

PROVISIONAL APPLICATION FOR PATENT

FOR

A Vehicle-Mounted Elevated Access System

BACKGROUND OF THE INVENTION

[001] In the course of tactical (police, SWAT, or military), firefighting, rescue operations, and in other lines of work, it is sometimes necessary for groups of people to use external means to rapidly enter or exit elevated points of interest including buildings, structures, or mobile targets (such as commercial aircraft parked on tarmac). It is beneficial to these operations, to maintain a continuous route of access between the ground and the elevated point of interest, in order that rapid movements of personnel between elevations may be achieved at any time throughout the operation.

[002] In service of this need, elevated access systems exist which may be mounted or dismounted from various vehicles in order that the vehicle may be used in a variety of functions. When mounted to a suitable vehicle, such systems consist substantially of a base structure connected to the vehicle at a plurality of points, and one or more ramps or stairways [Access Structure(s)], which can be inclined with respect to the base structure, providing personnel access between ground level and points some height above the ground.

[003] Shortcomings of such vehicle mounted systems may include:

- The use of a fixed hinge point between the Access Structure and the Base structure, causing a reduction in horizontal overhang of the Access Structure as the inclination angle increases. Horizontal overhang is necessary for the elevated access system to extend beyond the furthest point of the vehicle it is mounted to, in order to achieve close enough proximity to the elevated target.
- To achieve increased horizontal reach with a fixed hinge point, some systems may incorporate telescopic or sliding extensions into the Access Structure itself. Such extensions use a second method of actuation and may cause there to be substantial cantilevered sections of the Access Structure. Cantilevered structures are subject to increased bending forces and deflections (movement under load) as compared to non-cantilevered structures of equal proportion and loading. Substantial movements at such heights may cause significant danger, real and perceived, to users of the system and may cause such users to reduce their rate of progress along the Access Structure, leading to delay of the mission or operation.
- The use of column-loaded actuator elements which may be limited in length by inherent instability and failure modes such as buckling. Length limitations on actuation elements may require connection of such elements at points closer to the proximal end of Access Structure, increasing length of cantilever section of Access Structure.
- Manual (performed by a user or technician directly – i.e. not accomplished via electronic remote control or other non-human powered means) assembly or configuration of portions of the system prior to use in an operation, including for example: (a) Manual configuration of any Platform at distal end of Access Structure from stowed/folded position into an operational position at a fixed angle relative to Access Structure, using cooperating pins and holes or some

other means of manual position locking. (b) Manual deployment of safety handrails/guardrails along the Access Structure and end platform from stowed/folded position into extended or upright operational position. Manual configuration/assembly of system components requires time to perform and may lead to delay of the mission or operation.

[004] There is a need for an elevated access system that provides:

- Moving hinge point between Access Structure and Base structure in order to improve horizontal reach without requiring telescopic or sliding segments within the Access Structure itself.
- Self-deploying and stowing handrails/guardrails along the Access Structure and End Platform requiring no manual deployment or configuration.
- Self-deploying and stowing End Platform requiring no manual deployment or configuration.
- Access Structure actuation components substantially loaded in tension to avoid length limitations of column-loading components, and subsequently able to be attached further along Access Structure, reducing cantilevered lengths of Access Structure.

DETAILED DESCRIPTION OF THE INVENTION

[005] The methods and systems of the invention disclosed herein address these and other needs by providing a vehicle-mounted platform that has one or more Access Structures that connect to the Base structure at moving hinge points, allowing the entire Access Structure to advance toward the above ground target prior to and/or during elevation/inclination. The actuation mechanisms of the invention are substantially loaded in tension, the handrails/guardrails and platform at end of the Access Structure may be deployed/configured automatically and without manual effort.

[006] The following detailed description illustrates by way of example, not by way of limitation, the principles of the invention. This description will clearly enable one skilled in the art to make and use the invention, and describes several embodiments, adaptations, variations, alternatives and uses of the invention, including what is presently believed to be the best mode of carrying out the invention. It should be understood that the drawings are diagrammatic, schematic, or exemplary of certain potential embodiments of the invention, and are not limiting of the present invention nor are they necessarily drawn to scale.

[007] As used herein, the terms “about,” “substantially,” “significantly,” or “approximately” for any numerical values, ranges, shapes, distances, relative relationships, etc., indicate a suitable dimensional tolerance that allows the part or collection of components to function for its intended purpose as described herein.

[008] Exemplary embodiments of the invention may constitute a mobile elevated access system. The elevated access system may be mounted to a suitable vehicle and capable of providing external means of human access between elevated points of interest and ground level. The system may consist of a base structure attachable to the vehicle, one or more inclinable access structures, a plurality of tension elements, one or more lifting masts, actuation mechanisms, actuation power sources, and an associated control system. Structural elements of the invention may be constructed from suitable materials that

offer a balance of lightweight, strength and rigidity, such as Aluminum, Stainless Steel, Titanium, Carbon Fiber, Aramid, or other such similar material.

[009] In an exemplary embodiment, the suitable vehicle may be one that is intended and authorized for on-road operation or for off-road operation or a vehicle which is intended and authorized for both on and off-road operation. The vehicle may be powered by an internal combustion engine or may be powered by electric propulsion systems with onboard battery energy storage, or may be powered by a hybrid system consisting of both internal combustion engine and battery and electric drive components.

[010] In an exemplary embodiment, the base structure may span above the vehicle and may be mounted at three or more points to the front, rear, and/or top of the vehicle. The base structure may have a substantially flat, upward-facing deck section suitable for walking or standing on. The base structure may include one or more track channels containing moving hinge points which may be connected to and positioned by hinge position actuation mechanisms mounted within the base structure. Track channels may be oriented in the longitudinal front-rear direction of the vehicle.

[011] In an exemplary embodiment, hinge position actuation mechanisms may be connected between the base structure and moving hinge points within the track channels and may be used to rapidly move access structure hinge points forward or rearward relative to the base structure, and to maintain the position of the hinge points for extended periods of time as necessary for operation. The hinge position actuation mechanisms may substantially consist of a power source, and an appropriate means of applying force over a distance, for example: extending/retracting linear electric or hydraulic actuators of single or multiple stages; screw, chain, belt, or pinion drive mechanisms; cable or rope winch mechanisms; or other suitable means.

[012] In an exemplary embodiment, the actuation power source may be comprised of one or more hydraulic power units made up of an electrically powered motor and series of valves to pressurize and deliver hydraulic fluid to linear or rotary hydraulic actuation mechanisms by way of tubes and fittings. Such hydraulic power units may be supplied with electrical energy by way of batteries and/or generators contained within the elevated access system or by way of power systems onboard the host vehicle, such as generators or powertrain batteries.

[013] In an exemplary embodiment, the actuation power source may be comprised of dedicated batteries which may supply energy to electromechanical actuation systems. Such batteries may themselves be supplied with charge by way of generator systems onboard the elevated access system or may be supplied with charge by way of power systems onboard the host vehicle, such as generators or powertrain batteries. Such recharge elements may be configured in order that connection and disconnection may be achieved in an expedited fashion and may or may not require the use of tools, in order that detachment of the elevated access system from the host vehicle may be achieved in an expedited fashion.

[014] In an exemplary embodiment, the actuation power source may be comprised of power diverted directly from the host vehicle, in which onboard vehicle systems such as a hydraulic Power Takeoff (PTO) may supply hydraulic power to elevated access system actuation mechanisms by way of adequate pressure lines and fittings. Such lines and fittings may be configured in order that connection and disconnection may be achieved in an expedited fashion and may or may not require the use of tools, in

order that detachment of the elevated access system from the host vehicle may be achieved in an expedited fashion.

[015] In an exemplary embodiment, the actuation power source may be comprised of power diverted directly from the host vehicle, in which onboard vehicle systems such as generators or drivetrain batteries may supply electrical power to elevated access system actuation mechanisms by way of adequate electrical conductors. Such conductors may be configured in order that connection and disconnection may be achieved in an expedited fashion and may or may not require the use of tools, in order that detachment of the elevated access system from the host vehicle may be achieved in an expedited fashion.

[016] In an exemplary embodiment, an inclinable access structure may consist of longitudinal stringers, connected transversely by a plurality of step elements, each step pivotally attached to each stringer and featuring tread material on its upward facing surface. Each stringer may be pivotally attached to the moving hinge points within the base structure. When the access structure is laid flat on the base structure, the tread surfaces of the stair elements may lie in a substantially flat plane, forming a deck atop the vehicle. Upon inclination of distal end of the access structure, the upper tread surfaces of the step elements may remain substantially parallel and upward facing, while relative vertical space is established between the steps, forming a stairway.

[017] In an exemplary embodiment consistent with the present invention, an inclinable access structure may be configured like a walkway with tread material on its upward facing surfaces, which may form a ramp when distal end of the access structure is elevated.

[018] In an exemplary embodiment, tension elements may be made substantially of flexible rope or cable of appropriate material, for example steel, carbon fiber, or synthetic fiber, or tension elements may be made of more rigid metal plate or tube assemblies. Tension elements may be equipped with end fittings, loops, or other suitable end terminations to facilitate adequate structural connections.

[019] In an exemplary embodiment, lifting masts may be pivotally attached at one end to the base structure. One or more rear tension elements of fixed length may extend from base structure to each lifting mast. One or more forward tension elements of fixed length may extend from each lifting mast to a corresponding access structure. During actuated movement of access structure hinge points, forward tension elements may pull on and passively elevate lifting masts into an angled or upright position. Ultimate upright angle of lifting masts may be determined and limited by fixed length of rear tension elements. Upon reaching limit of motion of lifting mast, continued actuation of access structure hinge points may cause distal end of access structure to elevate by way of force applied through forward tension elements and reacted by lifting mast and rear tension elements. In this embodiment, actuation and control of access structure hinge positions may allow management of inclination angle of access structure.

[020] In an exemplary embodiment, lifting masts may be pivotally attached at one end to the base structure and one or more forward tension elements of fixed length may extend from each lifting mast to a corresponding access structure. Lifting masts may be actively rotated into an upright angle relative to the base structure by way of rear actuator mechanisms connected between lifting masts and base structure. Rear actuator mechanisms may consist substantially of electric or hydraulic actuators,

winches, or similar means of applying force over a distance. Actuation of access structure moving hinge points may cause distal end of access structure to elevate by way of force applied through forward tension elements and resisted by lifting masts and rear actuator mechanisms. In this embodiment, coordinated actuation and control of lifting mast angle and access structure hinge positions may allow discrete management of both inclination angle and horizontal position of access structure.

[021] In an exemplary embodiment, a two-position end breaching platform may be pivotally attached to distal end of an access structure. The end breaching platform may be configured with tread material on upward facing surfaces. During actuation of access structure hinge points, the two-position end breaching platform may, by way of a linkage mechanism, be automatically toggled between a deployed position and a stowed position. In a stowed position, end breaching platform may be rotated pivotally backward to lie substantially flat atop access structure. In a deployed position, end breaching platform may be rotated pivotally forward into operational position extending horizontally at distal end of access structure. The end breaching platform pivotal connections may be configured such that, in a deployed position, the end breaching platform tread surfaces may passively remain in a substantially flat and upward facing plane at all operational angles of access structure, providing a working platform for users at uppermost point on elevated access system.

[022] In an exemplary embodiment, a multi-position end breaching platform may be pivotally attached to distal end of an access structure. The end breaching platform may be configured with tread material on upward facing surfaces. During actuation of access structure hinge points, the multi-position end breaching platform may, by way of a linkage mechanism, be automatically toggled between a first deployed position and a stowed position. In a stowed position, end breaching platform may be rotated pivotally backward to lie substantially flat atop access structure. In a first deployed position, end breaching platform may be rotated pivotally forward until extending horizontally at distal end of access structure. The multi-position end breaching platform pivotal connections may be configured such that, in a first deployed position, the end breaching platform tread surfaces may passively remain in a substantially flat and upward facing plane at all operational angles of access structure. The multi-position end breaching platform may, by way of an additional end platform actuation mechanism, be selectively toggled from a first deployed position to a second deployed position. In a second deployed position, the multi-position end breaching platform may be inclined to a desired angle above horizontal, even to be substantially parallel to access structure at any operational angle of access structure. In a second deployed position, multi-position end breaching platform tread surfaces may remain substantially parallel and upward facing, while relative vertical space may be established between the tread surfaces, forming a stairway at distal end of access structure; or tread surfaces may remain substantially in a plane, forming a ramp at distal end of access structure.

[023] In an exemplary embodiment, handrails or guardrails may be configured along the length of an access structure. Handrails may be configured with a plurality of upright supports pivotally attached to access structure. Railing elements for users to hold onto or lean against may be pivotally attached to upright supports. Handrails may be configured by way of one or more deployment linkages to automatically transition between a stowed position and a deployed position during actuation of access structure hinge points. In a stowed position, handrail upright supports and railing elements may rotate pivotally to lie substantially flat and parallel to access structure. In a deployed position, handrail upright supports may rotate pivotally, elevating railing elements into a raised position, substantially parallel to access structure at all operational angles of access structure.

[024] In an exemplary embodiment, handrails or guardrails may be configured along the length of a two-position or a multi-position end breaching platform. Handrails may be configured with a plurality of upright supports pivotally attached to end breaching platform structure. Railing elements for users to hold onto or lean against may be pivotally attached to upright supports. Handrails may be configured by way of one or more mechanical linkages to automatically transition between a stowed position and a deployed position during transition of end breaching platform from a stowed position to a deployed position. In a stowed position, handrail upright supports and railing elements may rotate pivotally to lie substantially flat and parallel to end breaching platform structure. In a deployed position, handrail upright supports may rotate pivotally, elevating railing elements into a raised position, substantially parallel to end breaching platform structure at all deployed positions of end breaching platform.

[025] In an exemplary embodiment, a control system may be configured to manage power distribution to actuation mechanisms of an elevated access system such that components of elevated access system may be configured and positioned as appropriate for operational need. Control system may consist substantially of one or more arrays of user switches connected by way of electrical harnessing to a power distribution center which may divert power via relays and other appropriate means to actuation mechanisms upon user command. The power distribution center of the control system may contain distributed failsafe elements such as for example, positional and/or orientation sensors, mechanical limit switches, circuit breakers, fuses or fusible links, and other appropriate elements to maintain safe and effective operation of the elevated access system and to provide for management of overload conditions. A user switch array may be fixed in position within the host vehicle or may be fixed in position on the elevated access structure, or a user switch array may be tethered to control system by way of a length of electrical harnessing to allow for a user to operate from a multitude of positions. A control system may provide open loop or closed loop feedback or warning about operational condition of elevated access system to user by way of audible or visual signals triggered by switches and sensors. User switch array may be equipped with a locking cover or power disconnect key or similar device to prevent unintentional or unauthorized control or actuation of elevated access system.

[026] In an exemplary embodiment, a control system may be configured to manage power distribution to actuation mechanisms of an elevated access system such that components of elevated access system may be configured and positioned as appropriate for operational need. Control system may consist substantially of one or more arrays of physical user switches connected by way of electrical harnessing to a power distribution center which may divert power via relays and other appropriate means to actuation mechanisms upon user command. The control system may additionally consist of a graphical user interface, backend software, and programmable logic controller, allowing interactive control and observation of condition and configuration of elevated access system. The graphical user interface may be hosted on one or more wireless computing devices simultaneously, which may be connected via wireless RF transmission to the power distribution center. A wireless computing device compatible with graphical user interface and backend software may be equipped with or without a touch sensitive display. A graphical user interface control system may provide open loop or closed loop feedback or warning about operational condition of elevated access system to user by way of audible or visual signals or data streams from sensors integrated into elevated access system including cameras, position sensors or encoders, limit switches or other appropriate elements. Graphical user interface may be

equipped with password protection or user identity verification measures to prevent unintentional or unauthorized control or actuation of elevated access system.

[027] In an exemplary embodiment, the graphical user interface and backend software may be configured to allow for visual-based control of elevated access system in operation-specific modes, for example, in an aircraft mode or in a preset mode. By way of example, controlling the elevated access system in an aircraft mode may consist of user selection, by image or description, of a desired model of aircraft. Upon selection, the graphical user interface may be configured to display a preloaded representative 2 dimensional or 3 dimensional image of the specified model of aircraft. User may further indicate by selection of a region of the image, a target point of access on the aircraft, for example a wing, door, or window. Upon selection of target point of access, user may execute a command to configure elevated access system to an optimal height for accessing such target point. Execution command may consist of user holding down a prompt button on the graphical user interface until access structure has been elevated into an appropriate position and has stopped movement. Appropriate position of access structure and limit of movement for a selected target height, may be calculated and controlled by the backend software in combination with position/orientation sensors and programmable logic controller.

BRIEF DESCRIPTION OF FIGURES:

Some of the features and elements of the invention have been set forth in prior sections of the description, while other features and elements of the invention will be accounted and described in the following descriptions and figures.

FIG1 presents a perspective view of a Vehicle-Mounted Elevated Access System consistent with the disclosed invention.

FIG2 presents a side view of a Vehicle-Mounted Elevated Access System consistent with the disclosed invention and represented in a stowed configuration.

FIG3 presents a side view of a Vehicle-Mounted Elevated Access System consistent with the disclosed invention and represented in a deployed flat configuration.

FIG4 presents a side view of a Vehicle-Mounted Elevated Access System consistent with the disclosed invention and represented in a deployed low angle configuration.

FIG5 presents a side view of a Vehicle-Mounted Elevated Access System consistent with the disclosed invention and represented in a deployed high angle configuration.

FIG6 presents a side view of a Vehicle-Mounted Elevated Access System consistent with the disclosed invention and represented in a deployed high angle configuration with a Multi-Position End Breaching Platform represented in a Stairway Configuration.

FIG7 presents a front view of a suitable wireless computing device displaying a representative graphical user interface consistent with the disclosed invention.

DETAILED DESCRIPTION OF FIGURES

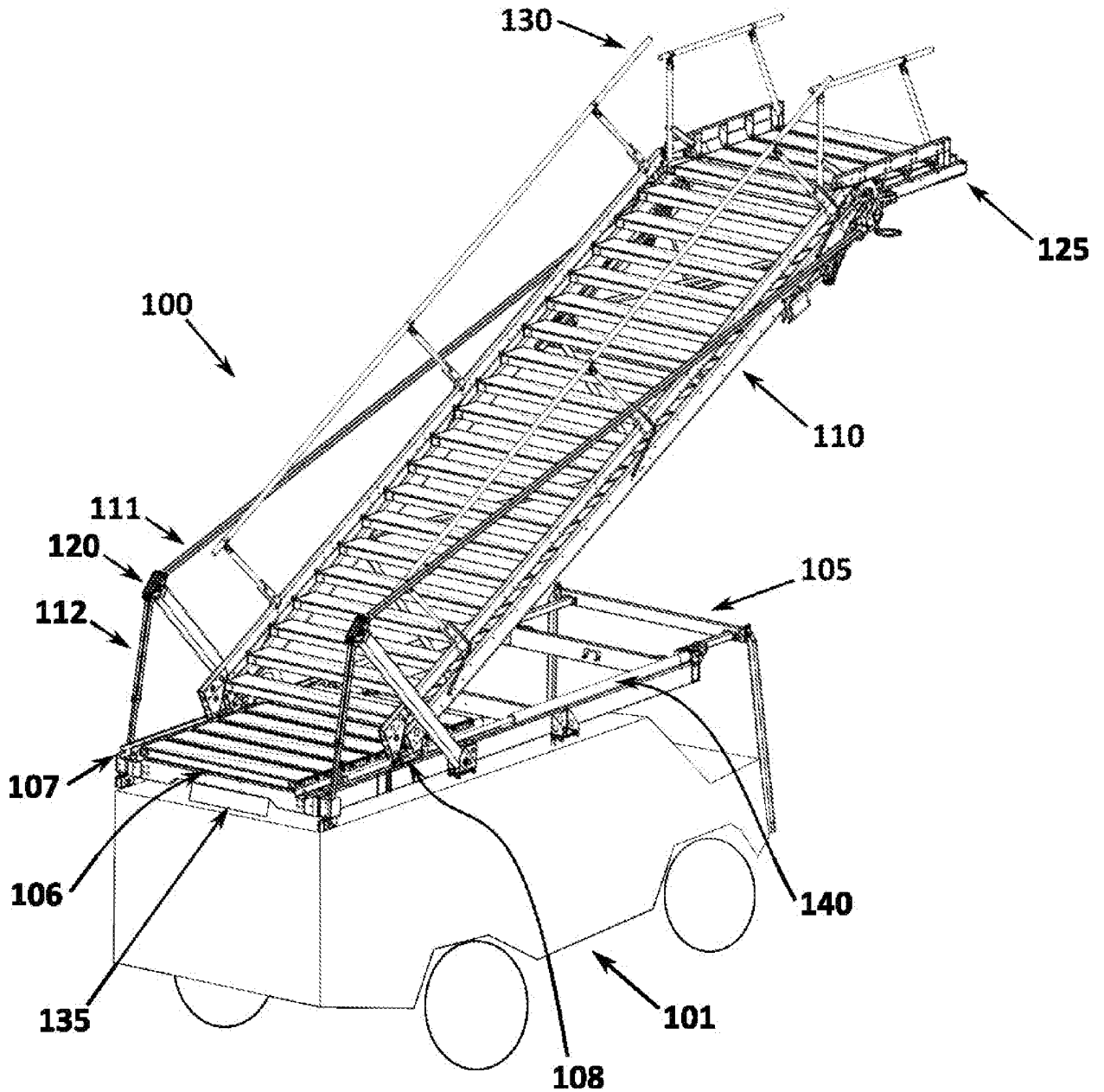


Figure 1

Figure 1. Is a side view representation of an elevated access system **100** mounted to a suitable Host Vehicle **101**, and featuring a Fixed Base structure **105** mounted at a plurality of points along the front, rear, and top of the vehicle **101**.

An inclinable Access Structure **110**, is connected by way of a plurality of Forward Tension Elements **111** to two Lifting Masts **120**. The Lifting Masts **120** are connected by way of rear tension elements **112** to the Fixed base Structure **105**.

The Fixed Base Structure **105** features a substantially flat, upward-facing deck section **106**, suitable for walking or standing, and two track channels **107** containing Moving Hinge Points **108** to which an Inclinable Access Structure **110** may be pivotally attached. Actuator Mechanisms **140** may be connected between the Moving Hinge Points **108**, and Fixed Base Structure **105**. When the Actuator Mechanisms **140** pull the proximal end of the Inclinable Access Structure **110**, the distal end of the Inclinable Access Structure **110** may be elevated by way of forces applied through Forward Tension Elements **111**, and reacted by Lifting Masts **120**, and Rear Tension Elements **112** into Fixed Base Structure **105**, and Host Vehicle **101**.

A Multi-Position End Breaching Platform **125** may be pivotally mounted to the distal end of the Inclinable Access Structure **110**. Handrails **130** may be positioned along and pivotally mounted to, the Inclinable Access Structure **110**, and Multi-Position End Breaching Platform **125**.

A Control System **135** may be contained within the vehicle or within the Fixed Base Structure **105**.

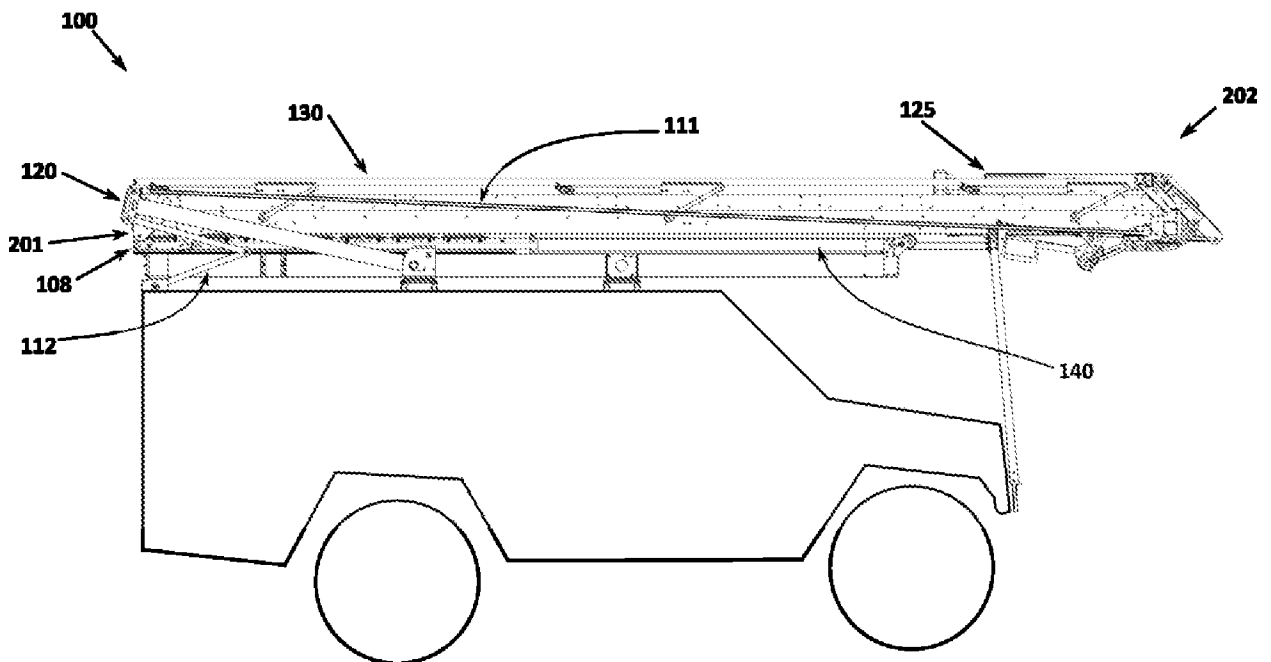


Figure 2

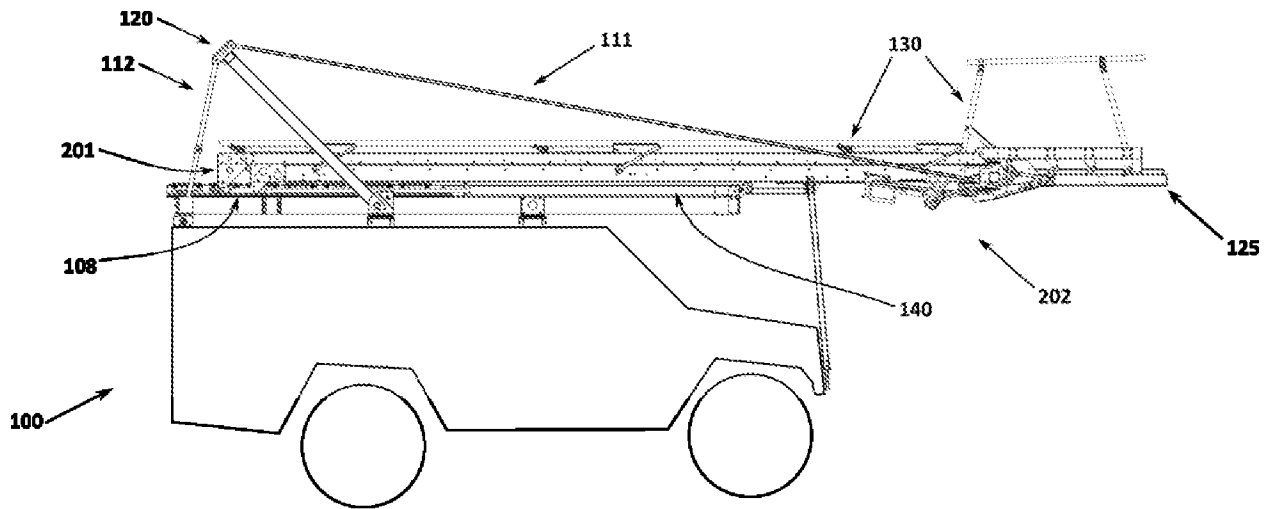


Figure 3

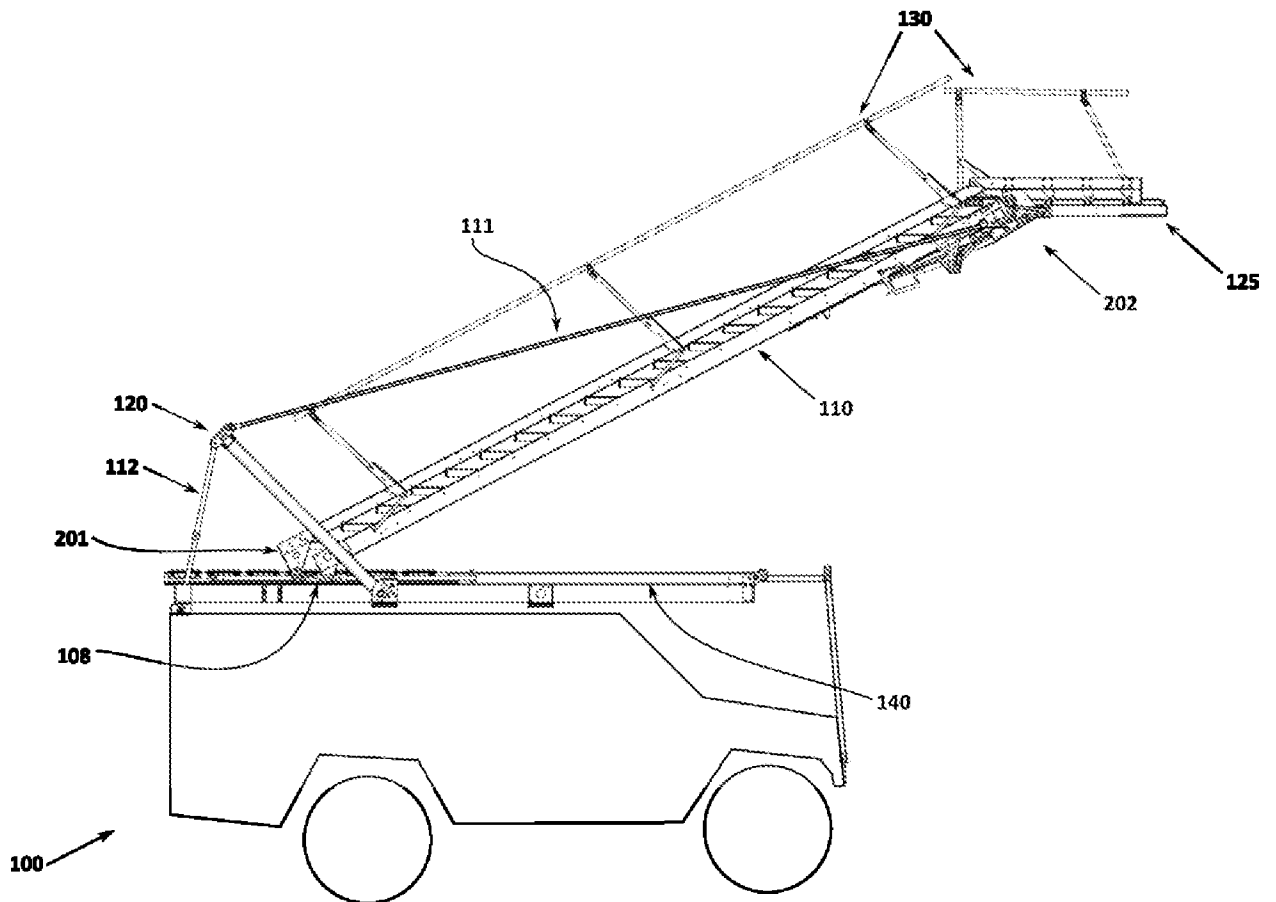


Figure 4

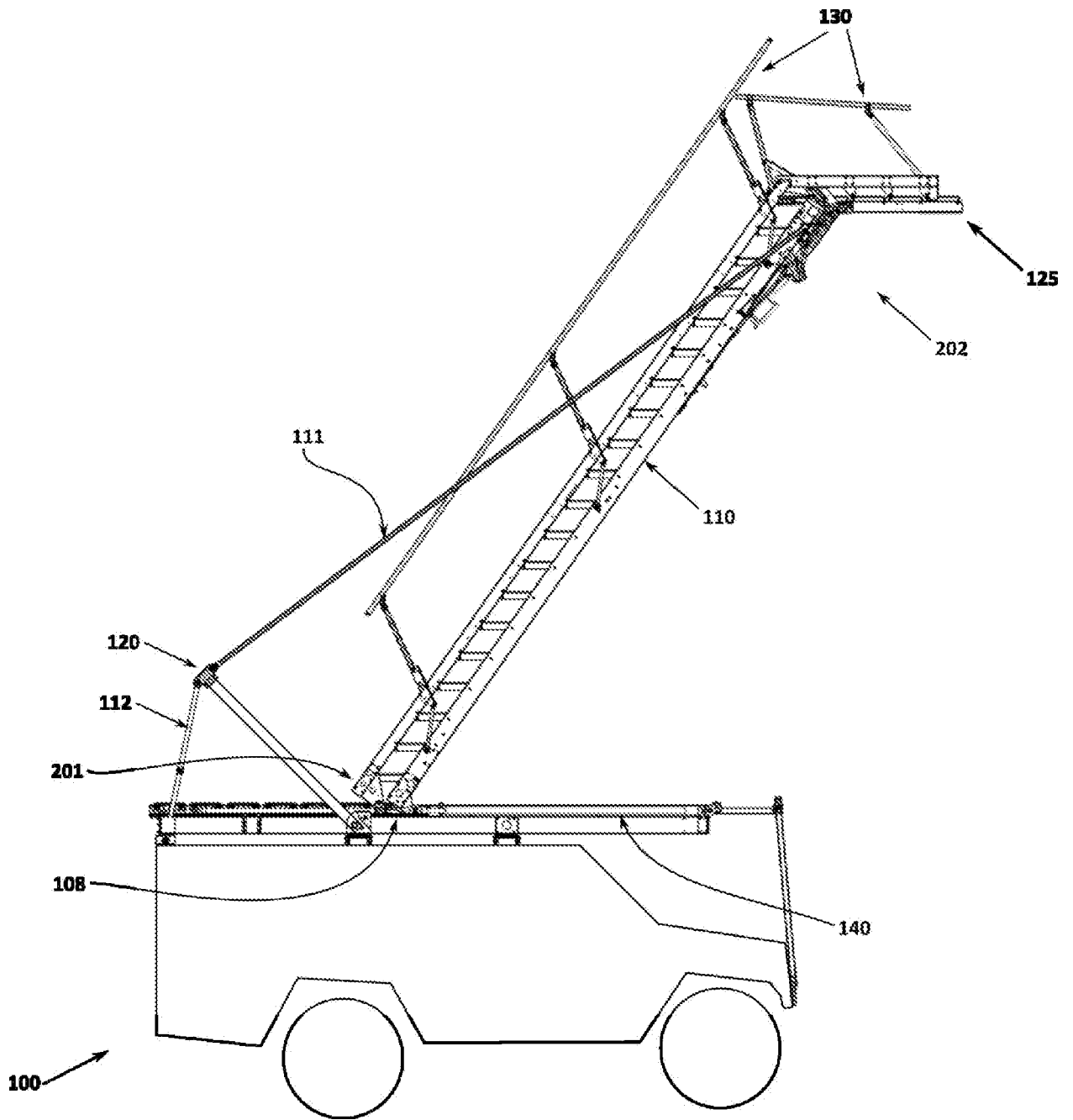


Figure 5

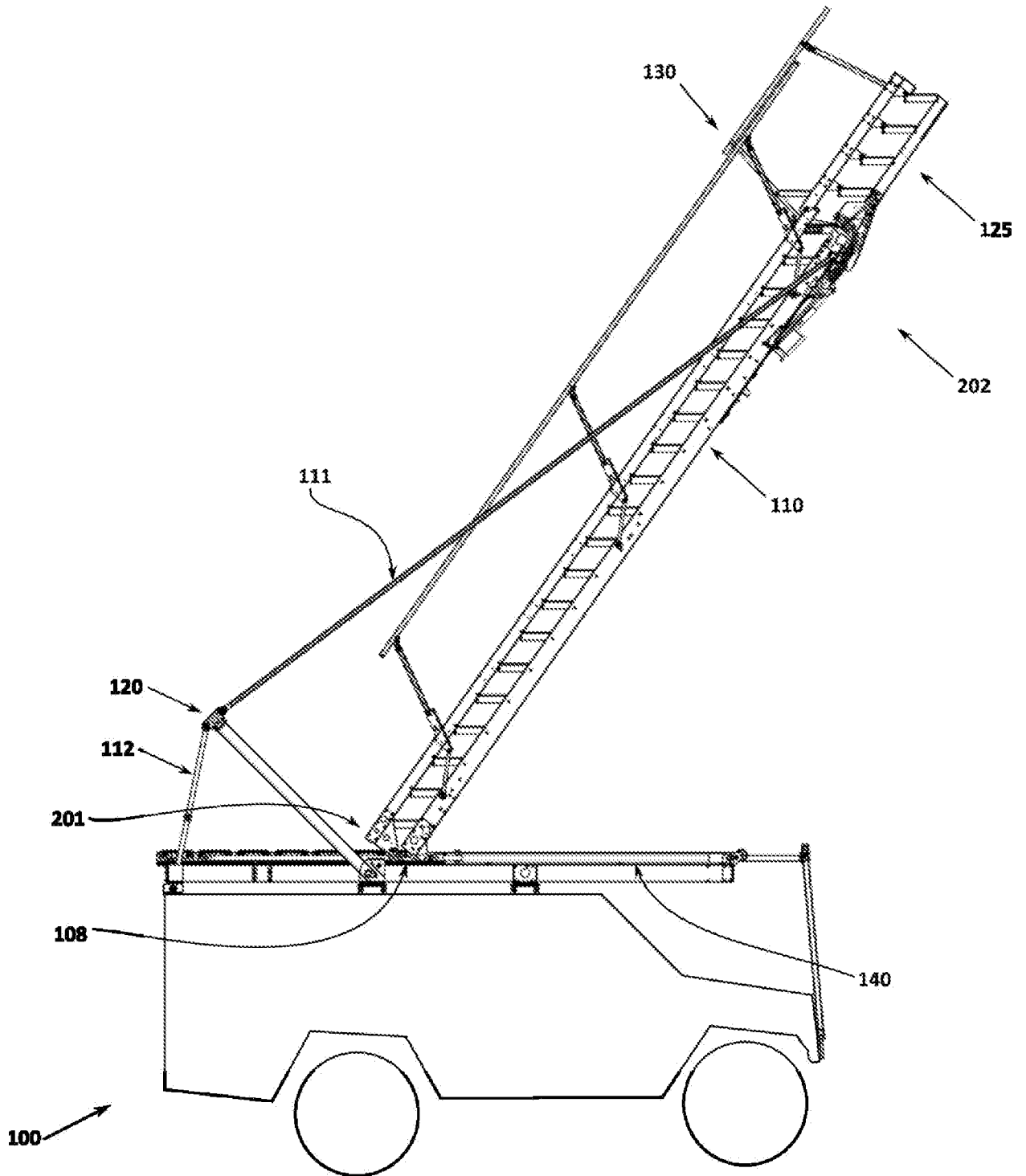


Figure 6

Figure 2, Figure 3, Figure 4, and Figure 5 Show a progression of positions a Vehicle Mounted Elevated Access System **100**, from a Stowed configuration **Figure 2**, into a Deployed Flat Configuration **Figure 3**, into a First Deployed Inclined Position **Figure 4**, into a Second Deployed Inclined Position **Figure 5**. The method of action of the Elevated Access System **100**, may be understood visually by the progression of these positions. It may be evident that the longitudinal movement of the Moving Hinge Points **108** and proximal end **201** of the Inclinal Access Structure **110** by means of the Actuator Mechanisms **140**, may cause the distal end **202** of the Inclinal Access Structure **110** to be elevated by way of forces applied through Forward Tension Elements **111**, and reacted by Lifting Masts **120**, and Rear Tension Elements **112** into Fixed Base Structure **105**, and Host Vehicle **101**.

Referring again to **Figure 2, Figure 3, Figure 5**, and now to **Figure 6**, a Multi-Position End Breaching Platform **125** may be shown in a progression of configurations, from **Figure 2** a Stowed Configuration, to **Figure 3** a Deployed Flat Platform configuration at distal end of a Flat Access Structure **110**, to **Figure 5** a Deployed Flat Platform at distal end of an Inclined Access Structure **110**, to **Figure 6** an Inclined Stairway **221** at distal end of an Inclined Access Structure **110**.

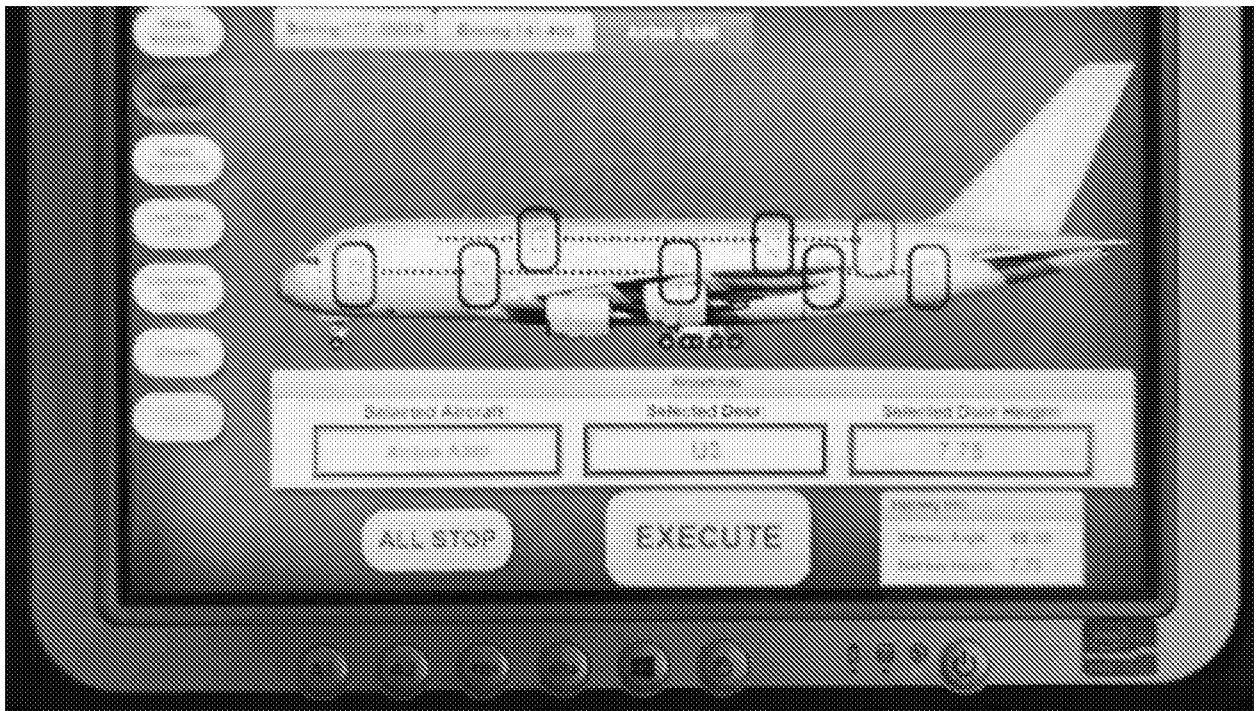


Figure 7

Figure 7 is an image of a Graphical User Interface on a suitable wireless computing device and is shown depicting an Aircraft Mode as described in prior sections.