OT-2026-000000043

Guided Glide Shoe Arrangement for Extended Unsupported Energy Chain Travels

Published	September 15, 2026 at 11:45:01 UTC
Permanent URL	https://opentechnical.org/p/OT-2026-000000043
Classification	Industrial Components, Safety & Infrastructure > Electrical Infrastructure > Energy Chains
Document SHA-256	489abdb4c72c0f338768830633019aae29652895606d2bcdf4bd385d40289dc3
Extent	2,443 words, 16 numbered paragraphs, 2 figures

Abstract

This disclosure describes a guided glide shoe arrangement designed to manage the dynamics of energy chains operating over extended unsupported travel distances. The arrangement mitigates the problem of sag-induced interference and wear between the upper and lower runs of the energy chain, which can occur during long-stroke applications. It incorporates specific features to maintain a consistent cable bend radius, extend the permissible travel range, and provide visual indication of component wear, thereby enhancing operational reliability and service life.

1. Technical Field

[0001] This disclosure relates to systems for guiding and supporting energy chains in applications requiring extended unsupported travel distances. Specifically, it addresses arrangements that mitigate wear and structural issues associated with the dynamic movement of energy chains over long spans, particularly in industrial machinery, automation, and material handling systems. The technical field encompasses the mechanical design of energy chain components, guide elements, and wear monitoring features within such systems.

2. Technical Context

[0002] Energy chains are widely employed to guide and protect cables, hoses, and conduits that supply power, data, and fluids to moving machine parts. In applications where the moving part travels a significant distance, the energy chain often operates in an unsupported configuration, where a portion of the chain spans between a fixed anchor point and the moving connection point. As the travel distance increases, the unsupported length of the energy chain also increases, leading to a greater sag in the upper run of the chain. Without adequate management, this sag can cause the upper run to make contact with, or even drop into, the lower run of the energy chain. This interference results in abrasive wear between the chain links, potential damage to the enclosed cables and hoses, and increased friction that can overload the drive mechanism. The problem intensifies with higher speeds, greater accelerations, and heavier cable packages. The wear can compromise the structural integrity of the energy chain, leading to premature failure and system downtime. Furthermore, the dynamic nature of long unsupported energy chains can induce undesirable stresses on the cables and hoses, potentially violating their minimum bend radius requirements and shortening their operational life.

3. System Overview

[0003] The disclosed arrangement provides a guided glide shoe system for energy chains operating over extended unsupported travels, as depicted in FIG. 1. The system comprises an energy chain (12) that conveys a cable package (24) between a moving machine part (10) and a fixed machine part (18). The energy chain (12) incorporates one or more glide shoes (14) attached to or integrated within its links, particularly on the lower surface of the chain's lower run. These glide shoes (14) engage with a continuous guide channel (16) that extends along the entire travel path. The guide channel (16) provides a continuous, low-friction surface upon which the energy chain (12) can slide, effectively preventing the upper run from sagging into the lower run and maintaining a consistent vertical separation. The arrangement is designed to accommodate travel distances up to 100 meters or more, depending on the specific chain and glide shoe materials. The glide shoe (14) is manufactured from a material selected for its low coefficient of friction and high wear resistance, such as an engineered polymer. The glide shoe (14) also features an integral wear indicator (20), as shown in FIG. 2, which provides a visual means to assess the remaining service life of the shoe. The geometry of the energy chain (12) and the guide channel (16) are designed to preserve the minimum bend radius of the enclosed cable package (24) throughout the entire range of motion, even under conditions of high acceleration or deceleration.

4. Components

[0004] The primary components of this arrangement include:

[0005]

- **Energy Chain (12):** This is the main carrier structure for cables and hoses. It consists of a series of interconnected links, typically made from a polymer or steel, designed to allow movement in one plane while maintaining a minimum bend radius for the enclosed contents. The chain has an upper run and a lower run.
- **Glide Shoe (14):** These components are affixed to or integrated into the exterior surface of the energy chain (12) links that contact the guide channel (16). A glide shoe (14) is typically fabricated from a low-friction, wear-resistant polymer such as a high-molecular-weight polyethylene or a polyamide compound. Its profile is designed to fit precisely within the guide channel (16) and to present a smooth, durable sliding surface. As shown in FIG. 2, the glide shoe (14) may feature a specific geometry to mate with the energy chain (12) links and a broader base to distribute contact pressure over the guide channel (16).
- **Wear Indicator (20):** An integral feature of the glide shoe (14), the wear indicator (20) is typically a groove, recess, or contrasting material layer embedded within the glide shoe (14) body. Its depth is calculated such that its exposure or disappearance indicates that a predetermined percentage of the glide shoe's (14) wear material has been consumed, signaling the need for replacement. For example, a groove might be machined to a depth representing 75% of the allowable wear.
- **Guide Channel (16):** This is a rigid, stationary structure that supports and guides the glide shoe (14) and, by extension, the energy chain (12). The guide channel (16) is typically constructed from a structural material like steel or aluminum, with its internal surfaces designed to provide a smooth, low-friction pathway for the glide shoe (14). It has a base surface and may include side walls (22) for lateral guidance. The guide channel (16) is mounted to the machine's supporting structure.

- **Moving Machine Part (10):** The component of the machine that translates along the travel path, to which one end of the energy chain (12) is connected.
- **Fixed Machine Part (18):** The stationary component of the machine, to which the other end of the energy chain (12) is connected.
- **Cable Package (24):** The collection of electrical cables, optical fibers, pneumatic hoses, and/or hydraulic lines contained and protected within the energy chain (12). The system preserves the minimum bend radius for these elements.

5. Operation

[0006] The operation of the guided glide shoe arrangement proceeds as follows:

[0007] **Start-up:** Upon initial movement of the moving machine part (10), the energy chain (12) begins to articulate. The portion of the energy chain (12) that constitutes the lower run is supported by the glide shoes (14) resting within the guide channel (16). The guide channel (16) ensures that the energy chain (12) remains horizontally aligned and vertically supported, preventing the lower run from dropping below its intended path.

[0008] **Steady Running:** As the moving machine part (10) traverses the full travel distance (L), the energy chain (12) continuously unfolds from the fixed machine part (18) and folds onto itself at the moving end. The glide shoes (14) on the lower run of the energy chain (12) slide smoothly along the base of the guide channel (16). The guide channel (16) maintains a precise vertical separation between the upper and lower runs of the energy chain (12), even for long unsupported spans. This separation prevents mechanical interference and abrasive wear between the chain links. The lateral walls (22) of the guide channel (16) provide guidance, preventing lateral deviation of the energy chain (12) and ensuring its proper alignment. The geometry of the energy chain (12) links, in conjunction with the fixed dimensions of the guide channel (16), ensures that the cables and hoses within the cable package (24) are always maintained above their specified minimum bend radius, preventing stress and fatigue.

[0009] **Wear Indication:** During prolonged operation, the glide shoes (14) will experience gradual wear due to friction with the guide channel (16). The wear indicator (20) becomes visible or changes its appearance as the wear depth approaches a critical limit. For example, a groove may become shallower and eventually disappear, or a subsurface layer of contrasting color may become exposed. This visual cue allows maintenance personnel to schedule replacement of the glide shoes (14) proactively, before significant wear compromises the system's integrity or leads to chain-to-chain contact.

[0010] **Fault or Interruption:** In the event of a fault, such as excessive wear of the glide shoes (14) or an obstruction in the guide channel (16), the system's performance may degrade. If the glide shoes (14) wear beyond their effective depth, the energy chain (12) may sag sufficiently to permit contact between the upper and lower runs, leading to increased friction and noise. A failure of the guide channel (16) or a foreign object within it could impede the smooth travel of the glide shoes (14), potentially causing the energy chain (12) to jam or misalign. Such events would typically trigger a system shutdown or generate an error signal from monitoring systems that detect abnormal current draw from the drive motor or deviations in position.

6. Example Embodiments

[0011] **Embodiment 1** An energy chain (12) for a gantry crane with a travel distance of 75 meters. The energy chain (12) is constructed from a reinforced polymer. Individual glide shoes (14) are bolted to the underside of every second link of the lower run of the chain. These glide shoes (14) are formed from ultra-high-molecular-weight polyethylene (UHMW-PE) and feature a wear indicator (20) as a 2 mm deep groove machined into their sliding surface. The guide channel (16) is fabricated from galvanized steel with a UHMW-PE lining on its base surface, providing a low-friction interface. The internal width of the guide channel (16) is sized to provide 2 mm of lateral clearance on each side of the glide shoe (14). The energy chain (12) maintains a minimum internal bend radius of 150 mm for the contained cables.

[0012] **Embodiment 2** A guided energy chain (12) system for an automated storage and retrieval system operating over a 120-meter travel. In this configuration, the energy chain (12) links themselves are designed with an integrated glide surface and wear indicator (20). The lower part of each outer link in the chain's lower run is molded with an extended, thickened base section that serves as the glide shoe (14). This section incorporates a co-molded layer of high-contrast polymer beneath the primary wear surface, acting as the wear indicator (20). The guide channel (16) is an extruded aluminum profile with hardened anodic coating on the internal sliding surfaces. The energy chain (12) maintains a minimum internal bend radius of 100 mm for the contained cables. The glide surface is approximately 40 mm wide.

[0013] **Embodiment 3** An energy chain (12) arrangement for a machine tool with a 40-meter travel. Here, the energy chain (12) is of a modular design, allowing glide shoes (14) to be clipped onto the lower surface of specific links, typically every 1 meter along the chain's lower run. The glide shoes (14) are made of a self-lubricating polymer blend, incorporating solid lubricants, and feature a series of three progressively shallower recesses as the wear indicator (20). The guide channel (16) is formed from stainless steel sheet, with its base and lateral walls (22) lined with low-friction polyamide plates. The energy chain (12) maintains a minimum internal bend radius of 80 mm for the contained hoses and cables.

7. Alternative Configurations

[0014] Instead of glide shoes (14) being attached to the energy chain (12), the lower run of the energy chain (12) itself could be designed with a thickened, wear-resistant base profile that directly engages with the guide channel (16). This integrated design might reduce the number of individual components. The guide channel (16) could be formed with an inverted T-profile, with the energy chain (12) having a corresponding slot, providing interlocked guidance rather than merely resting on a flat surface, which could be advantageous for systems with significant lateral forces. The wear indicator (20) could be implemented as a mechanically activated switch or sensor that trips when the glide shoe (14) wears to a certain depth, providing an automated alert rather than just a visual indication. Such a sensor could be a small embedded magnet detected by a hall-effect sensor in the guide channel (16), or a conductive path that breaks or completes a circuit. The guide channel (16) material could be varied, for instance, using hard-anodized aluminum or composite materials for reduced weight and improved corrosion resistance.

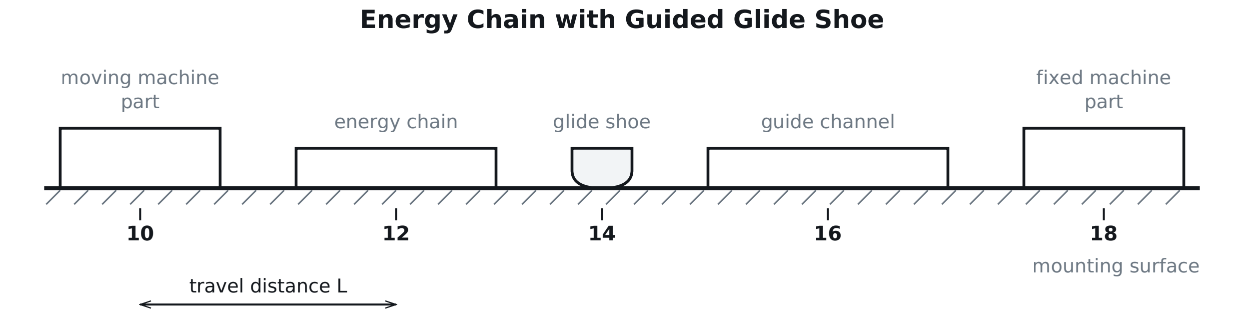
8. Parameter Variations

Parameter	Range	Effect of Varying Parameter (Increasing Value)
Travel Distance (L)	10 to 200 meters	Increases chain length, sag potential, and cumulative wear on glide shoes (14) and guide channel (16).
Energy Chain Weight	2 to 20 kg/meter	Increases vertical load on glide shoes (14), accelerating wear. Requires stronger glide shoe materials.
Operating Speed	0.5 to 10 m/s	Increases frictional heating and wear rate. May necessitate more frequent glide shoe (14) replacement.
Acceleration/Deceleration	1 to 10 m/s²	Increases dynamic forces on glide shoes (14) and guide channel (16). May require tighter lateral clearances.
Glide Shoe Material Hardness	60 to 85 Shore D	Improves wear resistance but may reduce impact absorption.
Wear Indicator Depth	1 to 5 mm	Provides longer warning period for deeper indicators but reduces total available wear material.
Guide Channel Clearance	1 to 5 mm (per side)	Larger clearance reduces friction but increases lateral play and potential for misalignment.
Minimum Bend Radius	50 to 400 mm	Larger radius reduces stress on cables (24) but requires a larger chain and more space.

9. Additional Implementations

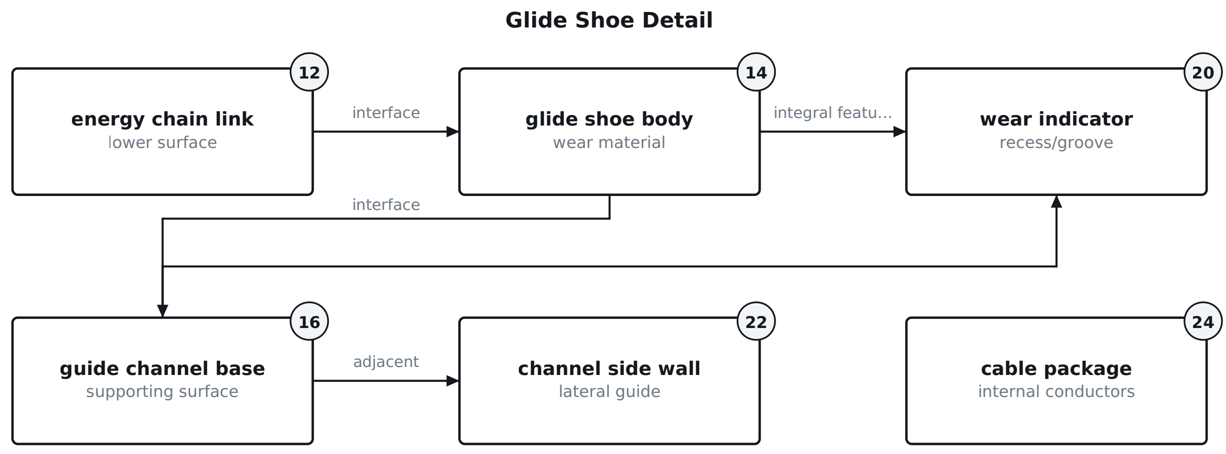
[0016] This guided glide shoe arrangement can be adapted for submerged applications, such as in wastewater treatment plants or offshore platforms, where the components would be selected for corrosion resistance and suitability for continuous fluid contact. For extremely harsh environments, such as those with abrasive dust or high temperatures, the glide shoe (14) material could incorporate ceramic or metallic inserts at critical wear points, or the guide channel (16) could be equipped with integrated cleaning mechanisms, such as brushes or air jets, to prevent accumulation of debris. The system could also be implemented with multiple guide channels (16) arranged in parallel for very wide energy chains (12) or for systems requiring redundant support. In applications where space is highly constrained, the guide channel (16) could be integrated directly into the machine's structural frame rather than being a separate bolted-on component, optimizing space utilization. For extremely long travels, multiple glide shoes (14) per link or a continuous glide strip rather than discrete shoes could be employed to further distribute wear and maintain consistent support. The energy chain (12) could be designed to ride on rollers within the guide channel (16) instead of sliding, reducing friction significantly, though introducing additional mechanical complexity and potential failure points for bearings.

10. Figures



energy chain (12) connects the moving part (10) to the fixed part (18) and is supported by a glide shoe (14) within a guide channel

FIG. 1 An elevation view of an energy chain incorporating a guided glide shoe arrangement for long unsupported travel. PNG



The glide shoe (14) is designed with an integral wear indicator (20) and interfaces with both the energy chain (12) and the guide channel (16).

FIG. 2 A detailed view of the glide shoe and its interface with the energy chain and guide channel. PNG

OpenTechnical Publication OT-2026-000000043. Published September 15, 2026 at 11:45:01 UTC. https://opentechnical.org/p/OT-2026-000000043