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(54) FLEXIBLE LINE GUIDE FOR INDUSTRIAL ROBOT
SCHLAUCHFÜHRUNGSVORRICHTUNG FÜR EINEN INDUSTRIEROBOTER
DISPOSITIF DE GUIDAGE DE CONDUITE SOUPLE POUR UN ROBOT INDUSTRIEL

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Description

TECHNICAL FIELD

[0001] The invention relates to a flexible line guide for an industrial robot according to the introduction to claim 1.

[0002] Such guides are commonly used for carrying an outer line in the form of a welding cable or a pressurised fluid line, for example, between the foot and the rotating upper section of an industrial robot.

PRIOR ART

[0003] Guides of this type are known, for example, from US-A-5 694 813, US-A-4 427 170 and EP-A-0 552 688. A disadvantage of such known guides is that the outer peripheral side of the loop, especially at the bend, must be guided by the inside of a stationary cylindrical wall or a cylindrical wall that rotates together upper section of the robot, in order not to deviate outwards from the path of movement around the axis, which causes undesirable friction and wear on the covering of the line.

SUMMARY OF THE INVENTION

[0004] One objective of the present invention is to achieve a guide of the type stated in the introduction that significantly reduces wear and thus increases the working life of the covering of the line.

[0005] A second objective is to obtain a guide that makes it easy to replace the line.

[0006] These are achieved by means of the features that are stated in the following claims.

[0007] According to an aspect of the invention, a separate groove for every strand is the only engagement provided between the cable loop and the parts that rotate relative to one another. In this way, none of the strands nor the bend come into sliding contact with a wall, as is the case in the prior art, so that essentially all the relative movement between the covering of the line and the parts that rotate relative to one another that causes wear is eliminated. A further advantage with this arrangement is that thanks to the resulting free space between the grooves, the line is easier to remove from the guide and be put back there when it needs to be replaced.

[0008] According to one preferred embodiment of the invention, the grooves have different mutual radii so that the bend will be angled relative to the common axis of rotation. In this way, the radius of curvature of the bend can also be increased advantageously at a predetermined axial distance between the grooves. This ensures partly that the insignificant relative movement that does nevertheless occur between the line and the groove takes place primarily only at the transition between the strand and the bend of the groove with the smaller radius and partly that the bend has less of a tendency to deviate at a tangent outwards from the path of rotation since it leans inwards from the largest radius.

[0009] If the grooves are formed in groove elements that can be mounted on the outsides of the respective parts in a removable fashion, an existing robot can later easily have an additional guide fitted according to the invention.

[0010] Other features and advantages of the invention are evident from the claims and the following detailed description.

DESCRIPTION OF THE DRAWINGS

[0011] Embodiments of the invention is described by way of example in detail below with reference to the enclosed drawings, where

FIG. 1 is a diagrammatic view from behind of an industrial robot with some parts removed fitted with a guide according to the invention and;

FIG. 2 is a simplified diagrammatic view of the guide according to FIG. 1 seen from above at an oblique angle;

FIG. 3 is a view partly in cross-section and with parts removed of one preferred embodiment of a groove element according to the invention;

FIG. 4 is a cross-sectional view of an alternative embodiment of a groove element according to the invention;

FIG. 5 is a view seen from the front and from above at an oblique angle of a foot and the frame element of an industrial robot equipped with a groove element according FIG. 3; and

FIG. 6 is a side view of a guide according to the invention provided with a support for an upper part of the guided line.

DETAILED DESCRIPTION OF EMBODIMENTS

[0012] In the diagrammatic representation according to FIG. 1, an industrial robot is generally designated 10 and includes a lower section 12 in the form of a stationary foot and a rotating upper section 14 in the form of a frame unit that rotates relative to the foot around a vertical axis 18. The lower section 12 and the upper section 14 are joined with one another via a bearing arrangement 16 that is not shown in any greater detail.

[0013] A flexible, continuous line 40 with a covering that is not shown in detail extends between the lower section 12 and the upper section 14. This covering can typically enclose a welding cable, but also other types of lines for, for example, transport of fluids or other media. The covering can also be a separate outer covering.
for that part of the line that extends between parts 12 and 14 (not shown). In order for the upper part 14 to rotate without hinder for approximately 180° clockwise and 180° counter-clockwise from the mid-point of rotation in FIG. 1, a slack of the line 40 to accommodate the movement of rotation extends in a loop round about 90° of the space between parts 12 and 14. More specifically, the loop has a lower partly circular strand 42, an upper partly circular strand 44 and a bend or nose 46 of line 40 that joins the strands. When the upper part 14 rotates counter-clockwise, the upper strand 44 is transferred to the lower strand 42 via the bend 46 "rolling forwards" when part 14 rotates clockwise, the lower strand 42 is transferred to the upper strand 44 in the reversed manner via the bend 46 "rolling backwards."

According to the invention, strands 42, 44 are guided by their engagement with their own groove 22 and 32 respectively. In the examples of the embodiments shown, grooves 22, 32 both extend in a circular arch around a front of the robot 10 when this is positioned in the middle of its field of rotation. Grooves 22 and 32 have different radii R1 and R2 respectively with regard to their common axis 18. The lower groove has the larger radius in the example shown, but the opposite case is also possible. It is also possible to have grooves with different radii in the same radial plane with regard to axis 18, so that the parts of the loops and the bend run in a common horizontal plane around the robot (not shown). The cross-section of the groove can be varied to achieve an optimal compromise between minimal wear and best guidance, especially between the transition of the line between the strand and the bend in the groove with the smallest radius R2. According to one preferred embodiment of the invention shown in FIGS. 3 and 5, such an optimised groove is formed in groove element 21 from extruded and bent light metal, preferably aluminium.

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Each groove element 21 (FIG. 3) is attached to the associated part 12 of robot 10 from the outside of the robot by means of, for example, a screw fitting and is suitably positioned at the peripheral edge of associated part 12 via a peripheral corner recess 27 formed on the outside of the bottom 24 of the groove. The downwards facing groove especially can be formed in this way to prevent the line falling out from the groove due to its weight.

Since an operator or service technician will for various reasons from time to time need to climb up onto the robot and can then need to use the groove elements as foot supports, these are suitably dimensioned to have the size and durability to match this need.

So that the upwards facing groove of the guide will not collect liquids and foreign objects, such as welding sparks and similar, this groove preferably has openings running through it. The openings can, in a way not shown, be accommodated in the bottom and in the flanges of the already described embodiments made of steel plate and light metal.

In the embodiment shown in FIG. 4, the groove element is made of a welded steel wire construction. In this case, the groove is formed from essentially a half-circular arch-shape of steel wires 50, 52 that are carried on steel wires 54 (only one is shown) that are at right angles to these and that are evenly spaced peripherally, and that are shaped to the desired profile of the groove. As a consequence, the desired openings in the groove are formed by the gaps 56 between the steel wires. The downwards facing groove especially can be formed in this way to prevent the line falling out from the groove due to its weight.

FIG. 6 shows another embodiment of a guide according to the invention in the position at the end of its rotation (180° clockwise rotation) where the major portion of line 40 is in the upper strand 44. To avoid the risk that this might fall down from the upper groove 32, a lower support 60 is arranged for line 40. In the preferred embodiment, lower support 60 has the form of a hanging support comprised of a bent tube 62. Tube 62 extends concentrically to the upper groove 32 in such a way that it captures and holds the upper strand 44 from below when this tends to exit the groove due to its weight. Tube 62 suitably has a smaller radius than the
radius of upper groove 32. If lower groove 22 additionally has a larger radius than upper groove 32, as is preferable, the bend of line 40 is angled inwards towards the upper groove without the risk of coming in contact with tube 62.

Claims

1. A line guide (20) for an industrial robot with a flexible continuous line (40) comprising a loop between a pair of rotatable parts (12, 14) of an industrial robot (10) that rotate relative to one another around an axis (18), whereby the loop includes a pair of strands (42, 44) of the line joined by a bend (46) that extend around axis (18), outer sides of the strands being in engagement with the respective parts so that the loop is caused to perform a movement around the axis (18) when the parts rotate relative to one another characterised in that the engagement comprises a separate groove (22, 32) arranged for each strand (42, 44).

2. The guide according to claim 1 characterised in that the grooves (22, 32) extend with mutually different distances (R1, R2) from axis (18).

3. The guide according to claim 2 characterised in that the grooves comprise an upper groove (32) and a lower groove (22) where the lower one extends at a greater distance from the axis (18) that the upper one.

4. The guide according to claim 2 characterised in that the grooves comprise an upper groove (32) and a lower groove (22) where the upper one extends at a greater distance from the axis (18) that the lower one.

5. The guide according to claim 2 characterised in that the grooves extend in a common radial plane with regard to the axis (18).

6. The guide according to any of the previous claims characterised in that the groove is formed in a groove element (21) that can be attached to and removed from the outer surface of the respective part (12, 14).

7. The guide according to claim 6 characterised in that the groove element includes an extruded and bent light metal element.

8. The guide according to claim 6 or 7 characterised in that a bottom side of the groove element (21) has a peripheral recess (27) arranged to position the groove element (21) at a peripheral edge of the respective part (12, 14).

9. The guide according to any of the previous claims characterised in that the groove (22, 23) extends about 180° around the robot (10).

10. The guide according to any of the previous claims characterised in that the groove extends with essentially flat outwardly facing flanges (26, 28; 36, 38) from an essentially flat bottom (24; 34) of the groove.

11. The guide according to any of the previous claims characterised in that the groove, when seen in cross-section, has convex flanks (26, 28).

12. The guide according to any of the previous claims characterised in that at least one upwardly facing groove of the said grooves has openings (56) running through it.

13. The guide according to any of claims 1-6 and 9-13 characterised in that the groove is formed from a welded wire construction.

14. The guide according to any of claims 3-13 characterised in that there is an underlying support (60) for the upper strand (44) of the line where the underlying support (60) extends concentrically along and below the upper groove (32).

Patentansprüche

1. Eine Leitungsführung (20) für einen Industrieroboter mit einer flexiblen, durchgehenden Leitung (40), die zwischen einem Paar drehbarer, sich relativ zueinander um eine Achse (18) drehender Teile (12, 14) eines Industrieroboters (10) eine Schlaufe aufweist, wobei die Schlaufe ein Paar Stränge (42, 44) aufweist, die äusseren Seiten der Stränge mit den jeweiligen Teilen in Eingriff stehen, so dass eine Drehung der Schlaufe um die Achse (18) bewirkt wird wenn sich die Teile gegeneinander drehen, dadurch gekennzeichnet, dass der Eingriff für jeden Strang (42, 44) eine separate Rille (22, 32) aufweist.

2. Die Führung nach Anspruch 1, dadurch gekennzeichnet, dass die Rillen (22, 32) in gegenseitig unterschiedlichem Abstand (R1, R2) von der Achse (18) verlaufen.

3. Die Führung nach Anspruch 2, dadurch gekennzeichnet, dass die Rillen eine obere Rille (32) und eine untere Rille (22) beinhalten, wobei die untere in grösserem Abstand von der Achse (18) verläuft als die obere.
4. Die Führung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Rillen eine obere Rille (32) und eine untere Rille (22) beinhalten, wobei die obere in grösserem Abstand von der Achse (18) verläuft als die untere.

5. Die Führung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Rillen in Bezug auf die Achse (18) in einer gemeinsamen radialen Ebene verlaufen.

6. Die Führung nach einem beliebigen der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Rille als von der Aussenfläche des jeweiligen Teils (12, 14) entfernbares Rillenelement (21) ausgebildet ist.

7. Die Führung nach Anspruch 6, **dadurch gekennzeichnet, dass** das Rillenelement ein extrudiertes und gebogenes Leichtmetallelement beinhaltet.

8. Die Führung nach Anspruch 6 oder 7, **dadurch gekennzeichnet, dass** eine Unterseite des Rillenelements (21) einen zur Positionierung des Ringelement (27) aufweist.

9. Die Führung nach beliebigen der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sich die Rille (22, 23) über etwa 180° um den Roboter (10) erstreckt.

10. Die Führung nach einem beliebigen der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** sich die Rille mit im Wesentlichen flachen, nach aussen gerichteten Flügeln (26, 28, 36, 38) von einem im wesentlichen flachen Rillenboden (24, 34) erstreckt.

11. Die Führung nach einem beliebigen der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Rille, bei Betrachtung in Schnitt-Ansicht, konvexe Flanken (26, 28) aufweist.

12. Die Führung nach einem beliebigen der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** von den genannten Rillen zumindest eine nach oben gerichtete Rille durch diese hindurchgehende Öffnungen aufweist.

13. Die Führung nach einem der Ansprüche 1 bis 6 und 9 bis 13, **dadurch gekennzeichnet, dass** die Rille aus einer geschweissten Drahtkonstruktion geformt ist.

14. Die Führung nach einem der Ansprüche 3 bis 13, **dadurch gekennzeichnet, dass** für den oberen Strang (44) der Leitung eine untergreifende Auflage (60) vorgesehen ist, die sich konzentrisch entlang und unter die obere Rille (32) erstreckt.

**Revendications**

1. Dispositif de guidage de conduite pour un robot industriel avec une conduite continue flexible (40) qui comprend une boucle entre une paire de parties rotatives (12, 14) d’un robot industriel (10) qui tournent l’une par rapport à l’autre autour d’un axe (18), la boucle incluant une paire de cordes (42, 44) de la conduite réunies par une courbe (46) qui s’étendent autour de l’axe (18), les faces extérieures des cordes étant en prise avec les parties respectives de sorte que la boucle est entraînée dans un mouvement autour de l’axe (18) lorsque les parties se tournent l’une par rapport à l’autre, **caractérisé en ce que** la prise comporte une rainure séparée (22, 32) pour chaque corde (42, 44).

2. Le dispositif de guidage selon la revendication 1, **caractérisé en ce que** les rainures (22, 32) s’étendent à des distances (R1, R2) de l’axe (18) qui sont différentes l’une de l’autre.

3. Le dispositif de guidage selon la revendication 2, **caractérisé en ce que** les rainures comprennent une rainure supérieure (32) et une rainure inférieure (22), la rainure inférieure s’étendant à une distance de l’axe (18) supérieure à celle de la rainure supérieure.

4. Le dispositif de guidage selon la revendication 2, **caractérisé en ce que** les rainures comprennent une rainure supérieure (32) et une rainure inférieure (22), la rainure supérieure s’étendant à une distance de l’axe (18) supérieure à celle de la rainure inférieure.

5. Le dispositif de guidage selon la revendication 2, **caractérisé en ce que** les rainures s’étendent dans un plan radial commun par rapport à l’axe (18).

6. Le dispositif de guidage selon la revendication 2, **caractérisé en ce que** la rainure a la forme d’un élément de rainure (21) qui peut être attaché et enlevé de la face extérieure de la partie (12, 14) respective.

7. Le dispositif de guidage selon la revendication 6, **caractérisé en ce que** l’élément de rainure comporte un élément extrudé et courbé en métal léger.

8. Le dispositif de guidage selon la revendication 6 ou 7, **caractérisé en ce qu’** une face inférieure de l’élément de rainure présente un retrait périphérique.
9. Le dispositif de guidage selon l'une quelconque des revendications précédentes, caractérisé en ce que la rainure (22, 23) s'étend environ 180° autour du robot (10).

10. Le dispositif de guidage selon l'une quelconque des revendications précédentes, caractérisé en ce que la rainure s'étend avec des ailes (26, 28, 36, 38) essentiellement plats dirigés vers l'extérieur à partir d'un fond (24, 34) essentiellement plat de la rainure.

11. Le dispositif de guidage selon l'une quelconque des revendications précédentes, caractérisé en ce que la rainure, vue en coupe transversale, a des flancs convexes (26, 28).

12. Le dispositif de guidage selon l'une quelconque des revendications précédentes, caractérisé en ce qu'au moins une desdites rainures, qui est dirigée vers le haut, est traversée par des ouvertures (56).

13. Le dispositif de guidage selon l'une des revendications 1 à 6 et 9 à 13, caractérisé en ce que la rainure est formée d'une construction en fil métallique soudé.

14. Le dispositif de guidage selon l'une des revendications 3 à 13, caractérisé en ce qu'il est pourvu d'un support sous-jacent (60) pour la corde supérieure (44) de la conduite, lequel support (60) s'étend de façon concentrique le long et sous la rainure supérieure (32).