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(54) Title: FLAME RETARDANT TENSION MEMBER

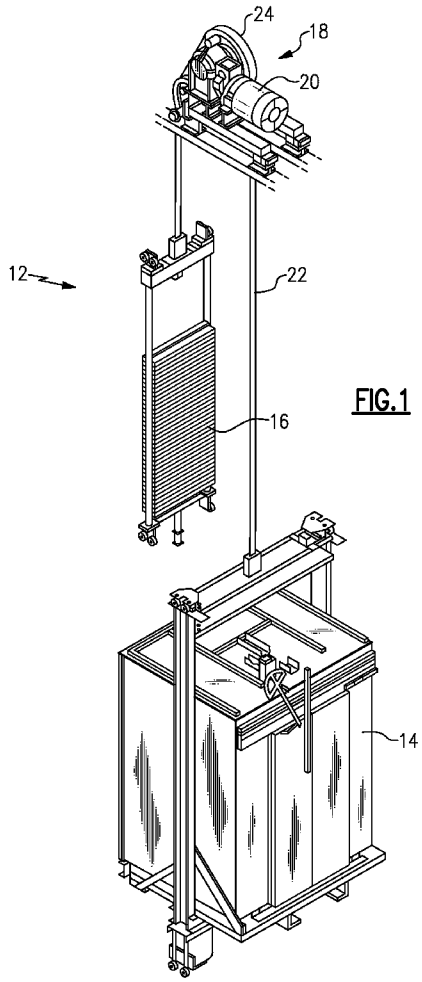

FIG.1

(57) Abstract: A flame retardant tension member for an elevator system includes a wire and/or a fiber and a jacket applied to the wire and/or fiber, the jacket including a flame retardant additive comprising phosphazene.

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FLAME RETARDANT TENSION MEMBER

TECHNICAL FIELD

[0001] The present invention relates to tension members for elevator systems, and more particularly to flame retardant tension members.

BACKGROUND

[0002] Conventional traction elevator systems can include a car, a counterweight, two or more ropes interconnecting the car and the counterweight, and a traction sheave to move the ropes, and machine to rotate the traction sheave. The ropes were conventionally formed of steel wires formed into strands, the strands then formed into cords, and the cords then formed into the rope.

[0003] Although conventional steel ropes have proven very reliable and cost effective as tension members, other tension members have been used in recent years.

[0004] For example, high tensile strength, lightweight synthetic fibers have been used in place of steel ropes in elevator systems. Such fibers may include Aramid or Kevlar® fibers. A coating could be provided on and around these synthetic fibers. The coating is used as a jacket.

[0005] In addition, flat ropes have been used in place of steel ropes in elevator systems. Such flat ropes have a plurality of cords with a coating provided on and around the cords. The coating is used as a jacket. U.S. Patent number 6,739,433, herein incorporated by reference, describes one such flat rope.

[0006] There is a demand jacket materials to have flame retardant properties when used in elevator rope applications. Flame retardant additives such as melamine cyanurate, melamine phosphate and other organic phosphates called phosphate esters have been proposed to be added to polyurethane jackets. These additives, if used in combination with each other, could be effective in enhancing the flame retardant properties of polyurethane jackets. While enhancing flame retardant properties, however, phosphate additives are not suitable with certain jacket materials under certain conditions. For example, the use of phosphate additives with polyester-

based thermoplastic urethanes in high temperature and/or high humidity environments could promote jacket degradation since the phosphate additive could react with heat and water to create phosphoric acid that subsequently attacks and degrades the jacket material.

[0007] As used herein, the term "flame retardant" is synonymous with the term "fire resistant" (although the term "flame retardant" will be used throughout) and means inhibiting or resisting the spread of fire. The level of flame retardancy of the jacket material could be classified, for example, using the UL94 standard.

SUMMARY

[0008] According to an example disclosed herein, a flame retardant tension member for an elevator system includes a wire and/or a fiber, and a jacket applied to the wire and/or fiber, the jacket including a flame retardant additive comprising phosphazene.

[0009] According to a further example disclosed herein, a method of jacketing a rope for an elevator system includes the steps of providing a wire or fiber, providing a jacket material, adding phosphazene to the jacket material to provide a flame retardant jacket, and applying the flame retardant jacket to the wire or fiber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is a perspective view of an exemplary elevator system using a tension member according to the present invention.

[0011] Figure 2 is a sectional side view of one possible arrangement of a tension member according to the present invention.

[0012] Figure 3 is a sectional side view of another possible arrangement of a tension member according to the present invention.

DETAILED DESCRIPTION

[0013] Illustrated in Figure 1 is an exemplary traction elevator system 12. The elevator system 12 can include a car 14, a counterweight 16, a traction drive 18 including a machine 20 and traction sheave 24, and a tension member 22. The traction drive 18 moves tension member 22 (e.g., rope) interconnecting the car 14 and counterweight 16 using traction sheave 24. The tension member 22 is engaged with sheave 24 such that rotation of the sheave 24 moves the tension member 22, and thereby the car 14 and the counterweight 16. Although shown as a geared machine 20, it should be noted that this figuration is for illustrative purposes only, and the present invention may be used with geared, gearless or other machines. In addition, other components of the elevator system 12 that are not required to be discussed for an understanding of the present invention (*e.g.* safeties, rails, *etc.*) will not be discussed. Finally, although the elevator system 12 shown in Figure 1 uses 1:1 roping, other roping arrangements could likewise be used.

[0014] The tension member 22 is illustrated, in one possible arrangement, in Figure 2. The tension member 22 of Figure 2 could include a plurality of metallic wires and/or a plurality of synthetic fibers within a common coating layer 28 or jacket to form a flat rope. The wires and/or fibers could be twisted into strands, and the strands then twisted into a cord 26. The plurality of cords 26 in the tension member 22 could have equal length, be spaced width-wise within the coating layer 28 and arranged linearly along the width dimension. The coating layer 28 could be formed from a polyurethane material, such as polyester-based thermoplastic urethane or a polyether-based thermoplastic urethane, that could be applied to the plurality of cords 26 in such a manner, such as using a mould wheel or extrusion, that each of the individual cords 26 can be retained against longitudinal movement relative to the other ropes 26. As one example, and as seen in Figure 2, the coating layer 28 could surround the cords 26. Other materials may also be used for the coating layer 28 if they are sufficient to meet one or more of the exemplary functions of the coating layer; such as traction, wear, and transmission of traction loads to the ropes 26 and resistance to environmental factors. The coating layer 28 engages the traction sheave 24 and serves to transmit the forces from the rotation of the sheave 24 to the load carrying cords 26.

[0015] Figure 3 illustrates another possible embodiment of tension member 22. The tension member 22 of Figure 3 could include a plurality of metallic wires and/or a plurality of synthetic fibers within a common coating layer 28 or jacket to form a round rope. The wires and/or fibers could be twisted into strands, the strands then twisted into cords, and the cords then twisted into a rope 27. Similar the previously described tension member, the coating layer 28 could be formed from a polyurethane material, such as polyester-based thermoplastic urethane or a polyether-based thermoplastic urethane, applied to the rope 27. As one example, and as seen in Figure 3, the coating layer 28 could surround the rope 27. Other materials may also be used for the coating layer 28 if they are sufficient to meet one or more of the exemplary functions of the coating layer; such as traction, wear, and transmission of traction loads to the ropes 26 and resistance to environmental factors. The coating layer 28 engages the traction sheave 24 and serves to transmit the forces from the rotation of the sheave 24 to the rope 27.

[0016] The Applicant has discovered that a relatively new compound called phosphazene could be used as an additive in the jacket material. Phosphazene may be obtained from Otsuka Chemical Co., Ltd. Polyphosphazene has superior hydrolysis resistance and provides flame retardant properties. Because of the Applicant's discovery that phosphazene is a usable additive that resists humidity or water degrading the polyester urethane, flame retardant tension members 22 can now use polyester-based urethane as the jacket material. Additionally, because the phosphazene is both hydrolytically resistant and provides flame retardant properties, not as much additive is necessary.

[0017] In formulating a polyester-based polyurethane as a jacket, a range of between about 5 parts to about 20 parts per 100 parts of phosphazene to polyester polyurethane may be utilized, a range of between about 10 to about 15 parts per hundred phosphazene to polyester-based polyurethane may also be used, and about 12 ½ parts per 100 of phosphazene to polyester-based polyurethane may be deemed ideal. In the prior art, the number of parts of additives per hundred of parts of polyether polyurethane has a range of 15 to 50 with 20 to 35 preferred and 28 deemed ideal. By using the phosphazene as an additive, similarly, the number of additives used as flame retardants per 100 parts of polyether-based polyurethane drops at least 5% with a 10% reduction being deemed ideal compared to the prior art. The additive phosphazene may be mixed with the polyester-based or polyether-based urethane, melted and then applied to the cords

26. One of ordinary skill in the art will recognize from the teachings herein that polyester-based urethanes and polyether-based urethanes may require different formulations for use with phosphazene.

[0018] The additive may also include melamine cyanurate or other compounds, such as zinc borate and the like, and the ratio of melamine compounds to the number of phosphazene parts is from about 10 to 1 to 1 to 2 with about 5 to 1 being preferred and about 3 to 1 deemed ideal. The combination of melamine cyanurate and phosphazene should not be greater than 20 parts of the 100 parts that form the coating layer 28.

[0019] Although the invention has been shown and described with respect to the exemplary embodiments thereof, it should be understood by those skilled in the art that various changes, omissions and additions may be made thereto without departing from the spirit and scope of the invention.

CLAIMS

What is claimed is:

1. A flame retardant tension member for an elevator system, said tension member comprising:

a wire and/or a fiber,

a jacket applied to said wire and/or fiber, said jacket including a flame retardant additive comprising phosphazene.

2. The member of claim 1 wherein a ratio of phosphazene to jacket material is in a range of between about 5 parts to about 20 parts of phosphazene per 100 parts of said jacket material.

3. The member of claim 2 wherein said ratio is in a range of between about 10 parts to about 15 parts of phosphazene per 100 parts of said jacket material.

4. The member of claim 5 wherein said ratio is 12 ½ parts of phosphzene per 100 parts of said jacket material.

5. The member of claim 1, wherein the jacket comprises a polyester-based urethane or a polyether-based urethane.

6. The member of claim 1, wherein the tension member is a flat rope or a round rope.

7. The member of claim 1, wherein a plurality of wires and/or fibers are formed into strands then formed into cords.

8. The member of claim 7, wherein the cords are formed into a rope.

9. A method of jacketing a rope for an elevator system, comprising the steps of:

providing a wire or fiber,

providing a jacket material,

adding phosphazene to said jacket material to provide a flame retardant jacket, and

applying said flame retardant jacket to said wire or fiber.

10. The method of claim 9, wherein the adding step comprises:

adding a range of between about 5 to about 20 parts of phosphazene to 100 parts of said jacket material to provide a flame retardant jacket.

11. The method of claim 10 wherein the adding step comprises:

adding a range of between about 10 to about 15 parts of phosphazene to 100 parts of said jacket material to provide a flame retardant jacket.

12. The method of claim 11 wherein the adding step comprises:

adding about 12.5 parts of phosphazene to 100 parts of said jacket material to provide a flame retardant jacket.

13. The method of claim 9, wherein the jacket providing step comprises:
providing a jacket material comprising a polyester-based urethane or a polyether-based urethane.

14. The method of claim 9, wherein the applying step produces a flat rope or a round rope.

15. The method of claim 9, wherein the wire and/or fiber providing step comprises: providing a plurality of wires or fibers formed into strands then formed into cords.

16. The member of claim 9, wherein the wire and/or fiber providing step includes forming said cords into a rope.

17. The member of claim 9 wherein a second flame retardant is added to said jacket material.

18. The member of claim 17 wherein said second flame retardant and said phosphazene sum to form about 20 parts to each 100 parts of said jacket material.

19. The member of claim 17 wherein a ratio of said second flame retardant and said phosphazene to is about 5:1.

20. The member of claim 17 wherein said second flame retardant is melamine cyanurate.

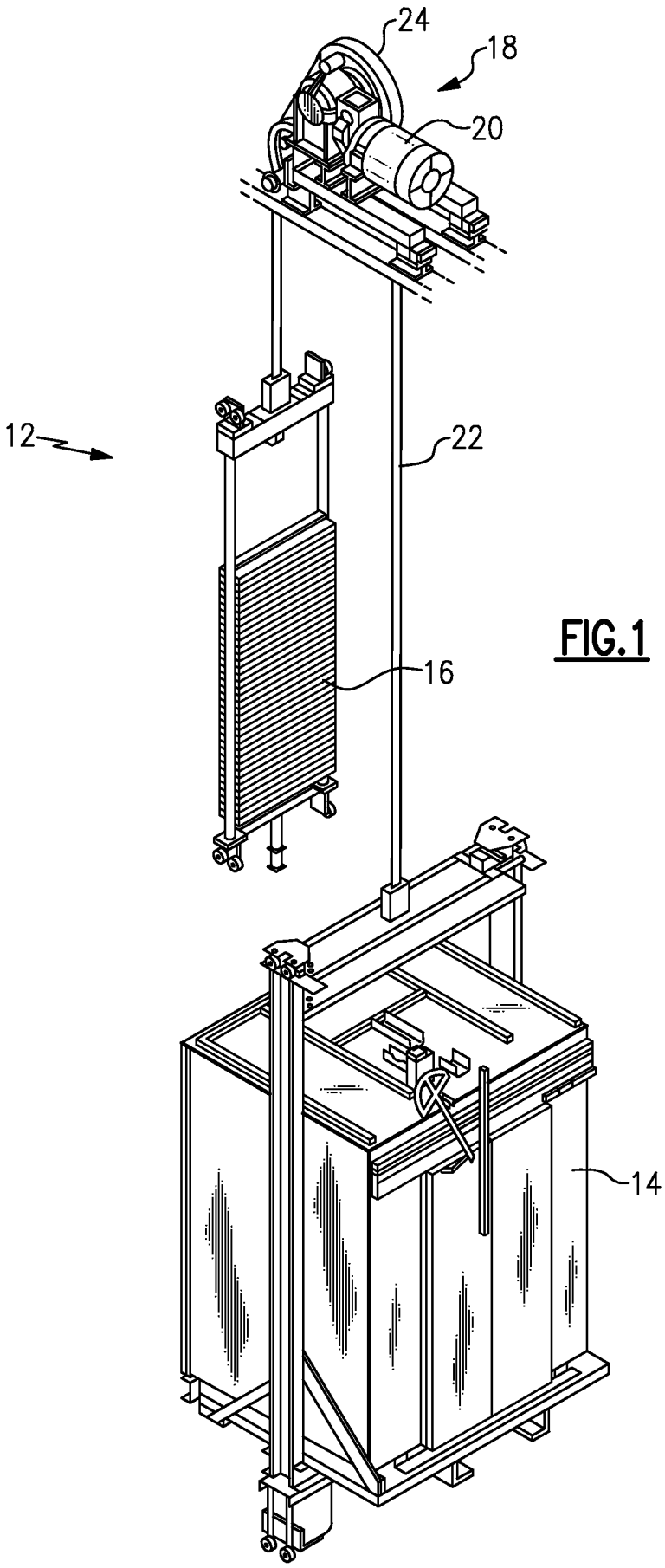

FIG.1

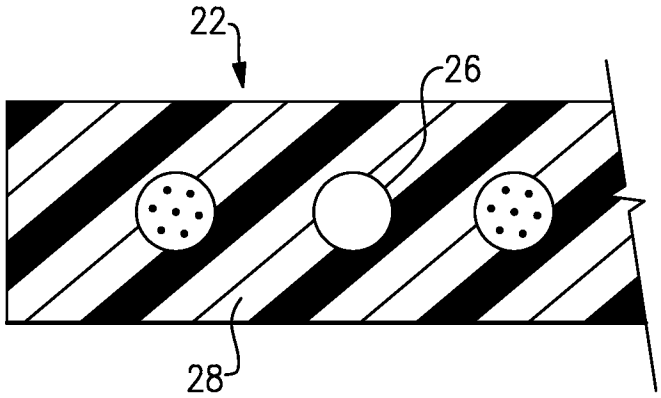

FIG.2

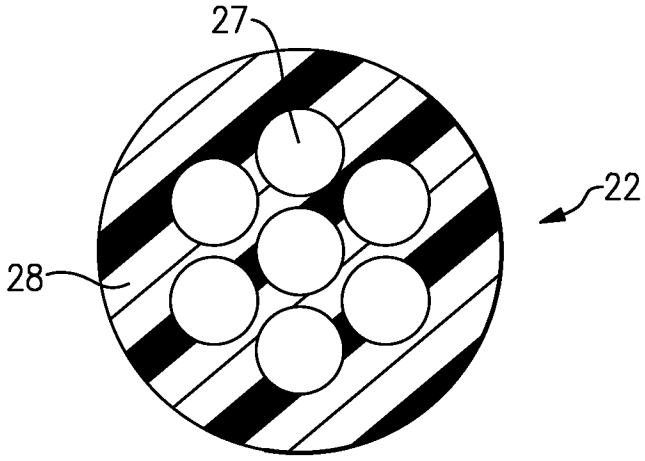

FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/55940

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B66B 11/04 (2012.01)
USPC - 187/251
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC: 187/251

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 187/240, 250, 251; 427/256 (text search - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Google
Search Terms: flame, retardant, phosphazene, melamine cyanurate, jacket, elevator, tension, rope, wire, urethane, polyurethane, coating

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/0100759 A1 (YU et al.) 05 May 2011 (05.05.2011), entire document especially Fig 7; paras [0004-[0016], [0028]	1-20
Y	US 3,859,249 A (MCNEELY) 07 January 1975 (07.01.1975), entire document especially the Abstract; col 8, lns 55-57	1-20
Y	US 6,164,053 A (O'DONNEL et al.) 26 December 2000 (26.12.2000), entire document especially col 1, lns 56-63	5, 13
A	US 7,595,362 B2 (KAWABE et al.) 29 September 2009 (29.09.2009), entire document	1-20
A	US 2003/0220515 A1 (YOSHIFUMI) 27 November 2003 (27.11.2003), entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 February 2012 (28.02.2012)	7 MAR 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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