(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 January 2025 (16.01.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/014692 A2

(51) International Patent Classification:
Not classified

(21) International Application Number:
PCT/US2024/036498

(22) International Filing Date:
02 July 2024 (02.07.2024)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/512,983 11 July 2023 (11.07.2023) US

(71) Applicant: **SIGNODE INDUSTRIAL GROUP LLC** [US/US]; Hidden River Corporate Center Two, 14025 Riveredge Drive, Suite 500, Tampa, Florida 33637 (US).

(72) Inventor: **MUSTONEN, Pekka**; Esterinkuja 2 A3, 21250 Masku (FI).

(74) Agent: **MASIA, Adam H.**; Neal, Gerber & Eisenberg LLP, Two North LaSalle Street, Suite 1700, Chicago, Illinois 60602 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) **Title:** STRETCH-WRAPPING MACHINE HAVING A ROPING ASSEMBLY INCLUDING FILM GUIDE ASSEMBLIES

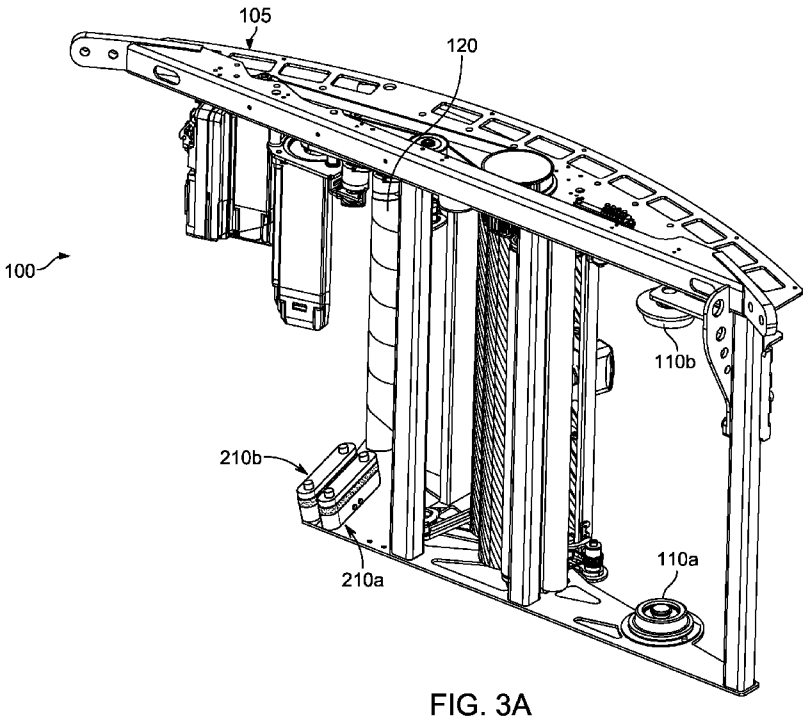

FIG. 3A

(57) **Abstract:** Various embodiments of the present disclosure provide a stretch-wrapping machine having a first film-engagement member and a second film-engagement member configured to engage and cause part of a film to be manipulated into a rope form.

WO 2025/014692 A2

[Continued on next page]

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

STRETCH-WRAPPING MACHINE HAVING A ROPING ASSEMBLY INCLUDING FILM GUIDE ASSEMBLIES

Priority

[0001] This application claims priority to and the benefit of U.S. Provisional Patent Application No. 63/512,983, filed July 11, 2023, the entire contents of which is incorporated herein by reference.

Field

[0002] The present disclosure relates to a stretch-wrapping machine, and more particularly to a stretch-wrapping machine that includes a roping assembly having film guide assemblies configured to manipulate a film into a reduced-width rope form to secure a load of goods to a pallet.

Background

[0003] Several types of stretch-wrapping machines use stretch film to secure loads of goods on pallets. These stretch-wrapping machines include a film roll carriage configured to support a removable stretch film roll. Such stretch-wrapping machines are configured to rotate the film roll carriage relative to the load while vertically moving the film roll carriage relative to the load to wrap the load in a spiral pattern with the stretch film taken from the film roll.

[0004] When palletized loads are wrapped, it is beneficial to wrap the film around the base of the load and a top portion of the pallet supporting the load to secure the load to the pallet. It is also beneficial to manipulate the film at the bottom area of the film before applying it to the base of the load and the top portion of the pallet. This manipulation of the film is often referred to as roping.

Summary

[0005] Various embodiments of the present disclosure provide a stretch-wrapping machine including a roping assembly having film guide assemblies configured to manipulate a film to include a reduced-width rope form before applying the film to a base of a load and a top portion of a pallet to secure the load to the pallet.

Brief Description of the Figures

[0006] Figure 1 is a perspective view of a stretch-wrapping machine of one example embodiment of the present disclosure.

[0007] Figure 2 is a block diagram showing certain components of the stretch-wrapping machine of Figure 1.

[0008] Figure 3A is a perspective view of a film carriage of a wrapping assembly of the stretch-wrapping machine of Figure 1 showing a roping assembly thereof having film guide assemblies in retracted positions.

[0009] Figure 3B is a perspective view of the film carriage of Figure 3A showing the film guide assemblies in film engagement positions.

[0010] Figure 3C is a perspective view of the film guide assemblies removed from the film carriage and in the film engagement positions engaging a film, and roping the bottom portion of the film.

[0011] Figures 4A and 4B are top views of the film carriage of Figure 3A respectively showing the film guide assemblies in the respective retracted and film engagement positions.

[0012] Figures 5A and 5B are top diagrammatic views of a load on a pallet, the film guide assemblies removed from the film carriage and respectively in the retracted and film engagement positions, and a film guided toward the load on the pallet.

[0013] Figures 6A and 6B are side diagrammatic views of a load on a pallet, the film guide assemblies removed from the film carriage and respectively in the retracted and film engagement positions, and a film guide toward the load on the pallet.

Detailed Description

[0014] While the systems, devices, and methods described herein may be embodied in various forms, the drawings show, and the specification describes certain exemplary and non-limiting embodiments. Not all of the components shown in the drawings and described in the specification may be required, and certain implementations may include additional, different, or fewer components. Variations in the arrangement and type of the components; the shapes, sizes, and materials of the components; and the manners of connections of the components may be made without departing from the spirit or scope of the claims. Unless otherwise indicated, any directions referred to in the specification reflect the orientations of the components shown in the corresponding drawings and do not limit the scope of the present disclosure. Further, terms that refer to mounting methods, such as mounted, connected, etc., are not intended to be limited to direct mounting methods but should be interpreted broadly to include indirect and operably mounted, connected, and like mounting methods. This specification is intended to be taken as a whole and interpreted in accordance with the principles of the present disclosure and as understood by one of ordinary skill in the art.

[0015] Figures 1–6B show certain parts of a stretch-wrapping machine 1 (sometimes referred to herein as a "wrapping machine" for brevity) of one example embodiment of the present disclosure. The wrapping machine 1 includes a wrapping-machine frame 10, a circular guide 20, a guide actuator 30, a wrapping assembly 40, a cutting-and-fixing device (not shown), an operator interface 50, and a controller 60.

[0016] The wrapping-machine frame 10 is formed from multiple tubular and/or solid members (not individually labeled) and configured to support the other components of the wrapping machine 1. The wrapping-machine frame 10 defines a wrapping area within its interior and has an infeed area 10a at which a palletized load (such as a load L on a pallet P) is conveyed (such as via a conveyor C) into the wrapping area for wrapping and an outfeed area 10b at which the palletized load is conveyed (such as via the conveyor C) from the wrapping area after wrapping.

[0017] The circular guide 20 serves as the mount for the wrapping assembly 40 and is movably mounted to the wrapping-machine frame 10 (such as to one or more vertical members of the wrapping-machine frame 10) such that the circular guide 20 is vertically

movable relative to the wrapping-machine frame 10 between an upper position and a lower position.

[0018] The guide actuator 30 is operably connected to the circular guide 20 to move the circular guide 20 relative to the wrapping-machine frame 10 between the upper and lower positions. The guide actuator 30 includes one or more motors (not shown) operably connected to the circular guide 20 via one or more belt-and-pulley assemblies (not shown) to move the circular guide 20 between the upper and lower positions. The guide actuator could alternatively include one or more pneumatic or hydraulic cylinders (not shown) operably connected to the circular guide 20 to move the circular guide 20 between the upper and lower positions. The guide actuator 30 is operable under control of the controller 60.

[0019] The wrapping assembly 40 is movably mounted to the circular guide 20 such that the wrapping assembly 40 is rotatable relative to the circular guide 20. The wrapping assembly 40 includes a ring-shaped support (not shown), a film carriage 100 that supports a roping assembly 200, and a wrapping-assembly actuator 45.

[0020] The ring-shaped support serves as the mount for the film carriage 100 and is movably mounted to the circular guide 20 such that the support (and the carriage and other components connected to the support) is rotatable relative to the circular guide 20. The support is movably mounted to the circular guide 20 via multiple spaced-apart rollers (not shown) that are connected to the support and positioned on a track (not shown) on the circular guide 20.

[0021] The film carriage 100 is fixedly connected to the support to move with the support (i.e., rotate relative to the circular guide 20 and move vertically relative to the wrapping-machine frame 10). The film roll carriage 100 is configured to rotatably support a film roll (such as a plastic stretch film roll R shown in Figures 4A and 4B). The film carriage 100 includes a film-carriage frame 105 and spaced apart film-reel supports 110a and 110b connected to the frame 105. The film supports 110a and 110b are configured to removably hold the film roll R.

[0022] The film carriage 100 also includes various components (not labeled) that direct (and stretch) the film F from the film roll R to the roping assembly 200 and that are connected to and supported by the film-carriage frame 105. The film carriage 100 can include, for example, one or more film guide rollers such as but not limited to film guide roller 120 configured to direct the film F toward the roping assembly 200. These components are not described herein for brevity. The film F is drawn off the roll R and directed by and through these

components of the film carriage 100 in a downstream direction D. As used herein, "downstream" means the direction of travel of the film F as the film F is pulled off the film roll R and "upstream" means the direction opposite the direction of travel of the film F as the film F is pulled off the film roll R.

[0023] The film carriage 100 supports the roping assembly 200 in a manner that enables the roping assembly 200 to selectively engage the film. The roping assembly 200 is configured to guide the film that is pulled off of the film roll R such that a bottom portion of the film is at an elevation below a top portion of a pallet P supporting the load L (such as shown in Figure 6B). This causes the film to wrap around the base of the load L and the top of the pallet P to better secure the load L to the pallet P, thereby reducing the potential for the load L to shift on the pallet P during transport. The roping assembly 200 is also configured to cause a part of the film positioned below the top of the pallet to be formed into a rope-like structure (that is referred to herein as a "rope form" for brevity) and wrapped around the pallet P. Part of the rope form can also be wrapped around the load above the pallet P. The rope form is a portion of the film that is concentrated in a tightly compacted manner.

[0024] More specifically, in this example embodiment, the roping assembly 200 includes two film guide assemblies 210a and 210b and one or more assembly supports (not shown) mounted on a bottom support member (not labeled) of the film-carriage frame 105. In this example embodiment, the film guide assemblies 210a and 210b are outwardly moveable (away from each other) by the assembly support(s) to retracted positions such as shown in Figures 3A, 4A, 5A, and 6A. From those retracted positions, they are inwardly movable (toward each other) to film engagement positions such as shown in Figures 3B, 3C, 4B, 5B, and 6B. In the retracted positions, the film guide assemblies 210a and 210b are configured to allow the film F to pass between the film guide assemblies 210a and 210b without engagement by the film guide assemblies 210a and 210b. In the film engagement positions, the film guide assemblies 210a and 210b are configured to engage a bottom portion of the film F as the film F passes between the film guide assemblies 210a and 210b to create a rope form in the bottom portion of the film F as further described below.

[0025] In other example embodiments, one of the film guide assemblies 210a and 210b is stationary and the other film guide assembly is outwardly moveable (away from the stationary film guide assembly) to a retracted position, and from that retracted position is

inwardly movable (toward the stationary film guide assembly) to film engagement position that causes both film guide assemblies to engage the film as described herein. In various such embodiments, when the moveable film guide assembly is in the retracted position, the stationary film guide assembly can be spaced from the film, or the film can engage the film (where such engagement does not cause manipulation of the film).

[0026] In various embodiments, one of the film guide assemblies 210a and 210b includes a stationary film-engagement member and the other one of the film guide assemblies 210a and 210b includes one or more rotatable film-engagement members.

[0027] In various embodiments, each of the film guide assemblies 210a and 210b includes one or more rotatable film-engagement members.

[0028] In various embodiments, each of the rotatable film guide members is formed from one or more: belts, rollers, wheels, reels, tubes, or chains. The quantities of such rotatable film-engagement members can be the same or can vary for the film guide assemblies 210a and 210b. In various embodiments, one or more of the rotatable film-engagement members are all freely rotatable, and in other embodiments one or more of the rotatable film-engagement members are driven.

[0029] In various embodiments, one or more of the rotatable film guide members are coated with a suitable material – such as rubber coating. In various embodiments, one or more of the rotatable film guide members is/are a rubber member.

[0030] In the illustrated example embodiment, the rotatable film-engagement members are guide belts 220a and 220b that are configured to engage opposite sides of the film when the film guide assemblies 210a and 210b are in the engagement positions. Such example guide belts are not meant to limit the present disclosure.

[0031] As further discussed below, in various embodiments, the film guide assemblies 210a and 210b respectively include rotatable guide belts 220a and 220b that are configured to engage opposite sides of the film when the film guide assemblies 210a and 210b are respectively in the film engagement positions. In various embodiments, the guide belts 220a and 220b are not driven and freely rotate due to engagement with the film F as the film passes (i.e., moves downstream) between the film guide assemblies 210a and 210b. In various other embodiments, one or both of the guide belts 220a and 220b are driven and rotate as the film F

passes through the film guide assemblies 210a and 210b. The driven embodiments are primarily described below, but such embodiments are not meant to limit the present disclosure.

[0032] More specifically, as best shown in Figure 3C, the film guide assembly 210a includes a housing 215a, a guide belt 220a rotatably supported by the housing 215a, a rotatable first guide 230a supported by the housing 215a, and a rotatable second guide 240a supported by the housing 215a.

[0033] The housing 215a is configured to support the guide belt 220a in a position such that the guide belt 220a extends slightly outwardly of the inner side wall (not labeled) of the housing 215a such that the guide belt 220a can engage the film F when the film guide assembly 210a is in its film engagement position. The housing 215a can be alternatively positioned, sized, shaped, and otherwise configured in accordance with the present disclosure.

[0034] The guide belt 220a includes a flexible tubular member that extends around the first guide 230a and the second guide 240a and is configured to rotate around these guides 230a and 240a. The exterior surface of the guide belt 220a can include a suitable surface material (not shown) for engaging the film F. The interior surface of the guide belt 220a can include a suitable surface material for engaging the first guide 230a and the second guide 240a. The guide belt 220a can be alternatively positioned, sized, shaped, and otherwise configured in accordance with the present disclosure.

[0035] In one example embodiment, the first guide 230a is freely rotatably supported by the housing 215a. The first guide 230a can be alternatively positioned, sized, shaped, and otherwise configured in accordance with the present disclosure. In one example embodiment, the second guide 240a is also freely rotatably supported by the housing 215b. The second guide 240a can be alternatively positioned, sized, shaped, and otherwise configured in accordance with the present disclosure. In these embodiments, the first guide 230a and the second guide 240a are both not driven, and the movement of the film F causes the guide belts 220a and 220b to rotate.

[0036] In other embodiments, the first guide 230a is supported by the housing 215a and is rotatably driven under control of the controller 60. In other embodiments, the second guide 240a is supported by the housing 215b and is rotatably driven under control of the controller 60. In other embodiments, both the first guide 230a and the second guide 240a are each rotatably driven and controlled by the controller 60.

[0037] In further alternative embodiments, other mechanisms can be employed to suitably rotate the guide belts for engagement with the film F.

[0038] In this example embodiment, as best shown in Figure 3C, the film guide assembly 210b also includes a housing 215b, a guide belt 220b rotatably supported by the housing 215b, a rotatable first guide 230b supported by the housing 215b, and a rotatable second guide 240b supported by the housing 215b. In this example embodiment, the corresponding components are identical to the components of the film guide assembly 210a and are thus not described again for brevity.

[0039] In the example embodiments where the guide belts 220a and 220b are not driven, as the film F engages and passes between these guide belts, the film F causes the guide belt 220a to rotate in a counter-clockwise direction from a top view (as shown in Figures 3B and 5B), and the film F causes the guide belt 220b to rotate in a clockwise direction from a top view (as shown in Figures 3B and 5B). In other words, these guide belts are configured to rotate in opposite directions.

[0040] In the example embodiment where the guide belts are driven, the film guide assembly 210a is configured to rotate the guide belt 220a in a counter-clockwise direction from a top view (as shown in Figures 3B and 5B), and the film guide assembly 210b is configured to rotate the guide belt 220b in a clockwise direction from a top view (as shown in Figures 3B and 5B). In other words, these guide belts are rotated in opposite directions. In certain such embodiments, the rotatable guides 240a and 240b are configured to respectively rotate the guide belts 220a and 220b at a same speed.

[0041] In various embodiment, the film guide assemblies 210a and 210b are angled downwardly for engagement with the film F to produce downwards angled forces into the film F to move the film F downwardly. In other words, when the angled guide belts 220a and 220 engage the film F, they will catch the film F at a point of the film at the infeed position (i.e., the upper side of the film guide assemblies), and while film F is moving between and through the guide belts 220a and 220b, they will direct the film F downwardly in part due to the angle of the guide belts 220a and 220b and before the film F exits the guide belts 220a and 220b on the outfeed side (i.e., the lower side of the film guide assemblies). Thus, this angle produces forces pulling the film F downwardly.

[0042] The film guide assemblies 210a and 210b are movable from the respective retracted positions to the film engagement positions by one or more suitable assembly supports (not shown). The assembly supports are movable by one or more assembly support actuators 250 controlled by the controller 60.

[0043] The assembly support(s) can be configured to simultaneously move the film guide assemblies 210a and 210b from the retracted positions to the film engagement positions, or can be configured to separately and independently move the film guide assemblies 210a and 210b from the retracted positions to the film engagement positions. The assembly support(s) can be supported by the carriage 100, and specifically the bottom support member (not labeled) of the film-carriage frame 105. The assembly support(s) that can be employed to move the film guide assemblies 210a and 210b inwardly to their respective film engagement positions and outwardly to their respective extended positions can vary in accordance with the present disclosure.

[0044] When the film guide assemblies 210a and 210b are in their respective film engagement positions, they are configured to direct the film F in a manner that shortens the width of the film F and specifically to cause a bottom part of the film to be manipulated into a rope form as best shown in Figures 3C and 6B. In the film engagement positions, the film guide assemblies 210a and 210b cause a bottom portion (such as 2-3 inches of the bottom portion) of the film F to fold upon itself to create the rope form at the bottom of the film F. Specifically, the film guide assemblies 210a and 210b and specifically the rotating guide belts 220a and 220b cause a bottom outer edge of the film to move inward upon itself and toward the center of the film such that the film has shorter width and such that a lower part of the film is rolled upon itself to create a reinforced area of the film such as a rope form. The film guide assemblies 210a and 210b in the film engagement positions can also cause the bottom portion of the film that is manipulated into the rope form to be positioned below the load L and on the upper portion of the pallet P. More specifically, the film guide assemblies 210a and 210b create a force on the film F that results in the film F moving downward to cause the bottom edge of the film F to be roped as the film F is rolling upon itself. The film guide assemblies 210a and 210b can include one or more additional components (not shown) such as one or more horizontally fixed bars or horizontal rotating rollers to aid with creating the rope form. The position(s) of these components can be on the infeed or outfeed sides of the assemblies.

[0045] The operator interface 50 is configured to receive inputs from an operator and, in certain embodiments, to output information to the operator. The operator interface includes one or more input devices configured to receive inputs from the operator. In various embodiments, the one or more input devices include one or more buttons (such as hard or soft keys), one or more switches, and/or a touch panel. In various embodiments, the operator interface 50 includes a display device configured to display information to the operator, such as information about the palletized load, the status of the wrapping operation, or the parameters of the wrapping machine 1. The operator interface can include other output devices instead of or in addition to the display device, such as one or more speakers and/or one or more lights. In certain embodiments, the operator interface 50 is formed as part of the wrapping machine 1 and is, for instance, mounted to the wrapping-machine frame 10. In other embodiments, the operator interface is remote from the wrapping machine 1.

[0046] The controller 60 includes a processing device communicatively connected to a memory device. The processing device can include any suitable processing device such as, but not limited to, a general-purpose processor, a special-purpose processor, a digital-signal processor, one or more microprocessors, one or more microprocessors in association with a digital-signal processor core, one or more application-specific integrated circuits, one or more field-programmable gate array circuits, one or more integrated circuits, and/or a state machine. The memory device may include any suitable memory device such as, but not limited to, read-only memory, random-access memory, one or more digital registers, cache memory, one or more semiconductor memory devices, magnetic media such as integrated hard disks and/or removable memory, magneto-optical media, and/or optical media. The memory device stores instructions executable by the processing device to control operation of the wrapping machine 1 (such as to carry out a wrapping operation, as described below).

[0047] The controller 60 is communicatively connected to the actuators 30, 45, and 230 to control operation of these components in conjunction with the wrapping operations. The controller 60 is communicatively connected to the operator interface 50 to: (1) receive signals from the operator interface 50 that represent inputs received by the operator interface 50; and (2) send signals to the operator interface 50 to cause the operator interface 50 to output (such as to display) information.

[0048] A wrapping operation in which the wrapping machine 1 is used to wrap the load L and secure the load L to the pallet P is now described.

[0049] Initially, the circular guide 20 is at its upper position, the cutting-and-fixing device holds the leading end of the film F on the roll R, and the film guide assemblies 210a and 210b of the roping assembly 200 are in the retracted positions (as shown in Figure 3A, 4A, 5A, and 6A). The controller 60 controls the conveyor C to move the load L on the pallet P through the infeed area 10a and into the wrapping area of the wrapping machine 1.

[0050] After the load L on the pallet P reaches the wrapping area, the controller 60 controls the guide actuator 30 to lower the circular guide 20 such that the wrapping assembly 40 is at least partially vertically aligned with part of the load L. The controller 60 controls the cutting-and-fixing device to hold the leading end of the film F against the load L while controlling the wrapping-assembly actuator 45 to rotate the wrapping assembly 40 relative to the circular guide 20 and the load L. The rotation of the wrapping assembly 40 relative to the load L combined with the cutting-and-fixing device holding the leading end of the film F against the load L causes the film F to be drawn off of the roll R, directed through the components of the film carriage 100, directed through the film guide assemblies 210a and 210b that are in their retracted positions and wrapped around the load L.

[0051] Once the film F has been wrapped around the leading end, the controller 60 controls the cutting-and-fixing device to release the leading end and move away from the load L. The controller 60 continues to control the wrapping-assembly actuator 45 to rotate the wrapping assembly 40 while controlling the guide actuator 30 to vertically move the circular guide 20 such that the load L is wrapped with the film F in a spiral pattern. During wrapping, the controller 60 also controls the feed rate of the film F and the pre-stretch the film F. Figures 5A and 6A illustrate this stage of the wrapping operation during which the film F is at its full width is wrapped around the load L.

[0052] Near the end of the wrapping operation (at least in this example embodiment), the controller 60 controls the wrapping machine 1 to apply the rope form to the load L and the pallet P. In the embodiment where the guide belts are driven, the controller 60 controls the rotatable guides 240a and 240b to rotate the guide belts 220a and 220b at a same speed. The controller 60 controls the assembly support actuator(s) 250 to cause the film guide assemblies 210a and 210b to move inwardly to their respective film engagement positions. As

the film guide assemblies 210a and 210b move to their respective film engagement positions, the guide belts 220a and 220b of the film guide assemblies 210a and 210b contact and guide the film F to manipulate the film F into the rope form and cause the bottom of the film to be engaged with the pallet P below the load L. This enables the wrapping machine 1 to use the film in a rope form to secure the load L to the pallet P (without having to raise the load L and the pallet P above the conveyor C).

[0053] Afterwards, the controller 60 controls 60 controls the assembly support actuator(s) 250 to cause the film guide assemblies 210a and 210b to move outwardly to their respective retracted positions, which allows the film F to return to its full-width form. The controller 60 then controls the cutting-and-fixing device to cut the film F from the roll and secure the trailing end of the film F to the load L, thereby completing the wrapping operation. The controller 60 controls the conveyor C to move the wrapped load L and pallet P from the wrapping area and through the outfeed area 10b.

Claims

1. A stretch-wrapping machine comprising:

a frame that defines a wrapping area; and

a wrapping assembly positioned at least partially within the wrapping area and comprising:

a carriage,

a first film-engagement member supported by the carriage,

a second film-engagement member supported by the carriage, and

at least one actuator supported by the carriage, the at least one actuator configured to move at least one of the first film-engagement member and the second film-engagement member into an engagement position such that both the first film-engagement member and the second film-engagement member engage the film to move the film downwardly.

2. The stretch-wrapping machine of claim 1, wherein the first film-engagement member and the second film-engagement member are each freely rotatable.

3. The stretch-wrapping machine of claim 1, wherein at least one of the first film-engagement member and the second film-engagement member is rotatably driven.

4. The stretch-wrapping machine of claim 1, wherein the at least one actuator is configured to move at least one of the first film-engagement member and the second film-engagement member into the engagement position such that both the first film-engagement member and the second film-engagement member engage the film to create a rope form from a bottom portion of the film.

5. The stretch-wrapping machine of claim 1, which comprises a first film guide assembly that comprises the first film-engagement member and a second film guide assembly that comprises the second film-engagement member.

6. The stretch-wrapping machine of claim 5, wherein at least one of the first film guide assembly and the second film guide assembly are moveable to a retracted position and to a film engagement position.

7. The stretch-wrapping machine of claim 6, wherein in the retracted positions, the first and second film guide assemblies are spaced apart to enable the film to pass between the first and second film guide assemblies without engagement by the first film-engagement member and the second film-engagement member.

8. The stretch-wrapping machine of claim 6, wherein for the first film guide assembly, the first film-engagement member is not rotatable, and for the second film guide assembly, the second film-engagement member is rotatable.

9. The stretch-wrapping machine of claim 1, wherein the first film-engagement member comprises at least one belt, roller, wheel, reel, tube, or chain, and the second film-engagement member comprises at least one belt, roller, wheel, reel, tube, or chain.

10. The stretch-wrapping machine of claim 1, wherein the first film-engagement member comprises a first guide belt and the second film-engagement member comprises a second guide belt.

11. The stretch-wrapping machine of claim 10, wherein the first guide belt comprises a first flexible tubular member and the second guide belt comprises a second flexible tubular member.

12. The stretch-wrapping machine of claim 1, wherein the first film-engagement member and the second film-engagement member are configured to rotate in opposite directions.

13. The stretch-wrapping machine of claim 1, which is configured to rotate the first film-engagement member and the second film-engagement member at a same speed.

14. The stretch-wrapping machine of claim 1, wherein the first film-engagement member and the second film-engagement member are configured to be rotated by the film.

15. The stretch-wrapping machine of claim 1, wherein the first film-engagement member and the second film-engagement member are angled downwardly relative to a downstream direction of movement of the film.

16. A method of wrapping a load on a pallet, said method comprising:

causing at least one of a first film-engagement member and a second film-engagement member to be in a retracted position such that the first film-engagement member and the second film-engagement member do not engage a film being wrapped around the load; and

causing at least one the first film-engagement member and the second film-engagement member to move into an engagement position such that both the first film-engagement member and the second film-engagement member engage the film to move the film downwardly.

17. The method of Claim 16, which comprises causing each of the first film-engagement member and the second film-engagement member to move into engagement positions such that both the first film-engagement member and the second film-engagement member engage the film to move the film downwardly.

18. The method of Claim 16, which comprises allowing at least one of the first film-engagement member and the second film-engagement member to be freely rotated by the film when both the first film-engagement member and the second film-engagement member engage the film.

19. The method of Claim 16, which comprises rotating at least one of the first film-engagement member and the second film-engagement member when both the first film-engagement member and the second film-engagement member engage the film.

20. The method of Claim 16, which comprises rotating the first film-engagement member and the second film-engagement member in opposite directions when both the first film-engagement member and the second film-engagement member engage the film.

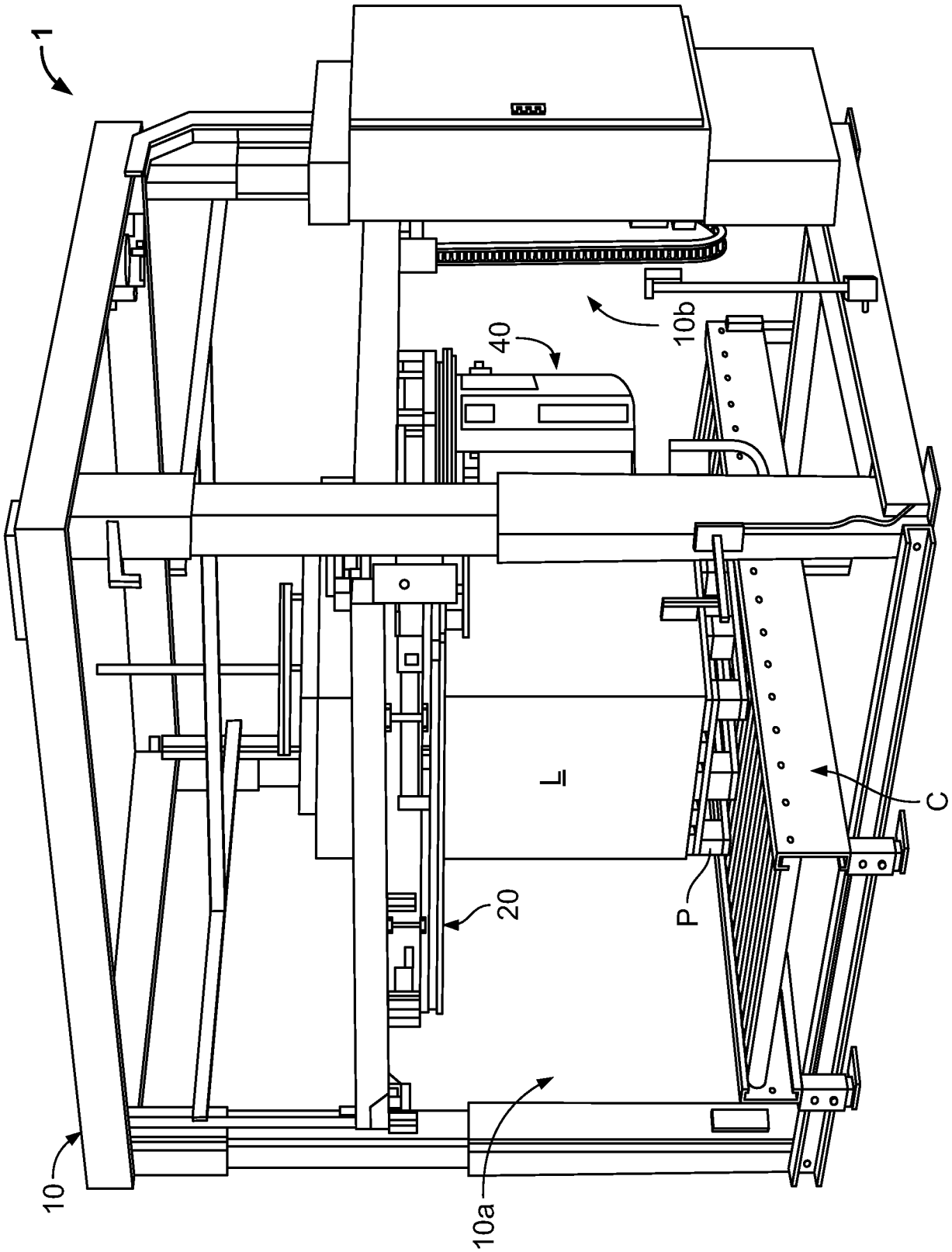

FIG. 1

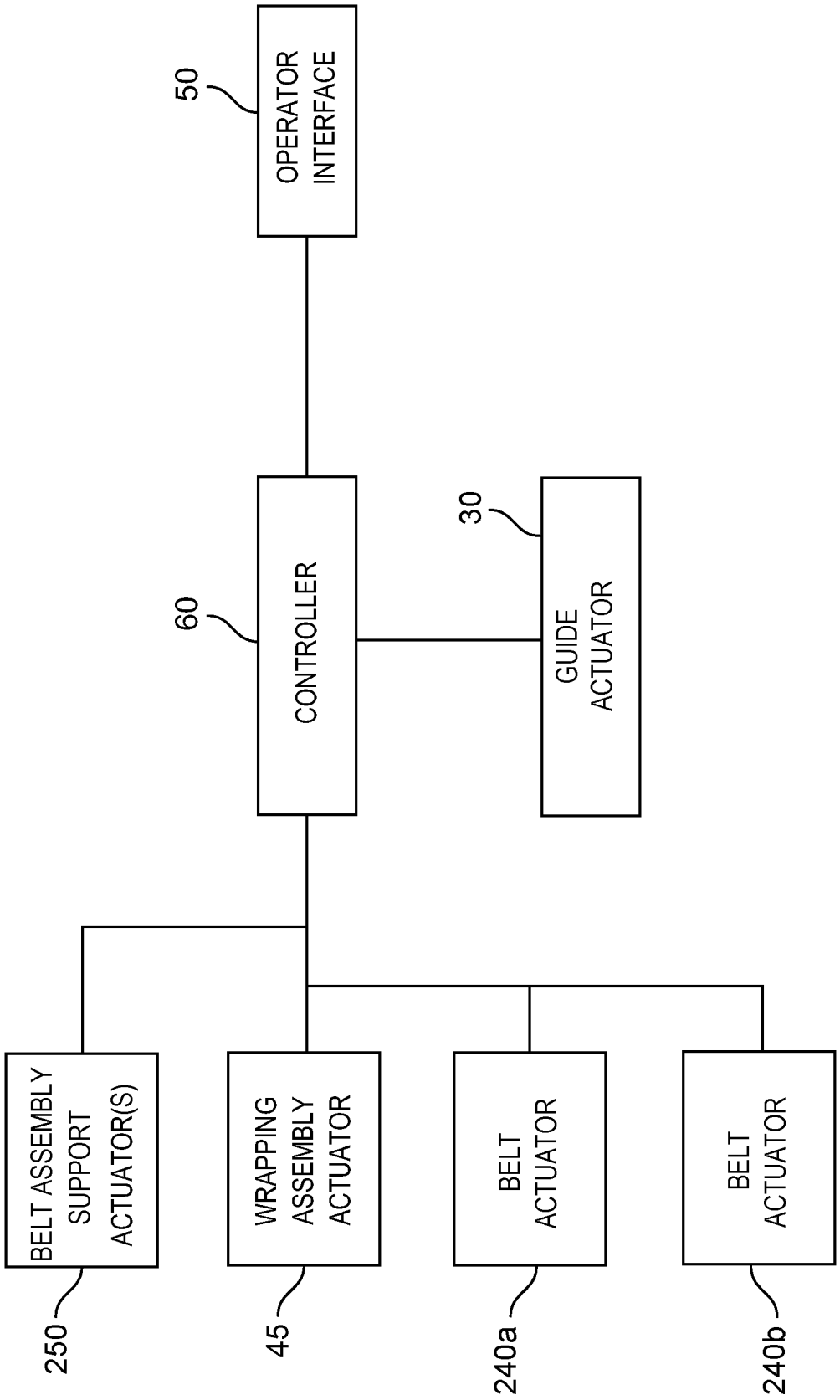
50
OPERATOR INTERFACE
60
CONTROLLER
30
GUIDE ACTUATOR
BELT ASSEMBLY SUPPORT ACTUATOR(S)
250
WRAPPING ASSEMBLY ACTUATOR
45
BELT ACTUATOR
240a
BELT ACTUATOR
240b

FIG. 2

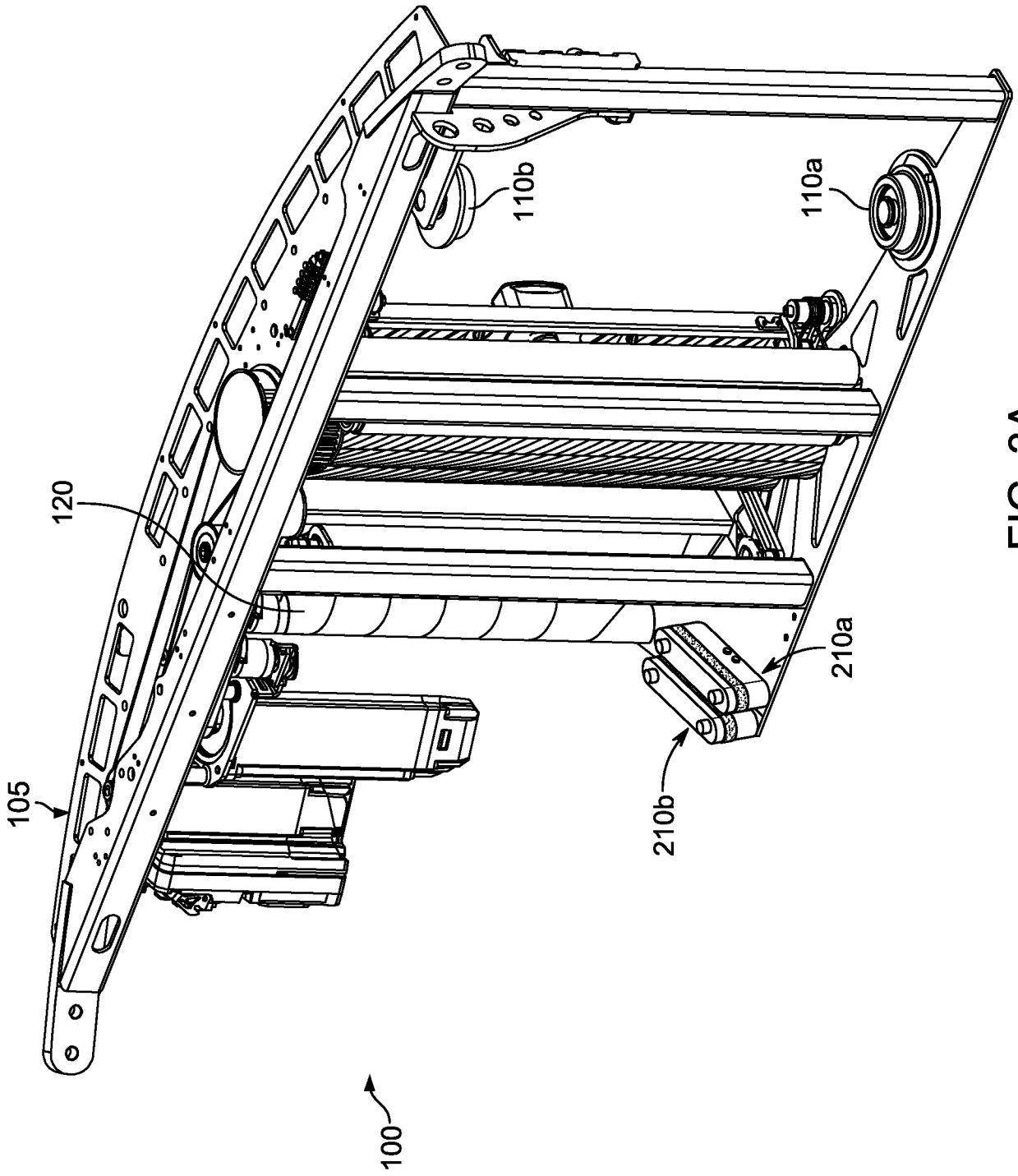

FIG. 3A

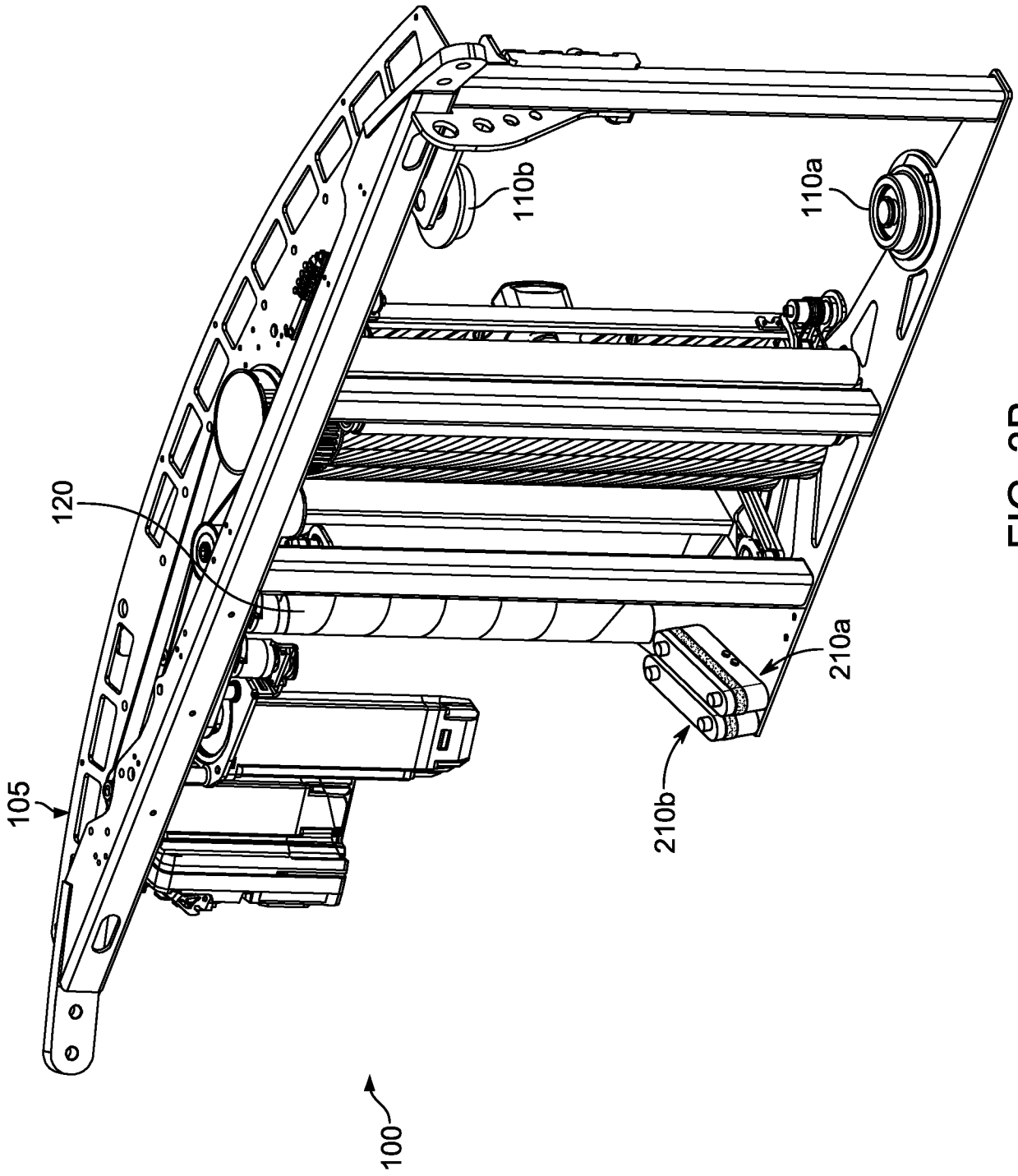

FIG. 3B

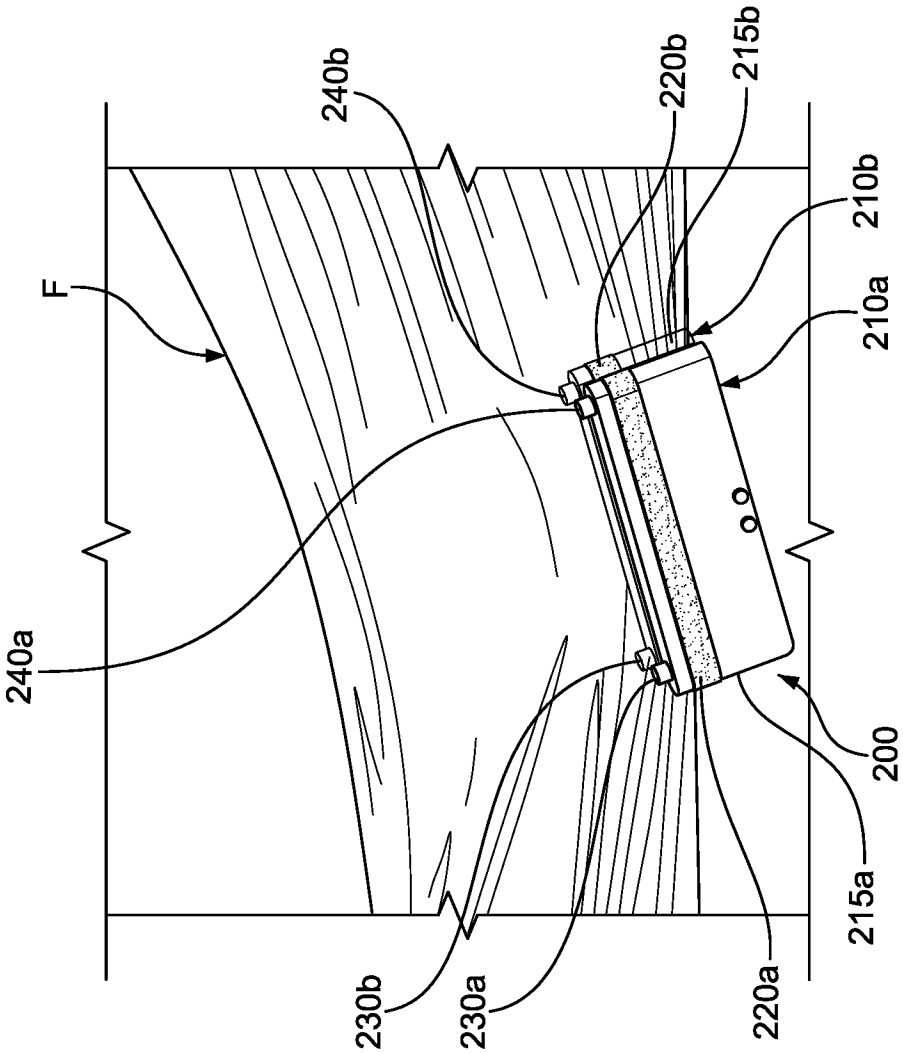

FIG. 3C

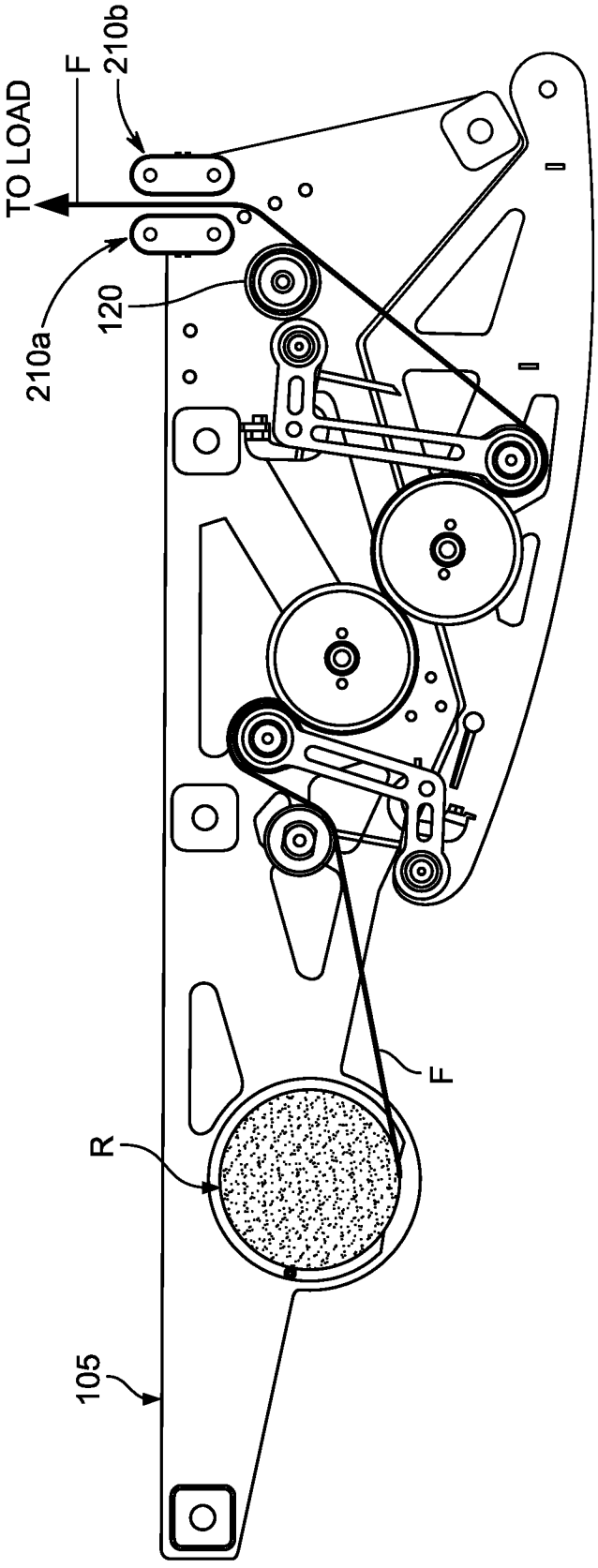

FIG. 4A

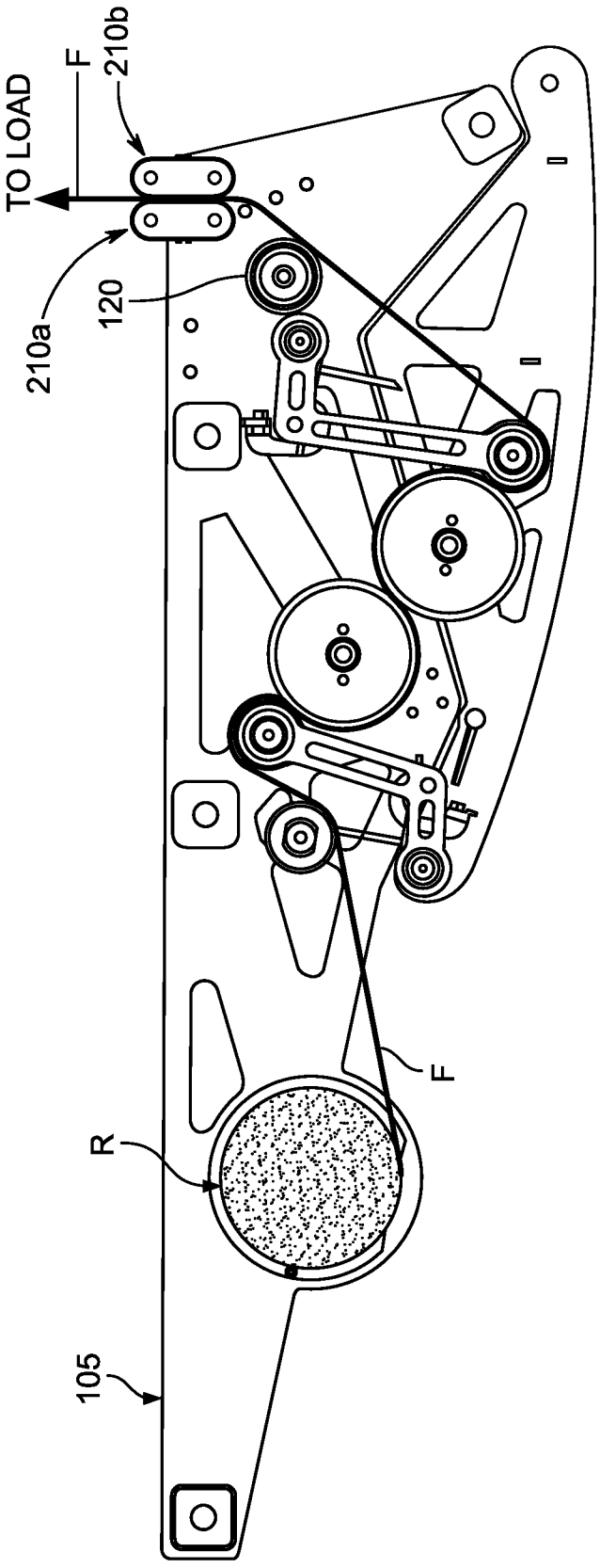

FIG. 4B

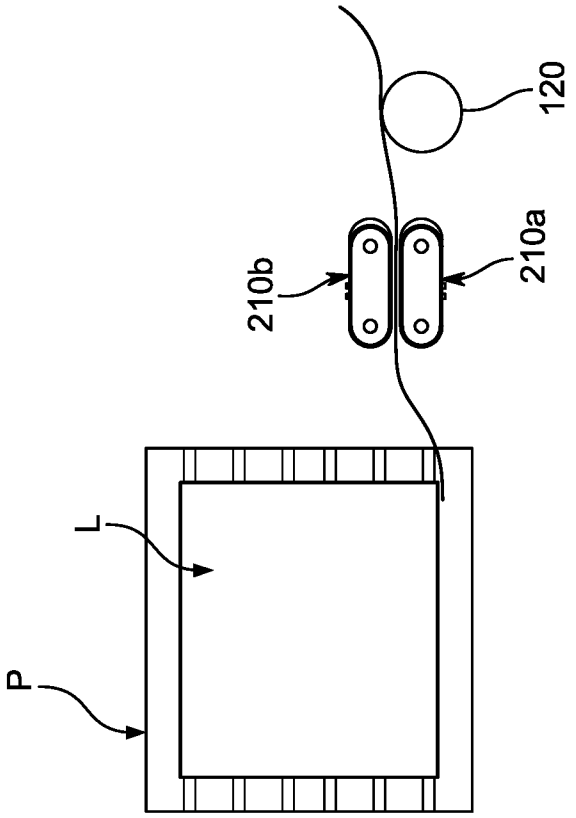

FIG. 5B

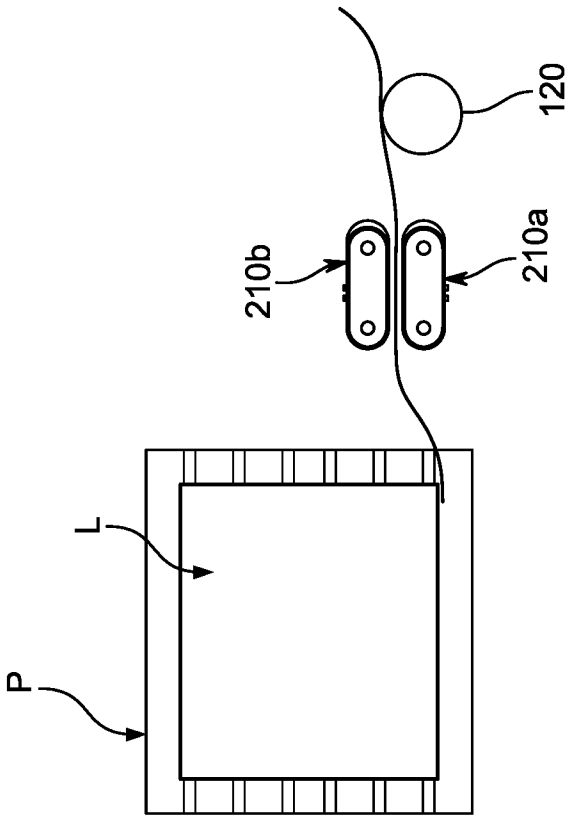

FIG. 5A

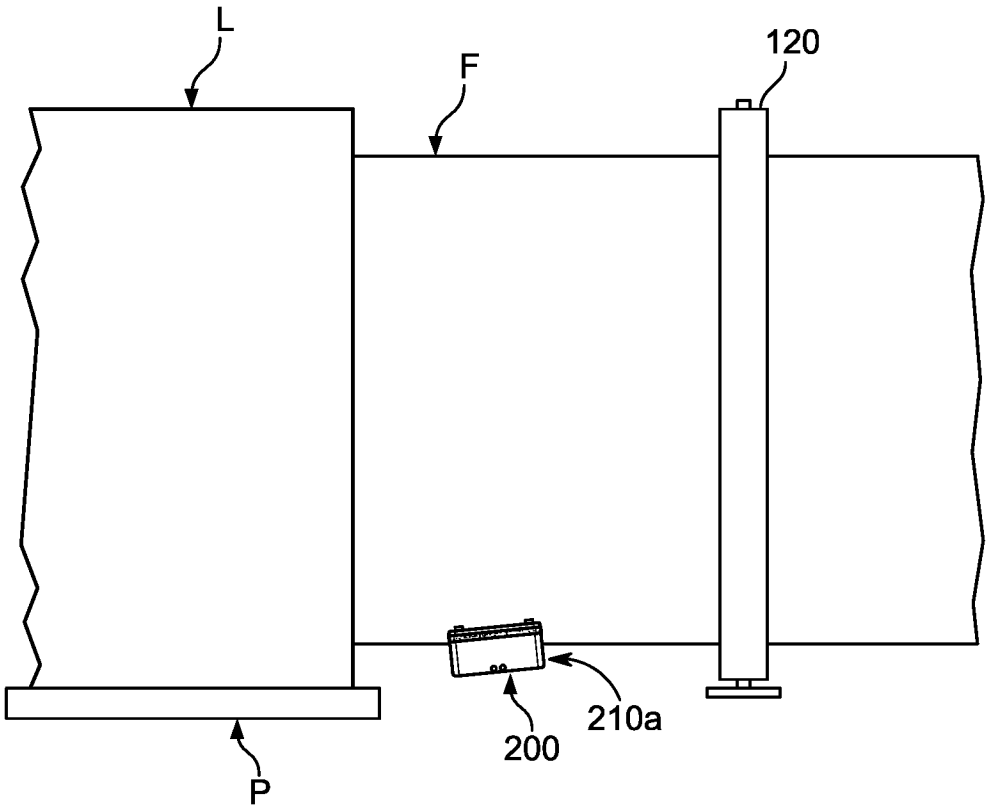

FIG. 6A

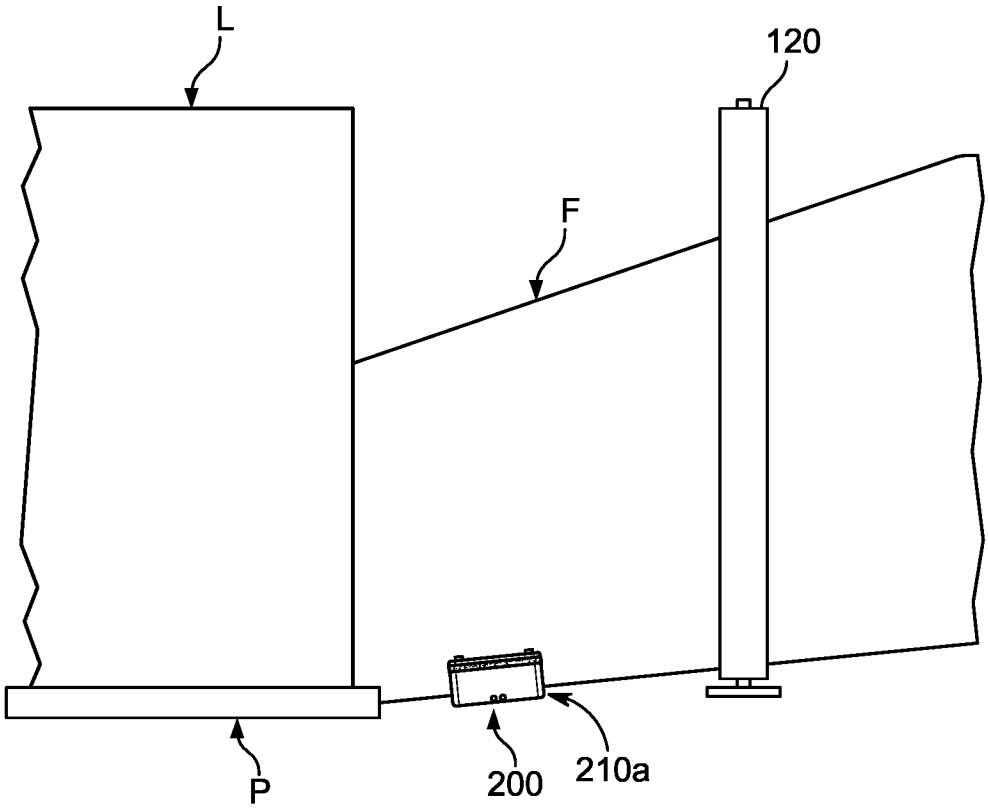

FIG. 6B