

SYSTEM FOR FACILITATING DELIVERY, PLACEMENT, AND/OR INSTALLATION OF A CABLE

Technical Field

- 5 The present disclosure relates to a system configured for positioning a cable such as a power cable alongside and below a cable trough, and delivering the cable to the cable trough within a space-constrained environment such as tunnel, passageway, or corridor.

Background

- 10 Traditionally, a power cable pulling system consists of a cable winch and rollers that pull the power cable, as illustrated in Fig. 1. Such a conventional approach is not optimally effective for use in a tunnel or passageway where the power cable is deployed and installed considering that significant amounts of manpower and time must be devoted for establishing the machinery setup and for pulling and/or organizing the power cable within
- 15 the tunnel or passageway, which can span multiple kilometers (e.g., 15 to 25 kilometers), with tunnel shafts spaced at particular intervals (e.g., every 2 to 5 kilometers). The conventional power cable installation approach requires the installation of multiple rollers and cable hauling machines at various locations on the route along which the power cable is pulled, organized and/or guide into a cable trough. The pulling process further requires
- 20 the attachment of one or more wire ropes to one end of the cable and release of the rest of the power cable progressively from a winch at another end of the cable. Under normal circumstances, wire ropes having an undesirably long length between 500m to 1000m are employed to effectuate the power cable pulling process into and through the tunnel. The management and maneuvering of the wire ropes and power cable across such a large
- 25 length typically requires an undesirably large work crew, and can be highly challenging when the work is carried out in a space-limited tunnel. Moreover, the wire ropes are usually under tension of 1 to 2 tons of pulling force. The constant exposure of the crews working around the wire ropes, cable head, and winch pose significant work safety risk. An improved and/or alternative system capable of mitigating one or more disadvantages

of the conventional approach for organizing and delivering a power cable in a cable tunnel is needed.

Summary

- 5 In accordance with an aspect of the present disclosure, a system for displacing or transporting an elongate cable is disclosed, the cable having a first end, a second end, and a length therebetween, where the system includes: (a) a modular track comprising a plurality of track assemblies couplable or coupled together to form an assembled track and decouplable from each other to form a disassembled track, wherein each track
10 assembly includes: an elongate rail couplable or coupled to another elongate rail of an adjacent track assembly; and a set rail support structures configured for upwardly elevating or suspending the elongate rail of the track assembly away from a floor surface along which the assembled track resides; (b) a plurality of carts, wherein each cart is slidably mountable or mounted on and slidably displaceable along the assembled track
15 by way of slidable displacement along the rails of the assembled track, wherein each cart is configured for securely holding and supporting or suspending a selected portion of the cable relative to the track, and wherein each cart includes: a body having a surface, a seat, a recess, a slot, or a channel configured for receiving the selected portion of the cable that the cart supports or suspends; a set of rollers coupled to the body and configured for
20 engaging with the rails of the assembled track; and a band, a belt, a strap, or a wrap engageable or engaged with the selected portion of the cable that the cart supports or suspends, and which is configured for aiding secure retention of the selected portion of the cable to the body; and typically or optionally (c) a locomotive displaceable in at least a first direction along the length of the assembled track and couplable or coupled to the
25 first end of the cable for exerting a pulling force on the first end of the cable, wherein when the locomotive is coupled to the first end of the cable and is displaced in the first direction, (i) a first end of the locomotive is oriented toward the first direction, (ii) an opposing second end of the locomotive is oriented in a second direction opposite to the first direction, and (iii) the second end of the locomotive faces toward the first end of the

cable, and wherein when the first end of the cable is coupled to the locomotive and selected portions of the cable trailing the first end of the cable in a direction toward the second end of the cable are supported or suspended the plurality of carts on the assembled track, the cable is displaceable or displaced along the assembled track in response to
5 displacement of the locomotive in the first direction, in combination with slidable displacement of the plurality of carts in the first direction.

In the absence of the cable, each cart mounted on the assembled track is typically or preferentially interfered with or constrained in its slidable displacement along the track
10 in the first direction and the second direction only by the presence of at least one other cart mounted on the assembled track. When carts mounted on the assembled track do not carry any portions of the cable, such carts mounted on the assembled track are typically or preferentially coupled to each other only by way of the assembled track.

15 When carts mounted on the assembled track carry selected portions of the cable, such carts mounted on the assembled track are typically or preferentially coupled to each other only by way of the assembled track and the cable.

In each track assembly, the set of rail support structures can be a pair of rail support
20 structures in which a first rail support structure is couplable or coupled to an underside of a first end portion of the rail of the track assembly, and a second rail support structure is couplable or coupled to an underside of an opposing second end portion of the rail of the track assembly.

25 The assembled track is typically or preferentially a monorail track.

The set of rollers of each cart can include a first roller configured for engaging with left side portions of the rails of the assembled track and a second roller configured for engaging with right side portions of the rails of the assembled track to facilitate or enable

reduced friction slidable displacement of the cart along the track (e.g., such that the rails of the assembled track are disposed between the first roller and the second roller).

5 The locomotive itself is typically or preferentially not directly coupled to the assembled track. The locomotive is typically or preferentially configured for straddling the assembled track when the locomotive is displaced in the first direction.

10 In accordance with another aspect of the present disclosure, the system can include a platform, scaffold, or ramp structure mountable or mounted to the locomotive and providing a sloping path, wherein the sloping path is inclined upwardly relative to a horizontal plane that is parallel to the floor surface, wherein a high end of the sloping path corresponding to one end of the locomotive is vertically higher than a low end of the sloping path corresponding to an opposing end of the locomotive, and wherein portions of the cable can progressively travel and/or be guided in an upward direction along the sloping path as the locomotive moves toward other portions of the cable proximate to the low end of the sloping path which have not yet traveled along the sloping path.

20 The platform, scaffold, or ramp structure can be removably mounted to the locomotive, and the platform, scaffold, or ramp structure can further include a set of wheels (e.g., a plurality of wheels) to facilitate displacement of the platform, scaffold, or ramp structure along the floor surface as the locomotive is displaced along the floor surface.

25 The platform, scaffold, or ramp structure can include: a pair of rails extending upwardly between the low end of the sloping path to the high end of the sloping path; and a plurality of support bars extending between the pair of rails, wherein each support bar is disposed vertically higher than another support bar, wherein the plurality of support bars is configured for progressively elevating portions of the cable as such portions of the cable travel away from the low end of the sloping path toward the high end of the sloping path

during displacement of the locomotive toward other portions of the cable proximate to the low end of the sloping path which have not yet traveled along the sloping path.

5 A set of cable guide structures can be coupled or mounted to the platform, scaffold, or ramp structure. The set of cable guide structures is configurable or configured for laterally guiding, routing, or directing portions of the cable carried by the platform, scaffold, or ramp structure as such portions of the cable travel along the sloping path during displacement of the locomotive toward other portions of the cable proximate to the low end of the sloping path which have not yet traveled along the sloping path.

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The set of cable guide structures can include a plurality of cable guide structures that are laterally positionable relative to each other along the sloping path, wherein each cable guide structure is configured for limiting or constraining lateral displacement of portions of the cable as such portions of the cable travel along the sloping path during displacement of the locomotive toward other portions of the cable proximate to the low end of the sloping path which have not yet traveled along the sloping path.

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Brief Description of the Drawings

Fig. 1 shows a schematic arrangement of a conventional system for cable pulling;

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Fig. 2 shows an embodiment of a unit of track assembly in accordance with the present disclosure;

Fig. 3 shows part of a track formed using two units of track assemblies illustrated in Fig.

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1 in accordance with an embodiment of the present disclosure;

Fig. 4 illustrates one embodiment of the cart mountable to the track in accordance with an embodiment of the present disclosure;

Fig. 5 illustrate a manner in which a system in accordance with an embodiment of the present disclosure can secure a cable onto multiple individual carts and convey the secured cable across or along the carts;

5 Fig. 6 depicts a locomotive in accordance with an embodiment of the present disclosure;

Fig. 7 depicts an embodiment which one end of the cable is coupled to a locomotive by a pair of wire ropes;

10 Fig. 8 is a perspective view of the locomotive incorporated with a platform having a sloping path for directing and/or guiding an unsheltered portion of the cable into a trough for sheltering and/or housing the cable therein; and

Fig. 9 shows engagement of the cable with a plurality of guiding elements arranged on
15 the sloping path in guiding and/or directing the cable into the trough in accordance with an embodiment of the present disclosure.

Detailed Description

Embodiments in accordance with the present disclosure as described herein can be
20 embodied in other specific forms without departing from the structures, methods, or other essential characteristics as described herein. The described embodiments are to be considered in all respects only illustrative, and not restrictive.

As used herein, the terms "approximately" or "about", in the context of expressions
25 associated with components, positions / locations, conditions, etc., means +/- 10% of a stated value, +/- 5% of the stated expression, or +/- 4% of the stated expression, or +/- 3% of the stated expression, or +/- 2% of the stated expression, or +/- 1% of the stated expression, or +/- 0.5% of the stated expression, or +/- 0% of the stated expression.

The terms “unsheltered cable” or “portion of unsheltered cable” herein refer to one or more portions or segments of the cable that are exposed to an external environment before being sheltered or housed in a receptacle or enclosure such as a cable trough.

5 Figs. 2 – 7 show aspects of a representative system 100 for facilitating or enabling the rapid and reduced friction delivery and/or placement of a cable 300 in accordance with an embodiment of the present disclosure. The cable 300 can be a power cable (e.g., a high voltage power cable), or another type of cable, or a cable-like structure, e.g., a pipe. The system 100 includes a track 110, which is typically (though not necessarily) a monorail
10 track, that can be placed upon and/or attached to a support surface or support structure, which is typically a floor surface 105 (e.g., corresponding to a personnel work surface or a floor or bottom surface along a cable tunnel); a plurality of individual carts 130 mountable or mounted to the track 110 in sequence, series, or tandem, where the carts 130 are free to slidably move along the track 110 relative to one another, each of the carts
15 130 carrying a surface, holder, or seat / saddle portion 138 for receiving a selected or particular portion of the cable 300 laid on the surface 138; and at least one prime mover (e.g., an apparatus, machine, or set of components that converts energy from an energy source into motive power) or locomotive 180 (which can also be referred to as a buggy) positioned forward of a frontmost cart 130a, where one end 303 of the cable 300 is carried
20 by or coupled or secured to a given locomotive 180, and trailing portions of the cable 300 have selected or particular portions thereof placed onto or supported or suspended by the plurality of carts 130 trailing the locomotive 180 (e.g., where such selected trailing portions of the cable 300 are supported or suspended by the cart surfaces 138 onto which they have been placed).

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In various embodiments, the locomotive 180 includes a housing, body, carriage, chassis, and/or set of platform structures coupled to or carrying a motor and a controller / control unit, where the motor is coupled to a set of wheels (e.g., typically four or six wheels, which can include tires in a manner readily understood by individuals having ordinary

skill in the art) 182 and is configured for propelling the locomotive 180 (e.g., along the floor surface 105) by way of rotationally powering the wheels 182. Thus, rotation of the wheels 182 against the floor surface 105 can move, drive, or propel the locomotive 180 along the floor surface 105. A first subset of wheels 182 is disposed on a first or left side of the locomotive 180, and hence are disposable or disposed on a corresponding first or left side of the track 110; and a second, opposite, or right subset of wheels 184 is disposed on a second, opposite, or right side of the locomotive 180, and hence are disposable or disposed on a corresponding second, opposite, or right side of the track 110. In multiple embodiments, the locomotive 180 and the wheels 182 coupled thereto can thus straddle the track 110 (e.g., such that the track 110 resides approximately midway between the first or left side of the locomotive 180 and the second or right side of the locomotive 180). As an alternative or in addition to the foregoing, in certain embodiments the locomotive 180 can be coupled to a set of treads (e.g., a pair of treads, such as a first or left side tread and a second or right side tread) that are driven by particular drive elements (e.g., wheels 182) for propelling the locomotive 180.

The locomotive 180 is positionable, positioned, configurable, or configured to travel in alignment (e.g., lengthwise or longitudinal alignment) with the track 110 (e.g., above, over, and/or along portions of the track 110) in or at least approximately along a target or first direction or towards a target or first destination at a selectable, selected, or predetermined speed (e.g., up to a predetermined maximum speed), for exerting a pulling force that pulls the cable 300 together with the carts 130 on which trailing portions of the cable 300 have been laid in the target direction or toward the target destination, such that the carts 130 slidably move along the track 110 and the cable 300 is displaced in the target direction or toward the target destination by way of slidable movement of the carts 130 along the track 110 as the locomotive 180 moves toward the target destination. In various embodiments, the locomotive 180 itself does not or need not make intentional or direct contact with the track 110, for instance, when the locomotive is lengthwise aligned over or with the track 110 (e.g., such that the track 110 is midway, essentially midway, or

approximately between the locomotive's first or left subset of wheels 182 and second or right subset of wheels 182).

As shown in Figs. 2 and 3, the track 110 generally includes or is formed with a plurality
5 of rail supports 111 and elongate rail segments or sections, which can simply be referred
to as rails 114. Each rail 114 can be a bar, pole, or shaft-like structure, member, or
construct. The rails 114 are typically hollow to reduce weight. The rail supports 111 reside
or rest upon or over or are anchored to a floor surface 105. At least one of the rails 114
can be secured or fastened to at least one of the rail supports 111 (e.g., in a manner shown).

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In several embodiments, the track 110 can be constructed from multiple units of track
assembly 120 (e.g., the track 110 can be constructed by coupling, linking, or joining
multiple track assemblies 120 in series). For instance, each unit of track assembly 120
includes a plurality of rail supports 111, such as a pair of rail supports 111, and an
15 elongate rail 114 (e.g., a single rail 114 in a monorail embodiment) that can extend
therebetween. A given rail support 111 can be in the form of a bar or shaft, such as an
inverted U-shaped frame having a top, and two lateral sidewalls or legs running
downward from the top. Distal ends of a rail support's legs can rest on the floor surface
105, and can provide bottom or base portions of the rail support 111. In certain
20 embodiments, a rail support 111 can include a structural bottom or base member that joins
the distal ends of the rail support's legs.

A stub 121 can upwardly project away from the top of the rail support frame. For each
track assembly 120, its pair of rail supports 111 rest against or reside upon the floor
25 surface 105. The pair of rail supports 111 are set apart from each other on the floor surface
105 at a distance not exceeding the length of the rail 114, such that the stub 121 of each
rail support 111 is insertable into a bore 115 prefabricated on and proximate to the end of
the rail 114 for anchoring the elongate rail 114 to the rail support 111 and supporting the
rail 114 relative to or above the floor surface 105. In some embodiments, the stub 121

includes two different portions or parts, namely, an enlarged base 122 directly adjoined to the top of the frame and a narrower or lean extension 123 further extending away from the enlarged base 122. In such embodiments, the enlarged base 122 is formed to have a diameter larger than the prefabricated bores 115, while the lean extension 123 has a diameter that is smaller or not greater than that of the prefabricated bores 115. The lean extension 123 can be fabricated to carry screw threads, and its tip may slightly project beyond the top surface of the rail 114 such that a nut can be coupled to the tip of the lean extension, securing or locking the rail 114 to the rail support 111. Thus, in several embodiments attaching the rail 114 of each track assembly 120 to the respective stubs 10 121 leads to suspension or elevation of the rail 114, supported on the enlarged base 122, above the top of the rail supports 111. In multiple embodiments, the rail supports 111 position or space the rails 114 fastened thereto away or apart from direct contact with the floor surface 105.

15 In various embodiments, each rail 114 has a first end 116 and a second end 117. The second end 117 of a given forward or first rail 114 is positionable or positioned forward or in front of the first end 116 of an immediately or directly adjacent rearward or second rail 114, i.e., a second rail 114 that is disposed directly behind the first rail 114. In several embodiments, the end of a rail 114 includes one or more through holes 119 such that two 20 immediately or directly adjacent rails 114 can be linked in tandem, series, or succession by way of a rail coupler 160. The rail coupler 160 includes a block 163 and a plurality of projections 164 erected sequentially or in series upward from a top portion of the block 163. Within the plurality of projections 164, particular projections 164 can be separately or individually couplable, coupled, engageable, or engaged with corresponding through 25 holes 119 located at end portions or ends of two adjacently positioned rails 114 to join and connect the adjacent rails 114 together for constructing part of the track 110. By linking multiple elongate rails 114 together in such a manner using the rail couplers 160 and rail supports 111, a modular track system (e.g., a modular monorail track system) can be easily and rapidly built and/or dissembled on site for extension and/or reduction of the

track 110 (e.g., in association or correspondence with the route and/or length of a cable trough in the tunnel). In such a system 100, the track 110 can be established or assembled (e.g., in a straightforward, simple, and typically rapid manner, even in a spatially-constrained environment such as a cable tunnel) along or adjacent to the trough where the cable 300 will be housed.

Fig. 4 shows a front perspective view of an embodiment of the cart 130, which can be slidably coupled or mounted to the track 110 and which can support a portion of a cable 300 such that the cable 300 can be slidably displaced along the track 110. The cart 130 includes a body 131 having or fabricated with a cutout section 132 for accommodating portions of the track 110, and more specifically the linked rails 114, therein. In some embodiments, the body 131 of the cart 130 can be a partially or substantially hollow block, such that the cutout section 132 stretches from a front or forward portion to a back or rearward portion of the block with an opening 134 at the bottom to access the cutout section 132 and mount the cart 130 onto the rail 114.

In multiple embodiments, the cart 130 includes a set of roller elements or rollers 133. For instance, one or more rollers 133 can reside in the cutout section 132 of the cart 130, and are couplable to or contactable with the track 110 to facilitate or enable reduced friction / low friction sliding movement of the cart 130 along the track 110 (e.g., along the rails 114 of the track 110). In various embodiments, each roller 133 can reside at a particular lateral side of the cutout section 132 and at a particular position or location between the front and back of the block, and is rotatable against lateral surface(s) of the rail 114 around an axis in a plane such as an angled plane transverse to the length of the rail 114 or a vertical plane perpendicular to the length of the rail 114. Each of the rollers 133 can include or be ball bearing rollers, which can grip or snugly clamp onto the lateral surfaces of the rail 114 to facilitate sliding movement of the cart 130 along the track 110 with reduced or minimal friction. In some embodiments, the set of rollers 133 includes a first set of rollers 133 corresponding to a first or left side of the cart 130 / a first or left lateral

side or edge of the track 110; and a second set of rollers 133 corresponding to an opposite second or right side of the cart 130 / a second or right lateral side or edge of the track 110.

A stage portion or stage 136 can rise from the top of the body 131 carrying the surface 138 for seating or laying a selected portion of the cable 300 thereupon. In several
5 embodiments, the surface 138 is formed as a concave structure, having a radius substantially corresponding or equal to or greater than an external radius of the cable 300 for receiving the portion of the cable 300 laid on the surface 138. A slightly elevated lateral edge of the stage 136 around the concave surface 138 can improve the grip of the
10 surface 138 towards the portion of the cable 300 laid thereon, constraining unwanted or undesirable sideways or sideward movement of the seated cable 300 during slidable movement of the cart 130 (and hence slidable movement of the cable 300) along the track 110.

15 As further depicted in association with Fig. 5, the cart 130 can be associated with or include a cable securing device or mechanism such as at least one belt, band, strap, or wrap structure 139. For instance, a strap 139 can include a first extremity couplable, coupled, attachable, or attached to a first lateral side of the surface 138, and a second extremity that is extendable over or stretchable across the surface 138 for adjustably
20 engaging with a fastening mechanism and/or buckle 174 located at a second lateral side of the surface 138 to securely retain the portion of the power cable 300 laid onto the surface 138. More specifically, in multiple embodiments a pair of substantially C-shaped arms or handles 170 can flank opposing lateral sides of the stage 136. One end of the strap 139 can be secured or attached to one of the handles 170, and another end of the strap
25 139 can be secured onto / inserted into the fastening mechanism or buckle 174 that is carried by or coupled or secured to another handle 170 on the opposing lateral side of the stage 136. In some embodiments, the fastening mechanism or buckle 174 includes one or more structures such as slots or loops 176 to facilitate retention of the strap 139 in or around the slots or loops 176 for securely holding a portion of the cable 300 around which

the strap 139 is wrapped. The fastening mechanism or buckle 174 can further engage with a latching or ratchet mechanism 178 capable of quick securing / locking and/or disengagement / release of the strap 139 from the fastening mechanism or buckle 174 by way of a release mechanism such as a lever or button.

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Fig. 6 shows an embodiment of a representative locomotive 180 that can be utilized in the system 100 to generate sufficient force and/or torque to pull the carts 130 and the cable 300 along the track 110. A control panel 185 can reside on the locomotive 180 for receiving user input such that a user of the system 100 can manage the speed and direction
10 of the locomotive 180. The locomotive 180 moves in the first direction and correspondingly pulls the carts 130 and the cable 300 secured thereto along the first direction, typically in alignment with or parallel to the cable trough. The movement of the locomotive 180 and the slidable displacement of the cable 300 in the first direction by way of the carts 130 that carry portions of the cable 300 and thus suspend the cable
15 300 relative to the track 110 can be considered as a first or primary operation mode of the system 100. The primary operation mode of the system 100 is for introducing and positioning the cable 300 in the cable tunnel, and organizing, positioning, and/or arranging the cable 300 relative to or alongside the trough (e.g., and typically below the trough, as the trough can generally be above the level of the cable 300 when the cable
20 300 is carried by the carts 130) in which the cable 300 is intended to reside prior to placing the cable 300 into the trough where the cable 300 will be housed.

In some embodiments, the locomotive 180 can be couplable or coupled to or include a steering mechanism (e.g., which can simply be a joystick mechanism) such that a system
25 user can maneuver the locomotive 180 or adjust the movement of the locomotive relative to the length of the track 110 (e.g., as the locomotive 180 travels in the first direction). As indicated above, in several embodiments the locomotive 180 does not or need not directly engage with the track 110; however, in certain embodiments, the locomotive 180 itself can include one or more structures or elements (e.g., rollers that are intended to

contact or engage with the track 110) which can or which are intended to directly engage with the track 110, for instance, to facilitate or enable automatic guidance or automatic steering of the locomotive 180 along the track 110.

- 5 Fig. 7 shows a representative manner which the system 100 can couple, engage, secure, or fasten the cable 300 to the locomotive 180. In the embodiment illustrated in Fig. 7, the locomotive 180 is positioned in front of the frontmost cart 130a and uses a set of wire ropes 187, such as a pair of wire ropes 187, to connect one end of the cable 300 to a rearward portion, back end, or back of the locomotive 180. Advancement of the
10 locomotive 180 towards the first direction exerts a force upon the wire rope 187, pulling the end of the cable 300 connected to the wire ropes 187. Concurrently, because the cable 300 is secured or fastened to multiple carts 130, the movement of the cable 300 as it is pulled by the locomotive 180 drags or slides the carts 130 along the track 110. The sliding motion of the carts 130 permits easier or much easier delivery of the cable 300 into and/or
15 along the cable tunnel, with reduced or minimized friction.

- In various embodiments, the carts 130 on the track 110 are not or need not be physically linked to one another by one or more chains, bars, wire ropes, or similar structures (e.g., non-track structures) that can or would couple or link the carts 130 in the absence of the
20 cable 300. Rather, (a) when the carts 130 on the track 110 do not carry or suspend portions of the cable 300, the carts 130 are slidably coupled to the track 110, and hence coupled along the track 110 only by the track 110 itself; and (b) when portions of the cable 300 are carried or suspended by the carts 130 on the track 110, those carts 130 that carry or suspend the cable 300 are further coupled, linked, or connected to each other by the cable
25 300 itself. Portions of cable 300 itself thus serve as a cart-to-cart coupling or connecting structure or member, and such portions of the cable 300 itself transfer / distribute the locomotive's pulling force across the carts 130, instead of using or requiring cart-to-cart coupling or connecting structures other than the cable 300 to transfer / distribute or aid the transference / distribution of the locomotive's pulling force across the carts 130.

Hence, in the absence of the cable 300, a given cart 130 on the track 110 is interfered with or constrained in its slidable movement along the track 110 only by the presence of the other cart(s) 130 adjacent to it; and thus in the absence of the cable 300, the carts 130 along the track 110 are coupled to each other only by way of the track 110 (e.g., rather than by direct links such as one or more chains, bars, wire ropes, or similar structures between the cart bodies 131). Notwithstanding, in certain embodiments, at least some subsets of carts 130, such as particular pairs of adjacent carts 130 can be physically coupled or linked to each other by one or more chains, bars, wire ropes, and/or similar structures in addition to being coupled or linked by the cable 300 along lengthwise sections of the track 110 (e.g., at least certain subsets of carts 130 can be coupled or joined in such a manner).

In view of the foregoing, the system 100 can be operated in a first / primary mode of operation corresponding to cable conveyance into and placement in a cable tunnel. In at least some embodiments, the system 100 can be operated in or switched into an additional, second / secondary, or reverse operation mode for progressively upwardly lifting portions of the cable 300 and guiding such lifted portions of the cable 300 toward and to a cable trough and possibly placing the cable 300 into the cable trough, after the cable 300 has been successfully initially positioned / arranged (e.g., on or near the cable tunnel floor) relative to or alongside the cable trough. The second mode of operation can also be referred to as a cable lifting mode of operation. In such embodiments, at least one locomotive 180 is couplable or coupled to a ramp structure configured for lifting or elevating portions of the cable 300, such that successive portions of the cable 300 are progressively upwardly lifted toward the cable trough in association with movement of the locomotive 180. For instance, the same locomotive 180 that was used for cable transport into and placement in the cable tunnel can also be configured to move in a second or reverse direction, which is opposite or substantially opposite to the first direction, for lifting, delivering, and/or placing portions of the cable into the trough by way of the ramp structure in the secondary operation mode. Additionally or alternatively,

another or a different locomotive 180 can be used for lifting, delivering, and/or placing portions of the cable into the trough by way of a ramp structure couplable or coupled to the other locomotive 180.

- 5 In order to effectuate such progressive cable lifting and guiding toward and to the trough, and cable placement into the trough, the system 100 can further include a platform, scaffold, or ramp structure 150 couplable or coupled to or carried by a given locomotive 180 (e.g., which can be selectively attached to and removed from the locomotive 180), where the platform 150 provides a sloping or inclined path 152 (e.g., upwardly sloping
10 relative to a horizontal plane that is parallel to the track 110) along which portions of the cable 300 can travel and/or be guided as the locomotive 180 moves in the second or reverse direction. The sloping path 152 extends upward at a selectable / adjustable or predetermined angle (e.g., towards the cable trough) forming an upper portion or end 151 and a lower portion or end 154 thereof, such that the upper end 151 of the sloping path
15 152 is positionable or positioned at a selectable / adjustable or predetermined height, for instance, substantially corresponding to or at least slightly above the height of the cable trough.

The platform 150 typically also includes a set of cable positioning or guide structures
20 configurable or configured for laterally (e.g., leftward and/or rightward) guiding, routing, or directing portions of the cable 300 as such portions of the cable 300 travel along the sloping path 152. For instance, in multiple embodiments, the platform 150 includes a plurality of guiding elements 156 spaced apart from one another along the length of the sloping path 152, for instance, as depicted in Figs. 8 and 9.

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In association with the cable lifting / second mode of operation, a section or segment of the cable 300 (which can initially be the end of the cable 300) proximate or adjacent to the locomotive 180 and adjoining sections or segments of the cable 300 can be positioned on the sloping path 152 and displaced from the lower end 154 of the sloping path 152

toward and to the upper end 151 of the sloping path 152, and further positioned at the upper end 151 of the sloping path, such that portions of the power cable 300 are directed toward, to, and/or into the cable trough with the aid of the plurality of guiding elements 156 by way of moving the locomotive 180 (e.g., locomotive motion in the second
5 direction opposite to the first direction). During the cable lifting / second operation mode, at least some portions of the cable 300 are typically freed from being secured to at least some of the carts 130, e.g., one or more carts 130 directly adjacent to or behind the locomotive 180. For instance, particular straps 139 wrapped around the cable 300 in the first / primary operation mode can be released or untied (e.g., progressively released or
10 untied) for at least the portions of the cable 300 that will next be progressively raised onto the sloping path 152 and delivered to or placed into the trough. The portions of the cable 300 that are no longer strapped to the carts 130 can be pushed or shifted to or placed on the floor surface 105, after which such portions of the cable 300 can be “upwardly scooped up” and upwardly displaced along the sloping path 152 by way of locomotive
15 movement (e.g., in the second direction).

In addition to the sloping path 152, the platform 150 can include a base or base frame 153 mounted and/or attached on the locomotive 180, where the base frame 153 aids or assists establishment of the sloping path 152 relative to the locomotive 180. One or more pairs
20 of wheels can be coupled to or fixed beneath the base frame 153 for the platform 150 to slide on the floor surface 105 corresponding to the movement of the locomotive 180 towards the second direction. In certain embodiments, the system 100 has the platform 150 set up and/or placed on the locomotive 180 only before commencement of the cable lifting / second operation mode, and the locomotive 180 can be free from carrying the
25 platform 150 when in the first / primary operation mode. In other embodiments, the locomotive 180 can carry the platform in the first / primary operation mode.

In accordance with several embodiments, the sloping path 152 on which the cable 300 can be laid and slide (e.g., upwardly slide) for cable placement can include or be a

structure similar or analogous to a ladder. For example, as shown in Figs. 8 and 9, the sloping path 152 includes a pair of support bars / rods or stringers 199 (e.g., outer or outward support bars / rods or stringers 199) running lengthwise in parallel, for instance, between a back or rear end of the locomotive 180 and a front or forward end of the locomotive 180 and vertically angled therebetween (e.g., in a manner that establishes an upwardly directed angle for the sloping path 152), where the locomotive's back and front ends are transverse or perpendicular to the track 110 and the locomotive 180 is configured for carrying or supporting portions of the cable 300 between the locomotive's back end and front end. The stringers 199 can be vertically elevated and/or supported at particular locations along their lengths by a series of progressively longer support bars 197 (e.g., which in at least some embodiments can have selectable or adjustable lengths, such that an angle of the sloping path 152 can be selected or adjusted). Multiple rungs 198 project from one stringer 199 joining to another stringer 199 in a direction perpendicular to the length of the stringers 199. The rungs 198 are set apart at an adjustable / selectable or predetermined distance to support the cable 300 laid on the sloping path 152 without having the cable 300 significantly bowing or falling into the space between two rungs 198 (e.g., directly adjacent rungs 198).

At least some rungs 198 or each rung 198 can carry a guiding element 156, where the position (e.g., lateral position) of at least some guiding elements 156 or each guiding element 156 can be selectable or adjustable in relation to a lengthwise axis of the locomotive 180, the sloping path 152, and/or the stringers 199 (e.g., the position of at least some guiding elements 156 or each guiding element 156 can be laterally adjustable relative to the lengthwise axis of the sloping path 152). In some embodiments, a given guiding element 156 is slidably adjustable along or on the rung 198 to which the guiding element 156 is coupled or connected. Furthermore, the guiding element 156 can include a pair of substantially vertically raising prongs 157 encompassing a gap or space therebetween for limiting the lateral displacement of a section, segment, or portion of the

power cable 300 slidably moving therethrough after such portion of the power cable 300 is raised onto or placed on the sloping path 152.

In some embodiments, a given guiding element 156 can take the form of portions of a hollow rectangle or square including the two prongs 157 at the sides to define the gap or space at a central region where the cable 300 passes through. The side prongs 157 restrict and control sideways movement of the cable 300 on the sloping path 152 when the cable 300 is placed or pushed into the trough in response to movement of the locomotive 180 in the second direction. In a number of embodiments, the guiding elements 156 are organized such that one guiding element 156 adopts a position offsetting the position of a preceding guiding element 156 closer to the cable trough. By organizing the guiding elements 156 in gradual offsetting positions, the system 100 progressively bends the cable 300 towards the trough as illustrated in Fig. 9. As such, the guiding elements 156 collectively define a sliding travel path (e.g., a curved or curvilinear path) for movement of the power cable 300 along the sloping path 152 to direct the power cable 300 toward, to, and/or into the cable trough. To bring the cable 300 closer to the trough, the last few rungs 198 on the sloping path 152 can further extend beyond the stringer 199, allowing the guiding elements 156 to hold a position closer to the trough.

In further embodiments, at least some rungs 198 and/or at least some guiding elements 156 (e.g., each guiding element 156) include one or more rollers (not shown) contactable with the power cable 300 placed on the sloping path 152, where the one or more rollers are rotatable to facilitate directing the power cable 300 toward and/or into the cable trough (e.g., with reduced friction). Such rollers are coupled to portions of the prongs 157 and/or the rungs 198 to smooth the sliding movement of the cable 300 on the sloping path 152.

In accordance with a related aspect of the present disclosure, a process or method for placing a portion of an unsheltered cable 300 (e.g., a power cable 300) into a cable trough for housing therein by way of a given locomotive 180 coupled to or carrying a ramp

structure such as the abovementioned platform 150 includes: providing or positioning the unsheltered portion of the cable 300 lengthwise along or parallel to portions of the cable trough (e.g. by way of displacement of the same or a different locomotive 180 in the first direction in association with the aforementioned first mode of operation, and
5 corresponding slidable displacement of the cable 300 along the track 110), where the unsheltered portion of the cable 300 and the cable trough are respectively located at a first level and a second level which is higher than the first level in a vertical plane (e.g., perpendicular to the floor surface 105); placing a segment of the unsheltered power cable 300 on a sloping path 152 of the platform 150 (e.g., by way of moving the given
10 locomotive 180 in the second direction after releasing straps holding the segment of the cable 300 and typically placing the segment of the cable on the floor surface 105), the sloping path 152 having a lower end 154 extending towards an upper end 151 where the upper end 151 is positioned at a height substantially corresponding to the second level and proximate or adjacent to a top opening of the cable trough; and displacing or moving
15 the platform 150 by way of displacing or moving this locomotive 180 (e.g., in the second direction) towards portions of power cable 300 placed on the first level, with the lower end 154 to the upper end 151 of the sloping path 152 configured to scoop and raise the unsheltered power cable 300 onto the sloping path 152 from the first level, further raise and guide the unsheltered power cable as it travels along the sloping path 152, and guide
20 the power cable 300 to or into the cable trough during or in association with the movement of the platform 150 and locomotive 180 (e.g., in the second direction).

The trough is typically mounted on a wall of the cable tunnel, while the unsheltered cable 300 can reside or be laid on the ground level or floor surface 105, e.g., alongside or
25 generally parallel to the trough in several embodiments, before displacing the locomotive 180 and the platform 150 in the cable lifting / second mode of operation. The platform 150 can be carried by or coupled, mounted, or attached to the locomotive 180, which is capable of generating enough power to move the platform 150 in a predetermined direction (e.g., the second direction) to scoop up the cable 300, raise the cable 300

- upwards in a direction toward the trough, and guide the cable 300 to and/or into the trough. As mentioned above, the platform 150 can include a base or base frame 153 mounted and/or attached on the locomotive 180, where the base frame 153 aids establishment of the sloping path 152 and attainment of a desired (e.g., selectable or adjustable) height and/or angle to guide and direct the cable 300 into the trough. One or more pairs of wheels can be coupled to or fixed underneath the base frame 153 for the platform 150 to slide along the floor surface 105 in a manner corresponding to the movement of the locomotive 180.
- 10 The sloping path 152 can include a pair of elongate shafts, bars, rods, or stringers 199 running in parallel with multiple rungs 198 projecting out from one stringer 199 joining into another stringer 199 at a direction perpendicular to the length of the stringers 199. The rungs 198 can be spaced or set apart at an adjustable / selectable or predetermined distance to adequately support the cable 300. In a number of embodiments, the platform
- 15 150 includes a plurality of guiding elements 156 spaced apart lengthwise from one and other on the sloping path 152. Each guiding element 156 can be coupled to an individual rung 198 such that the position of each guiding element 156 is adjustable on the respective rung 198 in relation to a lengthwise axis of the sloping path 152. In some embodiments, a guiding element 156 can include or be formed as a pair of substantially vertically raising
- 20 prongs 157 encompassing a gap or space therebetween for accommodating a portion of the power cable 300 slidably moving therethrough when the power cable 300 is guided along the sloping path 152. The side prongs 157 restrict and/or control the lateral or sideward movement of the cable 300 on the sloping path 152. With reference to several embodiments, the process or method further includes: organizing the guiding elements
- 25 156 on the sloping path 152 such that a vertically higher guiding element 156 adopts a position laterally offsetting the position of a preceding or vertically lower guiding element 156, rendering the vertically higher guiding element 156 closer to the cable trough in relation to the preceding or vertically lower guiding element 156. By organizing the guiding elements 156 in a series of gradual and sequential offsetting positions (e.g.,

laterally offset positions relative to each other), such a process or method can gradually or progressively bend or curve portions of the cable 300 towards the trough along the sloping path 152. The guiding elements 156 can thus collectively establish or define the sliding lateral movement of the cable 300 along the sloping path 152 toward the cable trough to direct the cable 300 to and/or into the cable trough.

Additionally, in some embodiments, at least some guiding elements 156 further include one or more rollers contactable with portions of the cable 300 along the sloping path 152, where the one or more rollers facilitate directing the cable 300 toward, to, and/or into the cable trough in a reduced friction manner.

In view of the foregoing, (a) in a cable placement / first mode of operation, a particular locomotive 180, in association or combination with the track 110 and carts 130, can progressively slidably displace the cable 300 into the cable tunnel, until the cable 300 resides at intended positions and/or at a target destination within the cable tunnel; and (b) in a cable lifting / second mode of operation, the same or a different locomotive 180 in association or combination with the sloping path 152, can progressively “scoop up” portions of the cable 300, and lift or elevate such scooped up portions of the cable 300 toward and to the cable trough. In various embodiments, in the first mode of operation the combination of the locomotive 180, track 110, and carts 130 operate as a first type of cable hauling machine configurable or configured for horizontally hauling or displacing the cable 300 relative to the floor surface 105 (e.g., at a vertical elevation or distance, such as an essentially constant vertical distance away from the floor surface 105 such that in the first operational mode the cable 300 remains or generally remains parallel to the floor surface 105, and/or a vertical distance or a set of vertical distances that remains closer to the floor surface 105 than the cable trough; and in the second mode of operation, the combination of the sloping path 152 and the same or a different locomotive 180 operate as a second type of cable hauling machine configurable or configured for hauling and guiding the cable 300 upwardly or upwardly – laterally along the sloping path 152.

Thus, at least some embodiments in accordance with the present disclosure provide a system 100 in which at least one locomotive 180 can be configured (e.g., in a selectable or adjustable manner) to operate as the drive or motive power component in (i) a horizontal cable hauling or displacement machine (e.g., for progressively hauling a cable 300 into a cable tunnel, such that the cable 300 can be initially positioned in the cable tunnel relative to a cable trough, such as below and generally parallel to the cable trough); and (ii) a vertical or vertical – lateral cable hauling or displacement machine (e.g., for progressively scooping and lifting portions of the cable 300 toward and to and possibly into a cable trough after the cable 300 had been initially positioned in the cable tunnel relative to the cable trough). Horizontal cable hauling or displacement and vertical or vertical – lateral cable hauling or displacement can occur by way of the same locomotive 180 (e.g., a single locomotive 180), or different locomotives 180, depending upon embodiment and/or situational details.

15 A given locomotive 180 can travel in a first direction for transporting a cable 300 from a starting location to a target destination into a cable tunnel, and the same or a different locomotive 180 can subsequently travel away from the target destination in an opposite second direction for lifting the cable 300 toward, to, and/or into a cable trough (e.g., until reaching the starting location). Alternatively, a selected locomotive 180 can travel in a first direction for transporting a cable 300 from a starting location to a target destination into a cable tunnel, and the same or a different locomotive 180 corresponding to or located at the starting location can (e.g., subsequently) travel from the starting location toward the target destination in the first direction for lifting the cable 300 toward, to, and/or into a cable trough (e.g., until reaching the target destination).

Individuals having ordinary skill in the relevant art will understand that a cable tunnel can be accessible from ground level or the surface of the earth by way of a shaft (e.g., which can downwardly extend 50 – 60 metres downwardly from the surface of the earth),

which corresponds to or leads to an enlargement section that is coupled or connected to the cable tunnel. The enlargement section can couple or link different sections of the cable tunnel coupled thereto, for instance, a first section of the cable tunnel that extends away from the enlargement section, and a second section of the cable tunnel that extends away from the enlargement section. The first and second sections of the cable tunnel can extend in opposite directions away from the enlargement section. By way of the shaft and the enlargement section, one or more power cables 300 and various types of objects and/or equipment can be transferred and positioned relative to and/or in the cable tunnel.

10 In such situations, a cable 300 can be initially positioned in and along the cable tunnel, including in and along or across each of the first section of the cable tunnel, the enlargement section, and the second section of the cable tunnel by way of a given locomotive 180, such as in a manner described or indicated above. Subsequently, a pair of locomotives 180 (one of which can be, but need not be the given locomotive 180 used to initially position the cable 300 in and along the cable tunnel) can be driven, displaced, or moved in opposite directions (e.g., away from each other) toward different or opposing lengths or ends of the cable tunnel 10, where each of the pair of locomotives 180 scoops up and lifts / elevates portions of the cable 300 toward, to, and/or into a cable trough by way of a corresponding platform or ramp structure 150. Thus, (a) a first locomotive 180 can be displaced or driven toward and into a first section of the cable tunnel that extends away from the enlargement section, while progressively lifting portions of the cable 300 disposed in the first section of the cable tunnel (e.g., on a floor surface 105 of the first section of the cable tunnel) toward, to, and/or into the cable trough by way of a first platform or ramp structure 150 that provides a sloping path 152 in a manner set forth above; and (b) a second locomotive 180 can be displaced or driven toward and into a second section of the cable tunnel that also extends away from the enlargement section, while progressively lifting other portions of the cable 300 disposed in the second section of the cable tunnel (e.g., on a floor surface 105 of the second section of the cable tunnel) toward, to, and/or into the cable trough by way of a second platform or ramp structure

150 that provides a sloping path 152 in a manner set forth above. Such a pair of locomotives 180 can operate concurrently, or separately / sequentially (e.g., as needed) to facilitate time-efficient loading of the cable 300 into the cable trough.

- 5 Embodiments in accordance with the present disclosure can provide an efficient, reduced friction, rapid, low-cost, and minimal manpower manner (e.g., requiring as few as two workers, or even one worker) for delivering cables 300 into cable tunnels 10, and/or lifting or raising cables 300 toward, to, and/or into a receptacle or long-term / final destination such as a cable trough 20. It can be additionally noted that in various
10 embodiments, the elevation of track 110 away from the floor surface 105 in combination with each cart's set of rollers 133 provides a low or very low noise system 10 (e.g., an operationally quiet system 10) for cable transport and placement.

- It is to be understood that aspects of the present disclosure may be embodied in other
15 specific forms, and embodiments described and shown in the present disclosure are representative for purpose of aiding understanding. Embodiments in accordance with the present disclosure are not limited solely to the embodiments described and shown herein. For instance, one or more carts 130 can themselves carry a prime mover or motor (e.g., configured for rotatably driving the set of rollers 133 of each of such powered carts 130
20 to propel these powered carts 130 along the track 110), such that (a) a locomotive 180 may not be required or need not be used in at least some situations; and/or (b) after a cable 300 has been positioned in a cable tunnel 10 or loaded into a cable trough 20, one or more powered carts 130 (e.g., possibly in association with a set of non-powered carts 130 coupled thereto) can transport or shuttle other objects and/or equipment (e.g., objects
25 and/or equipment other than the cable 300) along the track 110 within a cable tunnel 10. Additional or other modifications and equivalents of the disclosed concepts, devices, and structures, such as those which would readily occur to an individual having ordinary skill in the relevant art, are encompassed by the scope of the present disclosure.