US012448257B2

(12) **United States Patent**
Brants et al.

(10) **Patent No.: US 12,448,257 B2**
(45) **Date of Patent: Oct. 21, 2025**

(54) **DRUM SPOOLING SYSTEM WITH LOAD-BEARING LINE PROTECTIVE WRAP**

(71) Applicant: **Protech Theatrical Services, Inc.**, North Las Vegas, NV (US)

(72) Inventors: **William H. Brants**, Las Vegas, NV (US); **Matthew B. Boswell**, North Las Vegas, NV (US); **Carroll R. Mayhew**, North Las Vegas, NV (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 277 days.

(21) Appl. No.: **18/129,828**

(22) Filed: **Mar. 31, 2023**

(65) **Prior Publication Data**

US 2023/0373763 A1 Nov. 23, 2023

Related U.S. Application Data

(60) Provisional application No. 63/325,715, filed on Mar. 31, 2022.

(51) **Int. Cl.**
B66D 1/28 (2006.01)
B66D 1/26 (2006.01)
B66D 1/60 (2006.01)

(52) **U.S. Cl.**
CPC ***B66D 1/28*** (2013.01); ***B66D 1/26*** (2013.01); ***B66D 1/60*** (2013.01)

(58) **Field of Classification Search**
CPC ... B66D 1/26; B66D 1/28; B66D 1/54; B66D 1/60; A63J 1/02; A63J 1/028
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

113,277	A *	4/1871	Dunne	A63J 1/028 472/78
8,544,823	B2 *	10/2013	Imberi	B66D 1/12 254/338
8,720,811	B2 *	5/2014	Zink	B65H 75/4478 242/397.2
9,616,357	B2 *	4/2017	Sowka	A63J 1/028
2011/0127477	A1 *	6/2011	Kokolis	B66D 1/26 254/338

* cited by examiner

Primary Examiner — Anna M Momper
Assistant Examiner — Nathaniel L Adams
(74) *Attorney, Agent, or Firm* — Newman Law, LLC

(57) **ABSTRACT**

A drum spooling system with a line protective material or wrap that can be wound and unwound with a load-bearing line, such as a wire rope, on a load drum to form a superposed arrangement of layers of the load-bearing line and protective material around the load drum, which advantageously reduces the pressure on the drum, radial space and/or drum size requirements, and damage to the wire rope resulting from the spooling and unspooling process, among other things.

7 Claims, 3 Drawing Sheets

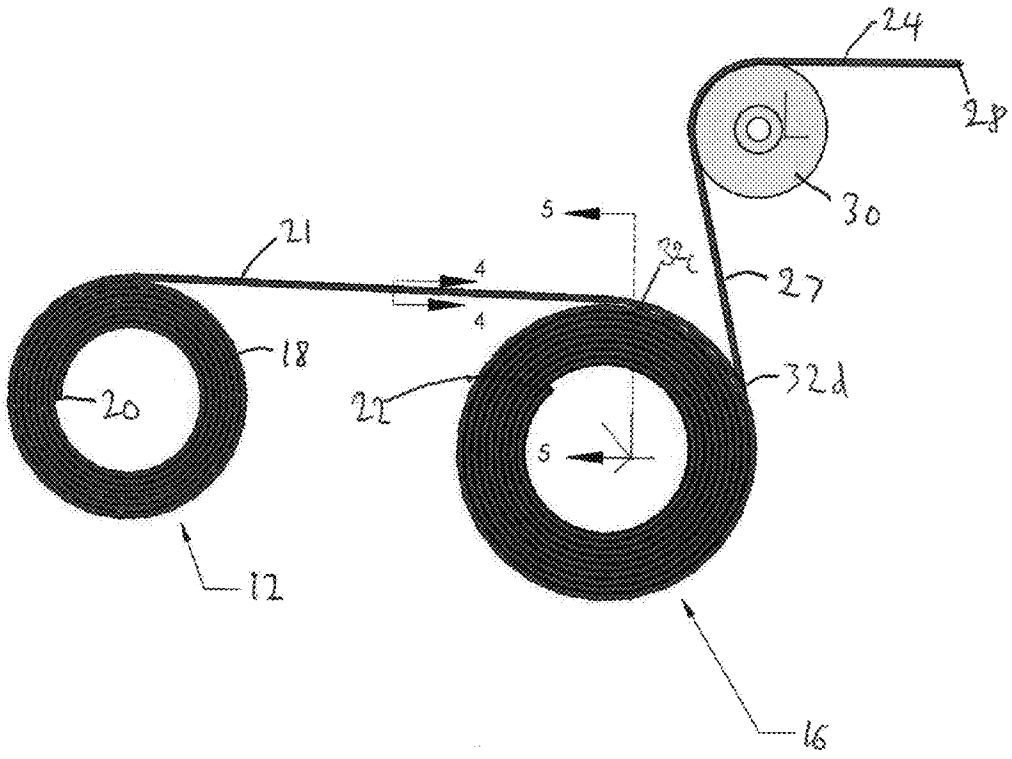


FIG. 1

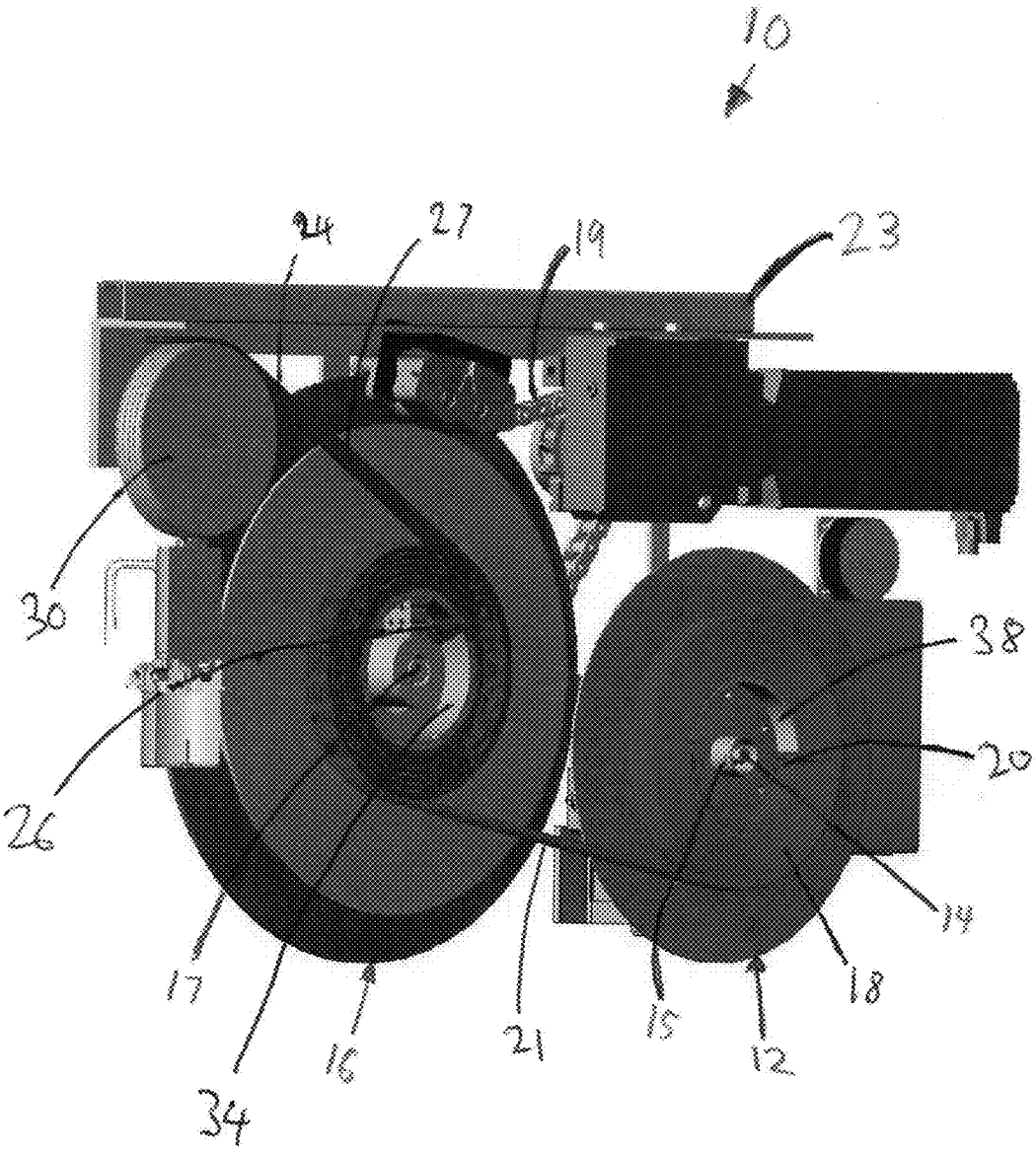
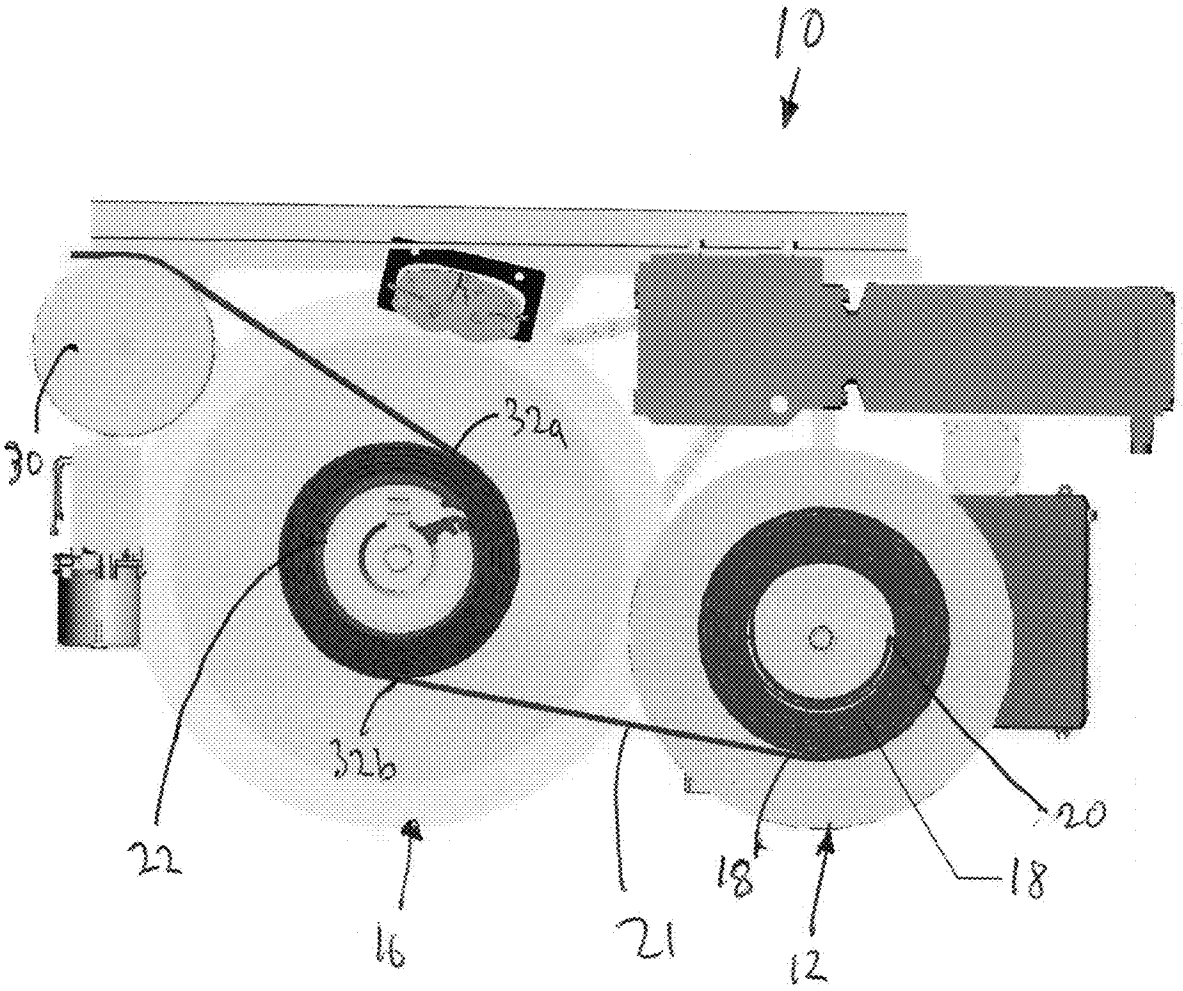
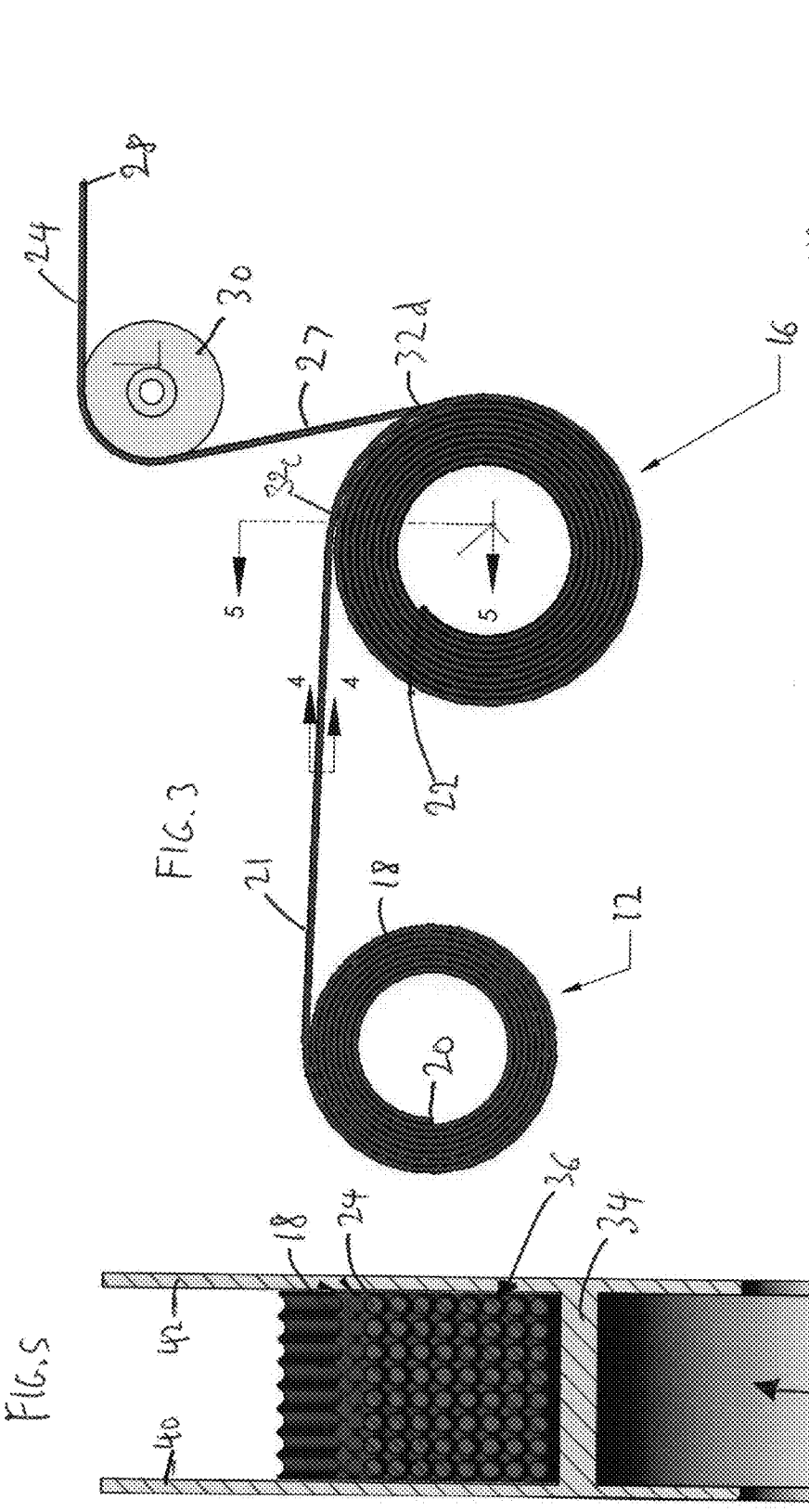
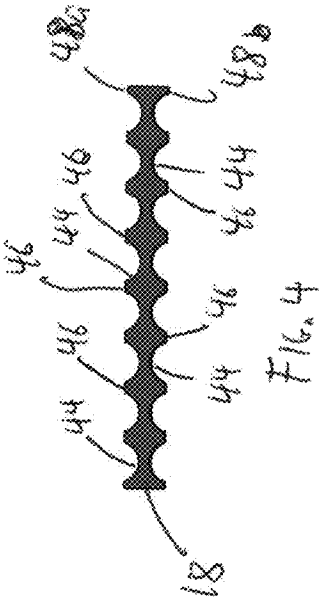


FIG. 2




28
24
30
27
32a
16
22
5
5
4
4
21
18
12
20
FIG. 3


48a
48b
46
44
46
44
46
44
46
44
18
FIG. 4

18
24
36
34
42
40
16
FIG. 5

DRUM SPOOLING SYSTEM WITH LOAD-BEARING LINE PROTECTIVE WRAP

FIELD OF THE INVENTION

The invention is directed to a spooling system, and more particularly to a spooling system with storage drum for winding lines, such as cable, wire and rope, on a drum under high tension. Embodiments of the invention may be advantageously adapted for use with theatrical scenery.

BACKGROUND OF THE INVENTION

Line driven systems use cables, ropes or wires ("lines") of long length which are wound and unwound on a drum at high tension. A drum as used herein, which may also include a spool, bobbin or reel, is cylindrical in shape with an axial hole for receiving an axis or a spindle during winding or unwinding. Optionally there can be a rim or a ridge at one or both ends of the cylinder in order to enable the drum to hold more line.

In a typical application one end of the line is attached to the drum while the other end is attached to an object or load to be alternately lifted by the rotational motion of the drum which in turn winds and/or unwinds the line on the drum through the counterclockwise and clockwise rotation of the drum on the spindle. The line or multiple lines may be maintained in position by one or more grooved pulley wheels, often at high tension as a result of the weight of the load.

The line or multiple lines are spooled onto the drum in a manner in which the line or layer of lines are wound circumferentially on top of one another. Each layer of line is thus in direct contact with either one or both of an inner and outer layer, with the lines of each layer of line generally settling into grooves formed by adjacent lines in the radially inner or previously wound layer of line.

The action of winding and unwinding the line on the drum is a repetitive operation that can cause damage to the line. It should be readily apparent that a damaged line used for lifting heavy objects creates a substantial safety issue.

Accordingly, there is a need in the art for improved drum spooling systems for at least the foregoing reasons.

SUMMARY OF THE INVENTION

The invention is generally directed to addressing the issues cited above, among others, by providing a drum spooling system with a line protective layer that can be wound and unwound in contact with a load-bearing line, such as a wire rope.

Some embodiments of the invention are directed to a drum spooling system, comprising: a load drum mounted for rotational motion, the load drum being operatively associated with a motor for driving rotational motion thereof; a storage drum mounted for rotational motion; a load-bearing line having a first end engaged with the load drum, a second end attached to a load, and an intermediate section, the intermediate section being alternately spooled on the load drum and unspooled from the load drum responsive to alternating rotational motion of the load drum; and an protective wrap having a longitudinal groove defined therein, the protective wrap having a first end engaged with the storage drum, a second end engaged with the load drum, a first intermediate portion and a second intermediate portion, wherein responsive to alternating rotational motion of the load drum, the first intermediate portion is alternately spooled on the storage drum and unspooled from storage drum and the second intermediate portion is alternately spooled on the load drum and unspooled from the load drum simultaneously with the intermediate section being alternately spooled on the load drum and unspooled from the load drum, wherein the intermediate section of the load-bearing line is received in the longitudinal groove of the second intermediate portion responsive to the spooling of the intermediate section of the load-bearing line on the load drum.

In some embodiments, the protective wrap is constructed of a deformable material.

In some embodiments, the aforementioned system further comprises a plurality of load-bearing lines.

In some embodiments, the protective wrap further comprises a plurality of longitudinal grooves, wherein each longitudinal groove of the plurality of longitudinal grooves receives each load-bearing line of the plurality of load-bearing lines.

In some embodiments, the protective wrap further comprises a plurality of longitudinal grooves.

In some embodiments, the protective wrap further comprises a plurality of longitudinal grooves.

In some embodiments, the intermediate section of the load-bearing line and the load-bearing line are spooled onto the load drum at a first circumferential position and a second circumferential position, respectively, wherein the first circumferential position and the second circumferential position are from about 0 degrees to about 180 degrees apart.

These features and advantages of the present disclosure may be appreciated by reviewing the following description of the present disclosure, along with the accompanying figures wherein like reference numerals refer to like parts.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings illustrate the embodiments of systems, methods, and other aspects of the disclosure. Any person with ordinary skills in the art will appreciate that the illustrated element boundaries (e.g., boxes, groups of boxes, or other shapes) in the figures represent an example of the boundaries. In some examples, one element may be designed as multiple elements, or multiple elements may be designed as one element. In some examples, an element shown as an internal component of one element may be implemented as an external component in another and vice versa. Furthermore, the elements may not be drawn to scale.

Various embodiments will hereinafter be described in accordance with the appended drawings, which are provided to illustrate, not limit, the scope, wherein similar designations denote similar elements, and in which:

FIG. **1** is a front perspective schematic cross-sectional view of a drum spooling system with a load-bearing line protective layer configured and constructed according to some embodiments of the invention;

FIG. **2** is a side view of the drum spooling system shown in FIG. **1**;

FIG. **3** is a schematic diagram of another configuration of a load-bearing line and protective layer system constructed in accordance with some embodiments of the invention;

FIG. **4** is a cross-sectional view of the protective layer constructed in accordance with some embodiments of the invention taken along line **4-4** of FIG. **3**; and

FIG. **5** is a cross-sectional view of the load drum taken along line **5-5** of FIG. **3** illustrating the superposed arrange-

ment formed by spooling the load-bearing line and protective layer onto load drum in accordance with some embodiments of the invention.

DETAILED DESCRIPTION OF SOME EMBODIMENTS OF THE INVENTION

Detailed Description of Embodiments of the Invention

The present disclosure is best understood with reference to the figures and description set forth herein. Various embodiments have been discussed with reference to the figures. However, those skilled in the art will readily appreciate that the detailed descriptions provided herein with respect to the figures are merely for explanatory purposes, as the methods and systems may extend beyond the described embodiments. For instance, the teachings presented and the needs of a particular application may yield multiple alternative and suitable approaches to implement the functionality of any detail described herein. Therefore, any approach may extend beyond certain implementation choices in the following embodiments.

References to "one embodiment," "at least one embodiment," "an embodiment," "one example," "an example," "for example," and so on indicate that the embodiment(s) or example(s) may include a particular feature, structure, characteristic, property, element, or limitation but that not every embodiment or example necessarily includes that particular feature, structure, characteristic, property, element, or limitation. Further, repeated use of the phrase "in an embodiment" does not necessarily refer to the same embodiment.

Methods of the present invention may be implemented by performing or completing manually, automatically, or a combination thereof, selected steps or tasks. The term "method" refers to manners, means, techniques, and procedures for accomplishing a given task including, but not limited to, those manners, means, techniques, and procedures either known to or readily developed from known manners, means, techniques, and procedures by practitioners of the art to which the invention belongs. The descriptions, examples, methods, and materials presented in the claims and the specification are not to be construed as limiting but rather as illustrative only. Those skilled in the art will envision many other possible variations within the scope of the technology described herein.

Embodiments of the invention disclosed herein are advantageously adapted to work with existing drum spooling systems. While the discussion and embodiments of the invention described herein is directed to such systems, it should be readily apparent that the same concepts of the invention discussed herein are also applicable to other applications and types of systems, and thus, the invention is not limited to any particular type of application or system.

Where certain elements of the disclosure can be partially or fully implemented using known components and processes, only those portions of such known components and processes that are helpful for providing an understanding of the embodiment of the invention disclosed are described, whereas detailed descriptions of other known components and processes are omitted so as not to obscure the invention. Furthermore, some components and processes have been omitted are shown unlabeled to illustrate certain elements of the invention and/or avoid obscuring certain elements of the invention that are described herein and depicted in the figures.

FIGS. **1-5** are directed to a system constructed or modified in accordance with some embodiments of the invention generally designated by the reference numeral **10**. System **10** including a storage drum **12** having an arbor **15** mounted on a spindle **14** for rotational motion and a load drum **16** mounted for rotational motion on a spindle **17**. Load drum **16** may be driven by a motorized mechanism **19**. In some embodiments, storage drum **12** is mounted adjacent to a load drum **16** and may be mounted to a housing or frame **23**.

A protective wrap **18** has a first end **20** secured or engaged to storage drum **12**, a second end **22** secured or engaged to load drum **16**, and an intermediate section **21** between first end **20** and second end **22**. Intermediate section **21** is alternately spooled and unspooled from storage drum **12** and load drum **16** as load drum **16** alternately rotates in a clockwise or counterclockwise manner. In some embodiments, protective wrap **18** is an elongated line of material, and may be of any cross-sectional shape, such as circular, square or rectangular.

A load-bearing line **24** has a first end **26** secured or engaged to load drum **16** and a second end **28** attached to a load (not shown), and an intermediate section **27** between first end **26** and second end **28**. Intermediate section **27** is alternately spooled and unspooled from load drum **16** as load drum **16** is alternately driven to rotate in a clockwise or counterclockwise manner by motorized mechanism **19**. Load-bearing line **24** is typically, but not always, is attached to a load after line **24** passes over or through one or more guides, sheaves or pulleys, one of which is generally depicted by reference numeral **30**.

System **10**, storage drum **12** and load drum **16** are positioned and configured to enable load-bearing line **24** and protective wrap **18** to come into contact with one another while being wound on barrel **34** of load drum **16**, whereby a superposed arrangement of load-bearing line **24** and protective wrap **18** is formed as shown by reference numeral **36**.

As load drum **16** rotates to unspool or unwind load-bearing line **24**, such as when a load at the end of line **24** is being lowered or moved with gravity or less resistance, load-bearing line **24** and protective wrap **18** separate with protective wrap **18**, with protective wrap **18** being spooled or wound on barrel **38** of storage drum **12**. As load drum **16** rotates in the opposing direction to wind load-bearing line **24** onto barrel **34** of load drum **16**, such as when a load is being lifted or moved against gravity with greater resistance, protective wrap **18** is unwound from barrel **38** of storage drum **12** and directed (which may include one or more sheaves or guide members) into contact with load-bearing line **24** as they are wound onto barrel **34** load drum **16** in the superposed arrangement **36**.

It should be understood that load drum **16** and storage drum **12** may be configured in a variety of positions relative to one another, and/or load-bearing line **24** and protective wrap **18** may be directed from multiple directions at various angles or degrees relative to one another based on the position of drum **16** and drum **12** and/or through the use of elements for directing line **24** and layer **18**, such as guides, pulleys or sheaves, so long as load-bearing line **24** and protective wrap **18** are brought into contact with one another when being spooled onto load drum **16**.

For example, in FIGS. **1** and **2**, load-bearing line **24** is directed to load drum **16** from an elevated position, and upon being spooled onto load drum **16**, feeds first onto load drum **16** from the radially opposite side of protective wrap **18**. Protective wrap **18**, which is directed to load drum **16** from a lower elevation, then contacts load drum **16** and meets with load-bearing line **24** thereon at a position **32***a* which is

about 180 degrees from the point **32***b* at which load-bearing line **24** contacts load drum **16**. In another example shown in FIG. **3**, load-bearing line **24** and protective wrap **18** are directed to load drum **16** from a similar radial side of load drum **16**, with protective wrap **18** being wound onto load drum **16** first at a point **32***c* and within 90 degrees of the point **32***d* at which load-bearing line then meets with protective wrap **18** on load drum **16**.

In the exemplary embodiment illustrated herein, protective wrap **18** is configured as an elongated generally planar strip of material having a longitudinal length equal or related to the length of a portion or the entirety of load-bearing line **24** and a width less than the lateral width of barrel **34** as also defined by opposing flanges **40** and **42** of load drum **16**. The width of protective wrap **18** is also be less than the width of barrel **38** of storage drum **12** defined by its opposing flanges (not shown).

In some embodiments, protective wrap **18** has a corrugated configuration and includes upper and lower sides **48***a* and **48***b* with opposing sets of upper and lower longitudinal grooves **44** defining adjacent ridges **46**. Each groove **44** and ridges **46** accommodates receiving load-bearing line **24** therein as line **24** and protective wrap **18** are wound together onto load drum **16**.

In the embodiment shown herein, load-bearing line **24** comprises a plurality of load-bearing lines **24** with each line being laterally positioned, such that rotating drum **16** in alternating directions either winds or unwinds the plurality of load-bearing lines **24** simultaneously on barrel **34**.

In this embodiment, protective wrap **18** is corrugated, that is, configured with a plurality of alternating adjacent grooves **44** and ridges **46**. In some embodiments, protective wrap **18** has the same amount of laterally adjacent grooves **44** as the amount of laterally adjacent load-bearing lines **24**, whereby each load-bearing line of the plurality of load bearing lines **24** is received by a groove **44** in protective wrap **18** as the plurality of laterally adjacent load-bearing lines **24** are wound on barrel **34** of load drum **16**.

In this embodiment, the lateral width of protective wrap **18** corresponds with the lateral with the lateral width of barrel **34** whereby protective wrap **18** is wrapped spirally and generally uniformly in a single layer about barrel **34** between flanges **40** and **42** as shown particularly in FIG. **5**.

System **10** enables the plurality of laterally adjacent load-bearing lines **24** to be maintained in the same laterally adjacent positions with respect to each other when wound as when unwound, with each individual line being received within cooperating laterally adjacent grooves **44** of protective wrap **18** upon being would onto barrel **34** of load drum **16**.

The superposed arrangement of line **24** with protective wrap **18** helps to, among other things, reduce the interlayer line pressure, particularly at the barrel **34** and/or core or arbor **15** of load drum **16** where pressure may be highest, and to conserve radial space (outwardly with respect to arbor **15**) on load drum **16**. The arrangement of lines **24** and protective wrap **18**, among other things, also enables the radially outward or vertical stacking of lines **24** on load drum **16**, with protective wrap **18** effectively filling in for the groove space which would naturally be formed between adjacently wound lines wrapped around a drum without protective wrap **18**. Multiple layers of line **24** may thus be wound on a single load drum **16** using protective wrap **18** without damage caused by direct line-to-line contact.

In some embodiments, the inclusion of protective wrap **18** further enables the controlled expansion of the drum wrapping (i.e., the lines **24** plus protective wrap **18**) to match the increase in diameter due to the previous layer of wrapping, thus eliminating crossover of lines **24** at the point of interference between successive layers of wrapping, among other things, in which the wrapping forms an Archimedean spiral.

In some embodiments where there is a single load-bearing line **24**, and an protective wrap **18** having a plurality of grooves **44** and ridges **46**, the line **24** may be wound laterally within grooves **44** crossing laterally from one longitudinal side of protective wrap **18** to the opposing longitudinal side, which among other things, conserves radial space on load drum **16**.

Protective wrap **18** may be constructed of a variety of materials. In this embodiment, protective wrap **18** is formed of a resilient, deformable or elastic material, such as a foam or foam-rubber, latex or polyurethane or the like. Other materials such as elastomer materials that could be used or combined to form the protective wrap include natural rubber or synthetic based rubber such as styrene-butadiene rubber (SBR), butyl rubber (MR), chloroprene rubber (CR), nitril rubber (NBR) or high performance rubbers such as ethene-propene (EPM, EPDM) or high performance rubbers like silicon rubbers or urethane rubbers. Alternatively some thermoplastic polymers like polyolefins and thermoplastic polyurethanes could be used.

Storage drum **12** may be motorized or driven passively by the rotational motion of load drum **16**, which is motorized.

An exemplary use of the system and methods of the invention is in theatrical rigging counterweight systems.

While exemplary apparatus, systems and methods of the invention have been described herein, it should also be understood that the foregoing is only illustrative of a few particular embodiments with exemplary and/or preferred features, as well as principles of the invention, and that various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention. Therefore, the described embodiments should not be considered as limiting of the scope of the invention in any way. Accordingly, the invention embraces alternatives, modifications and variations which fall within the spirit and scope of the invention as set forth herein, in the claims and any equivalents thereto.

The invention claimed is:

1. A drum spooling system, comprising:

a) a load drum mounted for rotational motion, the load drum being operatively associated with a motor for driving rotational motion thereof;

b) a storage drum mounted for rotational motion;

c) a load-bearing line having a first end engaged with the load drum, a second end attached to a load, and an intermediate section, the intermediate section being alternately spooled on the load drum and unspooled from the load drum responsive to alternating rotational motion of the load drum; and

d) an protective wrap having a longitudinal groove defined therein, the protective wrap having a first end engaged with the storage drum, a second end engaged with the load drum, a first intermediate portion and a second intermediate portion, wherein responsive to alternating rotational motion of the load drum, the first intermediate portion is alternately spooled on the storage drum and unspooled from storage drum and the second intermediate portion is alternately spooled on the load drum and unspooled from the load drum simultaneously with the intermediate section being alternately spooled on the load drum and unspooled from the load drum,

wherein the intermediate section of the load-bearing line is received in the longitudinal groove of the second intermediate portion responsive to the spooling of the intermediate section of the load-bearing line on the load drum.

2. The drum spooling system of claim **1**, wherein the protective wrap is constructed of a deformable material.

3. The drum spooling system of claim **1**, further comprising a plurality of load-bearing lines.

4. The drum spooling system of claim **3**, wherein the protective wrap further comprises a plurality of longitudinal grooves, wherein each longitudinal groove of the plurality of longitudinal grooves receives each load-bearing line of the plurality of load-bearing lines.

5. The drum spooling system of claim **3**, wherein the protective wrap further comprises a plurality of longitudinal grooves.

6. The drum spooling system of claim **1**, wherein the protective wrap further comprises a plurality of longitudinal grooves.

7. The drum spooling system of claim **1**, wherein the intermediate section of the load-bearing line and the protective wrap are spooled onto the load drum at a first circumferential position and a second circumferential position, respectively, wherein the first circumferential position and the second circumferential position are from about 0 degrees to about 180 degrees apart.

* * * * *