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(54) **AUTOMATED WIRE TAPING SYSTEM**

AUTOMATISCHES DRAHTABGREIFSYSTEM

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(73) Proprietor: **Aptiv Technologies AG**

8200 Schaffhausen (CH)

(72) Inventors:

- **CARROLO, Nuno**
1500-911 Lisboa (PT)
- **JIANLIANG, Qiu**
2785-355 Lisboa (PT)
- **MANTERYS, Marek**
31-416 Kraków (PL)

(74) Representative: **Bardehle Pagenberg**

Partnerschaft mbB
Patentanwälte Rechtsanwälte
Prinzregentenplatz 7
81675 München (DE)

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Description

FIELD OF INVENTION

[0001] The present disclosure relates to an automated wire taping system including a taping robot and a cassette system for automatically replacing the tape roll.

BACKGROUND

[0002] A vehicle wiring harness or wiring loom is a bundle of electrical cables used in automotive applications to transmit electrical power supply or data signals around a vehicle. Wiring harnesses are pre-assembled with the cables arranged in the correct routing lengths and configurations and bound together for example using tape, clips, cable ties, or conduits. The terminal ends of the cables are provided with connector elements for electrical connection to the associated in-vehicle components. The wiring harness is also provided with body clips at various locations along its limbs for mechanically connecting the cable harness to various structures within the vehicle. CN110444344A discloses a thin type full automatic adhesive tape winding machine head and device and a method therefor and belongs to the field of automation equipment. A full automatic winding device for winding adhesive tapes on positions with drops such as corrugated pipes and root parts of wire bodies is designed in the invention to solve problems in technologies of the prior art.

US 2015/0096688 A1 discusses a hand-carried taping machine for taping an elongated object is disclosed. The machine includes a powered gear set operably coupled to a body and powered by a drive system. An applicator head includes a substantially C-shaped gear in meshing engagement with the powered gear set such that the substantially C-shaped gear rotates about an application axis under control of the drive system, and a tape reel mount for rotatably mounting a reel of tape on the substantially C-shaped gear for rotation about the application axis and application of the tape to the elongated object. CN108455356A discloses a portable automatic adhesive tape winding device which comprises a housing, a mounting plate rotatably arranged in the housing, a wire harness penetrating hole, an adhesive tape supply device and an adhesive tape winding driving device, wherein the wire harness penetrating hole is of a through hole structure penetrating through the housing and the mounting plate simultaneously and is formed in the rotating center of the mounting plate; the adhesive tape supply device comprises an adhesive tape mounting base for placing an adhesive tape roll and a hold-down mechanism capable of extruding the adhesive tape.

JPH0761415A provides a rotary drive means such as torque motor, rotating member for winding an adhesive tape round an item to be bound such as wires bound in a bundle, frame for supporting the rotating member, tape retaining mechanism for retaining the tape to swing it,

stopper mechanism for stopping the member at a pre-determined rotational position, and tape cutting mechanism for cutting the tape.

[0003] In a common assembly process a wiring harness is manufactured on a harness assembly board or workbench. The harness assembly board typically comprises a schematic of the wiring routes and labelling indicating the components required at each associated location along the harness. A series of routing forks mounted on the harness assembly board support the wiring bundles. The electrical components are retained in mountings on the assembly board for connection to the cables. The harness assembly board also includes body clip holders to hold and retain the body clips during assembly.

[0004] A wiring bundle comprises a plurality of electrical cables. Adhesive tape is used to bind the electrical cables together along their length, along commonly routed sections of the harness. A taping robot may be used to automate the process of taping the cables. A taping robot comprises a multi axis robot having a taping head. The taping head includes a tape roll and a winding mechanism for winding the tape around a wiring bundle to wrap the cables. The winding mechanism includes a rotary plate and a feed mechanism that feeds tape from the tap roll to the rotary plate. The rotary plate is rotated about the cables to apply tape to the cables. As the rotary plate is rotated in a first rotational direction the robot moves the taping head axially along the wiring bundle in a second direction such that tape is applied along a given length of cable. A cutter mounted on the taping head cuts the tape once the taping process is completed.

[0005] A taping robot can automatically tape a series of wiring bundles without requiring manual intervention. However, when the tape is expended, or it is necessary to use a different coloured tape, and the tape roll must be replaced by an operator. The taping robot must be stopped while the tape roll is replaced, which requires the entire assembly line to be halted. An operator must then manually disconnect and remove the tape roll from the taping head and replace it with a new tape roll, which is manually loaded onto the taping head. Typically, the change over time to replace a tape roll is between 1-3 minutes. During this time the assembly line is non-operational. For applications where the colour of the tape must be changed several times during assembly of the harness. This can result in excessive down time that limits the operational efficiency of the assembly line.

[0006] It is therefore desirable to provide an improved automated wire taping system for a wiring harness, and/or a method of assembling a wiring harness which addresses the above-described problems and/or which offers improvements generally.

SUMMARY

[0007] According to the present disclosure there is provided an automated wire taping system as described

in the accompanying claims.

[0008] In an aspect of the disclosure there is provided an automated wire taping system comprising:

- a robot having an arm and a taping head mounted on the arm configured for wrapping tape around one or more cables;
- a tape roll cassette including a body, a roll of tape rotatably mounted to the body and at least one releasable connector for connecting the cassette to the taping head; and
- a storage device including a holder for receiving the cassette, wherein the storage device includes a release device arranged to automatically operate the at least one releasable connector to disconnect the cassette from the taping head.

[0009] The storage device is a docking station or any other suitable means of releasably holding and retaining the cassettes. The use of a tape roll cassette that is releasable from the taping head of the robot enables the tape rolls to be automatically detached from the taping head when the tape roll has expired, or an alternative tape is required. In arrangements of the prior art the tape roll is mounted on a spindle that is permanently connected to the taping head, and the tape must therefore be manually removed from the taping head and replaced which is time consuming. In contrast, the detachable cassette of the present disclosure may be docked in the storage device and automatically disconnected from the taping head, leaving the taping head free to automatically acquire a further tape roll cassette from the storage device.

[0010] The release device may be arranged to operate the at least one releasable connector when the cassette is docked within the holder. The releasable connector may include a push button or similar depressible mechanism for releasing the connect. The release mechanism may comprise a linear actuator that extends to operate the push release mechanism of the releasable connector.

[0011] The at least one releasable connector may include a locking element reconfigurable between a locked configuration that prevents release of the connector and a release configuration that allows the tape roll cassette to be disconnected from the taping head, and a release mechanism for allowing the locking element to move to the release configuration, and wherein the release device is arranged to operate the release mechanism to allow the taping head to disconnect from the tape roll cassette. The locking element may be a ball bearing or similar that is biased to a locked position and the release mechanism allows the ball bearing to move away from the locked position for release. The locking mechanism may be configured to automatically move to the locked configuration when received by the taping head. For example, the ball bearing may be spring loaded such that it is depressed when inserted into the taping head and then

automatically extended when aligned with a corresponding locking detent in the taping head.

[0012] The holder is configured to hold and retain the tape roll cassette when it is disconnected from the taping head. This includes holding the tape roll cassette as it is disconnected from or connected to the taping head. The holder may include a bracket or holster for slidably receiving the tape roll cassette. The tape roll cassette may include a mounting element located on the upper surface that is slidably received within the holder, which may include a stop element to locate and hold the mounting element within the holder. The mounting element and holder may be arranged such that the tape roll cassette is vertically inserted into the holder and removed therefrom.

[0013] The automated wire taping system may further comprise a plurality of tape roll cassettes and the storage device comprises a plurality of corresponding holders for holding each of the respective plurality of tape roll cassettes. At any given time, if a tape roll cassette is connected to the taping head, at least one of the holders is empty and available to receive said tape roll cassette from the taping head.

[0014] Each holder may include a release device associated with holder arranged to release the tape roll cassette held by the respective holder.

[0015] Each tape roll cassette may include an upper surface to which the tape roll is mounted and an opposing lower surface, the at least one releasable connector projects from the lower surface, and the holders are configured to hold the tape rolls cassettes in an orientation in which the lower surface faces away from the storage device for connection to by the taping head. The releasable controller preferably extends from the upper surface, through the body and projects away from the lower surface to a distal end. The proximal end at the upper surface includes the release mechanism which may be a push button.

[0016] The automated wire taping system may further comprise a processor for operating the tape robot, wherein the processor is programmed with information relating to the location of each holder and the location of each tape roll cassette on the storage device and is operable to control the taping robot to deposit a tape roll cassette at a selected one of said plurality of holders and/or connect to a selected tape roll cassette held with one of said plurality of holders. The processor may also include information relating to the type and/or colour of tape held by each tape roll cassette.

[0017] The taping head may include a mounting element such as a disc rotatable relative to the body and a drive mechanism for rotating the mounting disc, and the tape roll cassette is releasably connected to the mounting disc such that rotation of the mounting disc rotates the tape roll cassette. Rotation of the tape roll cassette causes the tape to be wrapped about the wires. The tape roll cassette includes a feed mechanism including one or more feed rollers for feeding the tape from the tape roll to point of application at the wires.

[0018] The mounting disc may include a first channel for receiving a cable and the tape roll cassette includes second channel for receiving a cable and the first and second channels align when the tape roll cassette connects to the mounting disc. The channels are open ended and allows the taping head to be located about the wires.

[0019] The storage device may comprise one or more vertically arranged support structures to which the holders are mounted, and the holders are configured to hold the tape roll cassettes such that the lower surface of the tape roll cassette is arranged in the vertical plane and the at least one releasable connector extends horizontally away from the storage device.

[0020] The storage device may have an outer surface and the plurality of holders are located at varying locations around the outer surface and the storage device is reconfigurable to move selected holders to a docking location where said selected holders are accessible to the taping head for docking or removing tape roll cassettes. The storage device may have a base section and a drive mechanism arranged to rotate the base section to rotate the main body of the support and rotationally move the holders around the support device.

[0021] In another aspect of the disclosure there is provided a system for assembling a wiring harness, the system comprising:

an assembly board comprising a plurality of wiring supports for holding the wires of a wiring harness in position on the assembly board;

a robot having an arm and a taping head mounted on the arm;

a tape roll cassette including a body, a roll of tape rotatably mounted to the body and at least one releasable connector for connecting the cassette to the taping head; and

a storage device including a holder for receiving the cassette, wherein the storage device includes a release device arranged to operate the at least one releasable connector when the cassette is docked within the holder to disconnect the cassette from the taping head;

wherein the robot is operable and arranged to wrap tape around wires held on the assembly board and to acquire and/or deposit tape roll cassettes at the storage device.

[0022] The system may comprise a processor for operating the robot, wherein the processor is programmed with information relating to the sections of wires to be taped, the taping operation required for each section of wiring to be taped and the tape roll cassette necessary to perform the required taping operation, the location of each holder on the storage device and the location of each tape roll cassette on the storage device and is operable to control the taping robot to acquire a tape roll from one of said plurality of holders and to control the robot to perform a taping operation using said tape roll

cassette.

[0023] A system according to claim 16 wherein the processor is further operable to control the robot to deposit a tape roll cassette at a selected one of said plurality of holders when it is required to replace said tape roll cassette.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The present disclosure will now be described by way of example only with reference to the following illustrative figures in which:

Figure 1 shows a taping robot according to an embodiment of the disclosure;

Figure 2 is a tape roll cassette according to an embodiment of the disclosure;

Figure 3 is a tape roll according to an embodiment of the disclosure;

Figure 4 is a tape roll cassette docking station according to an embodiment of the disclosure;

Figure 5 is a tape roll cassette holder according to an embodiment of the disclosure;

Figure 6 is a tape roll cassette and release mechanism according to an embodiment of the disclosure; and

Figure 7 is a view from beneath of the tape roll cassette docking station of Figure 4.

DESCRIPTION OF EMBODIMENTS

[0025] The following description presents exemplary embodiments and, together with the drawings, serves to explain principles of the disclosure. The scope of the disclosure is not intended to be limited to the precise details of the embodiments or exact adherence with all method steps. Variations will be apparent to a skilled person and are deemed also to be covered by the description. Terms for features used herein should be given a broad interpretation that also encompasses equivalent functions and features. In some cases, several alternative terms (synonyms) for structural features have been provided but such terms are not intended to be exhaustive.

[0026] Descriptive terms should also be given the broadest possible interpretation; e.g. the term "comprising" as used in this specification means "consisting at least in part of" such that interpreting each statement in this specification that includes the term "comprising", features other than that or those prefaced by the term may also be present. Related terms such as "comprise" and "comprises" are to be interpreted in the same man-

ner. Directional terms such as "vertical", "horizontal", "up", "down", "upper" and "lower" are relative terms that may be used for convenience of explanation usually with reference to the illustrations and are not intended to be ultimately limiting if an equivalent function can be achieved with an alternative dimension and/or direction.

[0027] The description herein refers to embodiments with particular combinations of configuration steps or features. However, it is envisaged that further combinations and cross-combinations of compatible steps or features between embodiments will be possible. The description of multiple features in relation to any specific embodiment is not an indication that such features are inextricably linked, and isolated features may function independently from other features and not necessarily require implementation as a complete combination.

[0028] Referring to Figure 1, a multi axis automated taping robot 2 comprises a body 4 and an arm 6 that is rotatable relative to the body 4 about a rotational axis A-A. The taping robot 2 further includes a taping head 8 mounted to the distal end 10 of the arm 6. The taping head 8 comprises a base plate 12 having a planar mounting surface 14. A mount 16 secures a proximal end 18 of the base plate 12 to the arm 6 such that the base plate 12 extends axially away from the distal end 10 of the arm 6. The distal end 20 of the base plate 12 includes a channel 22 having an opening at one end that in use receives the cables to be taped.

[0029] A rotational mounting disc 24 is located at the inner end of the channel 22. The rotational mounting disc 24 is a circular disc having a diameter greater than the width of the channel 22. The mounting disc 24 includes a u-shaped cut away section 26 that forms a channel extending from an opening into the centre disc 24 such that the rotational mounting disc 24 is substantially c-shaped. The u-shaped cutaway section 26 has a width corresponding to the width of the channel 22. In a first rotational position of the mounting disc 24 the u-shaped channel 26 aligns with and forms a continuation of the channel 26 of the base plate. The rotational mounting disc 24 is rotationally mounted to the base plate 12 within a corresponding circular aperture intersected by the channel 22. The mounting disc 24 is held in position by c-shaped locking plates 27 located at either side of the base plate 12 and secured to the base plate by fixings 29. A bush provides a low friction interface between the mounting disc 24 and the base plate 12. The mounting disc 24 is rotationally supported within the base plate 12 such that it rotates about a fixed rotational axis arranged perpendicular to the mounting surface 14 of the base plate 12.

[0030] A motor 28 is mounted to the base plate 12. A drive mechanism comprising a drive chain and series of gears is arranged on the lower surface 30 of the base plate 12, on the opposing side to the mounting surface 14. The drive mechanism is operatively connected to the mounting disc 24 via one or more the gears to transfer drive from the motor 28 to the mounting disc 24 to rotate

the mounting disc 24 relative to and within the base plate 12. The mounting disc 24 comprises a plurality of mounting apertures 32.

[0031] A tape roll cassette 34 mounts to the mounting disc 24 via plurality of connectors 25 that secure within the mounting apertures 32. The connectors 25 are described in further detail below. When the tape roll cassette 34 is connected to the mounting disc 24 it is rotated as the mounting disc 24 is rotated. As shown in Figure 2, the tape roll cassette 34 comprises a base plate 36 having a forward edge 38. A channel 40 is formed in the base plate 36 at the forward edge 38 having a shape corresponding to the shape of the channel defined by the u-shaped cutaway section 26 in the mounting disc 24. The semi-circular ends of the cut away section 26 and channel 40 are concentric when the base plate 36 is secured to the mounting disc 24. The radial centre of the semi-circular end sections are aligned and coaxial with the rotational axis of the mounting disc 24. The base plate 36 includes a plurality of mounting apertures 41 that align with the mounting apertures 32 of the mounting disc 24. Connectors 25 are inserted through the mounting apertures 41 into the mounting apertures 32 of the mounting disc 24 to secure the base plate 36 to the mounting disc 24. The mounting apertures 41 are arranged such that when the base plate 36 is secured to the mounting disc 24 the channel 40 of the base plate 36 is aligned with channel 26 of the mounting disc 24.

[0032] A spindle 44 is mounted to the base plate 36 and extends substantially perpendicularly away from the base plate 36. A tape roll 46 comprising a spool 48 supporting a length of tape 50 is rotatably mounted to the spindle 44 such that the tape roll 46 can rotate relative to the base plate 36. A tape guide 52 is located at the inner end of the channel 40. The tape guide 52 has a curved, semi-circular inner surface 54 corresponding in shape to the curved inner edge of the channel 40, which receives and guides the cables as the cassette 34 is rotated relative to the cables during taping. When the cable is located at the inner end of the channel 40 within the curved inner surface of the tape guide 52 it is coaxial with the rotational axis of the cassette, meaning that as the cassette 34 orbits the cable, the cable remains at a fixed spacing from the surrounding base plate 36.

[0033] The tape guide 52 includes two parts arranged on opposing sides of the channel 40 spaced by a gap 56 that receives and guides the tape. A roller 60 is arranged in a space location above the tape guide 52 between the tape guide 52 and the tape roll 46. The tape passes from the tape roll 46, over the roller 60 and then into the gap 56 of the tape guide 52. The tape extends from the tape guide 52 to a cutter 62. The cutter 62 comprises a main body and a movable jaw including a cutting blade.

[0034] The taping head 36 includes a linear actuator 53 such as a rack and pinion assembly for actuating the jaw of the cutter between a clamping position in which it holds and restrains the end of the tape, a closed cutting position in which it cuts through and releases the end of the tape,

and an open position in which it can receive the free end of the tape while it is applied to the cables. The tape is routed from the tape guide 52 to the cutter 62 and in a first condition is retained by the cutter 62 with the cutting jaw in the clamped position.

[0035] The connectors 25 are quick release connectors configured to releasably connect the tape cassette 34 to the mounting disc 24. The connectors 25 comprise button lock connectors having a shaft 64 and a head 66 including a release button 68. A pair of ball bearings 70 are located on opposing sides of the shaft 64. The ball bearings are spring loaded and biased to a position in which they protrude above the outer surface of the shaft 64. The proximal end of the shaft 64 includes a threaded section. The mounting apertures 41 each include a corresponding threaded section on their inner bore enabling the connector 25 to be threadingly connected within the bore of the mounting aperture 41. The length of the shaft 64 is such that when the connector 25 is threadingly received within the mounting aperture 41 the distal end of the shaft 64 extends from the opposing side of the base plate 36. The projecting section of the shaft 64 is received within the corresponding mounting aperture 32 of the mounting disc 24. Each mounting aperture 32 includes a pair of detents or apertures within the bore configured to receive the spring-loaded ball bearings 70 of the connector 25.

[0036] When the shaft 64 is inserted into the mounting aperture 32 the spring-loaded ball bearings lock within the corresponding apertures of the mounting aperture 32 thereby locking the shaft within the mounting aperture. The spring force of the ball bearings 70 is sufficient to securely retain the connectors 25 within the mounting apertures 32. The connectors 25 are therefore inserted into the mounting apertures 32 to provide a quick fix that locks the tape roll cassette 34 and mounting disc 24 together. The release button 68 is located at the opposing axial end to the shaft 64 and has an end face that is coplanar with the upper surface of the base plate 36. Depressing the release button 68 releases the spring force on the ball bearings 70 and allows the shaft 64 to be removed from the mounting apertures 32. Depressing the release buttons 68 of both connectors 25 therefore enables quick release of the tape roll cassette 34 from the mounting disc 24.

[0037] As shown in Figure 3, a mounting block 43 is also connected to the base plate 36, as will be described in further detail below. The mounting block 43 includes a front locating plate 45 and guide channels 47 located along the side edges of the mounting block 43 at opposing lateral sides between the locating plate 45 and the base plate 36.

[0038] Referring to Figure 4, a storage device comprising a docking station 72 is provided for storing a plurality of tape roll cassettes 34a-34c. The docking station 72 comprises a base 74 and a tower section 76 comprising a plurality of upstanding walls 78. A first upstanding wall 80 includes a plurality of holders 82a-82c for slidably receiving

and holding the tape roll cassettes 34a-34c respectively. Each holder 82 includes a bracket configured to slidably receive the mounting block 43 located on the base plate 36 of the corresponding tape roll cassette 34.

[0039] As shown in Figure 5, the bracket 86 includes a body 88 secured to the outer surface of the upstanding wall 80. The outer face of the bracket 86 includes a slot 90 vertically extending through the body 88. The slot 90 is configured to slidably receive the locating plate 45 of the mounting block 43. Vertically extending guides 92 are located forwardly of the slot 90, which locate within the corresponding guide channels 47 of the mounting block 43. A stop element 94 projects forwardly of the front face of the bracket 86 and is located at the lower edge of the front face. The stop element 94 is arranged to engage the base plate 36 of the tape roll cassette 34 to hold and vertically restrain the tape roll cassette 34 and prevent the mounting block 43 from sliding entirely through the slot 90.

[0040] The mounting block 43 is mounted to the outer face of the base plate 36 of the tape roll cassette 34. Therefore, when the tape roll cassette 34 is inserted into the bracket 86 the outer surface of the base plate 36 faces inwardly towards the tower 76. Consequently, the sections of the shafts 64 of the connectors 25 extending rearwardly through the rear surface of the base plate 36 project outwardly and horizontally away from the tower 76.

[0041] In use the robot 2 is operated to move the taping head 8 towards the location of a required tape roll cassette 34 on the docking station 72. The arm 6 is rotated to orient the base plate 12 of the taping head 8 such that the mounting surface 14 is vertically oriented and facing the rear surface of the corresponding tape roll cassette 34. The base plate 12 is moved into engagement with the tape roll cassette 34 such that the shafts 64 of the connectors 25 are received within the corresponding mounting apertures 32 of the mounting disc 24. As the base plate 12 is moved into further engagement with the tape roll cassette 34 the ball bearings 70 of the connectors 25 locate within the corresponding detents of the mounting apertures 32, thereby locking the base plate 12 and the tape roll cassette 34 together. The base plate 12 is moved vertically by the robot 2 to lift the tape roll cassette 34 causing the mounting block 43 to slide out of the corresponding slot 90 of the bracket 86. When the mounting block 43 has vertically cleared the bracket 86 the robot 2 is able to move the tape roll cassette 34 away from the docking station 72 to the wiring harness assembly board for use in taping the wiring harness.

[0042] When it becomes necessary to change the tape roll cassette 34, either because the tape roll has been fully used or an alternative tape colour or tape type is required, the robot 2 returns the tape cassette 34 to the docking station 72 and the tape cassette 34 is inserted into an empty bracket 86, which may be the bracket 86 from which the tape roll cassette 34 that was originally removed or may be an alternative bracket 86. The mount-

ing block 43 is slid into the slot 90 of the bracket 86 until the base plate 36 contacts the stop member 94. In this position, the end faces 66 of the connectors 25 are facing inwardly towards the tower 76.

[0043] Referring again to Figure 4, a plurality of linear actuators 77 are mounted on the tower 76, each actuator being located adjacent a corresponding bracket 86. For each holder, the corresponding linear actuator 57 is arranged such that the piston rod 79 is extendable to an extended position in which it engages the end faces 66 of the connectors 25 and depresses the buttons 68 of the connectors 25, as shown in Figure 6. This causes the ball bearings 70 to release and unlocks the shaft 64 of the connectors 25 from the corresponding mounting apertures 32. The linear actuator continues to depress the buttons 68 to hold the ball bearings 70 in the unlocked condition while the robot 2 moves the base plate 12 away from the tape roll cassette 34 to disconnect the base plate 12 from the tape roll cassette 34. The base plate 12 is then moved by the robot 2 to connect to and acquire a second tape roll cassette 34 from the further bracket 86 on the docking station 72.

[0044] A processor is programmed with information relating to the colour and/or type of tape roll mounted on each tape roll cassette 34 and the location of each tape roll cassette 34 on the docking station 72. The processor is also programmed with sequence information specifying the tape roll cassette 34 required for each stage of assembly. The system may further comprise a sensor arranged to determine when a tape roll has expired and the processor is operative to control the robot 2 in response to a signal from the sensor to replace the empty tape roll cassette 34 with a full tape roll cassette 34.

[0045] The docking station 72 includes additional brackets 86 mounted on further upstanding walls on further faces of the tower 76. As shown in Figure 7, the base 74 of the docking station 72 includes a rotational drive mechanism 76 arranged to rotate the base 74 and the tower 72 to present additional upstanding walls and therefore additional tape roll cassettes 34 to the robot 2. The processor is programmed with information relating to the circumferential and vertical position of each bracket 86 and the rotational movement required to rotate the tower 72 to present a given tape roll cassette 34 to the robot 2.

Claims

1. An automated wire taping system comprising:

a robot (2) having an arm (6) and a taping head (36) mounted on the arm (6) configured for wrapping tape around one or more cables;
a tape roll cassette (34) including a body (8), a roll of tape rotatably mounted to the body (8) and at least one releasable connector (25) for connecting the cassette (34) to the taping head (36);

characterized in that

the automated wire taping system comprises a storage device including a holder (82) for receiving the cassette (34), wherein the storage device includes a release device arranged to automatically operate the at least one releasable connector (25) to disconnect the cassette (34) from the taping head (36).

2. An automated wire taping system according to claim 1, wherein the release device is arranged to operate the at least one releasable connector (25) when the cassette (34) is docked within the holder (82).
3. An automated wire taping system according to claim 1 or 2, wherein the at least one releasable connector (25) includes a locking element reconfigurable between a locked configuration that prevents release of the connector and a release configuration that allows the tape roll cassette (34) to be disconnected from the taping head (36), and a release mechanism for allowing the locking element to move to the release configuration, and wherein the release device is arranged to operate the release mechanism to allow the taping head (36) to disconnect from the tape roll cassette (34).
4. An automated wire taping system according to claim 3, wherein the release mechanism comprises a linear actuator (53).
5. An automated wire taping system according to claim 3 or 4, wherein the locking mechanism is configured to automatically move to the locked configuration when received by the taping head (36).
6. An automated wire taping system according to claim 4 or 5, wherein the holder (82) is configured to hold and retain the tape roll cassette (34) when it is disconnected from the taping head (36).
7. An automated wire taping system according to claim 6, comprising a plurality of tape roll cassette (34)s and wherein the storage device comprises a plurality of corresponding holders (82) for holding each of the respective plurality of tape roll cassettes (34).
8. An automated wire taping system according to claim 7, wherein each holder (82) includes a release device arranged to release the tape roll cassette (34) held by the respective holder (82).
9. An automated wire taping system according to claim 8, wherein each tape roll cassette (34) includes an upper surface to which the tape roll is mounted and an opposing lower surface, the at least one releasable connector (25) projects from the lower surface, and the holders (82) are configured to hold the tape

roll cassettes (34) in an orientation in which the lower surface faces away from the storage device for connection to by the taping head (36).

10. An automated wire taping system according to claim 9, further comprising a processor for operating the robot (2), wherein the processor is programmed with information relating to the location of each holder (82) and the location of each tape roll cassette (34) on the storage device and is operable to control the taping robot (2) to deposit a tape roll cassette (34) at a selected one of said plurality of holders (82) and/or connect to a selected tape roll cassette (34) held with one of said plurality of holders (82).
11. An automated wire taping system according to any preceding claim, wherein the taping head (36) includes a mounting disc (24) rotatable relative to the body (8) and a drive mechanism for rotating the mounting disc (24), and the tape roll cassette (34) is releasably connected to the mounting disc (24) such that rotation of the mounting disc (24) rotates the tape roll cassette (34).
12. An automated wire taping system according to claim 11, wherein the mounting disc (24) includes a first channel for receiving a cable and the tape roll cassette (34) includes a second channel for receiving a cable and the first and second channels (47) align when the tape roll cassette (34) connects to the mounting disc (24).
13. An automated wire taping system according to any preceding claim, wherein the storage device comprises one or more vertically arranged support structures to which the holders (82) are mounted, and the holders (82) are configured to hold the respective tape roll cassettes (34) such that the lower surface of each tape roll cassette (34) is arranged in the vertical plane and the at least one releasable connector (25) extends horizontally away from the storage device.
14. An automated wire taping system according to claim 13, wherein the storage device has an outer surface, and the plurality of holders (82) are located at varying locations around the outer surface and the storage device is reconfigurable to move selected holders (82) to a docking location where said selected holders (82) are accessible to the taping head (36) for docking or removing tape roll cassettes (34).
15. An automated wire taping system according to any preceding claim, further comprising an assembly board having a plurality of wiring supports for holding the wires of a wiring harness in position on the assembly board, wherein the robot (2) is operable and arranged to wrap tape around wires held on the assembly board and to acquire and/or deposit tape

roll cassettes (34) at the storage device.

16. An automated wire taping system according to claim 15, further comprising a processor for operating the robot (2), wherein the processor is programmed with information relating to the sections of wires to be taped, the taping operation required for each section of wiring to be taped and the tape roll cassette (34) necessary to perform the required taping operation, the location of each holder (82) on the storage device and the location of each tape roll cassette (34) on the storage device and is operable to control the taping robot (2) to acquire a tape roll from one of said plurality of holders (82) and to control the robot (2) to perform a taping operation using said tape roll cassette (34).
17. An automated wire taping system according to claim 16, wherein the processor is further operable to control the robot to deposit a tape roll cassette (34) at a selected one of said plurality of holders (82) when it is required to replace said tape roll cassette (34).

Patentansprüche

1. Automatisiertes Kabelbindesystem, umfassend:

einen Roboter (2) mit einem Arm (6) und einem an dem Arm (6) angebrachten Bindekopf (36), der zum Wickeln von Band um ein oder mehrere Kabel konfiguriert ist;

eine Bandrollenkassette (34), die einen Körper (8), eine drehbar an dem Körper (8) angebrachte Bandrolle und mindestens einen lösbaren Verbinder (25) zum Verbinden der Kassette (34) mit dem Bindekopf (36) umfasst; **dadurch gekennzeichnet, dass**

das automatisierte Kabelbindesystem umfasst eine Speichervorrichtung, die einen Halter (82) zum Aufnehmen der Kassette (34) umfasst, wobei die Speichervorrichtung eine Freigabevorrichtung umfasst, die angeordnet ist, um den mindestens einen lösbaren Verbinder (25) automatisch zu betätigen, um die Kassette (34) von dem Bindekopf (36) zu trennen.

2. Automatisiertes Kabelbindesystem nach Anspruch 1, wobei die Freigabevorrichtung angeordnet ist, um den mindestens einen lösbaren Verbinder (25) zu betätigen, wenn die Kassette (34) innerhalb des Halters (82) angedockt ist.
3. Automatisiertes Kabelbindesystem nach Anspruch 1 oder 2, wobei der mindestens eine lösbare Verbinder (25) ein Verriegelungselement, das zwischen einer verriegelten Konfiguration, die eine Freigabe

- des Verbinders verhindert, und einer Freigabekonfiguration, die es ermöglicht, die Bandrollenkassette (34) von dem Bindekopf (36) zu trennen, rekonfigurierbar ist, und einen Freigabemechanismus umfasst, um es dem Verriegelungselement zu ermöglichen, sich in die Freigabekonfiguration zu bewegen, und wobei die Freigabevorrichtung angeordnet ist, um den Freigabemechanismus zu betätigen, um es dem Bindekopf (36) zu ermöglichen, sich von der Bandrollenkassette (34) zu trennen.
4. Automatisiertes Kabelbindesystem nach Anspruch 3, wobei der Freigabemechanismus einen Linearaktor (53) umfasst.
 5. Automatisiertes Kabelbindesystem nach Anspruch 3 oder 4, wobei der Verriegelungsmechanismus konfiguriert ist, um sich automatisch in die verriegelte Konfiguration zu bewegen, wenn er von dem Bindekopf (36) aufgenommen wird.
 6. Automatisiertes Kabelbindesystem nach Anspruch 4 oder 5, wobei der Halter (82) konfiguriert ist, um die Bandrollenkassette (34) zu halten und zurückzuhalten, wenn sie von dem Bindekopf (36) getrennt ist.
 7. Automatisiertes Kabelbindesystem nach Anspruch 6, umfassend eine Vielzahl von Bandrollenkassetten (34), und wobei die Speichervorrichtung eine Vielzahl von entsprechenden Haltern (82) zum Halten jeder der jeweiligen Vielzahl von Bandrollenkassetten (34) umfasst.
 8. Automatisiertes Kabelbindesystem nach Anspruch 7, wobei jeder Halter (82) eine Freigabevorrichtung umfasst, die angeordnet ist, um die von dem jeweiligen Halter (82) gehaltene Bandrollenkassette (34) freizugeben.
 9. Automatisiertes Kabelbindesystem nach Anspruch 8, wobei jede Bandrollenkassette (34) eine obere Oberfläche, an der die Bandrolle angebracht ist, und eine gegenüberliegende untere Oberfläche umfasst, wobei der mindestens eine lösbare Verbinder (25) von der unteren Oberfläche vorsteht und die Halter (82) konfiguriert sind, um die Bandrollenkassetten (34) in einer Ausrichtung zu halten, in der die untere Oberfläche von der Speichervorrichtung weg zur Verbindung mit dem Bindekopf (36) weist.
 10. Automatisiertes Kabelbindesystem nach Anspruch 9, ferner umfassend einen Prozessor zum Betreiben des Roboters (2), wobei der Prozessor mit Informationen in Bezug auf die Position jedes Halters (82) und die Position jeder Bandrollenkassette (34) auf der Speichervorrichtung programmiert ist und betreibbar ist, um den Binderoboter (2) zu steuern, um eine Bandrollenkassette (34) an einem aus-
- wählten der Vielzahl von Haltern (82) abzulegen und/oder mit einer ausgewählten Bandrollenkassette (34) zu verbinden, die mit einem der Vielzahl von Haltern (82) gehalten wird.
11. Automatisiertes Kabelbindesystem nach einem der vorhergehenden Ansprüche, wobei der Bindekopf (36) eine Anbringungsscheibe (24), die relativ zu dem Körper (8) drehbar ist, und einen Antriebsmechanismus zum Drehen der Anbringungsscheibe (24) umfasst und die Bandrollenkassette (34) lösbar mit der Anbringungsscheibe (24) verbunden ist, so dass eine Drehung der Anbringungsscheibe (24) die Bandrollenkassette (34) dreht.
 12. Automatisiertes Kabelbindesystem nach Anspruch 11, wobei die Anbringungsscheibe (24) einen ersten Kanal zum Aufnehmen eines Kabels umfasst und die Bandrollenkassette (34) einen zweiten Kanal zum Aufnehmen eines Kabels umfasst und der erste und der zweite Kanal (47) ausgerichtet sind, wenn die Bandrollenkassette (34) mit der Anbringungsscheibe (24) verbunden ist.
 13. Automatisiertes Kabelbindesystem nach einem der vorhergehenden Ansprüche, wobei die Speichervorrichtung eine oder mehrere vertikal angeordnete Stützstrukturen umfasst, an denen die Halter (82) angebracht sind, und die Halter (82) konfiguriert sind, um die jeweiligen Bandrollenkassetten (34) zu halten, so dass die untere Oberfläche jeder Bandrollenkassette (34) in der vertikalen Ebene angeordnet ist und sich der mindestens eine lösbare Verbinder (25) horizontal von der Speichervorrichtung weg erstreckt.
 14. Automatisiertes Kabelbindesystem nach Anspruch 13, wobei die Speichervorrichtung eine äußere Oberfläche aufweist und die Vielzahl von Haltern (82) an variierenden Positionen um die äußere Oberfläche angeordnet sind und die Speichervorrichtung rekonfigurierbar ist, um ausgewählte Halter (82) zu einer Andockposition zu bewegen, an der die ausgewählten Halter (82) für den Bindekopf (36) zum Andocken oder Entfernen von Bandrollenkassetten (34) zugänglich sind.
 15. Automatisiertes Kabelbindesystem nach einem der vorhergehenden Ansprüche, ferner umfassend eine Montageplatte mit einer Vielzahl von Verdrahtungsstützen zum Halten der Kabel eines Kabelbaums in Position auf der Montageplatte, wobei der Roboter (2) betreibbar und angeordnet ist, um Band um auf der Montageplatte gehaltene Kabel zu wickeln und Bandrollenkassetten (34) an der Speichervorrichtung zu erhalten und/oder abzulegen.
 16. Automatisiertes Kabelbindesystem nach Anspruch

- 15, ferner umfassend einen Prozessor zum Betreiben des Roboters (2), wobei der Prozessor mit Information in Bezug auf die Abschnitte von zu verbindenden Kabeln, den für jeden Abschnitt von zu verbindender Verdrahtung erforderlichen Bindevorgang und die Bandrollenkassette (34), die erforderlich ist, um den erforderlichen Bindevorgang durchzuführen, die Position jedes Halters (82) auf der Speichervorrichtung und die Position jeder Bandrollenkassette (34) auf der Speichervorrichtung programmiert ist und betreibbar ist, um den Binderoboter (2) zu steuern, um eine Bandrolle von einem der Vielzahl von Haltern (82) zu erhalten und den Roboter (2) zu steuern, um einen Bindevorgang unter Verwendung der Bandrollenkassette (34) durchzuführen.
17. Automatisiertes Kabelbindesystem nach Anspruch 16, wobei der Prozessor ferner betreibbar ist, um den Roboter zu steuern, um eine Bandrollenkassette (34) an einem ausgewählten der Vielzahl von Haltern (82) abzulegen, wenn es erforderlich ist, die Bandrollenkassette (34) zu ersetzen.

Revendications

1. Un système de rubanage automatisé de fils, comprenant :
 - un robot (2) avec un bras (6) et une tête de rubanage (36) montée sur le bras (6) configurée pour enrouler du ruban autour d'un ou plusieurs câbles ;
 - une cassette de rouleau de ruban (34) comprenant un corps (8), un rouleau de ruban monté à rotation sur le corps (8) et au moins un connecteur libérable (25) pour connecter la cassette (34) à la tête de rubanage (36) ;
 - caractérisé en ce que**
 - le système de rubanage automatisé de fils comprend un dispositif de stockage incluant un réceptacle (82) destiné à recevoir la cassette (34), le dispositif de stockage comprenant un dispositif de libération agencé pour actionner automatiquement l'au moins un connecteur libérable pour déconnecter la cassette (34) de la tête de rubanage (36).
2. Un système de rubanage automatisé de fils selon la revendication 1, dans lequel le dispositif de libération est agencé pour actionner l'au moins un connecteur libérable (25) lorsque la cassette (34) est emboîtée dans le réceptacle (82).
3. Un système de rubanage automatisé de fils selon la revendication 1 ou 2, dans lequel l'au moins un connecteur libérable (25) comprend un élément de

verrouillage reconfigurable entre une configuration verrouillée qui empêche la libération du connecteur et une configuration libérée qui permet à la cassette de rouleau de ruban (34) d'être déconnectée de la tête de rubanage (36), et un mécanisme de libération pour permettre à l'élément de verrouillage de se déplacer vers la configuration libérée, et dans lequel le dispositif de libération est agencé pour actionner le mécanisme de libération pour permettre à la tête de rubanage (36) de se déconnecter de la cassette de rouleau de ruban (34).

4. Un système de rubanage automatisé de fils selon la revendication 3, dans lequel le mécanisme de libération comprend un actionneur linéaire (53).
5. Un système de rubanage automatisé de fils selon la revendication 3 ou 4, dans lequel le mécanisme de verrouillage est configuré pour se déplacer automatiquement vers la configuration verrouillée lorsqu'il est reçu par la tête de rubanage (36).
6. Un système de rubanage automatisé de fils selon la revendication 4 ou 5, dans lequel le réceptacle (82) est configuré pour recevoir et maintenir la cassette de rouleau de ruban (34) lorsqu'il est déconnecté de la tête de rubanage (36).
7. Un système de rubanage automatisé de fils selon la revendication 6, comprenant une pluralité de cassettes de rouleau de ruban (34) et dans lequel le dispositif de stockage comprend une pluralité de réceptacles correspondants (82) pour recevoir chacune respective de la pluralité de cassettes de rouleau de ruban (34).
8. Un système de rubanage automatisé de fils selon la revendication 7, dans lequel chaque réceptacle (82) comprend un dispositif de libération agencé pour libérer la cassette de rouleau de ruban (34) maintenue par le réceptacle respectif (82).
9. Un système de rubanage automatisé de fils selon la revendication 8, dans lequel chaque cassette de rouleau de ruban (34) comprend une surface supérieure sur laquelle est monté le rouleau de ruban et une surface inférieure opposée, l'au moins un connecteur libérable (25) fait saillie de la surface inférieure, et les réceptacles (82) sont configurés pour maintenir les cassettes de rouleau de ruban (34) dans une orientation suivant laquelle la surface inférieure est tournée en éloignement du dispositif de stockage pour la connexion par la tête de rubanage (36).
10. Un système de rubanage automatisé de fils selon la revendication 9, comprenant en outre un processeur pour actionner le robot (2), dans lequel le processeur

- est programmé avec des informations relatives à l'emplacement de chaque réceptacle (82) et à l'emplacement de chaque cassette de rouleau de ruban (34) sur le dispositif de stockage, et est actionnable pour contrôler le robot de rubanage (2) pour remettre une cassette de rouleau de ruban (34) sur l'un sélectionné de ladite pluralité de réceptacles (82) et/ou se connecter à une cassette de rouleau de ruban (34) sélectionnée maintenue par l'un de ladite pluralité de réceptacles (82).
- 5
11. Un système de rubanage automatisé de fils selon l'une des revendications précédentes, dans lequel la tête de rubanage (36) comprend un disque de montage (24) mobile en rotation par rapport au corps (8) et un mécanisme d'entraînement pour entraîner en rotation le disque de montage (24), et la cassette de rouleau de ruban (34) est connectée de manière libérable au disque de montage (24) de telle manière que la rotation du disque de montage (24) fasse tourner la cassette de rouleau de ruban (34).
- 10 15 20
12. Un système de rubanage automatisé de fils selon la revendication 11, dans lequel le disque de montage (24) comprend une première gorge destinée à recevoir un câble et la cassette de rouleau de ruban (34) comprend une seconde gorge destinée à recevoir un câble, et la première et la seconde gorge (47) s'alignent lorsque la cassette de rouleau de ruban (34) se connecte au disque de montage (24).
- 25 30
13. Un système de rubanage automatisé de fils selon l'une des revendications précédentes, dans lequel le dispositif de stockage comprend une ou plusieurs structures support agencées verticalement sur lesquelles sont montés les réceptacles (82), et les réceptacles (82) sont configurés pour maintenir les cassettes de rouleau de ruban (34) respectives de telle manière que la surface inférieure de chaque cassette de rouleau de ruban (34) soit disposée dans le plan vertical et que l'au moins un connecteur libérable (25) s'étende horizontalement en éloignement du dispositif de stockage.
- 35 40
14. Un système de rubanage automatisé de fils selon la revendication 13, dans lequel le dispositif de stockage possède une surface externe et la pluralité de réceptacles (82) sont situés en des emplacements variables autour de la surface externe, et le dispositif de stockage est reconfigurable pour déplacer des réceptacles (82) sélectionnés vers un emplacement d'emboîtement où lesdits réceptacles (82) sélectionnés sont accessibles par la tête de rubanage (36) pour emboîter ou retirer des cassettes de rouleau de ruban (34).
- 45 50 55
15. Un système de rubanage automatisé de fils selon l'une des revendications précédentes, comprenant en outre un plateau de montage muni d'une pluralité de supports de câble pour maintenir les fils d'un faisceau de câbles positionné sur le plateau de montage, dans lequel le robot (2) est actionnable et agencé pour enrouler du ruban autour des fils maintenus sur le plateau de montage et pour aller chercher et/ou remettre des cassettes de rouleau de ruban (34) sur le dispositif de stockage.
- 10 16. Un système de rubanage automatisé de fils selon la revendication 15, comprenant en outre un processeur pour actionner le robot (2), dans lequel le processeur est programmé avec des informations relatives aux sections des fils à rubaner, à l'opération de rubanage requise pour chaque section de fils à rubaner et à la cassette de rouleau de ruban (34) nécessaire pour effectuer l'opération de rubanage requise, à l'emplacement de chaque réceptacle (82) sur le dispositif de stockage, et à l'emplacement de chaque cassette de rouleau de ruban (34) sur le dispositif de stockage, et est actionnable pour contrôler le robot de rubanage (2) pour aller chercher un rouleau de ruban depuis l'un de ladite pluralité de réceptacles (82) et pour contrôler le robot (2) pour effectuer une opération de rubanage à l'aide de ladite cassette de rouleau de ruban (34).
17. Un système de rubanage automatisé de fils selon la revendication 16, dans lequel le processeur est en outre actionnable pour contrôler le robot pour remettre une cassette de rouleau de ruban (34) sur l'un sélectionné de ladite pluralité de réceptacles (82) lorsqu'il est nécessaire de remplacer ladite cassette de rouleau de ruban (34).

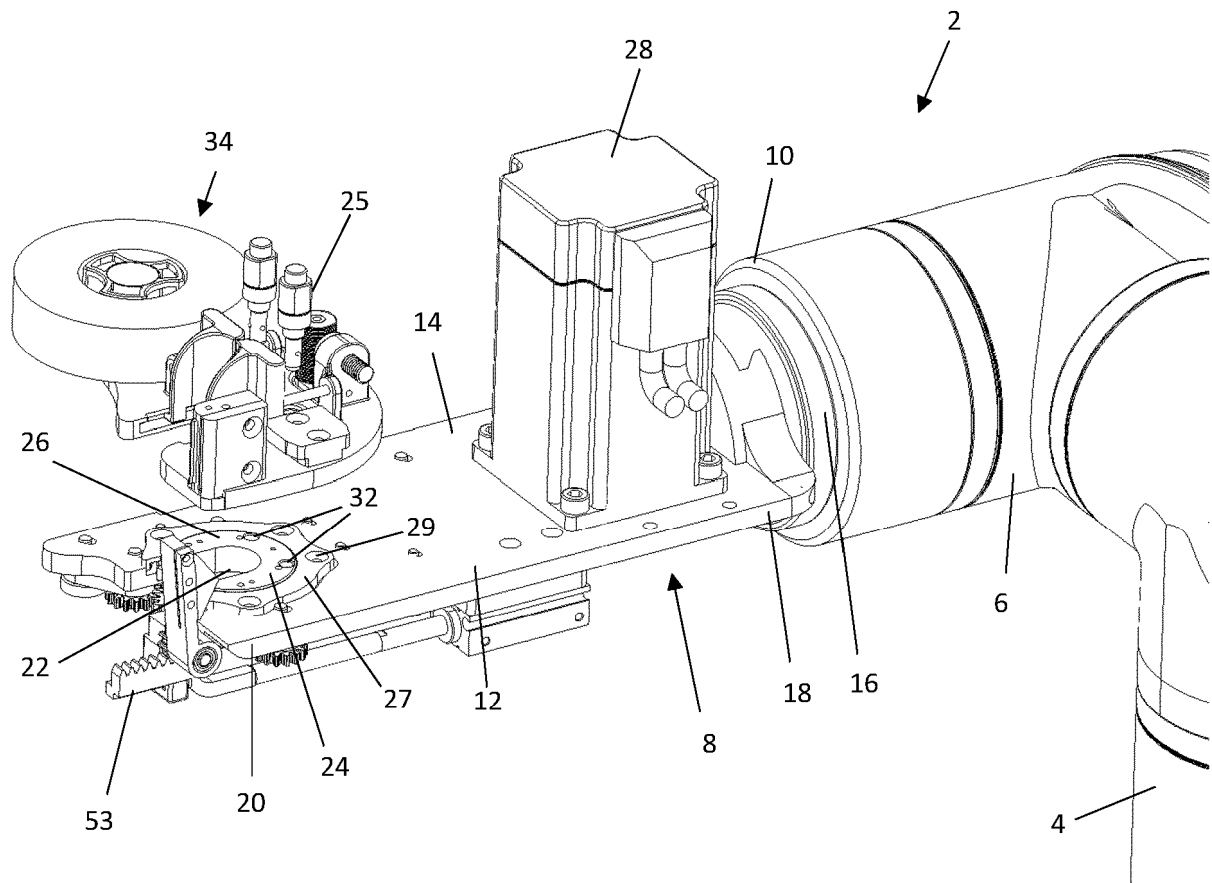


FIG. 1

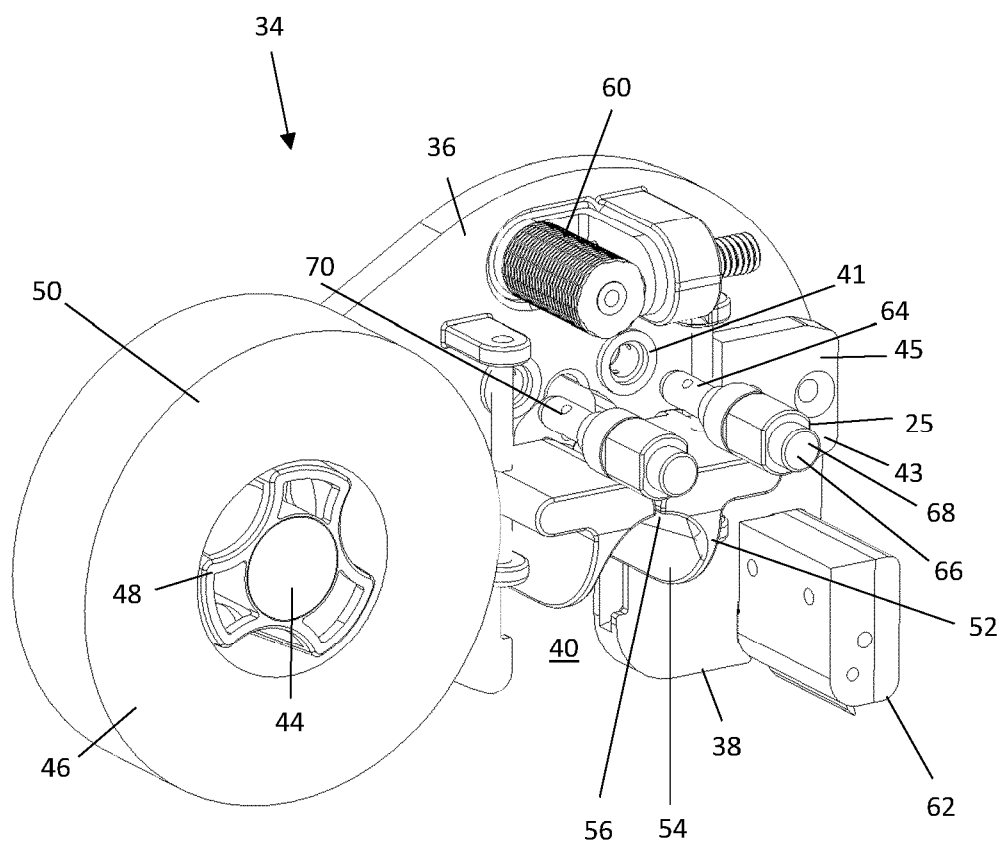


FIG. 2

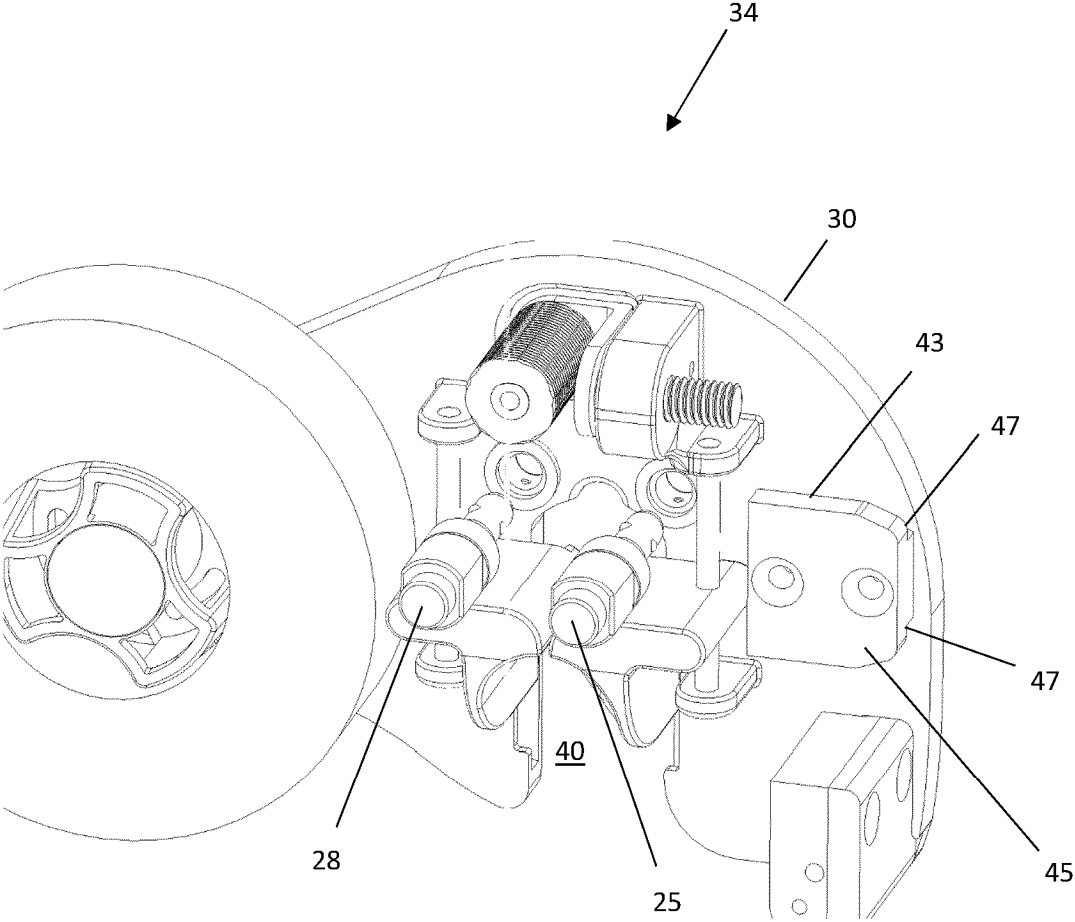


FIG. 3

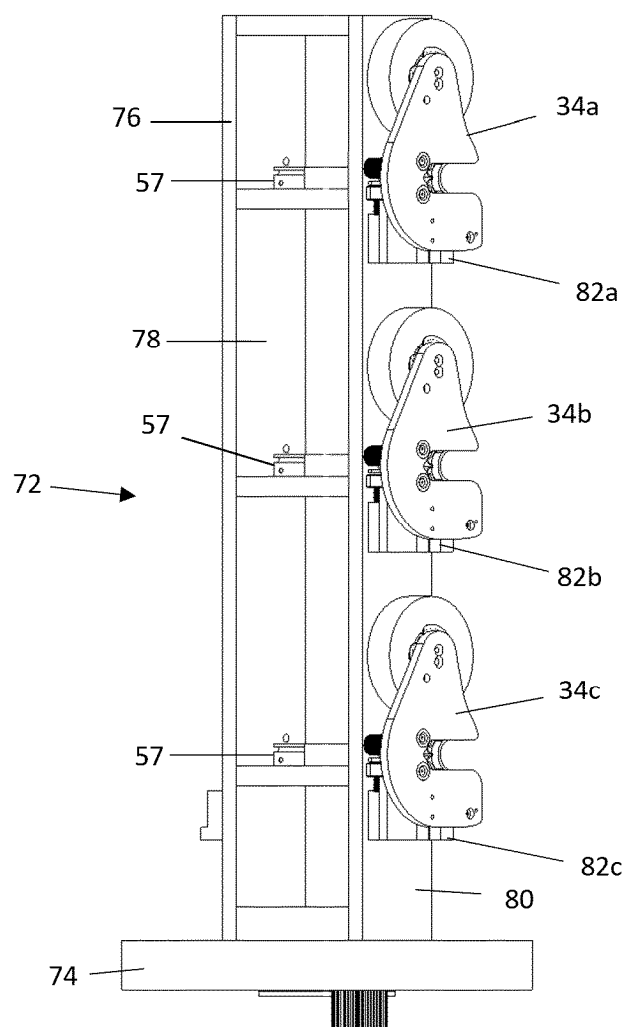


FIG. 4

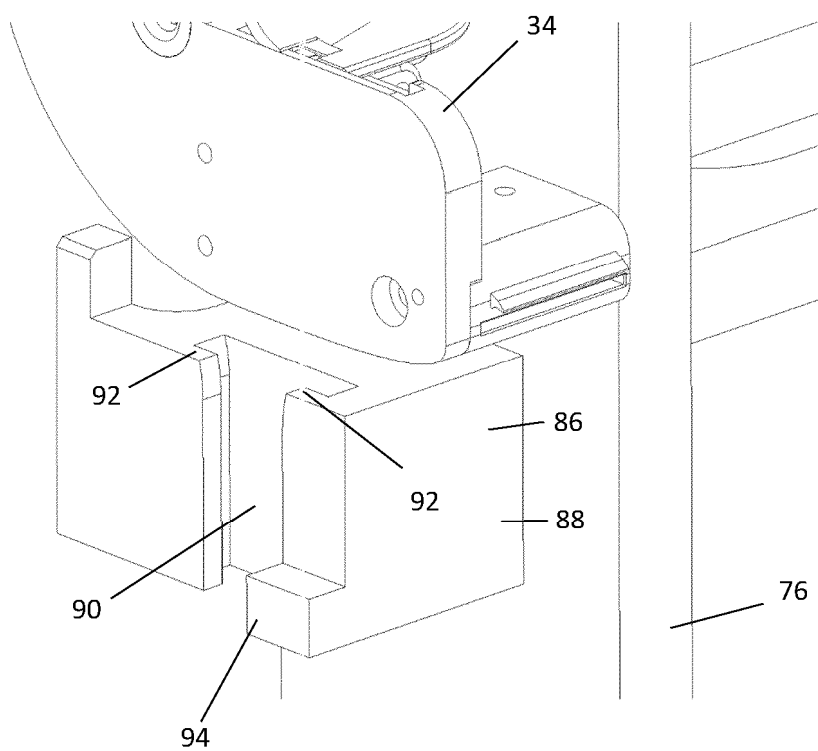


FIG. 5

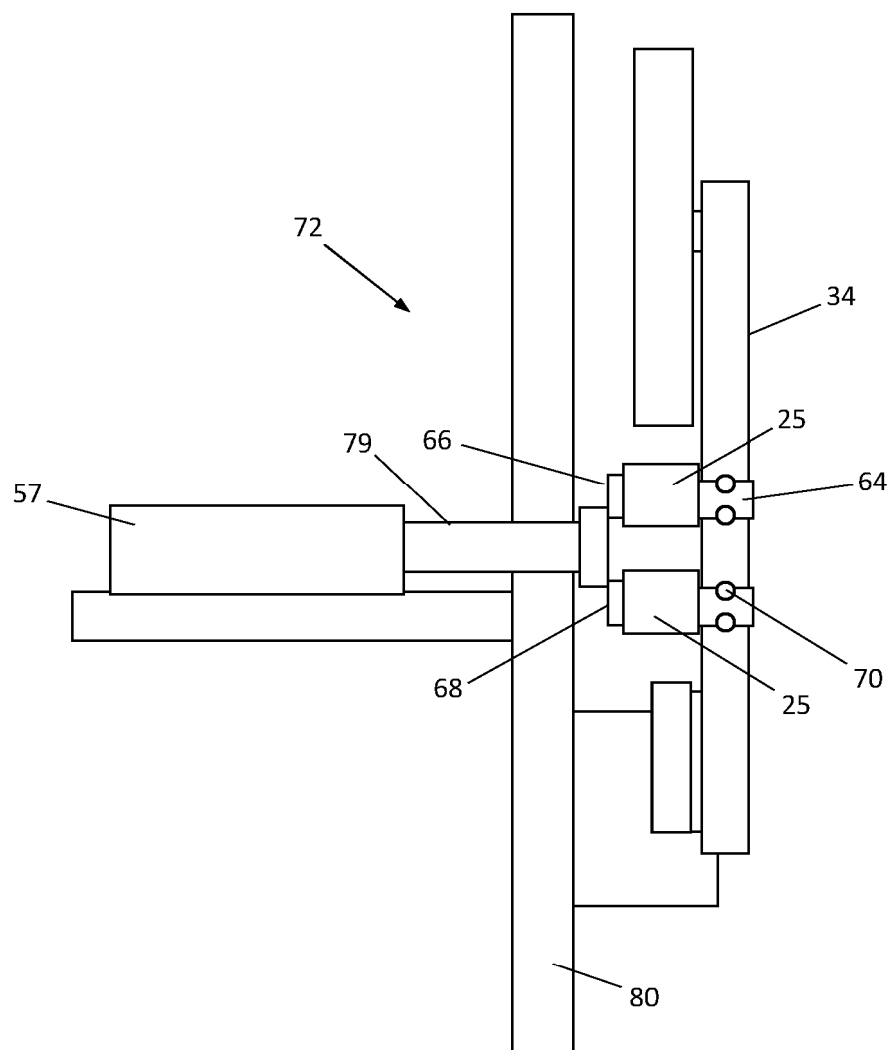


FIG. 6

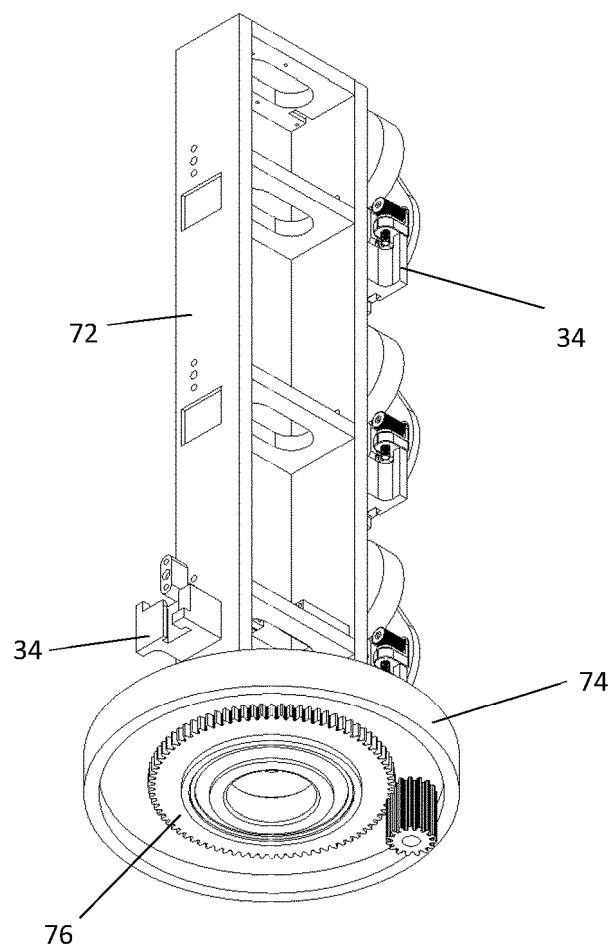


FIG. 7

REFERENCES CITED IN THE DESCRIPTION

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