple interior skin layers 18a, 18b. An additional structural filler layer 32 is positioned between the two interior skin layers 18a, 18b. The structural filler layer 32 might be made of a structural foam, as discussed above, and shown in Figure 8, or alternatively, formed of metal tubes or rods, or some other suitable elements to provide strength and structure between the skin layers as discussed herein.

[00044] Around the interior skin layer 18a, another structural filler layer 34 might be utilized to provide additional strength to the pole. In the embodiment illustrated in Figure 8, the structural filler layer 34 is in the form of a fluted layer, such as a fluted metal sheet. To provide additional structural strength, a rigid foam 36 might be applied or positioned in openings that are formed between the individual flutes 37. As such, the foam 36 might provide another structural filler layer, along with the fluted layer 34. In an alternative embodiment of the invention, other structural filler elements, such as metal tubes or rods might also be utilized in the space between the individual flutes or corrugations 37 of layer 34. Accordingly, the present invention is not limited to a particular number of interior skin layers or structural filler layers. Rather, multiple such skin layers might be utilized for strengthening of a pole structure.

[00045] In accordance with another embodiment of the invention, the various additional inner layers, as illustrated in Figure 8, might be incorporated in different sections of the pole. For example, additional inner layers, such as additional interior skin layers and structural filler layers, might terminate at different heights along the height or length of the pole in order to minimize the amount of material used in the construction. For example, the base of the pole might be significantly strengthened by the additional interior skin layers and structural filler layers, as illustrated in Figure 8. However, at some position along the pole's height or length, those additional layers may terminate. The rest of the pole then might proceed with a single interior skin layer, and a single structural filler layer inside of the exterior skin layer, as illustrated in Figure 6. Therefore, additional skin layers and structural filler layers may have a length less than the length of the at least one interior skin layer or structural filler layer. Of course, multiple different sections along the length of the pole might also be implemented such that different interior skin layers and structural filler layers terminate at different positions along the height of the pole. For example, the base portion of the pole might have three sets of interior skin layers and filler layers; the middle portion two such sets of layers; and the top portion only one set. As the general rule, more additional layers will be located more at the base and bottom portion of the pole where additional strength is needed, and less layers will be implemented progressing to the top.

[00046] Figure 9 illustrates an alternative embodiment of the invention, wherein the structural filler layer 46 varies in thickness around the perimeter of the pole. For example, the pole 40 has an interior skin layer 42, an exterior skin layer 44, and a structural filler layer 46. As illustrated, the structural filler layer is thinner, as indicated at T_1 at a certain point in the perimeter than it is at another point in the

perimeter, as indicated by T_2 . As illustrated in Figure 9, the thickness may vary from T_1 to T_2 , as the structural filler layer progresses around the perimeter of pole 40. In that way, the strength of the pole might be made greater on one side than on another. The structural filler layer 46 might be constructed as noted herein.

[00047] In accordance with another aspect of the invention, the structural filler layer may vary in thickness along the height of the pole. For example, one portion of the height of the pole, such as the base portion of the pole, may have a structural filler layer of thickness T_2 . However, progressing along the height of the pole to the top of the pole, the structural filler layer 46 may diminish to a thickness T_1 . As such, the structural filler layer may take a tapered shape, with varying thickness along its height. The thickness might vary discreetly in steps T_1 , T_2 , T_3 , etc. rather than a continuous taper. As noted above, the outside tapering of the pole and the tapering of the interior skin layer are not necessarily dictated by the thickness of the structural filler layer. For example, the structural filler layer may maintain a constant thickness throughout the height of the pole, although the exterior skin layer tapers from top to bottom.

[00048] Turning now to Figures, 10A and 10B, a method of manufacturing a pole in accordance with the principles of the present invention is illustrated. As discussed above, the pole has interior and exterior skin layers that are made continuous along the length of the pole. As such, the pole may be continuously fabricated to any desired height utilizing continuous sheet stock. Specifically, referring to Figure 10A, a roll forming fabrication station 50 is illustrated. The process may begin with a roll of sheet material or sheet stock 52 that may be transported as a compact roll, so that the pole may be manufactured on site. As may be appreciated, multiple rolls of material 52 might be shipped to the site for fabrication

of the multi-component pole. One advantage of the present invention is that all the materials needed for fabrication of the pole are provided in a compact form for shipment. The rolls of sheet material and other material utilized to form a structural filler layer may also be shipped in a compact fashion. For example, if rigid foam, such as a urethane foam, is utilized for the filler layer, containers of the two liquids that are combined to form the foam may be shipped to the installation site. For a particular installation, a skid of the necessary materials might be made up at a central location, and then shipped on a "just in time" manner to distribution or installation sites. At a distribution site, the poles might either be fabricated in a factory setting or the raw materials loaded onto fabrication trailer trucks. When utilizing fabrication trailer trucks, the materials might be driven to the installation site, or construction site, and fabrication would take place at the installation site. As such, utilizing the present invention, poles of any length and construction can be fabricated on site when necessary or productive to do so, or the poles might be fabricated off site at a distribution site when so desired.

[00049] Referring again to Figure 10A, the rolls of continuous sheet material or stock 52 are placed on a de-coiling apparatus 54, and fed through a roll-forming station indicated by reference numeral 50. A series of multiple forming wheels are shown at individual forming stages 56a-56d, wherein the sheet material 62 is rolled appropriately to form the shape of the skin layer. In the example illustrated in Figures 10A and-10B, the skin layer formed from sheet material 62 is generally cylindrical and has a circular cross-section. As such, the flat sheet material 62 is rolled and formed, in one or more passes through the roll forming station, until the opposing edges of the material 62 are brought together at seam 72 to form the completed skin layer or tubular skin structure. The opposing edges 70 are brought

closer and closer together as the sheet material progresses continuously through each stage 56a-56d. The pole would then pass through a continuous seam-welding station 74 to weld the seam 72. The joining of the seam is not limited to welding the seam. There are other methods of joining as well. Fast setting adhesives, epoxies, a simple mechanical joint, or a combination of adhesive and mechanical joint is all examples that are within the scope of this invention.

[00050] Both the interior and exterior skin layers may be formed in such a continuous fashion using the same roll forming station 50. As may be appreciated, the continuous construction of the skin layers provides for fabrication of a skin layer of any suitable length, diameter, shape, or height. Accordingly, very long poles might be fabricated on site, and then installed, rather than being manufactured off site and shipped. The present invention thus eliminates the need to, ship a long heavy pole by providing the ability to fabricate a continuous pole of any suitable length at the installation site.

[00051] Figure 10B illustrates in detail one suitable forming wheel configuration for a roll-forming station 56. Each of the roll-forming stations 56a-56d comprises a series of matched forming wheels 58 and backing wheels 66. Therein, the continuous sheet material 62 is engaged between a convex forming wheel 58 and the opposite concave backing wheel 66 under tension or force, such as provided by biased springs 64. The convex forming wheel 58 and the opposite concave backing wheel 66 roll on independent yet parallel axes, and are driven in the direction illustrated by arrow 67, to pull the sheet material 62 through the forming wheel set, and thus form the flat and continuous sheet material 62 into the desired shape. Moving these wheels and changing the spacing between the wheels during the fabrication process will produce a tapered form or other forms as needed.

[00052] Figure 11 illustrates possible embodiments of a fabrication site 51 in accordance with the principles of the invention. The fabrication site includes one or more fabrication stations 50a that may be implemented within one or more trailers 130 that might be pulled to an installation site by a suitable tractor 132. The trailer might be temperature controlled. Rolls of sheet material 62 and other materials 63 for forming a pole in accordance with the invention might also be stored on the trailer to travel with the fabrication station 50a. In that way, the fabrication site is mobile and might be moved to the installation site so that poles are fabricated on-site. In an alternative embodiment, when not taken to an installation site, the trailer 130 and fabrication station 50a might be parked proximate a fabrication factory or enclosure 134 or other building for manufacturing poles that might then be shipped to the installation site in a suitable fashion. Alternatively, the enclosure 134 might also be portable and might be taken to the installation sight along with trailer 130. The rolls of sheet material 62 and other materials 63 are sequentially fed through the fabrication stations 50a and may be telescopically assembled at a final assembly station 136 after forming. A powder coating station and curing oven may be included as part of the fabrication site 51.

[00053] Referring to Figure 2 or 3, an interior skin layer or an exterior skin layer having a polygonal (e.g., a hexagon) cross section might also be formed in the roll forming station, illustrated in Figure 10B. Differently shaped rollers might be utilized to obtain different forms.

[00054] As shown in Figure 3, the tubular skin layer 18 is generally positioned inside of another tubular skin layer 22, which may act as the exterior skin layer (or another interior skin layer), with respect to the complete pole structure. That is, the skin layers 18 and 22 are telescopically nested together to form the multiple skin

layers of the inventive pole. Prior to such nesting, a structural filler layer 20 is positioned around the interior skin layer 18. As discussed above, the structural filler layer 20 may take various forms. In the example shown in Figures 2 and 3, the structural filler layer includes a plurality of foam inserts 24, wherein one or more inserts are positioned around the interior skin layer 18. In the embodiment of Figure 14, the filler layer 20 is sprayed onto the interior skin layer 18. For example, the foam inserts 24 are sprayed onto the facets 19 of the tubular skin layer 18. A urethane foam might be utilized and sprayed onto the outside of the tubular skin layer 18 utilizing multiple spray heads 90 that are positioned in a generally circular fashion to form an array. The interior skin structure or skin layer 18 is passed through the array of spray heads 90, and a material for making foam is mixed and flows from the containers 88 to the array of spray heads 90. While the embodiment of Figure 3 only illustrates a single structural element sprayed onto each facet of the skin layer 18, the array of spray heads 90 might be arranged to spray more than one element onto each facet 19 of the skin layer 18. Furthermore, the array of spray heads 90 might be operated in order to provide a structural filler layer that varies in thickness around the perimeter of the skin structure 18, or along the height of the skin structure. For example, the foam might be applied thicker to certain facets, or to certain side areas, or along certain lengths of the skin layer 18.

[00055] In an alternative embodiment of the invention, wherein a structural filler layer is formed with other elements, such as metal tubes or rods, or fluted or corrugated sheet metal, such a filler layer might be applied in a different fashion. For example, rolls of tubular material or rod material might be laid out along skin layer 18, similar to the way in which the array of spray heads spray the foam elements 24. In another scenario, a roll of corrugated or fluted sheet metal might be

de-coiled, and wrapped spirally or longitudinally around a tubular structure around skin layer 18. For example, rather than the spiral wrap, as shown in Figures 5 and 7, the structural filler layer might be formed from sheet material using manufacturing equipment similar to that used to manufacture the skin layers.

[00056] Another option for a structural filler layer would be sleeve 23 that is positioned between the various interior and exterior skin structures or layers. For example, a metallic wool sleeve soaked in an adhesive or urethane may be one kind of sleeve. The sleeve could be shipped in compact form and slid between the skin layers before curing. The sleeve 23 might be slid onto the interior skin layer 18 as illustrated in Figure 3A during fabrication of a pole.

[00057] After the structural filler layer has been applied to the interior skin layer 18, and after another tubular skin structure has been formed to provide the exterior skin layer, the skin layers may be mated at a suitable assembly station 50. Various steps might be utilized to further finish the pole. For example, a powder coating might be applied, and then the pole might pass through an oven to bake the powder coating. Other outer finishes might also be applied, as desired.

[00058] In accordance with another aspect of the invention, the utilization of the pole in various applications, a base structure and a cap structure are placed at opposite ends of the assembled pole structure for both securing the pole at an installation site, and also for securing the item to be supported, such as a light fixture, to the pole.

[00059] Referring to Figure 12, the base structure includes an inner core section 100, and an outer base section or casting 104. The base end of the pole structure 10 fits over and around the inner core section 100. The inner core section is secured to the innermost surface of the pole, such as the innermost interior skin

layer 18. The pole might be secured utilizing adhesive. Such adhesive bonding of the base structure to the pole would avoid any weld-induced annealing in the pole structure.

[00060] The outer base section 104 is slid down over the outside of the pole structure, such that a flange 106 of the outer base section engages the outer-most layer or exterior skin layer 22 of the pole. In that way, the base of the pole is sandwiched between the flange 106 of the base section 104 and the inner core section 100. The flange 106 might also be bonded to the exterior skin layer utilizing an adhesive.

[00061] The inner core section 100 includes a bolt flange 102, which may be utilized to secure the inner core section 100 to the outer base casting 104 using fasteners (not shown) through fastener holes 103 that go into tapped holes (not shown) in the casting 104. Bolt holes, 105 are provided for suitable fasteners, such as bolts, that pass through the holes 105 to anchor the base structure and pole to a concrete footer or breakaway base (not shown) to secure the base structure and pole to a suitable base at the installation site.

[00062] In one preferred embodiment of the invention, the inner core section 100 of the base extends well above the height of the flange 106, in the outer base section 104. In that way, a hand access hole 108 might be utilized within the inner core section without compromising the strength of the pole structure. Such a hole may allow access to wiring and electronics at the base end of the pole.

[00063] To secure a fixture, signage, or other element to the top of the pole structure, a two-part cap structure may be utilized, as illustrated in Figure 13 and 14.

Cap structure 110 includes a center core section 112 and a top cap section 114.

The top cap section 114 is placed on the top end of the pole around the exterior skin

layer 22. The center core section 112 is then inserted into the center of the pole, and slides down through the center of the pole until a stop flange 116 on the center core section 112 abuts against the cap section 114. The portion of the core section above the stop flange 116 is configured to hold the light fixture, signage, or other component. The center core section 112 may also include one or more holes 118 for running necessary electrical wires.

[00064] Figure 14 illustrates the two part cap structure 110 positioned on the top of the inventive pole structure 10, similar to that illustrated in Figure 2, which has an interior skin layer 18, a structural filler layer 20, and an exterior skin layer 22. Adhesive or mechanical fasteners may be used to secure the two-part cap structure to the top of the pole structure.

[00065] While the present invention has been illustrated by the description of the embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicant to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. Therefore, the invention in its broader aspects is not limited to the specific details representative apparatus and method, and illustrative examples shown and described. Accordingly, departures may be made from such details without departure from the spirit or scope of applicant's general inventive concept.

[00066] What is claimed is:

1. A pole for supporting another structure comprising:
 - at least one interior skin layer;
 - at least one structural filler layer coupled with the at least one interior skin layer and positioned around an outer surface of the interior skin layer;
 - at least one exterior skin layer positioned around an outer surface of the structural filler layer, the exterior skin layer being coupled with the structural filler layer;
 - the exterior skin layer being formed from a continuous sheet of material to be continuous along the length of the pole.
2. The pole of claim 1 wherein the structural filler layer is fixed to at least one of the interior skin layer or the exterior skin layer with an adhesive.
3. The pole of claim 1 wherein the structural filler layer is fixed to at least one of the interior skin layer or the exterior skin layer with mechanical means.
4. The pole of claim 1 further comprising:
 - an additional interior skin layer and an additional structural filler layer positioned around the additional interior skin layer;
 - the additional layers positioned around an outer surface of the at least one interior skin layer and at least one structural filler layer.
5. The pole of claim 1 wherein the at least one interior skin layer has a thickness in the range of 0.010 to 0.250 inches.

6. The pole of claim 1 wherein the at least one structural filler layer has a thickness in the range of 0.110 to 10.0 inches.
7. The pole of claim 1 wherein the exterior skin layer has a thickness in the range of 0.010 to 0.250 inches.
8. The pole of claim 1 wherein the exterior skin layer is configured so that the cross section of the skin layer is in a shape from the group of shapes including: round, square, polygonal, and fluted.
9. The pole of claim 1 wherein the interior skin layer is configured so that the cross section of the skin layer is in a shape from the group of shapes including: round, square, polygonal, and fluted.
10. The pole of claim 1 wherein the exterior skin layer is made of a metal material.
11. The pole of claim 10 wherein the metal is a material from the group of: aluminum, steel, brass, copper and stainless steel.
12. The pole of claim 1 wherein the exterior skin layer is made with a composite pultruded material.
13. The pole of claim 1 wherein the interior skin layer is made of a metal material.

14. The pole of claim 13 wherein the metal is a material from the group of:
aluminum, steel, brass, copper and stainless steel.
13. The pole of claim 1 wherein the interior skin layer is made with a composite pultruded material.
14. The pole of claim 1 wherein the structural filler layer varies in thickness around a perimeter of the pole.
15. The pole of claim 1 wherein the structural filler layer varies in thickness along a height of the pole.
16. The pole of claim 1 wherein the structural filler layer includes a foam material positioned between the interior skin layer and exterior skin layer and bonded to both layers.
17. The pole of claim 1 wherein the structural filler layer includes a fluted metal component.
18. The pole of claim 1 wherein the structural filler layer includes a plurality of tubes or rods, the tubes or rods having long axes that are positioned generally in the same orientation of a long axis of the pole.
19. The pole of claim 1 wherein the structural filler layer is a continuous material spirally wrapped around the interior skin layer.

20. The pole of claim 19 wherein the spiral wrap varies in pitch along the height of the pole.
21. The pole of claim 1 wherein the structural filler layer is sprayed onto the interior skin layer.
22. The pole of claim 21 wherein the structural filler layer is a foam.
23. The pole of claim 1 wherein the structural filler layer includes a sleeve positioned between the interior and exterior skin layers.
24. The pole of claim 4 wherein the additional interior skin layer and additional structural filler layer have a defined length that is less than the defined length of the at least one interior skin layer.
25. A pole for supporting another structure comprising:
- at least one interior skin layer;
 - at least one structural filler layer coupled with the at least one interior skin layer and positioned around an outer surface of the interior skin layer;
 - at least one exterior skin layer positioned around an outer surface of the structural filler layer, the exterior skin layer being coupled with the structural filler layer;
 - the exterior skin layer being formed from a continuous sheet of material to be continuous along the length of the pole;

a base structure including a core section and a base section, the core section configured for engaging an end of the pole inside of the interior skin layer and structural filler layer, the base section configured for engaging the end of the pole and surrounding the exterior skin layer to cooperate with the core section and capture the end of the pole.

26. The pole of claim 25 wherein the structural filler layer is a continuous sheet material spirally wrapped around the interior skin layer.

27. The pole of claim 26 wherein the spiral wrap varies in pitch along the height of the pole.

28. The pole of claim 25 wherein the structural filler layer is sprayed onto the interior skin layer.

29. The pole of claim 28 wherein the structural filler layer is a foam.

30. A pole for supporting another structure comprising:
at least one interior skin layer;
at least one structural filler layer coupled with the at least one interior skin layer and positioned around an outer surface of the interior skin layer;
at least one exterior skin layer positioned around an outer surface of the structural filler layer, the exterior skin layer being coupled with the structural filler layer;

the exterior skin layer being formed from a continuous sheet of material to be continuous along the length of the pole;

a cap structure including a core section and a cap section, the core section configured for engaging an end of the pole inside of the interior skin layer and structural filler layer, the cap section configured for engaging the end of the pole and surrounding the exterior skin layer to cooperate with the core section and capture the end of the pole.

31. The pole of claim 30 wherein the structural filler layer is a continuous sheet material spirally wrapped around the interior skin layer.

32. The pole of claim 31 wherein the spiral wrap varies in pitch along the height of the pole.

33. The pole of claim 30 wherein the structural filler layer is sprayed onto the interior skin layer.

34. The pole of claim 33 wherein the structural filler layer is a foam.

35. A method of manufacturing a support pole comprising:
providing a continuous sheet stock having opposing edges;
rolling the continuous sheet stock along its length to bring the opposing edges into proximity with each other;
fixing the opposing edges with each other to form a tubular first skin structure of a defined length;

repeating the rolling and fixing steps to form at least tubular second skin structure of a defined length;

positioning a structural filler layer around the first skin structure and coupling the structural filler layer with the first skin structure;

positioning the second skin structure around the structural filler layer and coupling the second skin structure with the structural filler layer to form a pole.

36. The method of claim 34 further comprising:

repeating the rolling and fixing steps to form at least one additional tubular skin structure of a defined length;

positioning an associated structural filler layer around the additional skin structure and coupling the structural filler layer with the additional skin structure;

positioning the additional skin structure and associated structural filler layer inside first skin structure and coupling the associated structural filler layer with the first skin layer.

37. The method of claim 36 wherein the additional skin structure has a defined length that is less than the defined length of the first skin structure.

38. The method of claim 35 wherein the sheet stock has a thickness in the range of 0.010 to 0.250 inches.

39. The method of claim 35 further comprising forming the first skin structure to have a tubular shape with a cross section that is in a shape from the group of shapes including: round, square, polygonal, and fluted.
40. The method of claim 35 further comprising forming the second skin structure to have a tubular shape with a cross section that is in a shape from the group of shapes including: round, square, polygonal, and fluted.
41. The method of claim 35 further comprising spraying the structural filler layer onto the first skin structure.
42. The method of claim 41 wherein the structural filler layer is a foam.
43. The pole of claim 1 wherein the structural filler layer includes a sleeve positioned between the interior and exterior skin layers.
44. The method of claim 35 further comprising varying the thickness of the structural filler layer around a perimeter of the pole.
45. The method of claim 35 further comprising varying the thickness of the structural filler layer along a height of the pole.
46. The method of claim 35 further comprising wrapping a continuous sheet of material spirally around the first skin structure to form the structural filler layer.

47. The method of claim 46 further comprising varying the spiral wrap in pitch along the height of the pole.

48. The method of claim 35 further comprising positioning a plurality of tubes or rods having long axes along the first skin structure generally in the same orientation as a long axis of the tubular first skin structure.

48. The method of claim 35 further comprising:

positioning a core section of a base structure to engage an end of the pole inside of the first skin structure and structural filler layer;

positioning a base section of the base structure to engage the end of the pole and surround the second skin structure;

positioning the base section proximate the core section so they cooperate to capture the end of the pole.

50. The method of claim 35 further comprising:

positioning a core section of a cap structure to engage an end of the pole inside of the first skin structure and structural filler layer;

positioning a cap section of the cap structure to engage the end of the pole and surround the second skin structure layer;

positioning the base section proximate the core section so they cooperate to capture the end of the pole.

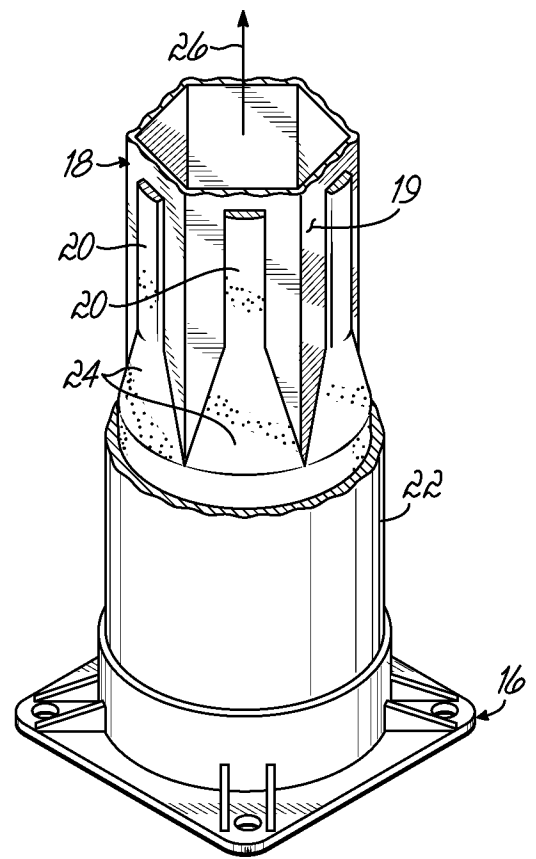
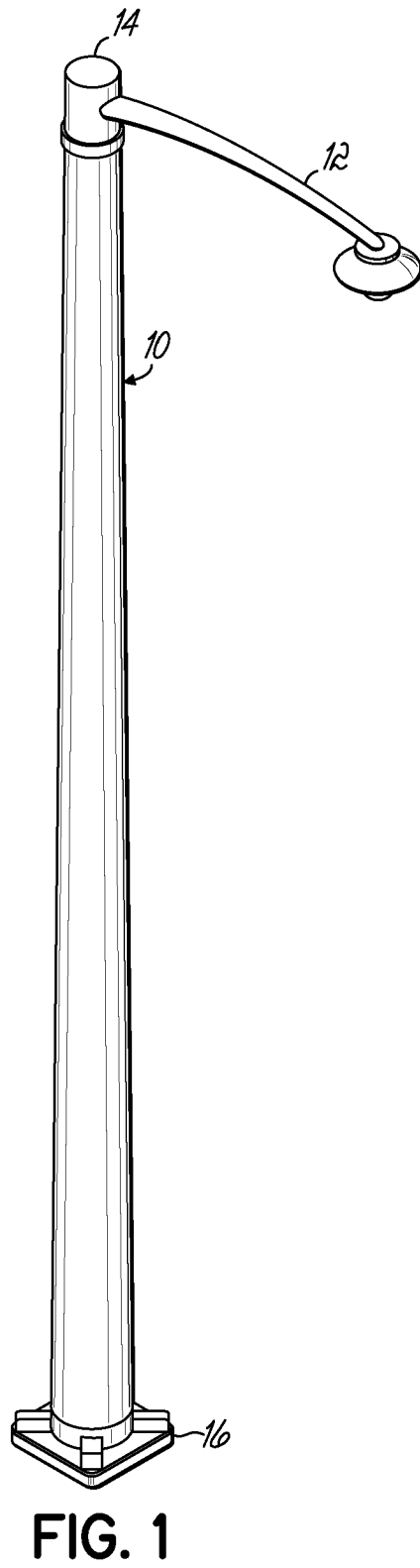


FIG. 2

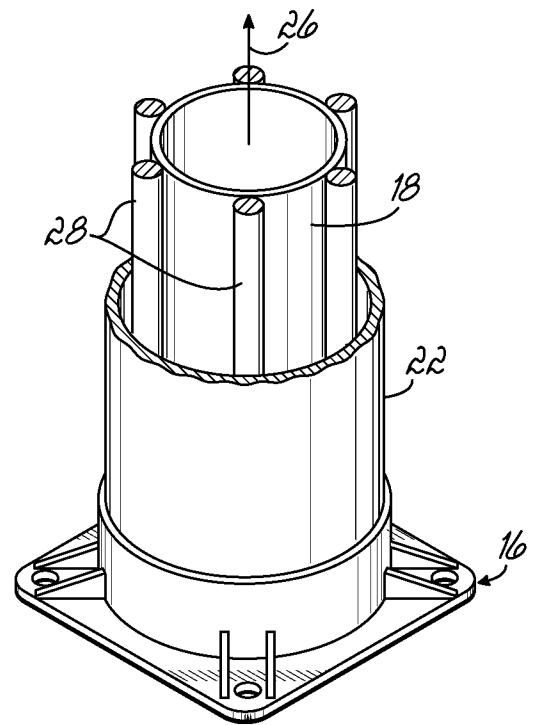


FIG. 4

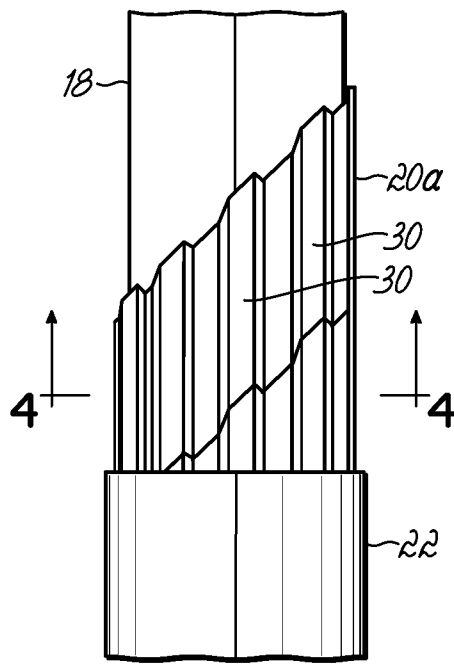


FIG. 5

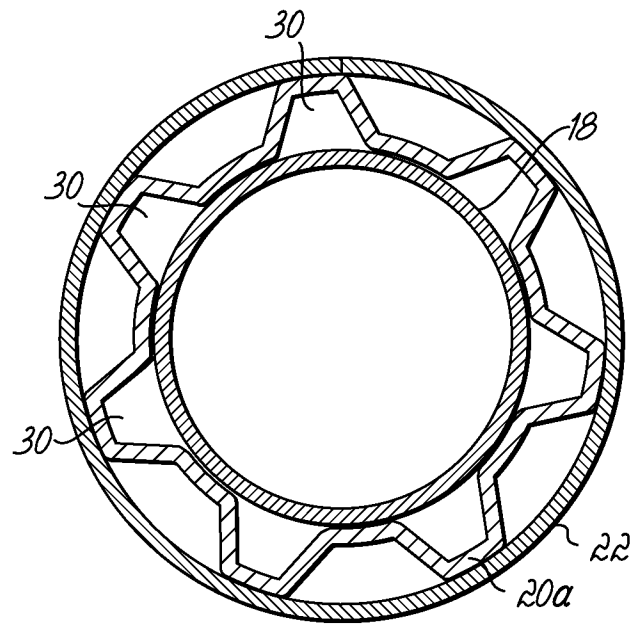


FIG. 6

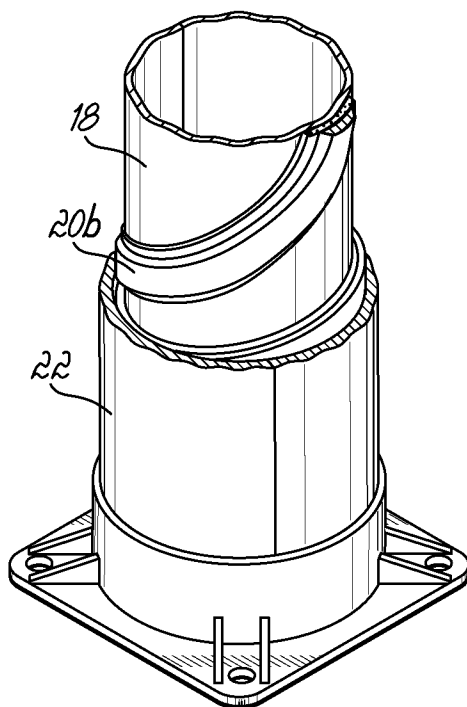


FIG. 7

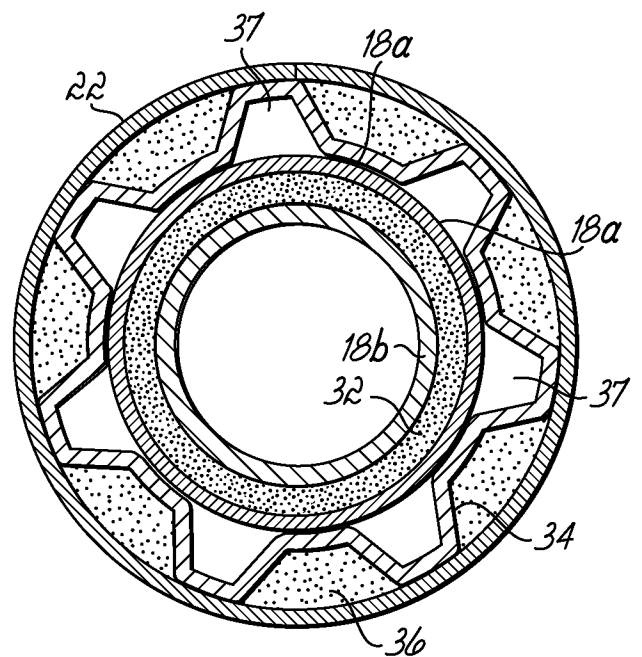


FIG. 8

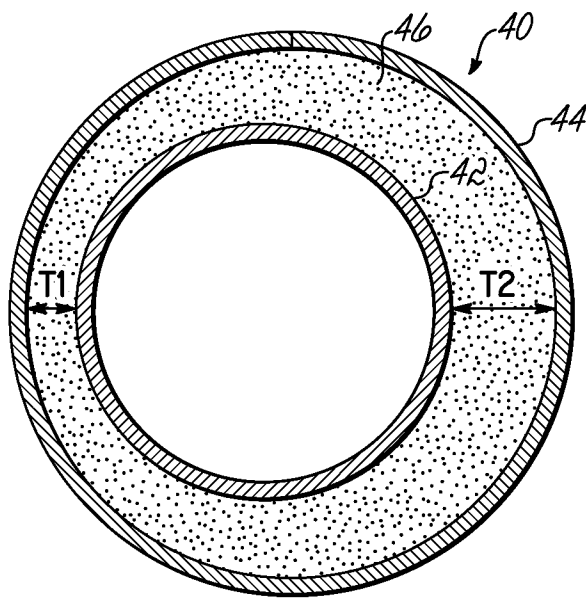


FIG. 9

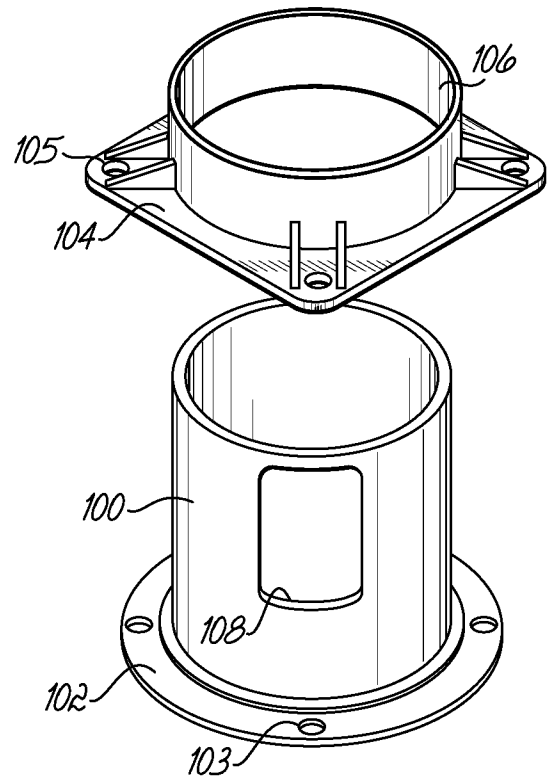


FIG. 12

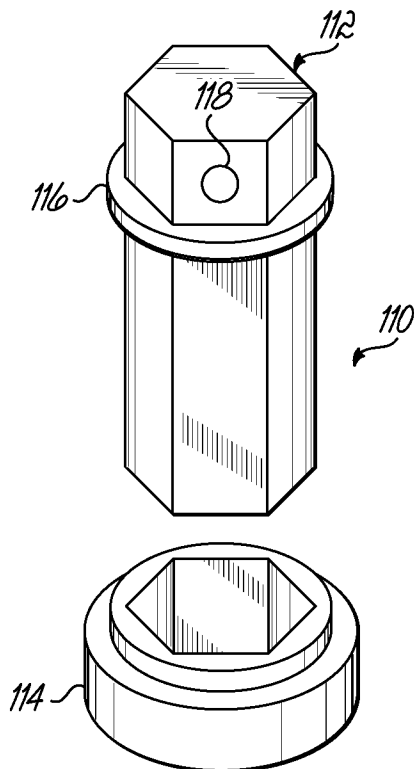


FIG. 13

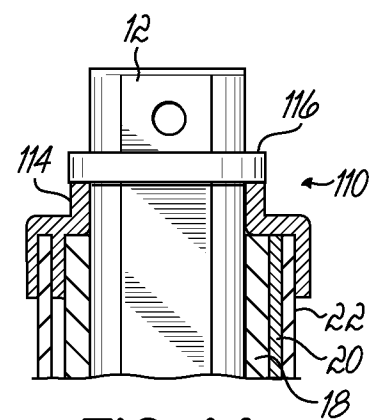


FIG. 14

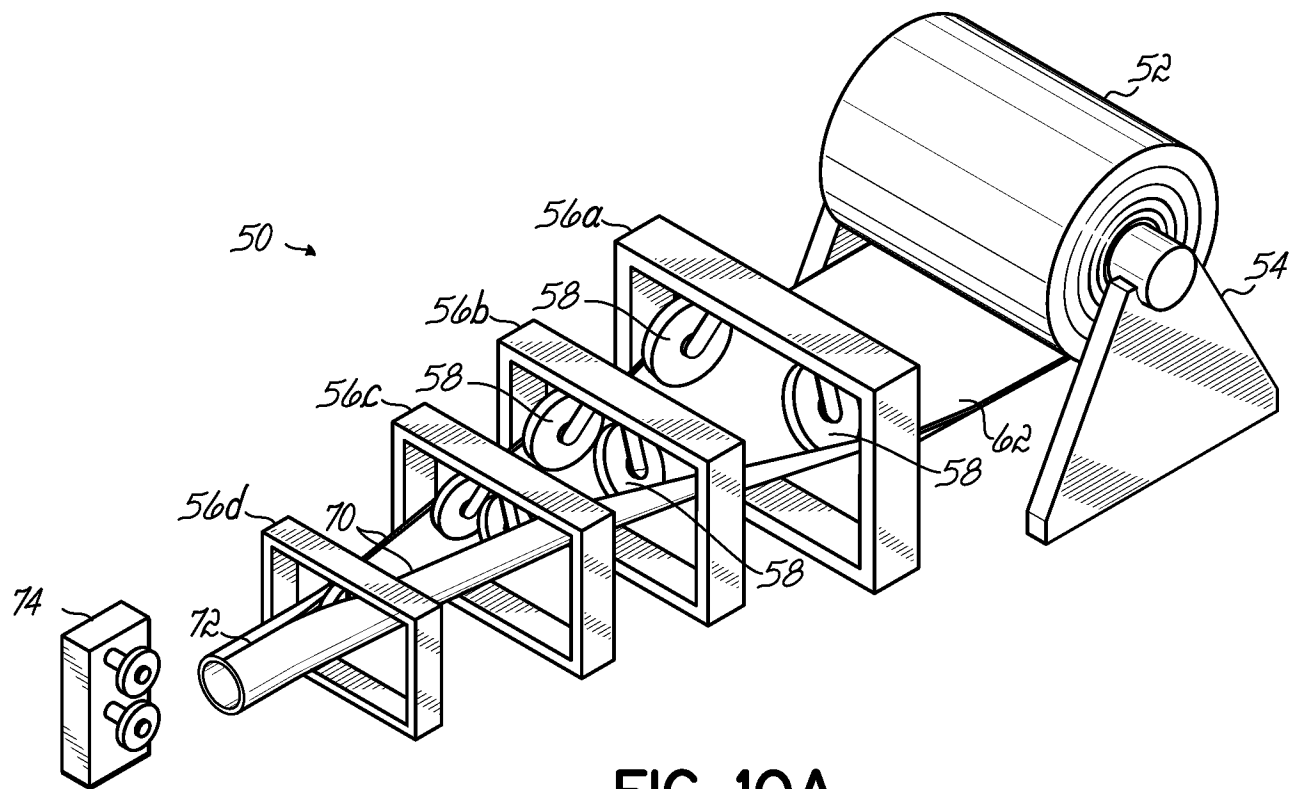


FIG. 10A

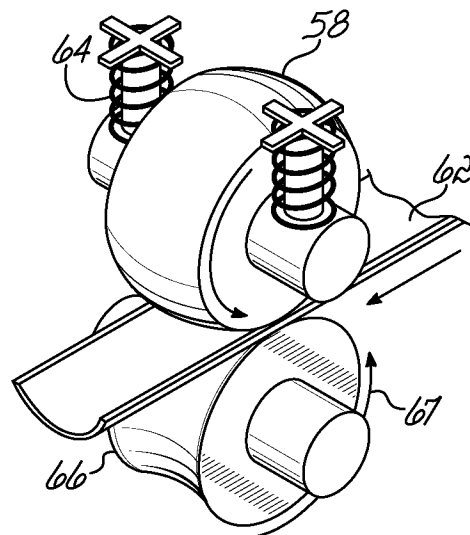
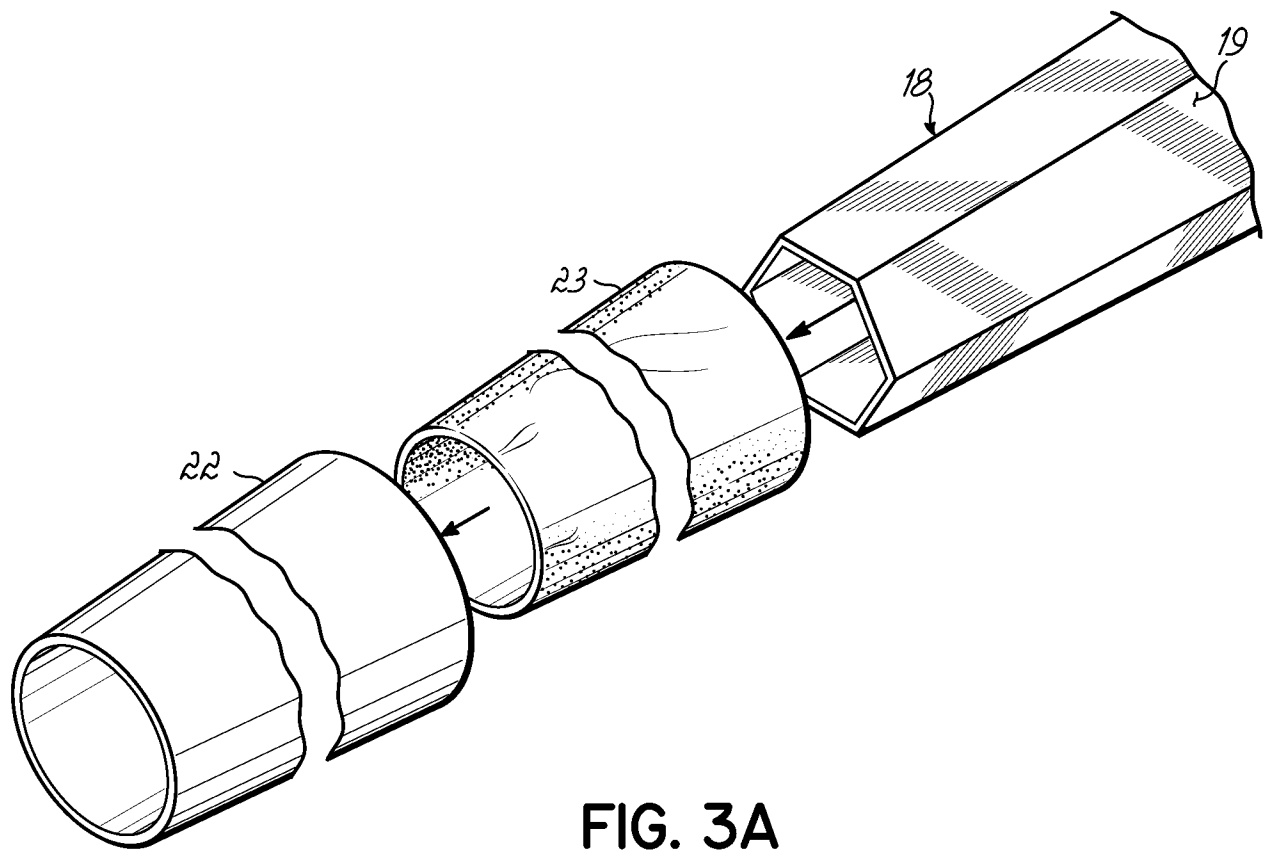
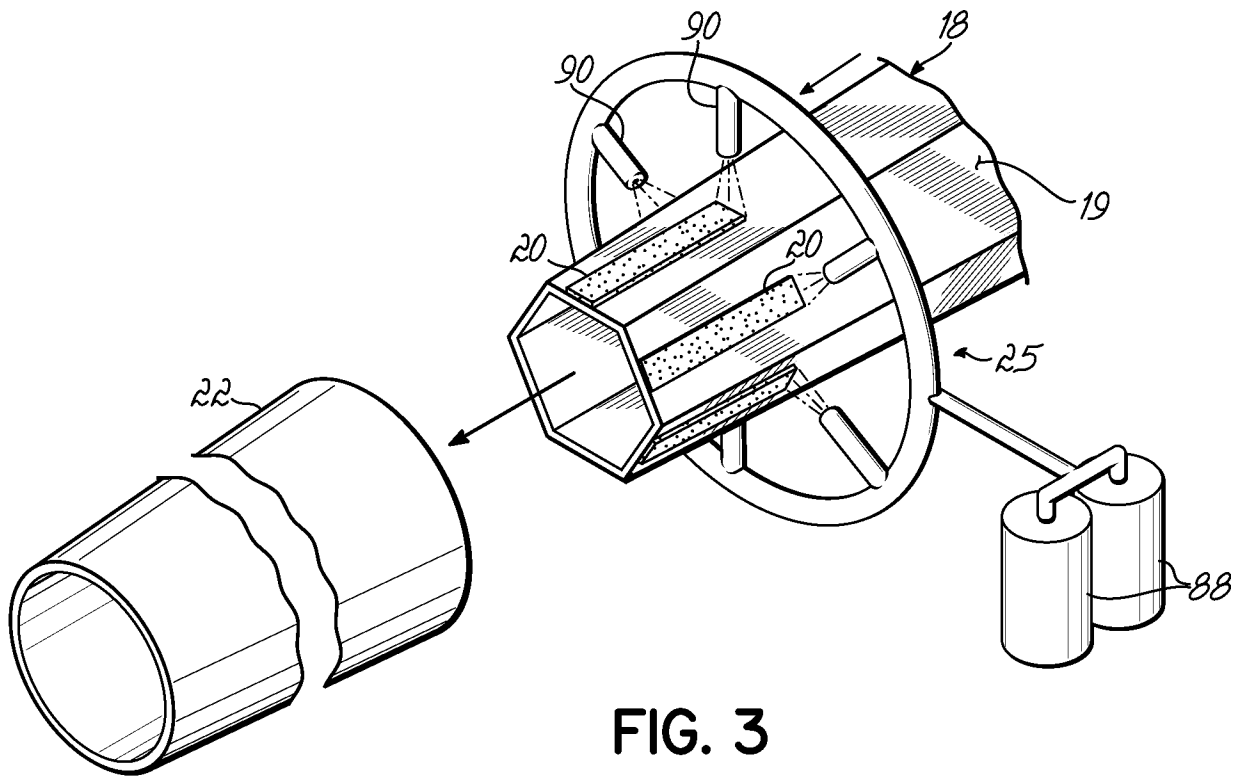


FIG. 10B





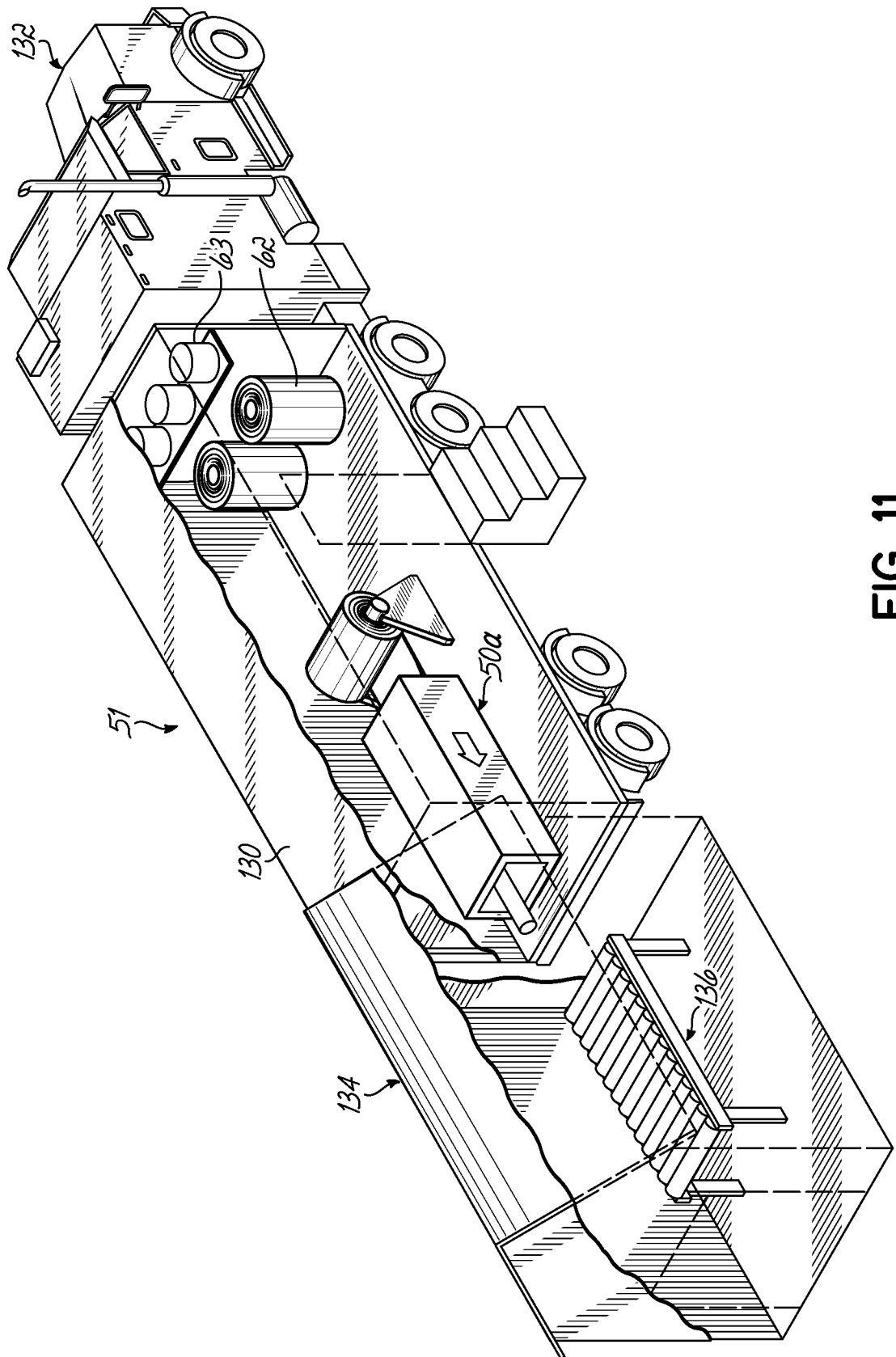


FIG. 11