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(54) **MULTI-PACKAGE BUCKETS, SYSTEMS AND METHODS OF FORMING YARN, AND APPARATUS FOR TWISTING OR CABLING YARN**

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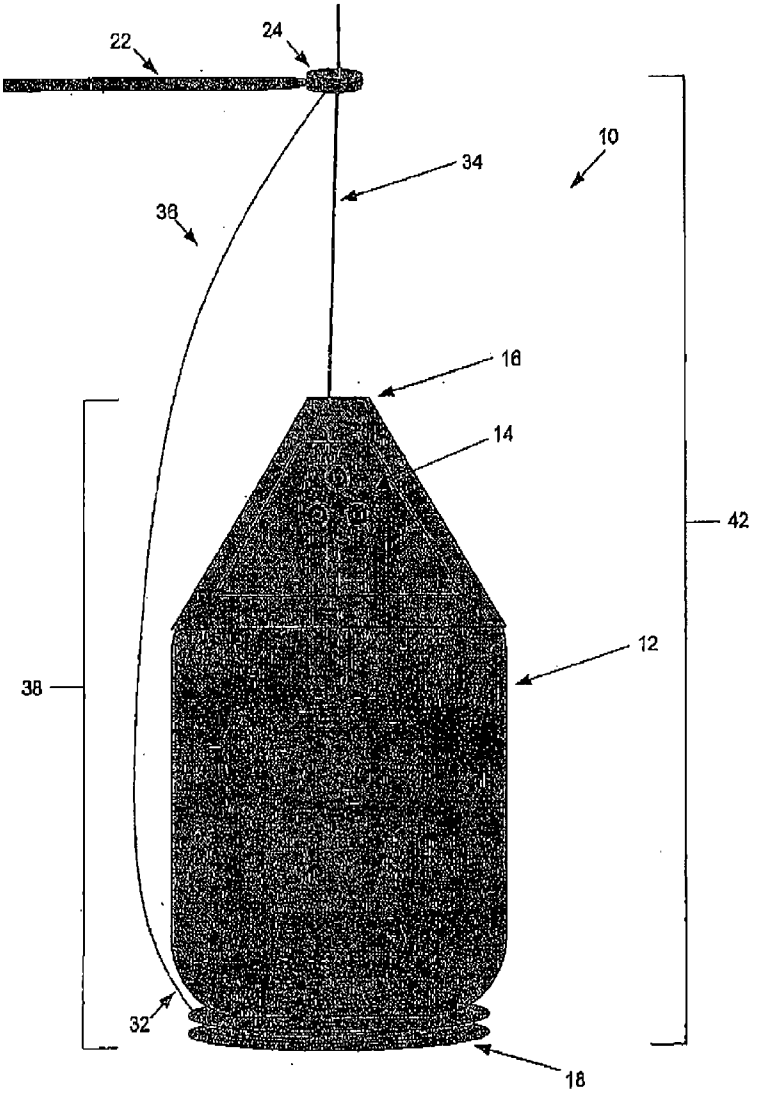
(57) **ABSTRACT**

Briefly described, embodiments of this disclosure include multi-package buckets, yarn twisting or cabling apparatus including, methods of twisting or cabling yarn, and the like.



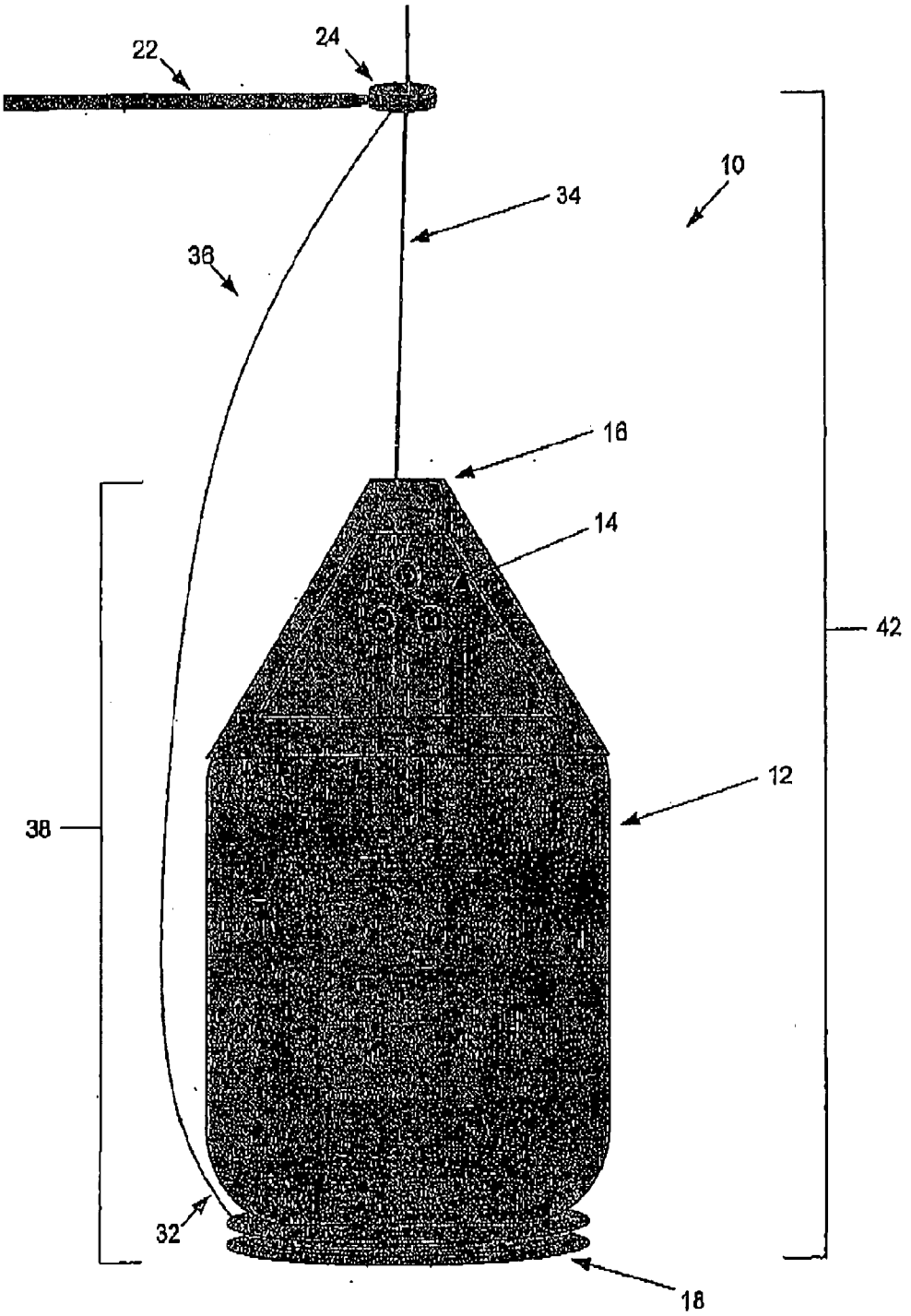


FIG. 1

MULTI-PACKAGE BUCKETS, SYSTEMS AND METHODS OF FORMING YARN, AND APPARATUS FOR TWISTING OR CABLING YARN

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims benefit of priority from Provisional Application No. 61/084,720 filed Jul. 30, 2008.

BACKGROUND

[0002] Two or more yarns are often twisted or "cabled" together to form plied yarns having various properties useful in the construction of soft floor coverings (i.e., tufted rugs and carpets). A standard cabling process involves physically rotating one yarn, fed from a creel, around a second yarn fed from a "bucket", both yarns being under carefully controlled tension, and then winding up the combined yarns in the form of a single, cabled (plied) yarn package.

[0003] Machines to perform this operation are sold by various manufacturers, including: Oerlikon (Volkmann), Rieter (ICBT), China Textile Machinery Corporation (CTMC), Belmont, and the like. These machines typically include a creel to hold one or more feed yarns; a tension frame to control creel yarn tension; a tube to convey the creel yarn to a spindle; a "bucket", located above the spindle, containing the second feed yarn; tension devices; a bucket lid; and an extension arm (located no more than about 7 inches from the top of the bucket) to combine the bucket yarn with the creel yarn traveling around the bucket yarn at specified speed).

[0004] Twisting technology is one of the limitations of the carpet industry because although twisting is important to achieve the density and resilience required of tufted carpet, cabled yarns are processed relatively slowly compared to the preceding and subsequent processes. As a result of this industry "bottleneck", a relatively large investment in twisters and process inventory is required.

[0005] Yarns are twisted together at frequencies ranging from about one turn to more than eight turns per inch, depending on yarn thickness and the intended effect. The higher the number of turns per inch the slower the operation becomes as the spindle carrying the creel yarn must complete a revolution for each "turn". For example, if two yarns are twisted at about 6000 rpm, at a frequency of two turns per inch, the winding speed of the product will be approximately 3000 inches (83 yards) per minute, neglecting other factors. Doubling turn frequency to four turns per inch would approximately halve the production rate (assuming the yarns are thin enough to permit the higher level of twist). Winding speed for a commercial twisting operation is usually about 50 yards per minute up to about 100 yards per minute achieving rotational speeds of 6000 up to claims of about 9000 rpm for lighter deniers.

[0006] Other carpet related yarn processes run much more quickly than cable-twisting does today. Spinning machines wind up at speeds in excess of 3000 yards per minute, while heat setting processes wind up at about 600 yards per minute. Thus, there is a need in the industry to increase cabling efficiency without deteriorating the properties of the yarn.

SUMMARY

[0007] Briefly described, embodiments of this disclosure include yarn twisting or cabling apparatus, and the like. One exemplary yarn twisting or cabling apparatus, among others, includes: a multi-package bucket having a bucket top and a bucket bottom, a reserve disc, and an adjustable extension arm with a balloon thread guide, wherein the multi-bucket is adapted to include at least two full size 11 inch tubes, wherein the reserve disc is disposed at the bucket bottom, wherein the adjustable extension arm is positioned so that the balloon thread guide is positioned above the bucket top along the center line of the bucket.

[0008] Another exemplary method of twisting or cabling yarn, among others, includes: providing an apparatus yarn twisting or cabling apparatus as described herein that includes a multi-package bucket; and twisting a bucket yarn with a creel yarn to form a piled yarn.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present disclosure.

[0010] FIG. **1** illustrates an embodiment of a yarn twisting or cabling apparatus including an embodiment of a double-bucket.

DETAILED DESCRIPTION

[0011] Before the present disclosure is described in greater detail, it is to be understood that this disclosure is not limited to particular embodiments described, as such may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting, since the scope of the present disclosure will be limited only by the appended claims.

[0012] Where a range of values is provided, it is understood that each intervening value, to the tenth of the unit of the lower limit (unless the context clearly dictates otherwise), between the upper and lower limit of that range, and any other stated or intervening value in that stated range, is encompassed within the disclosure. The upper and lower limits of these smaller ranges may independently be included in the smaller ranges and are also encompassed within the disclosure, subject to any specifically excluded limit in the stated range. Where the stated range includes one or both of the limits, ranges excluding either or both of those included limits are also included in the disclosure.

[0013] Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Although any methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present disclosure, the preferred methods and materials are now described.

[0014] All publications and patents cited in this specification are herein incorporated by reference as if each individual publication or patent were specifically and individually indicated to be incorporated by reference and are incorporated herein by reference to disclose and describe the methods and/or materials in connection with which the publications are cited. The citation of any publication is for its disclosure prior to the filing date and should not be construed as an admission that the present disclosure is not entitled to antedate such publication by virtue of prior disclosure. Further,

the dates of publication provided could be different from the actual publication dates that may need to be independently confirmed.

[0015] As will be apparent to those of skill in the art upon reading this disclosure, each of the individual embodiments described and illustrated herein has discrete components and features which may be readily separated from or combined with the features of any of the other several embodiments without departing from the scope or spirit of the present disclosure. Any recited method can be carried out in the order of events recited or in any other order that is logically possible.

[0016] Embodiments of the present disclosure will employ, unless otherwise indicated, techniques of fibers, yarns, textiles, processes with making yarn, and the like, which are within the skill of the art. Such techniques are explained fully in the literature.

[0017] The following examples are put forth so as to provide those of ordinary skill in the art with a complete disclosure and description of how to perform the methods and use the compositions and compounds disclosed and claimed herein. Efforts have been made to ensure accuracy with respect to numbers (e.g., amounts, temperature, etc.), but some errors and deviations should be accounted for.

[0018] Before the embodiments of the present disclosure are described in detail, it is to be understood that, unless otherwise indicated, the present disclosure is not limited to particular materials, reagents, reaction materials, manufacturing processes, or the like, as such can vary. It is also to be understood that the terminology used herein is for purposes of describing particular embodiments only, and is not intended to be limiting. It is also possible in the present disclosure that steps can be executed in different sequence where this is logically possible.

[0019] It must be noted that, as used in the specification and the appended claims, the singular forms "a," "an," and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a support" includes a plurality of supports. In this specification and in the claims that follow, reference will be made to a number of terms that shall be defined to have the following meanings unless a contrary intention is apparent.

DEFINITIONS

[0020] As used herein, the term "fiber" refers to filamentous material that can be used in fabric and yarn as well as textile fabrication. One or more fibers can be used to produce a fabric or yarn. The yarn can be fully drawn or textured according to methods described herein.

[0021] As used herein, the term "cable" or "cabling" refers to twisting together two or more yarns.

[0022] As used herein, the term "cabled yarn" refers to two or more yarns twisted together.

[0023] As used herein, the term "conventional twister" refers to a system of producing a yarn by twisting together two or more single yarns simultaneously.

[0024] As used herein, the term "folded yarn" or "plied yarn" is a yarn in which two or more single yarns are twisted together in one operation (e.g., two-folded yarn (two-ply yarn), three-fold yarn (three ply yarn), and the like).

Discussion

[0025] Embodiments of the present disclosure provide for multi-package buckets (e.g., double bucket), systems and methods of forming yarn, apparatus for twisting or cabling yarn (also referred to as "yarn twisting or cabling apparatus"), and the like. Embodiments of the present disclosure reduce how often bucket doffing is performed. The standard industrial doffing procedure is to remove the bucket package and replace it when it is depleted to one half. If the practice of bucket doffing when only a half of a package remains in the bucket is used then, in a particular embodiment, at a constant twisting rate, the time between each doff cycle triples if a double-bucket (e.g., sized to include two full size tubes and the tube yarns are tied to one another) is used instead of a single tube bucket (sized to include a single tube). In another embodiment, at a constant twisting rate, the time between doff cycles increase five fold if a triple-bucket is used. Increasing the time between doff cycles may result in limiting downtime thereby increasing the efficiency. Also the less doffing required per pound of yarn, the fewer employees required for processing that yarn, thereby decreasing labor costs. Embodiments of the present disclosure include multi-package buckets that can be used on a conventional yarn twisting or cabling apparatus or on high-speed yarn twisting or cabling apparatus.

[0026] In general, embodiments of the present disclosure use two or more bulk continuous fibers or synthetic yarns (e.g., nylon or other polyamides) to create a plied yarn (two-ply, three-ply, or more) that can be used in textiles such as rugs, carpets, and the like. An embodiment of the present disclosure includes a multi-package bucket that can include 2, 3, 4, or more full sized (11 inches) tubes (e.g., yarn tube or yarn package). Each additional tube can increase the time between each doff cycle by a factor relative to a bucket including a single full size tube, where the factor can be determined using the following formula: $((A\times2)-1)$, where A is the number of tubes. For example, if the multi-package bucket is a double-bucket that includes two full size tubes, then the factor is 3, so that the time between doff cycles increases by a factor of three relative to a bucket including a single full size tube doffed when half depleted.

[0027] The yarns of each of the tubes are tied to one another to form a continuous yarn. In an embodiment having two tubes (a double-bucket), the end of the yarn of the first tube or top tube is tied to the start of the yarn of the second tube or bottom tube so that once the first tube is completely unwound, the yarn of the second tube is taken up. In another embodiment having three tubes (a triple-bucket), the end of the yarn of the first tube or top tube is tied to the start of the yarn of the second tube or middle tube, and the end of the second tube is tied to the start of the yarn of the bottom or third tube. Initially, the first tube will unwind, and then the second tube will unwind since the end of the first tube is tied to the start of the second tube. Once the second tube unwinds, the third tube will unwind since the end of the second tube is tied to the start of the third tube. The term "top tube" refers to the tube located at the top of the multi-bucket. The term "bottom tube" refers to the tube located at the bottom of the multi-bucket. The term "middle tube" refers to one or more of the tubes located between the top tube and the bottom tube.

[0028] In an embodiment, the tubes (2 or more) are disposed on a device (e.g., a tube transfer spindle housing). The tubes can be tied together before or after being disposed onto the device. Once the tubes are disposed on the device, the device can be disposed into the multi-bucket and connected to a yarn twisting or cabling apparatus. Embodiments of the device may limit the amount of time during bucket doffing.

[0029] It should also be noted that as additional tubes are included in the multi-package bucket system the height of the bucket and the distance from the balloon thread guide to the reserve disc can be increased according to the increase associated with adding each tube. In an embodiment, the bucket height may increase by about 11-13 inches per addition of each tube. The exact height increase depends upon the design of the apparatus for twisting or cabling yarn, the type of yarn, and the like. In an embodiment, the diameter of the multi-package bucket may increase so that the tube package can (tubes loaded on the tube transfer spindle housing) be inserted and removed from the multi-package bucket. In an embodiment, the diameter of the multi-package bucket is greater than the diameter of the yarn package.

[0030] The multi-package bucket can be used in embodiments of the yarn twisting or cabling apparatus. In an embodiment, the multi-package bucket can be used in a standard yarn twisting or cabling apparatus. In an embodiment, the yarn twisting or cabling apparatus is a high speed yarn twisting or cabling apparatus, such as that described in Attachment A.

[0031] An embodiment of a yarn twisting or cabling apparatus **10** including a double-bucket **12** is shown in FIG. **1**. FIG. **1** is not intended to limit the yarn twisting or cabling apparatus to a double-bucket system; rather FIG. **1** illustrates an implementation of the multi-package bucket system, and this implementation can be extended to multi-package bucket systems having 3 or more tubes.

[0032] The yarn twisting or cabling apparatus **10** includes a creel peg (not shown), a tension frame (not shown) (controls creel tension), tube transfer to spindle housing (not shown), spindle (not shown), "bucket" **12**, bucket tension devices **14**, bucket top **16**, reserve disc **18**, and an adjustable extension arm **22** with balloon thread guide **24**. As shown in FIG. **1**, the dimensions (e.g., the height) of a double bucket **12** increased to include two full length tubes (first tube **42***a* and second tube **42***b*), in contrast to some systems including two half tubes or a system including a single tube. This is advantageous because the tubes are doffed less often than current systems since the tubes are doffed when the tube is half full. Thus, embodiments of the present disclosure are doffed once one and a half tubes are used as opposed to only a half tube being used. In other words, the doff cycle triples compared to using a single tube bucket. In an embodiment, the double-bucket **12** can have a height of about 30 to 36 inches.

[0033] In an embodiment, the size of the double-bucket **12** can be increased because the balloon thread guide **24** can be moved to a larger distance from the reserve disc **18** (e.g., about 27.5 to 68, about 30 to 50, or about 30 to 42 inches from the reserve disc **18** to the balloon thread guide **24**), or from the top of the double bucket **12** to the balloon thread guide **24**. It should be noted that the balloon thread guide **24** could be moved in less than about 1 inch increments within the ranges noted above (e.g., the lower range could be about 28, 29, 30, 31, 32, 33, 34, 35, and so on, while the upper limit could be 68, 67, 66, 65, 64, 63, 62, 61, and so on, and combination of these lower and upper levels).

[0034] The diameter of the balloon thread guide **24** can be about 0.5 to 6 inches or about 1 inch. The reserve disc **18** can have a diameter of about 7 inches, and the distance **42** from the reserve disc to the balloon thread guide **24** can be about 28 to 68 inches, about 30 to 58 inches, or about 30 to 48 inches.

[0035] In short, a creel yarn (first yarn) **32** is disposed on the creel peg. The creel yarn **32** is guided through the tension frame and to the reserve disc **18**. The tension applied to the creel yarn **32** is about 100 g to 1000 g or about 200 g to 300 g. The creel yarn **32** is wrapped around the reserve disc **18** about 0.75 to 2.5 wraps. Subsequently, the creel yarn **32** is guided to the balloon thread guide **24** (forms the balloon **36**), where it is cabled with the bucket yarn **34**. The bucket yarn **34** is disposed in the double-bucket **12**. The end of the bucket yarn **34** of the top tube **42***a* is tied to the start of the bucket yarn of the bottom tube **42***b* to from a continuous bucket yarn **34**. The bucket yarn **34** is guided through the bucket tension devices **14** to the balloon thread guide **24**, where it is cabled with the creel yarn **32**. The balloon formed during operation is large enough to pass around the bucket. The bucket tension is about 100 g to 1000 g or about 200 g to 300 g. It should be noted that not all of the features of the apparatus are described for reasons of clarity and one skilled in the art would know how to properly set up the apparatus to run the twisting or cabling process.

[0036] The creel yarn can have a denier of about 300 to 6000. The bucket yarn can have a denier of about 300 to 6000. The creel yarn and the bucket yarn can be the same or different yarns having the same or different deniers.

[0037] As noted above, the yarn can include a polymer fiber. The polymer fiber can include fibers such as, but not limited to, a polyamide fiber, polyester fiber, polypropylene fiber, and the like. In particular, the polymer fiber can be a polyamide fiber. The term "polyamide" as used herein means the well-known fiber-forming substance that is a long-chain synthetic polyamide. The polyamides can be a homopolymer, copolymer, or terpolymer, or mixtures of polymers. Embodiments of polyamide fibers include, but are not limited to, polyhexamethylene adipamide (nylon 6, 6); polycaproamide (nylon 6); polyenanthamide (nylon 7); poly(10-aminodecanoic acid) (nylon 10); polydodecanolactam (nylon 12); polytetramethylene adipamide (nylon 4, 6); polyhexamethylene sebacamide homopolymer (nylon 6, 10); a polyamide of n-dodecanedioic acid and hexamethylenediamine homopolymer (nylon 6, 12); and a polyamide of dodecamethylenediamine and n-dodecanedioic acid (nylon 12, 12). In addition, the polyamide can be a copolymer polyamide (e.g., a polyamide polymer derived from two or more dissimilar monomers). In particular, the polyamide fiber is polyhexamethylene adipamide and copolymers thereof. The copolymer may contain a variety of comonomers known in the art, and in particular, may contain methylpentamethylene diamine and isophthalic acid. The polymer or copolymer can also include a variety of additives such as delusterants, pigments, stabilizers, antistatic agents, and the like.

[0038] It should be noted that ratios, concentrations, amounts, and other numerical data may be expressed herein in a range format. It is to be understood that such a range format is used for convenience and brevity, and thus, should be interpreted in a flexible manner to include not only the numerical values explicitly recited as the limits of the range, but also to include all the individual numerical values or sub-ranges encompassed within that range as if each numerical value and sub-range is explicitly recited. To illustrate, a concentration range of "about 0.1% to about 5%" should be interpreted to include not only the explicitly recited concentration of about 0.1 wt % to about 5 wt %, but also include individual concentrations (e.g., 1%, 2%, 3%, and 4%) and the sub-ranges (e.g., 0.5%, 1.1%, 2.2%, 3.3%, and 4.4%) within the indicated range. The term "about" can include ±1%, ±2%, ±3%, ±4%, ±5%, ±6%, ±7%, ±8%, ±9%, or ±10%, or more of

the numerical value(s) being modified. In addition, the phrase "about 'x' to 'y'" includes "about 'x' to about 'y'"

[0039] Many variations and modifications may be made to the above-described embodiments. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the following claims.

At least the following is claimed:

1. A yarn twisting or cabling apparatus comprising:

a multi-package bucket having a bucket top and a bucket bottom, a reserve disc, and an adjustable extension arm with a balloon thread guide, wherein the multi-bucket is adapted to include at least two full size about 11 inch tubes, wherein the reserve disc is disposed at the bucket bottom, wherein the adjustable extension arm is positioned so that the balloon thread guide is positioned above the bucket top along the center line of the bucket.

2. The yarn twisting or cabling apparatus of claim **1**, wherein the multi-package bucket is adapted to include at least three full size 11 inch tubes.

3. The yarn twisting or cabling apparatus of claim **1**, wherein the distance from the top of the multi-package bucket to the bucket bottom is greater than about 22 inches.

4. A structure comprising:

a multi-package bucket having a bucket top and a bucket bottom, wherein the multi-bucket is adapted to include at least two full size 11 inch tubes.

5. The structure of claim **4**, wherein the multi-package bucket is adapted to include at least three full size 11 inch tubes.

6. The structure of claim **4**, wherein the distance from the top of the multi-package bucket to the bucket bottom is greater than about 22 inches.

7. A method of twisting or cabling yarn, comprising:

providing an apparatus selected from an apparatus of claims **1** to **3**; and

twisting a bucket yarn with a creel yarn to form a piled yarn.

* * * * *