The present invention discloses reflective ropes, hangers, cables, and lifelines and methods for making them.
REFLECTIVE ROPE, HANGERS, CABLES, LIFELINES AND METHODS FOR MAKING THE SAME

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a nonprovisional application, which claims the benefit of the provisional patent application of the same title and same inventors, which was filed on Feb. 21, 2006, and assigned U.S. Patent Application No. 60/775,423. The application is also related to provisional application Ser. No. 60/710,359, filed on Aug. 23, 2005 and to nonprovisional application Ser. No. 11/287,747 filed on Nov. 28, 2005, Provisional Patent Application Nos. 60/775,423 and 60/710,359 and Non Provisional patent application Ser. No. 11/287,747 are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Mining is inherently dangerous. Miners are under constant threat of a collapse or an accident within the mines. Often the lighting in the mines is low or nonexistent, making quick escapes from the mines very difficult. Additionally, within a mine there may be numerous tunnels and pathways, only a few of which lead directly to the outside. Mining tunnels tend to be very dark and, in the event of a fire, smoke can also make visibility difficult. In an emergency situation, even experienced miners may lose their directional and become lost. Getting lost in a mine in an emergency situation can result in serious injury and/or death.

[0003] The mining industry constantly is searching for equipment to make mining safer. One such goal has been to incorporate reflective materials into mine-related equipment to aid miners in finding their way through the tunnels, particularly but not exclusively, in emergency situations. The present invention addresses this need and others by disclosing a reflective rope for use in mining.

[0004] One type of mine equipment that has been developed to increase mine safety is a safety directional line (or lifeline) for underground mining. One example of such a line is described in U.S. Pat. No. 5,088,101 to Jacobs, et al. These lines come in a variety of sizes, shapes, embodiments, etc. and are followed by miners to lead them to various places in the mine, outside of the mine, and/or to safety. Often these lines are made of a rope or cable with indicators along the line at given distances to comply with local requirements and regulations. Historically, it has been difficult to design reflective lifelines that also satisfy the other mining requirements, such as strength, nonflammability, nonconductivity, etc.

[0005] Additionally, many industries, including but not limited to the mining industry, require some means of temporarily supporting or suspending various articles for various purposes, and often have need of a simple yet durable and reflective strap or loop which may be used as a hanger for various parts and components. Often it is advantageous to have such a reflective hanger, strap, or loop (collectively referred to herein as a “hanger”) so that it can be seen easily in low light conditions. Some examples of various hangers and loops are described in U.S. Pat. Nos. 5,970,697 and 5,871,193, both issued to Jacobs, et al. Until the invention of present reflective rope, no reflective rope products of the types described herein were available to the mining community. The present invention addresses this need for reflective ropes and hangers.

SUMMARY OF THE INVENTION

[0006] One embodiment of the present invention discloses a reflective rope for use in the mining industry comprising the combination of at least one carrier of rope material and at least one reflective material and/or reflective tape.

[0007] Another embodiment of the present invention discloses a reflective rope for use in the mining industry comprising at least one carrier of rope material and at least one reflective material and/or reflective tape, which are combined into one of the following forms: a hollow braided rope (a braided rope with a hollow center), a solid braided rope, a twisted braided rope, or a plated rope.

[0008] Another embodiment of the present invention encompasses a method of making a reflective rope comprising braiding together at least two carriers of material, wherein at least one carrier comprises a reflective yarn comprising 0.5 mm glass beads bonded to polyester filament, in such a manner as to have at least two pics per inch of length. A reflective tape can also be used and is within the scope of the present invention.

[0009] Another embodiment of the present invention encompasses a method of making a reflective rope for use in the mining industry comprising combining at least one carrier of rope material and at least one reflective material, which is optionally a reflective tape.

[0010] One embodiment of the present invention encompasses a method of making a reflective rope for use in the mining industry comprising braiding into the form of a hollow braid eight carriers of monofilament flame retardant polypropylene, so as to have at least two pics per inch of length, wherein two of the eight carriers are marker carriers, and blending a reflective material and/or reflective tape into these two marker carriers.

[0011] Another embodiment of the present invention discloses a safety directional line comprising a reflective rope made from the combination of at least one carrier of rope material and at least one reflective material and/or reflective tape. A plurality of directional indicators are spaced evenly along the rope and positioned such that the indicators are pointing along the axis of the line.

[0012] Another embodiment of the present invention discloses an improved safety directional line for underground mining comprising a reflective rope, a pair of fasteners for attaching the rope to a wall, and a plurality of directional indicators, each of which comprises two identical cone-forming sections. Each cone-forming section has a first end and a second end, a first side wall extending outwardly from the first end to the second end defining a half-conically shaped surface, a second side wall having a flat surface opposite the conically shaped surface, wherein the cone forming section is semicircular in cross section; and wherein the second side wall is provided with a channel therein extending along the length of the cone-forming section from the first end to the second end, a semicircular end plate having a circular edge and a flat edge integrally formed with the second side wall and having a section removed from the flat edge which is concentric with the channel in the second side wall of the cone-forming section, a plurality of receptor
holes along the first side, wall and corresponding holes along the channel in the flat surface, a plurality of retaining pins for insertion into the receptor holes, a coupler for joining the cone-forming sections of each indicator, whereby, upon joining the cone-forming sections of each indicator such that the second side walls, and the first ends and the second ends are adjacent, the coupler is engaged and the cone-forming sections of each of the indicators form a continuous side wall which extends outwardly from the first end to the second end defining a conical outer configuration and an inner wall which defines a circular channel extending through the center of the indicator. The rope is inserted into the circular channel of each indicator and the retaining pins are inserted in the receptor holes and the holes along the channel and engage the rope.

[0013] Another embodiment of the present invention discloses an improved line with double spliced loops formed therein for suspending articles therefrom, comprising a length of reflective rope having a plurality of first diagonal directional carriers interwoven with a plurality of second diagonal directional carriers, a first end portion, and an opposite second end portion. Each end portion has a first connecting portion and a second connecting portion mating with the first connecting portion for forming a closed loop. Each first connecting portion passes diametrically through the corresponding second connecting portion at a first point thereon to form the closed loop and thereby define an intersecting portion, and thence each first connecting portion is inserted into the corresponding second connecting portion at a second point thereon and diametrically passed through the first connecting portion at the intersecting portion to form a knot, such that each first connecting portion passes concentrically through the corresponding second connecting portion to be captured therein. Each second point is separated from the corresponding first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent to at least one of the first directional carriers, with at least one of the first directional stands crossing over at least one of the second directional carriers. Each closed loop is connected to one another by an intermediate portion.

[0014] Another embodiment of the present invention discloses an improved hanger for temporarily suspending articles therefrom, comprising a length of reflective rope having a plurality of first diagonal directional carriers interwoven with a plurality of second diagonal directional carriers, and a first connecting portion with a first end and an opposite second connecting portion with a second end. The first connecting portion is positioned diametrically through the second connecting portion at a first point thereon and thence into the second connecting portion at a second point thereon, provided with a locking interweave of carriers about which a first connecting portion knot is formed, then inserted diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and concentrically through the second connecting portion to be captured therein. The second point being separated from the first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent to at least one of the first directional carriers, with at least one of the first directional carriers crossing over to at least one of the second directional carriers. The second connecting portion passes into the first connecting portion at a second connecting portion entrance point thereon providing with a locking interweave of carriers about which a first connecting portion knot is formed, then inserting diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and being captured concentrically within the first connecting portion to form a closed loop of increasing strength with increasing tensile force upon the closed loop. The rope comprises at least one carrier of rope material and at least one reflective material, optionally a reflective tape, which are combined into one of the following for a hollow braided rope, a solid braided rope, a twisted braided rope, or a plated rope.

[0015] Another embodiment of the present invention is a hanger comprising a rope made of at least two carriers of rope material, which are braided together, and wherein at least one carrier comprises a reflective yarn made of about 0.5 mm glass beads bonded to polyester filament. A reflective tape can also optionally be used in place of the reflective yarn.

[0016] Another embodiment of the present invention is a hanger for use in the mining industry comprising the combination of at least one carrier of rope material and at least one reflective material and/or reflective tape.

[0017] Another embodiment of the present invention comprises a method of making a safety directional line comprising braiding together at least one carrier of rope material and a reflective yarn comprising about 0.5 mm glass beads bonded to polyester filament, in such a manner as to have at least two pics per inch of length. Additionally, a plurality of directional indicators are attached at even spaces along the rope and positioned such that the indicators are pointing along the axis of the line.

[0018] Another method of making a safety directional line for use in the mining industry according to the present invention comprises combining at least one carrier of rope material and at least one reflective material and/or reflective tape and attaching a plurality of directional indicators spaced evenly along the rope and positioned such that the indicators point along the axis of the line.

[0019] Another embodiment of the present invention is a method of making an improved line with double spliced loops formed therein for suspending articles therefrom, which comprises the following steps: (i) weaving a length of reflective hollow braided rope having a plurality of first diagonal directional carriers with a plurality of second diagonal directional carriers, a first end portion, and an opposite second end portion; (ii) mating each of the ends portions having a first connecting portion and a second connecting portion mating with said first connecting portion for forming a closed loop; (iii) each said first connecting portion passing diametrically through the corresponding said second connecting portion at a first point thereon to form said closed loop and thereby define an intersecting portion, and (iv) thence each said first connecting portion being inserted into said corresponding second connecting portion at a second point thereon and diametrically passed through said first connecting portion at said intersecting portion to form a knot, such that each said first connecting portion passes concentrically through said corresponding second connecting portion to be captured therein. Each second point is separated from the corresponding said first point by at least one of the first directional carriers and at
least one of the second directional carriers immediately adjacent the at least one of the first directional carriers, with the at least one of the first directional carriers crossing over the at least one of the second directional carriers, and each closed loop being connected to one another by an intermediate portion.

0020 The present invention also includes a method of making an improved hanger for temporarily suspending articles therefrom, comprising the steps of: (i) weaving a length of hollow braided reflective rope having a plurality of first diagonal directional carriers with a plurality of second diagonal directional carriers, and a first connecting portion with a first end and an opposite second connecting portion with a second end; (ii) positioning the first connecting portion through the second connecting portion at a first point thereon and thence into the second connecting portion at a second point thereon, provided with a locking interweave of carriers about which a first connecting portion knot is formed, then inserting diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and concentrically through the second connecting portion to be captured therein; (iii) separating the second point from the first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent the at least one of the first directional carriers, with the at least one of the first directional carriers crossing over the at least one of the second directional carriers; and (iv) passing the second connecting portion into the first connecting portion at a second connecting portion entrance point thereon providing with a locking interweave of carriers about which a first connecting portion knot is formed, then inserting diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and being captured concentrically within the first connecting portion to form a closed loop of increasing strength with increasing tensile force upon the closed loop, wherein the rope comprises at least two carriers of rope material and at least one reflective material and/or reflective tape, which are combined into a form selected from the group consisting of a hollow braided rope, a solid braided rope, a twisted braided rope, and a plaited rope.

BRIEF DESCRIPTION OF THE DRAWINGS

0021 For the present invention to be easily understood and readily practiced, the invention will now be described, for the purposes of illustration and not limitation, in conjunction with the following figures, wherein:

0022 FIG. 1 illustrates two embodiments of a reflective rope according to the present invention;

0023 FIGS. 2 and 3 illustrate various reflective hangers made according to various embodiments of the present invention;

0024 FIG. 4 illustrates one embodiment of a lifeline that can be made from rope according to the present invention;

0025 FIG. 5 illustrates one embodiment of a line that can be made from rope according to the present invention;

0026 FIG. 6 illustrates one embodiment of a hanger that can be made from rope according to the present invention;

0027 FIG. 7 illustrates another embodiment of a hanger that can be made from rope according to the present invention.

0028 FIGS. 8, 9 and 10 illustrate other preferred embodiments of a hanger that incorporate reflective tape as the reflective material.

DESCRIPTION OF THE INVENTION

0029 Various embodiments of the present invention comprise reflective ropes, the methods of making and manufacturing these ropes, and various methods of making and devices for using the reflective ropes, including but not limited to, in lifelines, lines, hangers, cables, etc. as described more fully herein.

0030 One embodiment of the present invention is a reflective rope (10) comprising a braid as shown in FIG. 1. The rope (10) comprises a rope material and a reflective material and/or a reflective tape in one of the following forms, or any other equivalent form: a hollow braided rope (a braid with a hollow center), a solid braided rope, a twisted braided rope, or a plaited rope.

0031 In a preferred embodiment, the reflective rope (10) is a hollow braid consisting of eight carriers or bundles of monofilament flame retardant polypropylene, or an equivalent material. It will be known to those in the art, that carriers are comprised of one or more strands of a material. In the preferred embodiment of the present invention, the number of strands in a carrier is between twenty and sixty strands. Any number of strands and any number of carriers, which create a rope to satisfy its intended use, may be used to make the present invention reflective rope, and all such variations are included within the scope of this invention. The suggested number of strands and carriers help to define the preferred embodiment of the present invention rope, but are not intended to limit the rope to those numbers. For ease of discussion, the term “carriers” is used herein to mean any number of strands of a material or a bundle of strands, as described previously.

0032 One preferred embodiment uses a reflective yarn, specifically about 0.5 mm glass beads bonded to polyester filament, as the reflective material. Also in a preferred embodiment, a flame retardant is added to the rope (10) to make it flame resistant. The rope (10) may consist of any number of carriers, but eight carriers have been found to work best. In the preferred embodiment of the present invention, the reflective material is blended into two carriers (preferably two marker carriers) with the polypropylene to maintain the flame retardant nature as well as strength of the carrier for braiding. In the preferred embodiment of the present invention, the reflective rope (10) is non-conductive and flame retardant.

0033 In another preferred embodiment, the reflective material is a flexible reflective tape and/or flexible reflective strip. Kingtek Electronics Technology Corp., Merlon Corporation and 3M sell and/or make reflective tapes or strips that are compatible with the present invention. The flexible reflective tape or strip can optionally have small glass beads and/or reflective particles attached thereto using some type of adhesive. These beads and/or particles provide for increased reflectiveness.

0034 Strips of the flexible reflective tape are braided with, twisted with, incorporated into and/or otherwise
attached to the rope (10) in a manner known to one skilled in the art. The reflective tape strips generally have a width preferably between about 0.01 mm and about 6 mm, more preferably between about 0.1 mm and about 3 mm, and most preferably between about 0.38 mm and about 1 mm. However, any other width of reflective tape is also within the scope of the present invention. The number of reflective tape strips used in a particular embodiment can vary depending on the width of the each strip. If narrow strips are used, more strips will preferably be required than if wider strips are used in the same application. Embodiments of the present invention, using reflective tape as the reflective material, can be seen in FIGS. 8, 9 and 10.

[0035] The method of making the present invention also includes using the reflective tape and/or reflective strip as part of a type of reflective material. In that regard, the method of making the rope (10) with the reflective tape is the same as if another reflective material is used.

[0036] The rope (10) and the reflective material and/or reflective tape are nonconductive and nonflammable as required by the mining industry’s safety requirements. A conductive rope and/or flammable material would not be usable in an underground mining environment because of safety regulations. Further, the rope (10) and reflective material and/or reflective tape both do not require any type of charging from any external source to remain reflective or “glow.” The rope (10) is also waterproof which significantly reduces deterioration.

[0037] One preferred embodiment of the present invention is a reflective rope (10) for use in the mining industry comprising a hollow braid of eight carriers of monofilament flame retardant polypropylene. The rope (10) is assembled to have at least two pics per inch of length. In the preferred embodiments, the rope (10) will have two, three, or four pics per inch of length. Two of the eight carriers are marker carriers and a reflective material is blended into those two marker carriers. The preferred reflective material for this embodiment of a reflective rope (10) comprises a reflective yarn made of about 0.5 mm glass beads bonded to polyester filament, but it will be apparent to those in the art that other reflective materials may work as well. As described more fully below, any of the above-described embodiments of this rope (10) can be made into lifelines, hangers, cables, lines, etc. for use in the mining industry.

[0038] The present invention also comprises a method of making a reflective rope (10). In the preferred embodiment of this method, the combination is of at least one carrier of rope material and at least one reflective material and/or reflective tape into a form selected from the group consisting of a hollow braided rope, a solid braided rope, a twisted braided rope and a plaited rope. The preferred embodiment of this method comprises assembling the materials in such a manner as to have at least two, but preferably two, three, or four, pics per inch of length, so that the material may be spliced easily. Other embodiments for assembling the rope (10) are possible, will be apparent to those skilled in the art, and are contemplated and encompassed by this invention. Again, in the preferred embodiment of the method, the reflective material and/or reflective tape is blended into two carriers (preferably two marker carriers) with the polypropylene to maintain the flame retardant nature as well as strength of the carrier for braiding. A preferred reflective material presently can be purchased from King Tech International Corp. of San Diego, California (item number 803304). This preferred reflective material is a reflective yarn, 0.5 mm glass beads bonded to polyester filament. It will be obvious to those skilled in the art that other reflective materials will satisfy the criteria described herein, may be used, and are encompassed by the present invention.

[0039] The method according to the present invention can be used to make any of the above-described variations of reflective rope (10) including, but not limited to, polypropylene rope (10), flame retardant rope (10), nonconductive rope (10), rope (10) with reflective material blended into the marker carriers, etc.

[0040] The rope (10) construction is preferably braided, but includes any method of combining carriers, such as braiding, twisting, or plaiting, in such a manner so as to incorporate a reflective material into the rope (10). Within the mining industry, the rope (10) may be used in, among other things, lifelines, cables, or hangers, but it will be apparent to those in the art that the rope may be used in a variety of industries and a variety of products that call for reflective rope material. FIGS. 2 and 3 show some lines, cables and/or hangers made of reflective rope of the present invention.

[0041] One embodiment of the present invention also comprises a safety directional line (20) for underground mining operations that is made from any of the above-described reflective ropes and/or any of the above-described methods. One embodiment of a safety directional line (also known as a lifeline) (20) according to the present invention comprises a reflective rope made of at least one carrier of rope material and at least one reflective material and/or reflective tape, which are combined in one of the following forms, or an equivalent form: a hollow braided rope, a solid braided rope, a twisted braided rope, or a plaited rope. A plurality of directional indicators (21) are spaced along the rope (10) and positioned such that the directional indicators (21) are pointing along the axis of the line (20).

[0042] Another embodiment of the present invention is an improved safety directional line (20) for mining operations. This safety directional line (20) has a first end and a second end and comprises a reflective rope and a plurality of directional indicators (21). The reflective rope (10) can be made according to any of the above-identified variations, embodiments, and methods.

[0043] For one embodiment of an improved safety directional line (20) the directional indicators (21) have a first end and a second end and comprises two identical cone forming sections, which have a conically shaped side wall on one side and an opposite flat side wall, forming half cone-shaped cavity therein. The flat side wall is provided with a semicircular channel therein which extends from the first end to the second end. There is a semicircular end plate integrally formed with the cone forming section on the second end. There is a semicircular section defined on the end plate, which is concentric with the channel on the flat side wall. There are a series of receptor holes along the conical side wall and corresponding holes along the channel in the flat side wall for receiving retaining pins. The two cone-forming sections are removably coupled, whereby the directional indicator (21) has a continuous side wall which extends outwardly from the first end to the second end defining a
The directional indicators (21) on one embodiment of an improved safety directional line (20) are placed on the reflective rope (10) with the first end of the directional indicator (21) facing the first end of the directional line (20) such that when someone exiting the mine has his hand slides along the slope of the directional indicator (21) and meets little resistance due to the gradual slope of the indicator (21) side wall. In the event that the person is traveling the wrong direction, his hand will meet the flat end cap of the indicator (21) and come to an abrupt stop, indicating that he is traveling in the wrong direction.

For one embodiment of an improved safety directional line (20), there is a bronze swivel hook or a fixed hook attached to the second end of the safety line (20) to attach it to the wall of the mine. The first end of the safety line (20) is provided with a bronze ring to attach the safety line (20) to the opposite end of the mine near the entrance. The swivel hook prevents the rope (10) from being tangled. The bronze ring and hook are non-sparking and non-corrosive. The ring and hook need not be placed on the line (20) in this manner, but can alternatively be affixed to either end.

For one embodiment of an improved safety directional line (20), there is fluorescent tape on the directional indicators (21) to make them more visible to one trying to exit the mine. The tape is formed in an “X” on the end plate of the directional indicator (21) indicating that it is the wrong direction to travel to exit the mine. Additionally, the tape is placed parallel to the axis of the directional indicator (21) along the side wall indicating the correct direction of travel.

There are many varieties of lifelines (20) on the market today. FIG. 4 illustrates just one type of lifeline (20). The present invention encompasses the use of any of the above-described embodiments of reflective rope (10) with any lifeline (20), not just the embodiment illustrated in FIG. 4. Lifelines (20), in general, are rope-type lines with some device attached to the rope to allow a user to determine whether he/she is heading in the correct direction by feeling his/her way along the lifeline (20). The present invention encompasses any and all lifelines (20) that incorporate a reflective rope (10) according to the present invention.

The reflective rope (10) of the present invention can be used as three cone reflective spur line indicators in conjunction with hangers to designate cut-throughs, intersections, crib rooms, rescue equipment, first aid areas, and safety directional lines and all other forms of lifelines used in the mining industry to enhance the visibility for escape routes. The reflective rope (10), and devices made therefrom, will be used for rope droppers in engaging or retrieving where the safety directional lines or lifeline system is attached/tied to the roof for vehicle transport purposes. The dropper is attached to the lifeline at regular intervals, allowing the lifeline to be broken away from the roof when required by pulling down the rope dropper.

It will be obvious to one skilled in the art that the various embodiments of reflective rope (10) and methods of making the same according to the present invention can be used with any type of lifeline, hanger, and/or cable that is currently on the market or developed in the future, not just the preferred embodiments described and shown herein. All of those embodiments are contemplated as being a part of the present invention.

Another embodiment of the present invention comprises a reflective rope (10) according to any of the above-identified embodiments of reflective ropes (10) and/or methods of making the same, forming an improved line having integral first and second closed loops spliced therein at each end thereof, with an intermediate length extending therebetween, for use in tying off or suspending various articles. An example of the present line is shown in FIG. 5. This line is well suited for use in the underground mining industry for tying off cables from continuous miner machinery, or for supporting or suspending articles such as electrical cables, hydraulic and pneumatic lines, ventilation ducts, etc. from the roof or along the wall of a mine drift to keep such articles clear of the drift floor. The lines may be suspended by S-hooks or other suitable article attachment means, or looped about another article and secured, e.g. by means of a girth hitch as shown around the cables.

Another embodiment of the present invention comprises a reflective rope hanger for use in temporarily suspending various articles, with examples of two embodiments of the present hangers and their function being shown in FIGS. 6 and 7. In general, a mining hanger consists of some sort of hook connected to a rope or loop to suspend or hang items within a mine. The hangers are well suited for use in the underground mining industry for supporting articles such as electrical cables, hydraulic and pneumatic lines, ventilation ducts, etc. from the roof or along the wall of a mine drift to keep such articles clear of the drift floor. The hangers may be suspended by S-hooks or other suitable article attachments, with the S-hooks or other means in turn being removable secured to a conventional spike imbedded in a mine timber, or hooked to the corner of a conventional roof plate or otherwise suspended.
any arcing of electrical energy between the article suspended within the loops, such as the cable, and a grounded potential. The present hanger loops may be formed of virtually any diameter material, in virtually any size desired, and by a variety of methods, all of which are encompassed by this invention.

[0055] It will be seen that the use of an essentially pure, non-metallic fiber such as polypropylene, also provides an electrically non-conductive rope, lifeline, cable, line and/or hanger due to the electrically insulating properties of such materials, particularly synthetic plastic materials. This provides important safety benefits when the present hangers are used for the support of electrical equipment, such as electrical cables, etc., in various environments. Accordingly, the various types of snap hooks, D rings, etc., which may be installed upon the present hanger loops during or after their construction, are preferably formed of materials which are not prone to producing sparks when struck by another object, e.g., non metallic or bronze materials.

[0056] While the present rope hangers are well suited for use in providing temporary support for innumerable different articles in a vast variety of environments, they are particularly well suited for use in the underground mining industry, due to their flame retardant and electrically non-conductive properties. In a preferred embodiment, the present invention hangers, lifelines, cables, etc., may be formed using rope having a relatively bright color or colors in addition to the reflective material, in order to provide optimum visibility in the normally relatively dark conditions found in underground mines.

[0057] One embodiment of the present flame-resistant, electrically non-conductive hanger provides a useful means of temporarily suspending a variety of different articles in many different industries, such as underground mines, automobile assembly plants, shipyards, etc. The present hangers may be formed using virtually any suitable diameter of rope, depending upon the strength required for the completed hanger. The use of electrically non-conductive and flame resistant materials, as well as reflective material and bright and contrasting colors in different carriers of the hanger rope, provides hangers that are safe and durable in virtually any environment of use.

[0058] Another embodiment of the present invention discloses an improved line with double spliced loops formed therein for suspending articles therefrom, comprising a length of reflective rope having a plurality of first diagonal directional carriers interwoven with a plurality of second diagonal directional carriers, a first end portion, and an opposite second end portion. Each end portion has a first connecting portion and a second connecting portion mating with the first connecting portion for forming a closed loop. Each first connecting portion passes diametrically through the corresponding second connecting portion at a first point thereon to form the closed loop and thereby define an intersecting portion, and thence each first connecting portion is inserted into the corresponding second connecting portion at a second point thereon and diametrically passed through the first connecting portion at the intersecting portion to form a knot, such that each first connecting portion passes concentrically through the corresponding second connecting portion to be captured therein. Each second point is separated from the corresponding first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent to at least one of the first directional carriers, with at least one of the first directional stands crossing over at least one of the second directional carriers. Each closed loop is connected to one another by an intermediate portion. This improved line may be made from any of the above-identified embodiments of rope.

[0059] Another embodiment of the present invention discloses an improved hanger for temporarily suspending articles therefrom, comprising a length of reflective rope having a plurality of first diagonal directional carriers interwoven with a plurality of second diagonal directional carriers, and a first connecting portion with a first end and an opposite second connecting portion with a second end. The first connecting portion is positioned diametrically through the second connecting portion at a first point thereon and thence into the second connecting portion at a second point thereon, provided with a locking interweave of carriers about which a first connecting portion knot is formed, then inserted diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and concentrically through the second connecting portion to be captured therein. The second point being separated from the first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent to at least one of the first directional carriers, provided with one or more ties thereof, such as a locking interweave of carriers about which a first connecting portion knot is formed, then inserted diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and being captured concentrically within the first connecting portion to form a closed loop of increasing strength with increasing tensile force upon the closed loop. The rope comprises at least one carrier of rope material and at least one reflective material, which are combined into one of the following forms: a hollow braided rope, a solid braided rope, a twisted braided rope, or a plaited rope. This improved hanger may be made from any of the above-identified embodiments of rope.

[0060] Another embodiment of the present invention is a hanger comprising a rope made of at least two carriers of rope material, which are braided together, and wherein at least one carrier comprises a reflective yarn made of about 0.5 mm glass beads bonded to polyester filament.

[0061] Another embodiment of the present invention is a hanger for use in the mining industry comprising the combination of at least one carrier of rope material and at least one reflective material and/or reflective tape. This hanger may be made from any of the above-identified embodiments of rope.

[0062] Another embodiment of the present invention comprises a method of making a safety directional line comprising braiding together at least one carrier of rope material and a reflective yarn comprising about 0.5 mm glass beads bonded to polyester filament, in such a manner as to have at least two pals per inch of length. A reflective tape can also optionally be used instead of the reflective yarn. Addition-
ally, a plurality of directional indicators are attached at even spaces along the rope and positioned such that the indicators are pointing along the axis of the line. This method may be used in conjunction with any of the above-identified embodiments of rope.

Another method of making a safety directional line for use in the mining industry according to the present invention comprises combining at least one carrier of rope material and at least one reflective material and attaching a plurality of directional indicators spaced evenly along the rope and positioned such that the indicators point along the axis of the line. This method may be used in conjunction with any of the above-identified embodiments of rope.

Another embodiment of the present invention is a method of making an improved line with double spaced loops formed therein for suspending articles therefrom, which comprises the following steps: (i) weaving a length of reflective hollow braided rope having a plurality of first diagonal directional carriers with a plurality of second diagonal directional carriers, a first end portion, and an opposite second end portion; (ii) mating each of the end portions having a first connecting portion and a second connecting portion mating with said first connecting portion for forming a closed loop; (iii) each said first connecting portion passing diametrically through the corresponding said second connecting portion at a first point thereon so that said closed loop and thereby define an intersecting portion, and (iv) thence each said first connecting portion being inserted into said corresponding second connecting portion at a second point thereon and diametrically passed through said first connecting portion at said intersecting portion to form a knot, such that each said first connecting portion passes concentrically through said corresponding second connecting portion to be captured therein. Each second point is separated from the corresponding said first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent the at least one of the first directional carriers, with the at least one of the first directional carriers crossing over the at least one of the second directional carriers, and each closed loop being connected to one another by an intermediate portion. This method may be used in conjunction with any of the above-identified embodiments of rope.

The present invention also includes a method of making an improved hanger for temporarily suspending articles therefrom, comprising the steps of: (i) weaving a length of hollow braided reflective rope having a plurality of first diagonal directional carriers with a plurality of second diagonal directional carriers, and a first connecting portion with a first end and an opposite second connecting portion with a second end; (ii) positioning the first connecting portion through the second connecting portion at a first point thereon and thence into the second connecting portion at a second point thereon, provided with a locking interweave of carriers about which a first connecting portion knot is formed, then inserting diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and concentrically through the second connecting portion to be captured therein; (iii) separating the second point from the first point by at least one of the first directional carriers and at least one of the second directional carriers immediately adjacent the at least one of the first directional carriers, with the at least one of the first directional carriers crossing over the at least one of the second directional carriers; and (iv) passing the second connecting portion into the first connecting portion at a second connecting portion entrance point thereof providing with a locking interweave of carriers about which a first connecting portion knot is formed, then inserting diametrically through an intersecting portion of the first connecting portion within the hollow core of the second connecting portion and being captured concentrically within the first connecting portion to form a closed loop of increasing strength with increasing tensile force upon the closed loop, wherein the rope comprises at least two carriers of rope material and at least one reflective material and/or reflective tape, which are combined into a form selected from the group consisting of a hollow braided rope, a solid braided rope, a twisted braided rope, and a piated rope. This method may be used in conjunction with any of the above-identified embodiments of rope.

We claim:

1. A reflective rope, used in the mining industry, comprising the combination of at least one carrier of rope material and at least one reflective tape.

2. The reflective rope of claim 1, wherein said at least one carrier of rope material and said at least one reflective tape are combined into a form selected from the group consisting of a hollow braided rope, a solid braided rope, a twisted braided rope, and a piated rope.

3. The reflective rope of claim 1, wherein said reflective tape is between about 0.38 mm and about 1 mm in width.

4. The reflective rope of claim 2, wherein said hollow braided rope comprises eight carriers of monofilament flame retardant polypropylene.

5. The reflective rope of claim 2, wherein said rope is treated with a flame retardant.

6. The reflective rope of claim 4, wherein said reflective tape is blended into two of said carriers of said polypropylene.

7. The reflective rope of claim 2, wherein at least two of said carriers are marker carriers and wherein said reflective tape is blended into said marker carriers.

8. The reflective rope of claim 2, wherein said rope is non-conductive and flame retardant.

9. The reflective rope of claim 2, further comprising, a hollow braid of eight carriers of monofilament flame retardant polypropylene, wherein said rope has at least two per inch of length; two of said eight carriers are marker carriers; and a reflective tape is blended into said two marker carriers.

10. The reflective rope of claim 9, wherein said reflective tape is between about 0.38 mm and about 1 mm in width.

11. The reflective rope of claim 2, also comprising a plurality of directional indicators spaced evenly along said rope and positioned such that said indicators are pointing along the central axis of said rope.
12. A method of making a reflective rope, used in the mining industry, comprising braiding together at least two carriers of rope material, wherein at least one carrier comprises a reflective tape between about 0.38 mm and 1 mm in width.

13. A method of making a reflective rope, used in the mining industry, comprising combining at least one carrier of rope material and at least one reflective tape.

14. The method of claim 13, wherein said combination is of at least one carrier of rope material and at least one reflective tape into a form selected from the group consisting of a hollow braided rope, a solid braided rope, a twisted braided rope, and a plaited rope.

15. The method of claim 14, wherein said reflective tape is between about 0.38 mm and about 1 mm in width.

16. The method of claim 14, wherein said hollow braided rope comprises eight carriers of monofilament flame retardant polypropylene.

17. The method of claim 14, wherein said rope is treated with a flame retardant.

18. The method of claim 16, wherein said reflective tape is blended into two of said carriers of said polypropylene.

19. The method of claim 14, wherein at least two of said carriers are marker carriers and wherein said reflective tape is blended into said marker carriers.

20. The method of claim 14, wherein said rope is non-conductive and flame retardant.

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