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(54) Title: A SMART LADDER SYSTEM

(57) Abstract: Present disclosure relates to a smart ladder system (100) comprising at least one pair of columns (101) and a plurality of rungs (103) detachably attached between the pair of columns. At least one movable fixture (104) is movably attached to the pair of columns. Further, a support mechanism (112) is positioned on a bottom portion (BP) and connectable to the pair of columns (101). An actuator (116) is coupled to one of the movable fixtures (104) and the support mechanism, to displace the movable fixture to multiple positions on the pair of columns and actuate the support mechanism to toggle between a first condition and second condition. The system includes a control unit (120) configured to receive a signal from a controller (142) to activate the actuator to displace the movable fixture and the support mechanism. The movable fixture and the support mechanism comprises grippers to stabilize the system.

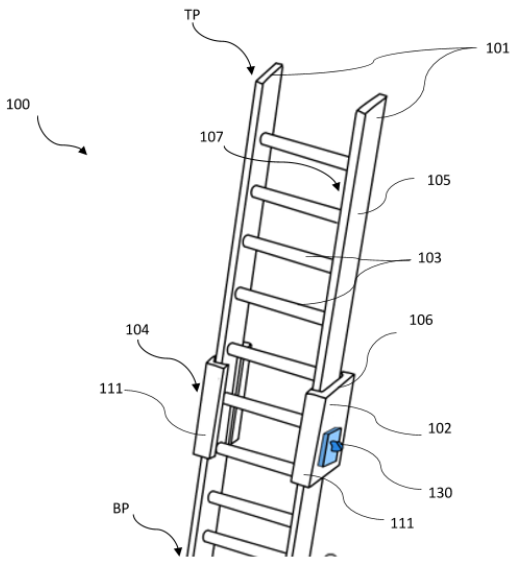

FIG. 1a

FORM 2

THE PATENTS ACT 1970
(39 OF 1970)
&
The Patent Rules, 2003

Complete Specification

(See Section 10 and Rule 13)

1. TITLE OF THE INVENTION

A SMART LADDER SYSTEM

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3. PREAMBLE TO THE DESCRIPTION

COMPLETE

The following specification describes the invention and the manner in which it is to be performed

TECHNICAL FIELD

[0001] Present disclosure relates to a field of ladders and support systems for the ladders. Particularly, but not exclusively the present disclosure relates to smart ladder system with improved stability.

BACKGROUND

[0002] A ladder is a structure formed with two rails and a plurality of rungs or steps vertically arranged at equal distance between the two rails for a user to climb. Conventional ladder used by workers or technicians, or other personnel includes a base section, a pair of rails and multiple rungs positioned in between the pair of rails. Often, the rails are supported on a wall or any suitable surface that supports the rails such that, the ladder is stable for any personnel to climb. However, most of the times, the pair of rails may not be supported properly against the wall or any other portion due to improper placement of the ladder or slippery sections on the wall. Typically, to counter this slippage of the pair of rails, an anti-slip tape is affixed on the ladder at a top end of each of the pair of rails to provide adequate support. However, such anti-slip tape may only be fixed to specific regions of the rails, which may impose a restricted use of the ladder with walls of a certain height. Further, there exists a possibility that the anti-slip tape may be worn out due to prolonged usage which may lead to lack of stability in the ladder. Additionally, there is a possibility that the anti-slip tape may not provide the required resistance/traction to hold the ladder in place. This also reduces safety of the personnel using the ladder without proper supporting means which is undesirable.

[0003] The present disclosure is directed to overcome one or more limitations stated above or any other limitations associated with the prior art. The information disclosed in this background of the disclosure section is only for enhancement of understanding of the general background of the invention and should not be taken as an acknowledgement or any form of suggestion that this information forms the prior art already known to a person skilled in the art.

SUMMARY OF THE INVENTION

[0004] One or more shortcomings of existing ladders or ladder support systems have been overcome, and additional advantages are provided through the system as claimed in the present disclosure. Additional features and advantages are realized through the techniques of the present disclosure. Other embodiments and aspects of the disclosure are described in detail herein and are considered a part of the claimed disclosure.

[0005] The limitations of the prior arts are addressed by a smart ladder system as disclosed in the present disclosure. The smart ladder system comprises at least one pair of columns defined with a top portion and a bottom portion. A plurality of rungs is detachably attached between the at least one pair of columns and at least one movable fixture is movably attached to the at least one pair of columns. Further, a support mechanism is positioned on the bottom portion and is connectable to each column of the at least one pair of columns. The support mechanism is configured to toggle between a first condition and a second condition. An actuator is coupled to one of the at least one movable fixture and the support mechanism. The actuator is configured to one of displace the at least one movable fixture to multiple positions on the at least one pair of columns and to actuate the support mechanism to toggle between the first condition and the second condition. A control unit connectable to the system and is configured to receive a first signal from a controller to activate the actuator to displace the at least one movable fixture from a first position to a second position or vice-versa on the at least one pair of columns. The control unit also receives a second signal from the controller to activate the actuator to deploy the support mechanism in one of the first condition or the second condition. The at least one movable fixture and the support mechanism comprises a plurality of grippers to stabilize the smart ladder system.

[0006] In an embodiment of the present disclosure, the system includes a locking mechanism to arrest the movement of the at least one movable fixture in at least one of the first position and the second position. The locking mechanism comprises at least one shaft which is disposed within the enclosure. A slit is defined on the at least one shaft such that the slit is capable of fastening with the at least one pair of rollers in the form of an interference fit. Further, a knob is operable in a clockwise and anticlockwise directions, wherein a rotation of the knob in a clockwise direction causes the interference fit between the slit with the at least one pair of rollers. Subsequently, the rotation of the knob in the anticlockwise direction releases the fastening between the slit and the at least one pair of rollers.

[0007] In an embodiment, the support mechanism comprises at least one shaft being slidably connected to a rack and pinion mechanism and is defined on the at least one pair of columns. A plurality of support rods is hingedly fixed to the shaft, wherein the support mechanism in the first condition, linearly displaces the at least one shaft from a non-deployed position to a deployed position to extend the plurality of support rods. In the first condition, each of the support

rod of the plurality of support rods engages with a ground surface to stabilize the system. Further, the support mechanism toggles from the first condition to the second condition to linearly displace the at least one shaft from the deployed position to the non-deployed position so as to retract the plurality of support rods, such that each support rod of the plurality of support rods disengages from the ground surface.

[0008] In an embodiment, the at least one movable fixture comprises a plurality of light sensors communicably connected to the control unit, the plurality of light sensors are configured to transmit signals to the control unit upon receiving light rays. The control unit is configured to actuate the at least one movable fixture from the first position to the second position upon receipt of the signals.

[0009] In an embodiment, the plurality of grippers is attached to the at least one movable fixture, wherein the plurality of grippers comprises at least one anti-slip tape to stabilize the system.

[0010] In an embodiment, the plurality of grippers is also attached to the plurality of support rods, wherein the plurality of grippers comprises at least one of suction cups or studs engageable with the ground surface to stabilize the system.

[0011] In an embodiment, the at least one movable fixture comprises at least one storage unit provided on an outer surface of the enclosure for storing at least one utility.

[0012] In another non-limiting embodiment of the present disclosure, the support mechanism comprises a telescopic means with a first rod and a second rod dis-posed within the at least one pair of columns. An actuation rod is connected to the telescopic means and the actuation rod is configured to actuate the telescopic means upon pressing a push button positioned on at least one pair of columns. A plurality of openings is defined on the at least one pair of columns to receive a plurality of latches. Further, at least one resilient member connectable to the plurality of supporting rods, actuation rod, the first rod and the second rod are defined with the plurality of latches. At least one sliding component is movably attached to the second rod and is connected to a plurality of support rods such that the plurality of latches is released from the plurality of openings by actuating the push button. The at least one sliding component is displaced along with the second rod so as to extend deploy the plurality of support rods to engage with the ground surface to stabilize the system.

[0013] It is to be understood that the aspects and embodiments of the disclosure described above may be used in any combination with each other. Several of the aspects and embodiments may be combined to form a further embodiment of the disclosure.

[0014] The foregoing summary is illustrative only and is not intended to be in any way limiting. In addition to the illustrative aspects and features described above, further aspects and features will become apparent by reference to the drawings and the following detailed description.

BRIEF DESCRIPTION OF ACCOMPANYING DRAWINGS

[0015] The novel features and characteristic of the disclosure are set forth in the appended claims. The disclosure itself, however, as well as a mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an embodiment when read in conjunction with reference to the accompanying drawings wherein like reference numerals represent like elements and in which:

[0016] FIG.1a illustrates a perspective view of a smart ladder system positioned for use in accordance with an embodiment of the present disclosure:

[0017] FIG. 1b is a block diagram of the smart ladder system in accordance with an embodiment of the present disclosure.

[0018] FIG. 2 illustrates a perspective view of the smart ladder of FIG.1 supported against a wall surface, in accordance with an embodiment of the present disclosure.

[0019] FIGS. 3 illustrates a perspective view of at least one movable fixture and a locking mechanism, in accordance with an embodiment of the present disclosure.

[0020] FIG. 4 illustrates a perspective view of a portion of the at least one movable fixture mounted on a column of the ladder, in accordance with another embodiment of the present disclosure.

[0021] FIG. 5 illustrates a perspective view of an actuator for actuating the at least one movable fixture on the column, in accordance with another embodiment of the present disclosure.

[0022] FIG. 6a and **FIG. 6b** illustrate front views of a support mechanism equipped to a smart ladder system of FIG. 4, in accordance with another embodiment of the present disclosure.

[0023] FIG. 7 illustrates a front view of the support mechanism for a smart ladder system of FIG. 1, in accordance with another embodiment of the present disclosure.

[0024] FIG. 8 illustrates a perspective view of the smart ladder system depicting the positioning of the at least one movable fixture on the columns of the smart ladder system, in accordance with another embodiment of the present disclosure.

[0025] FIG. 9 illustrates the perspective view of the smart ladder system depicting the actuation of the support mechanism to stabilize the system.

[0026] The figures depict embodiments of the disclosure for purposes of illustration only. One skilled in the art will readily recognize from the following description that alternative embodiments of the system and methods illustrated herein may be employed without departing from the objective of the disclosure described herein. It should be appreciated by those skilled in the art that any block diagrams herein represent conceptual views of illustrative systems embodying the principles of the present subject matter.

DETAILED DESCRIPTION OF THE DRAWINGS

[0027] The foregoing has broadly outlined the features and technical advantages of the present disclosure in order that the detailed description of the disclosure that follows may be better understood. Additional features and advantages of the disclosure will be described hereinafter which forms the subject of the claims of the disclosure. It should be appreciated by those skilled in the art that, the conception and specific embodiments disclosed may be readily utilized as a basis for modifying other devices, systems, assemblies, and mechanisms for carrying out the same purposes of the present disclosure. It should also be realized by those skilled in the art that, such equivalent constructions do not depart from the scope of the disclosure as set forth in the appended claims. The features which are believed to be characteristics of the disclosure, to its system, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure.

[0028] In accordance with various embodiments of the present disclosure, a smart ladder system may be described. The smart ladder system comprises at least one pair of columns defined with a top portion and a bottom portion. A plurality of rungs is detachably attached between the at least one pair of columns and at least one movable fixture is movably attached to the at least

one pair of columns. The system also comprises a support mechanism that is positioned on the bottom portion and is connectable to each column of the at least one pair of columns. The support mechanism is configured to toggle between a first condition and a second condition. An actuator is coupled to one of the at least one movable fixture and the support mechanism. The actuator is configured to one of displace the at least one movable fixture to multiple positions on the at least one pair of columns and to actuate the support mechanism to toggle between the first condition and the second condition. A control unit is communicatively connected to the system and is configured to receive a first signal from a controller to activate the actuator to displace the at least one movable fixture from a first position to a second position or vice-versa on the at least one pair of columns. The control unit also receives a second signal from the controller to activate the actuator to deploy the support mechanism in one of the first condition or the second condition. The at least one movable fixture and the support mechanism comprises a plurality of grippers to stabilize the smart ladder system. The forthcoming paragraphs will elucidate the configuration of the smart ladder system. Forthcoming embodiments elucidate the smart ladder system and its working in detail in conjunction to FIGs 1 to 9.

[0029] In an embodiment, the smart ladder system of the configuration described above provides improved support against a wall surface and improves overall stability of the ladder as compared to the conventional systems. Also, the system eliminates need of adjustment or re-installation of anti-slip tape or ladder pads as the position of the anti-slip tape can be automatically adjusted by the at least one movable fixture. The system also requires lesser number of components without any complex mechanisms, thereby reducing cost of installation and overall cost of the system significantly.

[0030] While the embodiments in the disclosure are subject to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the figures and will be described below. It should be understood, however, that it is not intended to limit the disclosure to the particular forms disclosed, but on the contrary, the disclosure is to cover all modifications, equivalents, and alternative falling within the scope of the disclosure.

[0031] It is to be noted that a person skilled in the art would be motivated from the present disclosure and modify construction of a smart ladder system. However, such modifications should be construed within the scope of the disclosure. Accordingly, the drawings show only those specific details that are pertinent to understand the embodiments of the present disclosure,

so as not to obscure the disclosure with details that will be readily apparent to those of ordinary skill in the art having benefit of the description herein.

[0032] The terms “comprise,” “comprising”, or any other variations thereof used in the disclosure, are intended to cover a non-exclusive inclusion, such that a system and method that comprises a list of components does not include only those components but may include other components not expressly listed or inherent to such system, method, or assembly, or device. In other words, one or more elements in a system or device proceeded by “comprises… a” does not, without more constraints, preclude the existence of other elements or additional elements in the system or device.

[0033] The following paragraphs describe the present disclosure with reference to FIG(s) 1 to 9. In the figures, the same element or elements which have similar functions are indicated by the same reference signs. With general reference to the drawings, a smart ladder system for supporting against the wall surface in accordance with the teachings of a preferred embodiment of the present disclosure is illustrated and generally identified at reference numeral 100. The smart ladder system (100) may be employed by a worker or a technician in the building or construction works to climb vertically. It will be understood that the teachings of the present disclosure are not limited to any particular hoisted structure.

[0034] The following detailed description is merely exemplary in nature and is not intended to limit application and uses. Furthermore, there is no intention to be bound by any theory presented in the preceding background or summary or the following detailed description. It is to be understood that the disclosure may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices or components illustrated in the attached drawings and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions or other physical characteristics relating to the embodiments that may be disclosed are not to be considered as limiting, unless the claims expressly state otherwise. Hereinafter, preferred embodiments of the present disclosure will be described referring to the accompanying drawings. While some specific terms of “upper”, “lower”, “below”, “above”, “right”, “left”, “rear” or “front” and other terms containing these specific terms and directed to a specific direction will be used, the purpose of usage of these terms or words is merely to facilitate understanding of the present invention referring to the

drawings. Accordingly, it should be noted that the meanings of these terms or words should not improperly limit the technical scope of the present invention.

[0035] Also, it is to be understood that the phraseology and terminology used herein is for description and should not be regarded as limiting. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings. Further, "connected" and "coupled" are not restricted to physical or mechanical connections or couplings. It is to be understood that this disclosure is not limited to the specific devices, methods, applications, conditions, or parameters described and/or shown herein and that the terminology used herein is to describe particular embodiments by way of example and is not intended to be limiting of the claimed invention. Hereinafter in the following description, various embodiments will be described. For purposes of explanation, specific configurations and details are outlined to provide a thorough understanding of the embodiments. However, it will also be apparent to one skilled in the art that the embodiments may be practiced without the specific details. Furthermore, well-known features may be omitted or simplified in order not to obscure the embodiment being described.

[0036] Referring to FIGs 1 to 9 in conjunction, which illustrates the smart ladder system (100) [hereinafter referred to as system (100)] and various components associated with the system (100). The system (100) of the present disclosure may be designed to be employed by personnel or a technician for use such as but not limiting to during climbing buildings, constructional works, painting walls, and the like. Also, application of the system (100) elucidated going forward should not be construed as a limitation of the present disclosure. The smart ladder system (100) of the present disclosure ensures effective gripping of the smart ladder (100) against the wall surface (122) and also provides improved stability for the safety of the personnel. FIG.1 and FIG.2 schematically illustrates an embodiment of the system (100) which may be mountable at an appropriate portion of the wall surface (122). In an illustrative embodiment, the position of the wall surface (122) may include a top surface of the wall or structure but not limiting to the top surface alone. Hereinafter, features of the smart ladder system (100) along with its working may be elucidated.

[0037] The smart ladder system (100) among other components may include at least one pair of columns (101) defined with a top portion (TP) and a bottom portion (BP). The at least one

pair of columns (101) [refer FIGs 1a and 2] of the present disclosure may be supported against the wall surface (122) at appropriate portions. In an embodiment, the least one pair of columns (101) may be supported on at least one of a top portion (TP), intermediate portion on the wall. In an embodiment, the least one pair of columns (101) may include a first surface (105) and a second surface (107). The second surface (107) may be defined with a groove (124) to support at least one pair of rollers (108) (as shown in FIG. 3). In an embodiment, the at least one pair of columns (101) may be manufactured by at least one of a stainless steel, aluminium, and their alloys, wood, or a polymeric material. In an embodiment, the at least one pair of columns (101) is defined as a hollow structure and however such structure may not be construed as a limitation and the at least one pair of columns (101) may be a solid structure with sufficient strength. Further, a plurality of rungs (103) is detachably attached between the least one pair of columns (101). In an embodiment, the plurality of rungs (103) may be fixedly attached to the least one pair of columns (101). The plurality of rungs (103) is positioned parallel to each other at an equal distance along a length of least one pair of columns (101). The plurality of rungs (103) is configured to support and enable the personnel to climb upon the wall surface (122) against which the system (100) is supported.

[0038] The system (100) further includes at least one movable fixture (104) that is movably attached to the least one pair of columns (101) [shown in FIG. 4]. The at least one movable fixture (104) is defined with an enclosure (106) formed with an outer surface (102) and at least two side surfaces (111) extending from the outer surface (102). In an embodiment, the enclosure (106) includes a front surface (109) defining a space in between and is configured to support the at least one pair of columns (101). At least one pair of rollers (106) are rotatably disposed within the enclosure (106). In an embodiment, the at least one pair of rollers (108) are mounted at all four ends of the enclosure (106). The at least one movable fixture (104) is attached to the at least one pair of columns (101) such that the at least one pair of rollers (108) are in contact with each side of the at least one pair of columns (101). In an embodiment, the at least one pair of rollers (108) may be in contact within the groove (124) to slide along the at least one pair of columns (101). In an embodiment, the at least one movable fixture (104) is configured to move along the length of the at least one pair of columns (101). The at least one movable fixture (104) comprises an anti-slip tape (160) which may be affixed to a portion of the enclosure (106) which is in contact with the wall surface (122). In an embodiment, the anti-slip tape (160) may be

affixed to the at least two side surfaces (111) of the enclosure (106). In an embodiment, the anti-slip tape (160) may be manufactured of a poly-vinyl chloride (PVC) material and may be affixed by at least one of an adhesive, a gel or any suitable means. Further, the at least one movable fixture (104) includes a locking mechanism (125) to arrest movement of the at least one movable fixture (104) in at least one of a first position and a second position. The locking mechanism (125) comprises a shaft (126) disposed within the enclosure (106). In an embodiment, the enclosure (106) may be defined with a provision (not shown in FIGS) on the at least two side surfaces (111) to receive the shaft (126). In an embodiment, the provision may be defined on a top portion of the at least two side surfaces (111) and however this should not be construed as a limitation and the provision may be defined at any position on a surface of the at least two side surfaces (111) to accommodate the shaft (126). Further, at least one slit (128) is defined on a portion of the shaft (126). In an embodiment, the thickness of the at least one slit (128) may correspond to a thickness of the at least one pair of rollers (108). The at least one slit (128) is capable of fastening with the at least one pair of rollers (108) in the form of an interference fit to block or arrest rotation of the at least one pair of rollers (108). In an embodiment, the at least one slit (128) may be defined with a projecting surface (113) to fasten with the at least one pair of rollers (108). The projecting surface (113) may have a profile similar to the profile of the at least one pair of rollers (108). The shaft (126) is coupled with a knob (130) mounted on the enclosure (106). The knob (130) is operable in a clockwise and anticlockwise directions, such that rotation of the knob (130) in a clockwise direction causes the interference fit between the slit (128) with the at least one pair of rollers (108). Further, the rotation of the knob (130) in the anticlockwise direction releases the fastening between the projecting surface (113) and the at least one pair of rollers (108) to enable the rotation of the at least one pair of rollers (108) to allow movement of the at least one movable fixture (104) along the column of the at least one pair of columns (101). In an embodiment, the at least one movable fixture (104) is defined with at least one storage unit (145) on the at least two side surfaces (111) to store a utility. In an embodiment, the utility may include a set of tools, a water bottle, or a mobile phone to be used by the personnel using the system (100).

[0039] Referring to Fig. 5, an actuator (116) for actuating the at least one movable fixture (104) on the at least one pair of columns (101) is disclosed. In an embodiment, the actuator (116) is also configured to actuate a support mechanism (112). The actuator (116) comprises a motor

and a drive unit (152) which may be coupled to a leadscrew (132) and nut (131) arrangement positioned within the at least one pair of columns (101). In an embodiment, the actuator (116) and the leadscrew (132) may be positioned at a rear surface of the at least one pair of columns (101). The nut (131) is coupled to the at least one movable fixture (104) by a suitable fastening means such as but not limited to a bolt studs or rivets and the like. The actuator (116) is configured to activate the motor which rotates the lead screw (132) to linearly displace the nut with the at least one movable fixture (104) along the length of the at least one pair of columns (101). In an embodiment, one end of the lead screw (132) is coupled to the drive motor and the other end is fixed to a support means which may be a slave block (133) supporting rotation of the leadscrew (132). In an embodiment, the motor may be configured to actuate the lead screw (132) in a clockwise direction to displace the at least one movable fixture (104) in an upward direction along the length of the at least one pair of columns (101) in the first position. In an embodiment, the motor is configured to rotate in a reverse direction to actuate the lead screw (132) in an anti-clockwise direction to displace the at least one movable fixture (104) downward on the at least one pair of columns (101) in the second position. In an embodiment, a drive motor (134) may be coupled to a belt and pulley mechanism (151) to linearly displace the at least one movable fixture (104) between the first position and the second position. In an embodiment, the pulley of the belt and pulley mechanism (151) may be rotated in clockwise and anti-clockwise directions to displace the at least one movable fixture (104) upward and downward on the at least one pair of columns (101) respectively. An actuator (116) may be coupled to a control unit (120) which is configured to activate the actuator (116) upon receiving an actuation signal from a controller (142). In an embodiment, the controller (142) may be at least one of a mobile device, a remote controller, a personal computer which may be communicatively coupled through wireless technology such as wi-fi, infrared or any other suitable means.

[0040] Now referring to FIGS. 6a and 6b, the support mechanism (112) configured to actuate by the actuator (116) to toggle between a deployed condition and a retracted condition is disclosed. The support mechanism (112) is positioned at the bottom portion of the system (100) and is disposed within each column of the at least one pair of columns (101). The support mechanism (112) comprises at least one shaft (140) defined with a top portion and a bottom portion. The support mechanism also includes a rack and pinion mechanism (136) defined on the top portion. A rack (143) is defined on the top portion and a pinion (147) engageable to the rack is

coupled to the at least one shaft (140). The pinion (147) may be coupled to a motor through a drive shaft (not shown in figs.). The drive shaft drives the pinion (147) upon actuation of a motor (161), such that the rack (143) is linearly displaced in an upward and a downward direction to toggle the at least one shaft (140) between the first condition and the second condition. Further, a plurality of support rods (138) is hingedly coupled to a bottom portion of the at least one shaft (140). In an embodiment a plurality of rods (139) may be coupled to the plurality of support rods (138) for structural support. In an embodiment, the plurality of rods (139) is hingedly fixed at the bottom portion of the at least one shaft (140) at one end. The plurality of rods (139) is coupled to the plurality of support rods (138) at another end. In an embodiment, the plurality of support rods (138) is in retracted condition when the at least one shaft (140) is stationary or within the at least one pair of columns (101). Upon actuation of the rack and pinion mechanism (136) by a motor (133), the at least one shaft (140) is displaced downwards causing the plurality of support rods (138) to be in the deployed condition from a retracted position. In an embodiment, the at least one pair of columns (101) may be defined with a plurality of openings (149) from which the plurality of support rods (138) may be deployed. The plurality of support rods (138) may be defined with at least one gripper which, for example, may be suction cups or studs (159) that are engageable with a ground surface (141) to stabilize the system (100). In an embodiment, the motor of the support mechanism (112) may be coupled to the actuator (116) to synchronously deploy the plurality of support rods (138) and displace the at least one movable fixture (104).

[0041] With reference to FIG. 7, the support mechanism (112) in accordance with another embodiment of the present disclosure is disclosed. The support mechanism (112) comprises of the plurality of support rods (138) disposed within the at least one pair of columns (101). The plurality of support rods (138) is configured to stabilize the system (100). According to an embodiment, an actuation rod (153) is connectable to a first rod (162) which is slidably disposed within a second rod (163). The first rod (163) is connected to the actuation rod (153) and the second rod (163) at its both ends. In an embodiment, the actuation rod (153) , first rod (163), and the second rod are interconnected via resilient members (144). The actuation rod (153) and the first rod (163) may include latches (155) with protrusions to lock the rods (153, 163) in one of a first position or second position with corresponding openings (149) on the at least one pair of columns (101).

[0042] In an embodiment, a push button (150) may be positioned at the top portion (TP) of the at least one pair of columns (101). The push button (150) may be defined with a protrusion (not shown in FIGS.) internally which engages to a hole (not shown in FIGS.) defined on the actuation rod (153) to hold the actuation rod (153) in place. The push button (150) is connected at one end of the actuation rod (153) and is configured to actuate the actuation rod (153) upon release of the protrusion from the hole. Another end of the actuation rod (153) is coupled to the telescopic means (167). The resilient member (144) may be connected to another end of the actuation rod (153) and to the telescopic means (167) such that, the actuation rod (153), the first rod (162) and the second rod (163) are interconnected to each other. The first rod (162) and the second rod (163) are defined with the latches (155) that are configured to engage with the corresponding openings (149) to restrict movement of the telescopic means (167). Further, at least one sliding component (157) is movably disposed on the second rod (163) and a plurality of support rods (138) are hingedly connected to the at least one sliding component (157). The telescopic means (167) is actuated in the first position and the second position upon the actuation of the push button (150). The telescopic means (167) is positioned within the at least one pair of columns (101) in the first position and at least one latch (155) defined on the first rod (162) that engages within an opening (149) defined on the at least one pair of columns (101). In an embodiment, the at least one resilient member (144) may be in a compressed state and the first rod (162) may be disposed within the second rod (163) in the first position. Additionally, the plurality of support rods (138) is in retracted condition in the first position as the at least one sliding component (157) is positioned substantially above the bottom portion of the at least one pair of columns (101) of the smart ladder system (100). Upon the actuation of the push button (150), the actuation rod (153) is displaced such that the telescopic means (167) is to release the latches (155) from the corresponding openings (149). This effects the displacement of the first rod (162) and the second rod (163) which is supported by the release of compressive force on the at least one resilient member (144) in the second position. The displacement of the second rod (163) actuates the at least one sliding component (157) to deploy the plurality of support rods (138) to contact the ground surface (141) to stabilize the system (100).

[0043] In another embodiment, the actuator (116) may include a double rack and pinion mechanism (not shown in FIGS) to simultaneously actuate the at least one movable fixture (104) and the support mechanism (112). The double rack and pinion mechanism may include a single

pinion connecting two racks. One of the two racks may be connected to the at least one movable fixture (104) and the other rack may be connected to the support mechanism (112). The pinion is configured to actuate each rack in opposite directions such that the at least one movable fixture (104) is displaced from a first position to a second position on the at least one pair of columns (101) and the support mechanism (112) is toggled from a first condition to maintain the plurality of support rods (138) in a retracted condition to a second condition to actuate the plurality of support rods (138) in a deployed condition to stabilize the system (100).

[0044] The system (10) further includes the control unit (120) [as shown in FIG.1b] communicatively coupled to the actuator (116) [as shown in FIG.5] and a controller (142). The control unit (120) may be configured to trigger the actuator (116) based on a plurality of signals received from the controller (142). The signal received from the actuator (116) may correspond to a pre-defined parameter. The pre-defined parameters are at least one of a position of the at least one movable fixture (104) between a first position and a second position on the at least one pair of columns (101). The predefined parameters also include the actuation of the support mechanism (112) for a predefined time or in an event of additional support requirement due to slippage of the system (100). In an embodiment, the controller (142) may be a mobile device or a remote-control device. The controller (142) sends the signal to the control unit (120) which then triggers the actuator (116) to operate the at least one movable fixture (104) and the support mechanism (112) simultaneously in the event of undesirable movement of the system (100).

[0045] In another embodiment, the positioning of the at least one movable fixture (104) on the at least one pair of columns (101) is disclosed with reference to FIG. 8. The at least one movable fixture (104) comprises a plurality of light sensors (148) mounted on an upper surface of the enclosure (106). However, this cannot be construed as limiting feature and the plurality of light sensors (108) may be mounted around the enclosure (106) based on the requirement. The plurality of light sensors (148) may be a photosensors or photo-resistive sensors. The plurality of light sensors (148) is communicatively coupled to the control unit (120). The at least one movable fixture (104) is configured to follow the light rays which are focused on a desired position on the at least one pair of columns (101) by the personnel using the smart ladder (100). Upon focusing the light rays, the plurality of light sensors (148) transmits a signal to the actuator (116) to operate the motor such that the at least one movable fixture (104) may be moved from the first position to the second position based on the requirement. In an embodiment, the light

rays may be focused from the controller (142) or a simple torch or from a smart device of the personnel. In an embodiment, the operation speeds of the motor may be programmed in the control unit (120) to displace the at least one movable fixture (104) at different speeds based on the intensity of light rays illuminated from the controller (142).

[0046] A working operation of the smart ladder system (100) in accordance with the embodiments of the present disclosure as elucidated below are now explained with reference to Fig. 9. The smart ladder (100) is rested on the wall surface (122) and the personnel steps on the plurality of rungs (103) to climb to a suitable height on the smart ladder (100). Based on a height of the wall surface (122), the personnel activates the actuator (116) to displace the at least one movable fixture (104) on the at least one pair of columns (101) along its length. The actuator (116) is activated by the control unit (120) upon receiving the signal from the controller (142) which may be a smart phone, a remote controller etc. which may be communicably coupled to the control unit (120). In an embodiment, the at least one movable fixture (104) comprises grippers such as the anti-slip tape (160) affixed on the at least two at least two side surfaces (111) of the enclosure (106) which may rest on the wall surface (122). The anti-slip tape (160) may be defined with a frictional surface and is configured to provide sufficient grip to the smart ladder (100) during its use. In an embodiment, the personnel may focus light rays on the pair of columns (101) at which the at least one movable fixture (104) must be positioned. The plurality of light sensors (148) may receive the light rays and send out a signal to the control unit (120) to actuate the motor to displace the at least one movable fixture (104) to the required position at which the light rays are focused. Further, in an undesirable event of slippage of the smart ladder (100) due to lack of friction between the anti-slip tape (160) and the wall surface (122), the personnel may actuate the push button (150) positioned at the top potion (TP) of the at least one pair of columns (101) (as shown in FIG. 9). This enables the telescopic mechanism (167) to be activated which further actuates the plurality of support rods (138) positioned at the bottom portion (BP) of the at least one pair of columns (101) in a deployed position. The plurality of support rods (138) engages with the ground surface (141) to stabilize the smart ladder (100). In an embodiment, the ground engaging portion of the plurality of support rods (138) may comprise grippers such as suctions cups (159) or studs that provide improved friction between the plurality of support rods (138) and the ground surface (141). This prevents the personnel from

falling down the smart ladder (100) and provides additional safety while using the smart ladder system (100).

[0047] In an embodiment of the disclosure, the control unit (120) may be a centralized control unit, or a resolute control unit associated with the system (100). The control unit (120) may be comprised of a processing unit. The processing unit may comprise at least one data processor for executing program components for executing user- or system-generated requests. The processing unit may be a specialized processing unit such as integrated system (bus) controllers, memory management control units, floating point units, graphics processing units, digital signal processing units, etc. The processing unit may include a microprocessor, such as AMD Athlon, Duron or Opteron, ARM's application, embedded or secure processors, IBM PowerPC, Intel's Core, Itanium, Xeon, Celeron, or other line of processors, etc. The processing unit may be implemented using a mainframe, distributed processor, multi-core, parallel, grid, or other architectures. Some embodiments may utilize embedded technologies like application-specific integrated circuits (ASICs), digital signal processors (DSPs), Field Programmable Gate Arrays (FPGAs), etc. In some embodiments, the processing unit may be disposed in communication with one or more memory devices (e.g., RAM, ROM etc.) via a storage interface. The storage interface may connect to memory devices including, without limitation, memory drives, removable disc drives, etc., employing connection protocols such as serial advanced technology attachment (SATA), integrated drive electronics (IDE), IEEE-1394, universal serial bus (USB), fiber channel, small computing system interface (SCSI), etc. The memory drives may further include a drum, magnetic disc drive, magneto-optical drive, optical drive, redundant array of independent discs (RAID), solid-state memory devices, solid-state drives, etc. In an embodiment, the control unit (120) may be a NodeMCU microcontroller with ESP8266 Wi-Fi module with a self-contained SOC (system-on-chip) with integrated TCP/IP protocol stack to access to a Wi-Fi network. In an embodiment, the control unit may also be an ATMega328P microcontroller with Arduino UNO (OR) Raspberry Pi Pico. It is to be understood that a person of ordinary skill in the art may develop a system and a method of similar configuration without deviating from the scope of the present disclosure. Such modifications and variations may be made without departing from the scope of the present disclosure. Therefore, it is intended that the present disclosure covers such modifications and variations provided they come within the ambit of the appended claims and their equivalents.

WE CLAIM:

1. A smart ladder system (100), the system (100) comprising:

at least one pair of columns (101) defined with a top portion (TP) and a bottom portion (BP);

a plurality of rungs (103) detachably attached between the at least one pair of columns (101);

at least one movable fixture (104) movably attached to the at least one pair of columns (101),

a support mechanism (112) positioned on the bottom portion (BP) and connectable to each column of the at least one pair of columns (101), wherein the support mechanism (112) is configured to toggle between a first condition and a second condition;

an actuator (116) coupled to one of the at least one movable fixture (104) and the support mechanism (112), wherein the actuator (116) is configured to one of

displace the at least one movable fixture (104) to multiple positions on the at least one pair of columns (101); and

actuate the support mechanism (112) to toggle between the first condition and the second condition;

a control unit (120) connectable to the system (100), the control unit (120) is configured to:

receive a first signal from a controller (142) to activate the actuator (116) to displace the at least one movable fixture (104) from a first position to a second position or vice-versa on the at least one pair of columns (101); or

receive a second signal from the controller (142) to activate the actuator (116) to deploy the support mechanism (112) in one of the first condition or the second condition;

wherein the at least one movable fixture (104) and the support mechanism (112) comprises a plurality of grippers to stabilize the system (100).

2. The system (100) as claimed in claim 1, wherein the at least one pair of columns (101) are defined with a groove (124) along their length to support the displacement of at least one pair of rollers (108).

3. The system (100) as claimed in claim 1 comprises a locking mechanism (125) to arrest movement of the at least one movable fixture (104) in at least one of the first position and the second position.

4. The system (100) as claimed in claim 3, wherein the locking mechanism (125) comprises:

a shaft (126) disposed within the at least one movable fixture (104);

at least one slit (128) defined on the shaft (126), the at least one slit (128) is capable of fastening with the at least one pair of rollers (108) in the form of an interference fit;

a knob (130) operable in a clockwise and anticlockwise directions, wherein a rotation of the knob (130) in a clockwise direction causes the interference fit between the at least one slit (128) with the at least one pair of rollers (108), and wherein the rotation of the knob (130) in the anticlockwise direction releases the fastening between the at least one slit (128) and the at least one pair of rollers (108).

5. The system (100) as claimed in claim 1, wherein the actuator (116) comprises a motor connected to a drive unit (152), wherein the motor and the drive unit (152) causes the movement of the at least one movable fixture (104) and toggles the support mechanism (112).

6. The system (100) as claimed in claim 1, wherein the support mechanism (112) comprises:

at least one shaft (140) slidably connected to a rack and pinion mechanism (136) defined on the at least one pair of columns (101);

a plurality of support rods (138) is one of hingedly fixed to the at least one shaft (140);

wherein the support mechanism (112) in the first condition, linearly displaces the at least one shaft (140) from a non-deployed position to a deployed position to extend the plurality of support rods (138) such that each of the support rod of the plurality of support rods (138) engages with a ground surface (141) to stabilize the system (100); and

wherein the support mechanism (112) toggles from the first condition to the second condition to linearly displace the at least one shaft (140) from the deployed

position to the non-deployed position so as to retract the plurality of support rods (138) such that each support rod of the plurality of support rods (138) disengages from the ground surface (141).

7. The system (100) as claimed in claim 1, wherein the support mechanism (112) comprises:

a telescopic means (167) with a first rod (162) and a second rod (163) disposed within the at least one pair of columns (101);

an actuation rod (153) connected to the telescopic means (167); the actuation rod (153) is configured to actuate the telescopic means (167) upon pressing a push button (150) positioned on at least one pair of columns (101);

a plurality of openings (149) defined on the at least one pair of columns (101) to receive a plurality of latches (155);

at least one resilient member (144) connectable to the actuation rod (153), the first rod (162) and the second rod (163) are defined with the plurality of latches (155) and

at least one sliding component (157) is movably attached to the second rod (163), the at least one sliding component (157) is connected to a plurality of support rods (138) wherein the plurality of latches (155) is released from the plurality of openings (149) by actuating the push button (150) to displace the at least one sliding component (157) so as to deploy the plurality of support rods (138) to engage with the ground surface (141) to stabilize the system (100).

8. The system (100) as claimed in claim 1, wherein the plurality of grippers is attached to the plurality of support rods (138), wherein the plurality of grippers comprises at least one of suction cups (159) or studs engageable with the ground surface (141) to stabilize the system (100).

9. The system (100) as claimed in claim 1, wherein the at least one movable fixture (104) comprises a plurality of light sensors (148) communicably connected to the control unit (120), the plurality of light sensors (148) is configured to transmit signals to the control unit (120) upon receiving light rays to displace the at least one movable fixture (104) from the first position to the second position.

10. The system (100) as claimed in claim 1, wherein the at least one movable fixture (14) comprises at least one storage unit (145) provided on at least two side surfaces (111) of the enclosure (106) for storing at least one utility.

11. The system (100) as claimed in claim 1, wherein the plurality of grippers is attached to the at least one movable fixture (104), wherein the plurality of grippers comprises at least one anti-slip tape (160) to stabilize the system (100).

Dated this 13th day of December 2022

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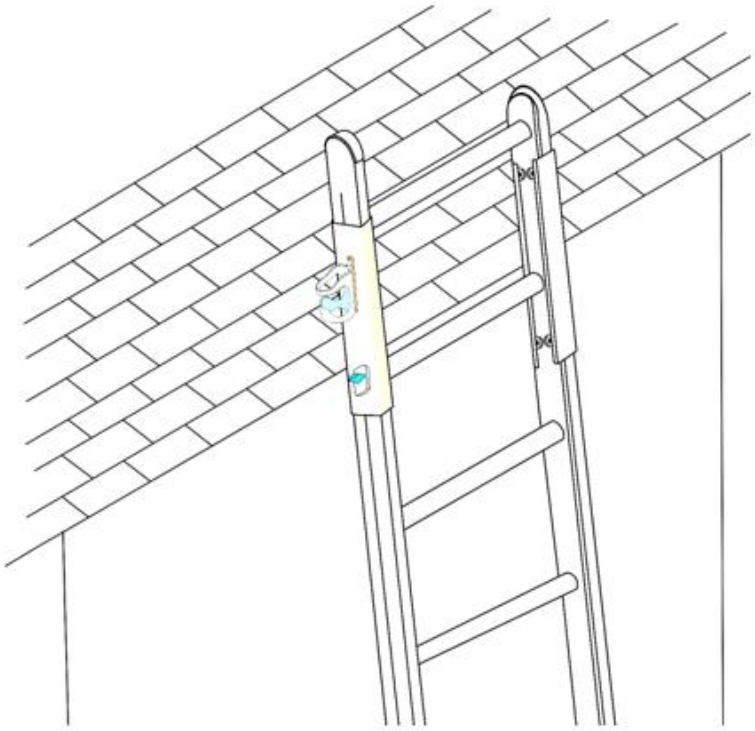
ABSTRACT

A SMART LADDER SYSTEM

Present disclosure relates to a smart ladder system (100) comprising at least one pair of columns (101) and a plurality of rungs (103) detachably attached between the pair of columns. At least one movable fixture (104) is movably attached to the pair of columns. Further, a support mechanism (112) is positioned on a bottom portion (BP) and connectable to the pair of columns (101). An actuator (116) is coupled to one of the movable fixtures (104) and the support mechanism, to displace the movable fixture to multiple positions on the pair of columns and actuate the support mechanism to toggle between a first condition and second condition. The system includes a control unit (120) configured to receive a signal from a controller (142) to activate the actuator to displace the movable fixture and the support mechanism. The movable fixture and the support mechanism comprises grippers to stabilize the system.



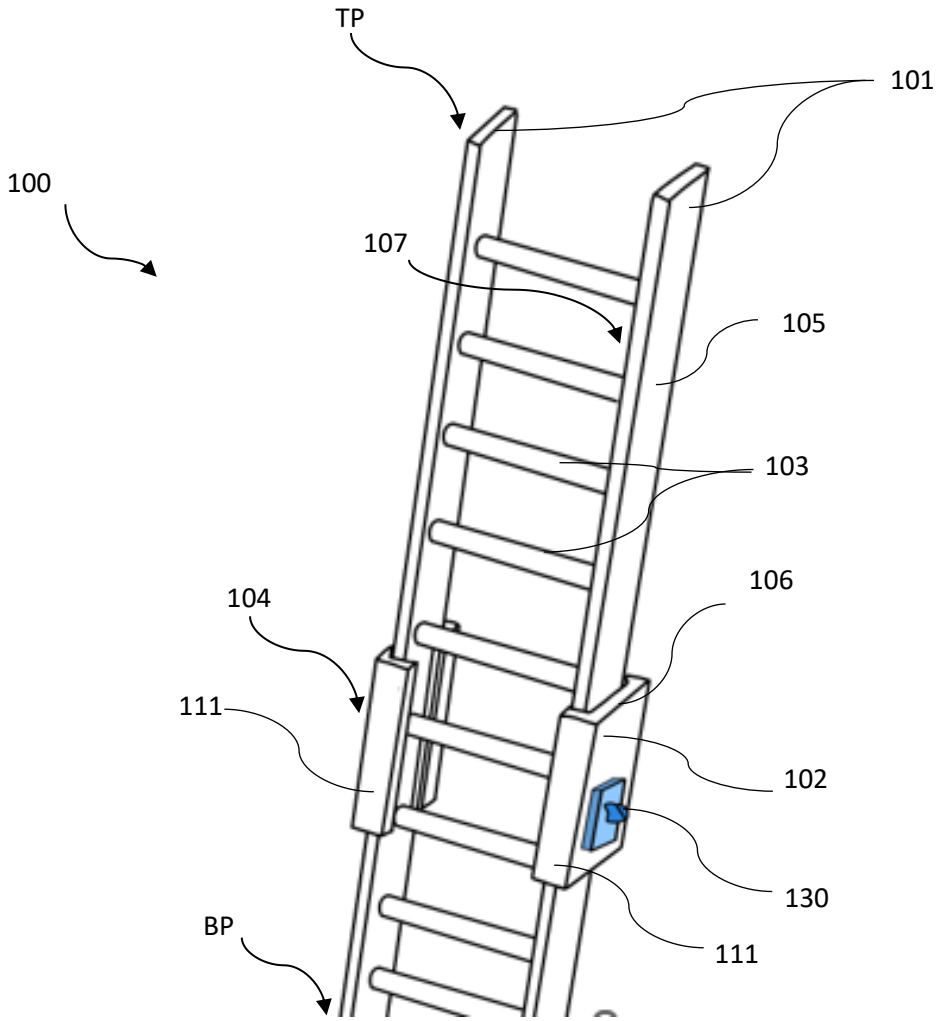


FIG. 1a

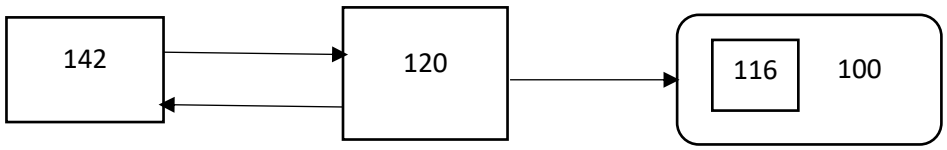


FIG. 1b

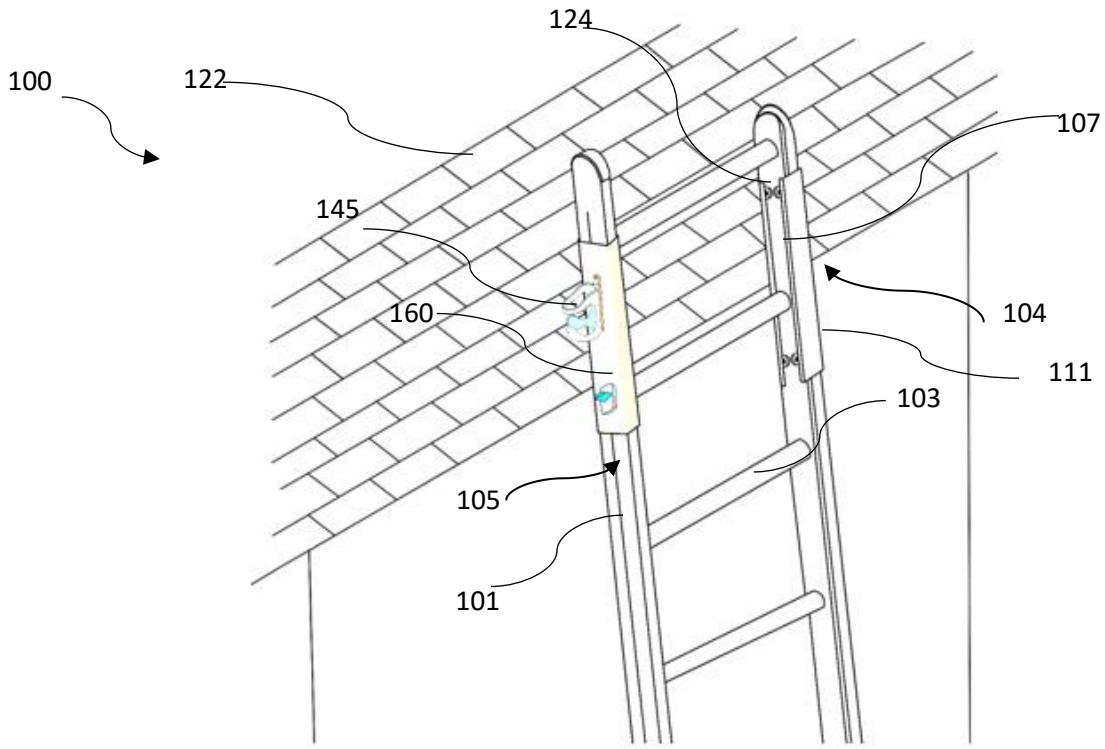


FIG. 2

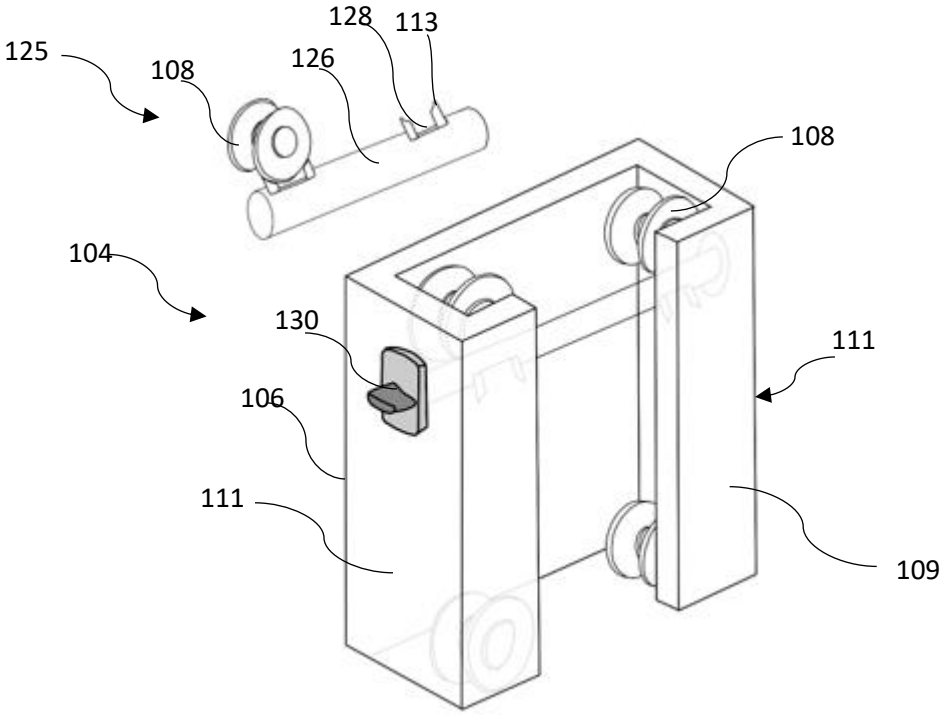


FIG. 3

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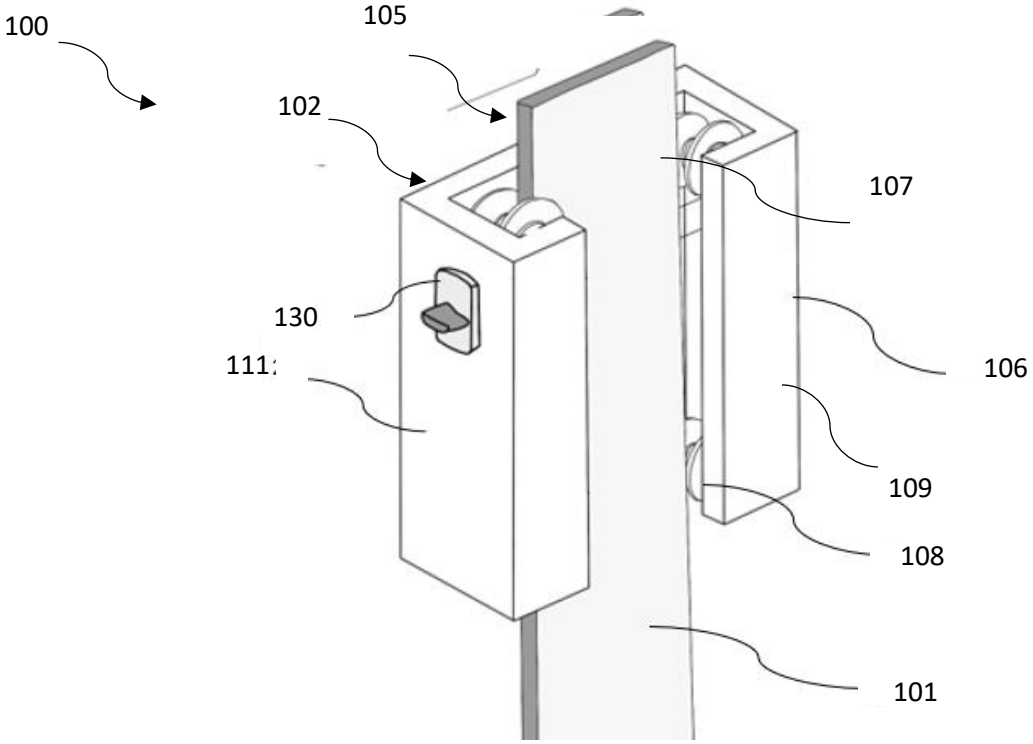

FIG. 4

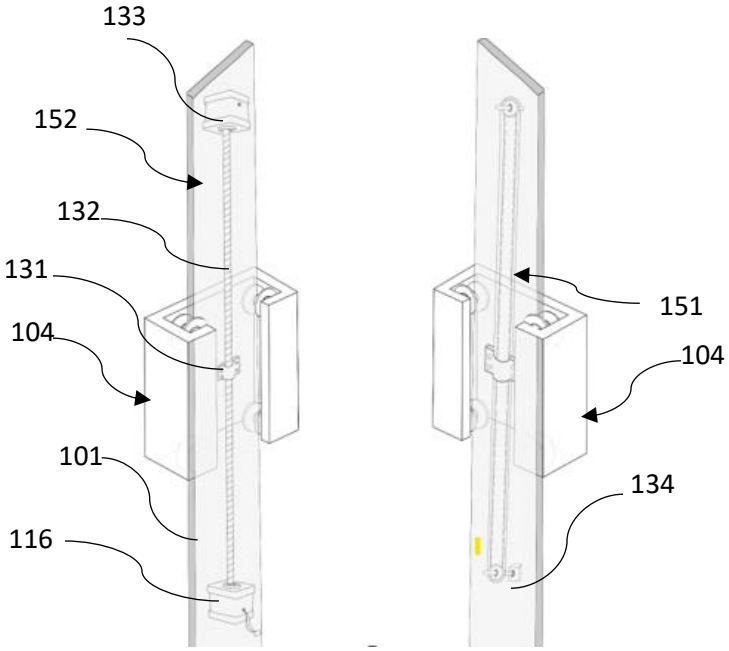

FIG. 5

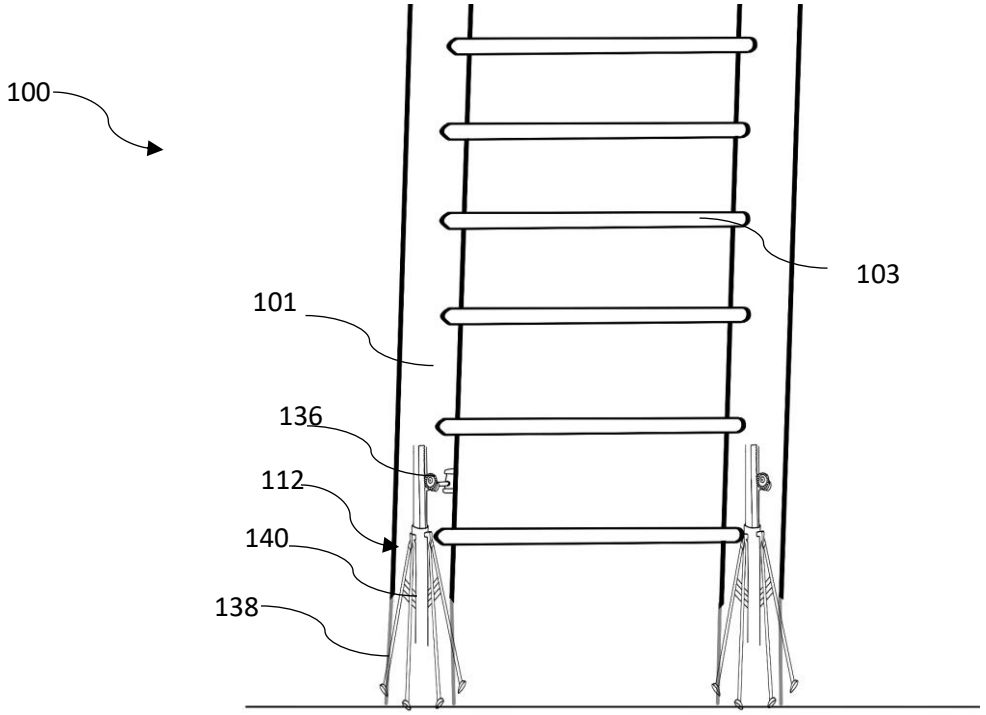

FIG. 6a

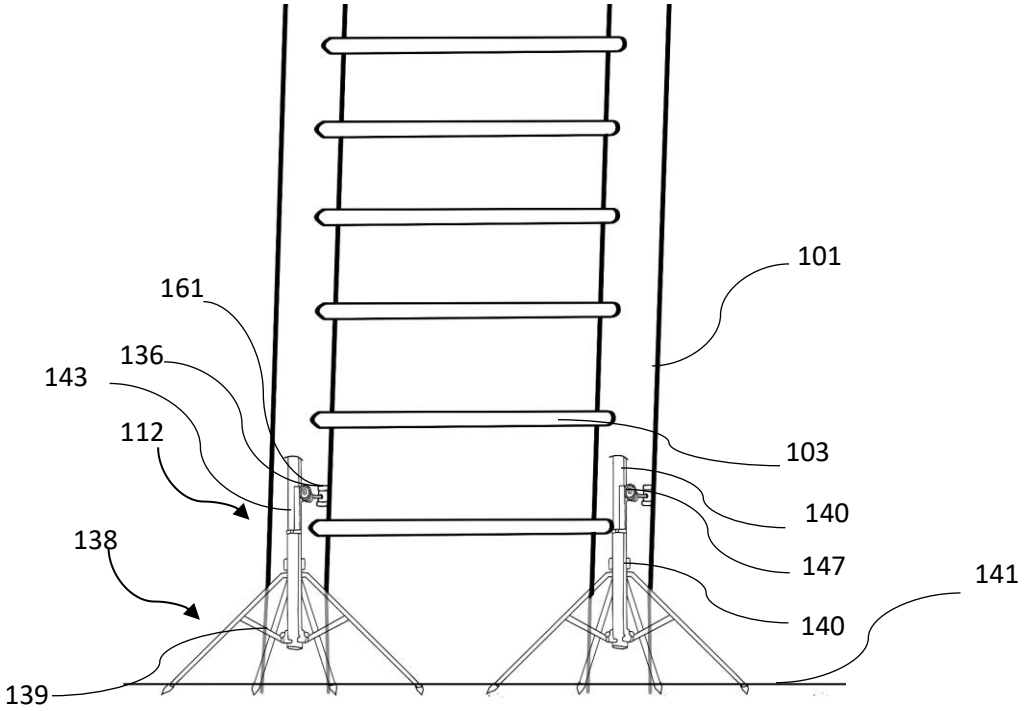

FIG. 6b

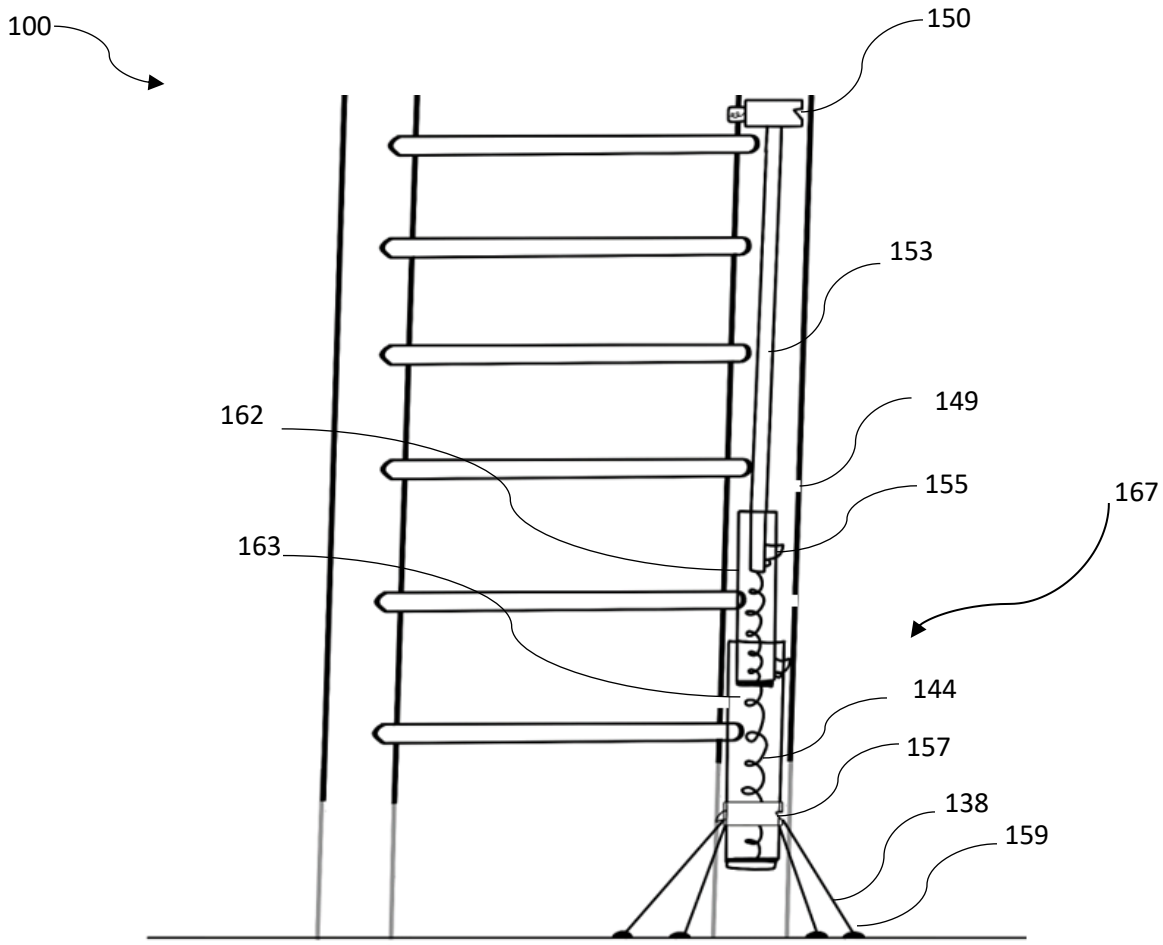

FIG. 7

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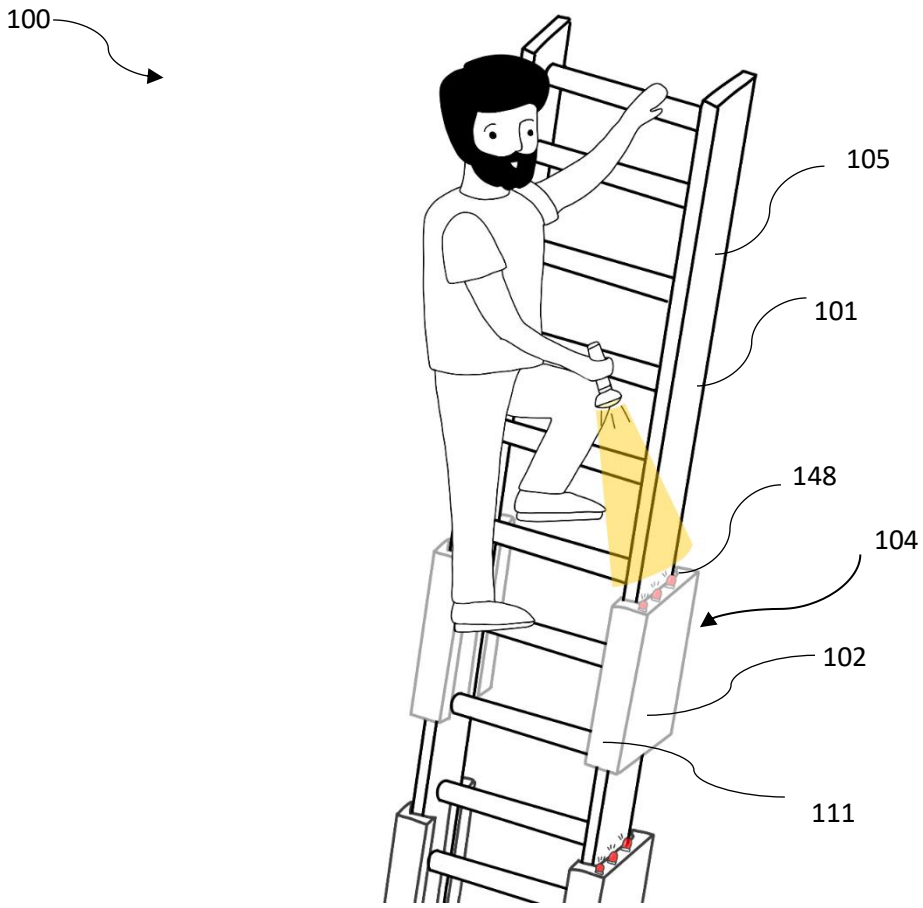

FIG. 8

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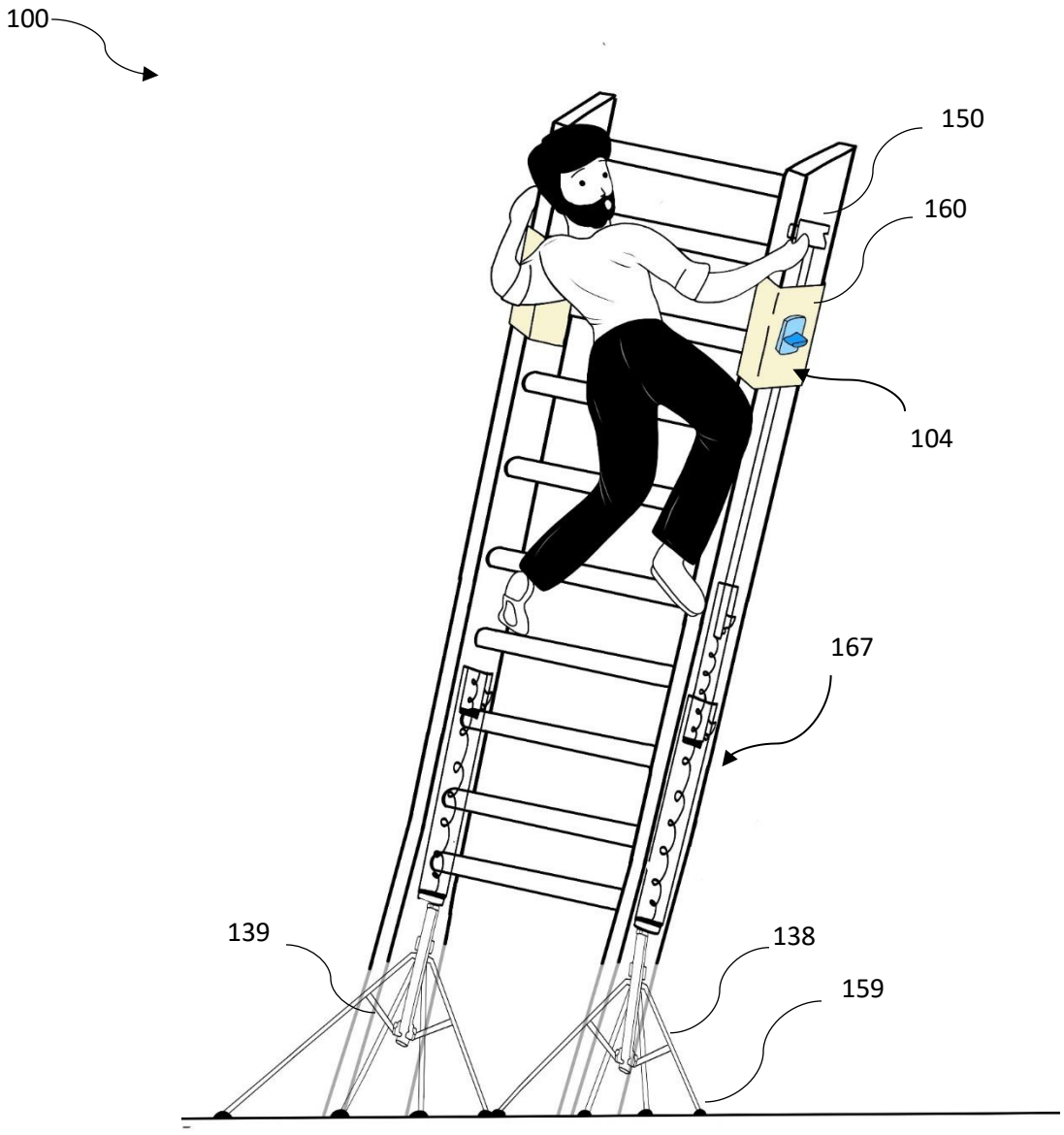

Fig. 9

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