Title: RAMP COVER MECHANISM FOR A WHEECHAIR RAMP

Abstract: A ramp cover mechanism for a wheelchair ramp system is provided. The wheelchair ramp system may include a flip-over ramp, which may have one or more ramp sections, that is hingedly connected to a mounting enclosure located within the vehicle threshold. A link is attached to the ramp and operates to deploy and stow the ramp in response to a drive system such as a hydraulic linear or rotary actuator. The link rests below the vehicle floor when the ramp is stowed generally flat on top of the vehicle threshold, and when the ramp is deployed, a cover plate adjacent the link is moved to conceal a gap left by the link when extended to deploy the ramp. In one embodiment, the cover plate is normally biased toward a horizontal orientation and the ramp cover mechanism includes a rotating cam that cooperates with an articulated lever assembly to raise and lower the cover plate. The cam rotates relative to the orientation of the ramp and the articulated lever assembly and may include a first link with a cam follower and a second link coupled to the first link and generally perpendicular thereto for moving the cover plate. In another embodiment, the ramp cover is normally biased toward a vertical orientation and the ramp cover mechanism includes a flexible link that is tensioned as the ramp is deployed to overcome the normal bias of the ramp cover thereby moving the cover plate to a horizontal orientation.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
RAMP COVER MECHANISM FOR A WHEELCHAIR RAMP

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit and priority of U.S. Provisional Patent Application No. 60/513,258, filed October 22, 2003.

FIELD OF THE INVENTION

[0002] The invention relates to wheelchair ramp systems. More particularly, the present invention relates to a cover mechanism for covering a recess in a vehicle’s floor when a wheelchair ramp is deployed.

BACKGROUND OF THE INVENTION

[0003] Wheelchair ramp systems for vehicles are well known, and have been employed to enable persons who are physically challenged or otherwise have limited mobility to board and leave a vehicle. Various wheelchair ramp systems have been proposed that include electrical, pneumatic, or hydraulic drive systems. Additionally, various drive mechanisms have been proposed that effect rotary, linear, or some other type of drive actuation. Regardless of whether the drive mechanism is electrical, hydraulic, rotary, or linear, the drive mechanism couples or cooperates with a driving link such as a rigid arm or linkage assembly that moves the ramp for deployment and stowage. To maximize the interior space of a vehicle, vehicle wheelchair ramp systems now provide movable ramps that fold substantially flat on the vehicle floor. Such ramp systems, which are known in the art as flip-over ramps, operate to pivot the movable ramp, which may include one or more movable ramp sections, through an angle of approximately 180 degrees relative to the horizontal plane of the vehicle floor.

[0004] The driving link and any following links coupled to the driving link (the driving link and following links comprising a link assembly) stow under the vehicle floor when the ramp is in a stowed orientation (i.e., folded on top of the threshold). To this end, one can appreciate that the driving link projects through the floor creating a gap (e.g., recess, channel, slit, slot or the like) in the floor surface when the ramp is fully deployed. This gap may have a relatively narrow and long shape and may potentially catch and retain a wheelchair wheel and is therefore undesirable. Moreover, the National Highway Traffic Safety Administration (NHTSA) is concerned about transitions entering or exiting ramps and platform such as
vertical gaps, horizontal gaps, and the like. While poor vertical transitions or vertical gaps may impede passengers from boarding and deboarding a vehicle, horizontal gaps may cause injury to a wheelchair user if the tires of the wheelchair fall into and become caught in horizontal gaps or threshold openings. In view of the foregoing, there exists a need for a mechanism to cover a gap present in a vehicle floor due to the deployment of a vehicle wheelchair ramp that is stowed generally flat on the vehicle floor.

SUMMARY OF THE INVENTION

[0005] A ramp cover mechanism for a wheelchair ramp system is provided. The wheelchair ramp system may include a flip-over ramp, which may have one or more ramp sections, that is hingedly connected to a mounting enclosure located within the vehicle threshold. A link is attached to the ramp and operates to deploy and stow the ramp in response to a drive system such as a hydraulic linear or rotary actuator. The link rests below the vehicle floor when the ramp is stowed generally flat on top of the vehicle threshold, and when the ramp is deployed, a cover plate adjacent the link is moved to cover a gap left by the link when extended to deploy the ramp. In one embodiment, the cover plate is normally biased toward a horizontal orientation and the ramp cover mechanism includes a rotating cam that cooperates with an articulated lever assembly to raise and lower the cover plate. In another embodiment, the ramp cover is normally biased toward a vertical orientation and the ramp cover mechanism includes a flexible link that is tensioned to overcome the normal bias of the ramp cover as the ramp is deployed, thereby moving the cover plate to a horizontal orientation.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The present invention is described with reference to the accompanying figures that illustrate embodiments of the present invention. However, it should be noted that the invention as disclosed in the accompanying figures is illustrated by way of example only.

[0007] FIG. 1 is a perspective view of an exemplary vehicle wheelchair ramp system shown in a fully deployed orientation, the system including a first embodiment of a ramp cover mechanism showing the internal components;

[0008] FIG. 2 is a perspective view of the embodiment of FIG. 1 shown in a fully stowed orientation;
FIG. 3 is a left-hand perspective view of the ramp enclosure of the embodiment of FIG. 1;

FIG. 4 is a left-hand perspective view of the ramp enclosure of the embodiment of FIG. 1 showing some of the relevant internal components;

FIGs. 5-8 are perspective views of the ramp enclosure of the embodiment of FIG. 1 showing the operation of relevant internal components; and

FIG. 9 is a perspective view of the exemplary vehicle wheelchair ramp system of FIG. 1, the system including a second embodiment of the ramp cover mechanism.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Referring now to the figures, a ramp cover mechanism is provided for a vehicle wheelchair ramp system. As shown in FIG. 1, the ramp system 100 includes a mounting enclosure 10 that is typically installed within the floor of a vehicle threshold so that persons who are physically challenged or otherwise have limited mobility may board and leave the vehicle. For ease of reference hereinafter, the modifier “inboard” shall refer to a direction toward the vehicle or enclosure 10, whereas the modifier “outboard” shall refer to a direction away from the vehicle or enclosure 10. As shown in FIG. 1, the exemplary wheelchair ramp system 100 includes a bi-fold ramp 32 with an inboard ramp section 34 and an outboard ramp section 36, but the ramp system 100 may include other types of ramps known in the art such as a single ramp section that flips over. The inboard ramp section 34 is coupled to the enclosure 10 at the ramp section’s inboard edge and the outboard ramp section 36 is coupled at its inboard edge to the outboard edge of the inboard ramp section 34. Thus coupled, the sections 34, 36 of ramp 32 fold and unfold in accordion-like fashion. As shown in FIG. 1, when the sections 34, 36 are completely unfolded, the sections 34, 36 are coplanar and cooperate to form the continuous ramp 32 to bridge from the vehicle floor elevation to the ground elevation. As shown in FIG. 2, when the sections 34, 36 are completely folded, the sections 34, 36 are folded upon one another back to back on top of the enclosure 10 so that the ramp system 100 has a compact form. As best illustrated in FIG. 3, the mounting enclosure 10 includes a cover plate 12 that is preferably at least partially removable so that the ramp drive system 200 shown in FIG. 4 within enclosure 10 may be serviced. The cover plate 12 is not illustrated in FIGs. 1
and 4 to better illustrate the ramp drive system 200 and other internal components of the system 100. In one exemplary embodiment the drive system 200 comprises a hydraulic type system that includes a hydraulic power unit and a linear actuator comprising a single-acting hydraulic cylinder 16 (FIG. 1), but the drive system 200 may be electric, pneumatic or other motive force and may use a rotary or other type of actuator. As can be appreciated from the Figures, the drive system 200 is fully housed within the enclosure 10 to provide a substantially self contained, “drop-in” ramp system 100.

[0014] The hydraulic cylinder 16 (FIG. 1) of the exemplary hydraulic drive system 200 includes a rod that moves outboardly and inboardly in response to a hydraulic power unit to respectively deploy and stow the ramp 32. Attached to the outboard end of the cylinder arm is a gear rack or the like which is toothed along one side to mesh with a gear 22 (FIG. 4). As best illustrated in FIG. 4, the gear 22 is mounted to shaft 24 which may be either fixed or free (i.e., the shaft 24 may rotate in response to rotation of the gear 22). Further, as shown in FIGs. 4-8, which illustrate the operation of the internal components, a support plate 23 that is rigidly affixed to the bottom of enclosure 10 includes a central hole which accepts and retains a first end of shaft 24. Similarly, a hole “H” (FIG. 3) in the left sidewall of pan 14 accepts and retains a second end of shaft 24, holding the shaft 24 substantially horizontal. Thus, as the rod of cylinder 16 extends and retracts, the gear rack attached thereto mates with gear 22 to rotate the gear 22 and/or shaft 24.

[0015] As shown in FIGs. 1 and 4, a driving link 26 may be the first link in a multi-link arrangement (26, 26a) but alternatively, driving link 26 may be the sole link for deploying and stowing the ramp 32. As can best be appreciated from FIGs. 6-8, the driving link 26 is bent at a slight angle proximate to its pivot end that is disposed on the shaft 24, but the link 26 may be shaped otherwise such as with multiple bends or angles, or in a curvilinear shape or the like so that the distal end (i.e., the end opposite the shaft 22) of the driving link 26 may be directly coupled to one or more of the ramp sections 34, 36 for movement thereof. As can be appreciated, when cylinder 16 is hydraulically actuated to extend its rod, the gear rack will advance linearly in the outboard direction thereby rotating the gear 22 and pivoting the driving link 26. As best shown in FIGs. 4 and 5, the driving link 26 is stowed within the enclosure 10 in a generally horizontal orientation. By fully extending the rod, the driving link 26 arcuately pivots through approximately 180 degrees about the shaft 24 from its stowed and generally
horizontal orientation within the enclosure 10, through a gap or slot 28 in the floor, and stopping at its fully deployed orientation (see FIGs. 5-8 in succession).

[0016] As shown in FIG. 1, the driving link 26 and following link 26a are oriented to couple with the outside of the left sidewall of the inboard ramp section 34. Of course, the ramp system 100 may include, where appropriate, another drive assembly on the right hand side of the enclosure 10 that is connected to the right hand side of the ramp 32. For convenience, only a single drive assembly on the left hand side of the enclosure will be discussed.

[0017] As best illustrated in FIG. 4, when the ramp sections 34, 36 are folded and stowed on top of the enclosure 10, the links 26, 26a are folded inside the enclosure 10 adjacent or alongside each other. To this end, a gap 28 is provided in the surface of the vehicle floor to allow the links 26, 26a to depend from and retract into the enclosure 10. As shown in FIG. 2, the gap 28 may have a relatively long and narrow shape on the left-hand side of the enclosure 10 and extending the entire distance therealong. Depending on the thickness of the links 26, 26a and total width (i.e., thickness) of a linking assembly comprising the driving link 26 and any following links, the gap 28 may be wider or narrower. Since such a gap 28 may be sized and shaped so that it may accidentally trap and retain the wheel of a wheelchair therein, a ramp cover mechanism is provided to cover the gap 28 when the ramp 32 is deployed. As can be best appreciated from FIGs. 2 and 3, the ramp cover mechanism includes a cover plate 30 that moves between a generally vertical orientation when the ramp 32 is stowed and a horizontal orientation when the ramp 32 is deployed. To cover the gap 28 the cover plate 30 is pivotally attached to the enclosure 10 by one or more hinges, and is positioned adjacent to the gap 28. As shown in FIGs. 1, 3, and 8, the cover plate 30 is sized and shaped to substantially cover the gap 28 when the plate 30 is in a covering (i.e., horizontal) orientation. Further as shown, the cover plate 30 may include a notch or cutout 40 that allows the driving link 26 to project through the plate 30 and vehicle floor when the ramp 32 is fully deployed. Moreover, the cover plate 30 may include a bias comprising a spring such as a torsion spring, hinge spring or the like to orient the cover plate 30 in a normal position as desired. Alternatively, the force of gravity may be sufficient to bias the cover plate 30 toward a horizontal orientation. In the currently described embodiment, the bias for the cover plate 30 normally orients the plate 30 toward a covering (i.e., horizontal) orientation to cover the gap 28. In another exemplary
embodiment discussed hereinafter, the bias may provide for orienting the cover plate 30 toward a generally vertical orientation.

[0018] Referring now to FIGs. 5-8, a cam 21 is disposed on the outer end of shaft 24 and is coupled with the driving link 26. The cam 21 rotates with the driving link 26 and operates to coordinate or synchronize the position of the ramp cover mechanism with the rotational position of the driving link 26 for moving the cover plate 30 relative to the orientation of the ramp 32. As shown, the cam 21 has a somewhat eccentric shape with a raised arcute portion and a depressed arcuate portion, but the cam 21 may be shaped otherwise as appropriate. As shown in FIG. 5 an articulated lever assembly includes a lever arm 25 and an actuating arm 29. As shown, lever arm 25 is pivotally retained in a generally horizontal orientation by fulcrum pin 27, which is fixedly attached to the left side wall (not shown) of pan 14. As shown, the fulcrum pin 27 is located at a point intermediate the cam follower 25a, which is disposed at the outboard end of lever arm 25, and the inboard end of the lever arm 25. More particularly the fulcrum pin 27 is positioned somewhat closer to the cam follower 25a to facilitate a greater lever force at the inboard end of the lever arm 25 for moving the actuating arm 29 as discussed hereinafter in further detail. As mentioned, the outboard end of lever arm 25 includes a cam follower 25a that contacts the perimeter of cam 21 and levers the inboard end of lever arm 25 up and down relative to the respective arcuate raised and depressed portions of the cam 21 as the cam 21 rotates when the driving link 26 pivots to deploy and stow the ramp 32. As shown, a notch 60 is formed in the lever arm 25 proximate the cam follower 25a. As best illustrated in FIGs. 7 and 8, the notch 60 is shaped to accept a raised portion of the cam 21 so that the cam follower 25a may operate to follow the depressed portion of the cam surface of the cam 21 when the ramp is substantially deployed. The inboard end of lever arm 25 couples with the actuating arm 29 for communicating the position of the ramp 32 from the cam 21 to the cover plate 30. To this end, the inboard end of lever arm 25 may be forked or include a slot or the like to accept a portion of the actuating arm 29 so that the lever arm 25 and actuating arm 29 may cooperate and articulate with each other.

[0019] Particularly, the actuating arm 29 includes a lower end with an engagement pin 50 that couples the actuating arm 29 with the lever arm 25. Further, the actuating arm 29 includes an upper edge 52 (FIG. 2) for contacting the cover plate 30, and a central lengthwise slot 54 therebetween. The actuating arm 29 is retained substantially vertically by a vertical pin
arrangement which includes pins 56 to prevent the actuating arm 29 from pivoting. Alternatively, mechanical fasteners such as rivets, screws, bolts, rods or the like may be used as suitable substitutes for the pins 56. The pins 56 are fixedly attached to the left sidewall of the enclosure 10 and operate to retain the actuating arm 29 in a substantially vertical orientation. Thus retained, the actuating arm 29 may slide up and down on the pins 56, which are captive in the slot 54. The engagement pin 50 couples with the inboard end of the lever arm 25 so that when the inboard end of lever arm 25 is levered upward in response to the cam follower 25a downward movement relative to rotation of cam 21, the actuating arm 29 slides upward to raise the cover plate 30. Similarly, when the inboard end of lever arm 25 is levered downward by the cam 21, the actuating arm 29 slides downward to lower the cover plate 30. Preferably, the cover plate 30 is a light but strong metal such as aluminum or the like so that the actuating arm 29 may easily lift the cover plate 30 against the normal horizontal bias (e.g., weight of the plate 30 and/or any included spring bias). In view of the foregoing, the ramp cover mechanism comprising the cam 21, articulated lever assembly including arms 25, 29 and cover plate 30 operates to cover and uncover the gap 28 relative to the position of the driving link 26 and ramp 32.

[0020] As can be appreciated from FIGs. 2, 4, and 5 where the ramp 32 is in a fully stowed orientation, the ramp sections 34 and 36 are folded upon each other on top of the ramp enclosure 10 and the drive link 26 is disposed below the vehicle floor and nested in an accordion-like fashion with the other links of the link arrangement. As shown, the cam 21 is rotated so that the cam follower 25a contacts the raised arcuate portion. Thus, the cam 21 operates to press down on the cam follower 25a to lever the inboard end of the lever arm upward such that actuating arm 29 is fully extended upward to raise the cover plate 30 away from the gap 28. When the ramp 32 is in a fully stowed orientation the cover plate 30 may be substantially vertical as shown in FIG. 2, but alternatively the cover plate 30 may be angled somewhat to form an inverted V shape with the adjacent sidewall of the outboard ramp section 36 so that the gap 28 is substantially obstructed or concealed and generally inaccessible.

[0021] When ramp deployment is actuated, the linear actuator or hydraulic cylinder 16 extends its actuating rod outward in response to the hydraulic power unit or other motive power source of the drive system 200. The rod of cylinder 16 moves outboardly and the gear rack attached to the rod mates with and rotates the gear 22 disposed on the shaft 24. The gear
22 and/or the shaft 24 couple with the driving link 26 which pivots arcurately upward and outward from below the vehicle floor relative to movement of the cylinder's rod. The cam 21 rotates in a clockwise direction when viewed from the left side of the enclosure 10 in concert with the link 26 to communicate the rotational position of the link 26. As can be appreciated, the cam 21 may be affixed to the driving link 26, the gear 22 or the shaft 24 depending on whether the shaft 24 is fixed or free to rotate. During the initial stage of ramp deployment (i.e., approximately the first 150 degrees of rotation of the link 26), the cam 21 is shaped so that the raised cam surface levers the cam follower 25a of the lever arm 25 generally downward. The inboard end of the lever arm 25 is levered or forced generally upward to extend the actuating arm 29 and overcome the cover plate bias thereby preventing the cover plate 30 from moving to a covering orientation.

[0022] As can be appreciated from FIG. 7, when the driving link 26 is rotated to a position where the inboard edge 261 of the link 26 clears the inboard edge of cover plate cutout 40, the radius of the cam 21 decreases (i.e., the cam surface is rotated so that the depressed portion acts on the cam follower 25a). The decreased cam radius permits the cam follower 25a to move upward due to a bias of the lever arm 25. The lever arm 25 bias may comprise a spring bias or the like, or alternatively the weight of or exerted upon the inboard end of the lever arm 25 may bias the cam follower 25a upward to maintain contact with the cam 21. Subsequently, the inboard end of the lever arm 25 moves downward, and the engagement pin 50 which is slotted in the inboard end of the lever arm 25 is pushed downward, thereby gradually retracting the actuating arm 29 into the enclosure 10. No longer supported in a generally vertical orientation by the actuating arm 29, the ramp cover plate 30 moves downwardly to cover the gap 28. As best illustrated in FIGs. 7 and 8, when the ramp is fully deployed, a raised portion of the cam surface of cam 21 may nest in the cutout 60 of the lever arm 25 so that the cover plate 30 is completely lowered to be substantially horizontal. As mentioned above, to facilitate positive coverage of the gap 28 by the cover plate 30, one or more springs such as torsion springs, hinge springs, or the like may be attached to the cover plate 30, cover plate hinges or elsewhere to bias the plate 30 in a horizontal (gap-covering) position. For example, the lever arm 25 may be spring biased at the fulcrum pin 27 so that the cam follower 25a maintains constant contact and accurately follows the cam 21. Now deployed, the ramp 32 may be used to enter or exit the vehicle with the cover plate 30 positioned to conceal the gap 28.
[0023] When ramp stowage is actuated, the hydraulic cylinder 16 moves its arm inward in response to the hydraulic power unit or other motive power source of the drive system 200. The arm and attached gear rack rotate the gear 22 on the shaft 24 to pivot the driving link 26 arcuately upward and inward. The cam 21 rotates with the driving link 26 to communicate the rotational position of the link 26 to the articulated lever assembly comprising the lever arm 25 and actuating arm 29. The cam 21 rotates counterclockwise when viewed from the left end of the ramp enclosure 10 so that the cam surface in contact with the cam follower 25a transitions from a decreased perimeter section (FIG. 8) to an increased perimeter section (FIGS. 7-5). As best illustrated in FIG. 7, the cam surface transition between the raised portion and the depressed portion occurs prior to the inboard edge 261 of the driving link 26 contacting the inboard edge of the cover plate cutout 40. The increased perimeter section (i.e., raised cam surface) of the cam 21 forces the cam follower 25a generally downward to move the inboard end of the lever arm 25 generally upward thereby extending or sliding the actuating arm 29 upward to move and support the cover plate 30 in a generally vertical orientation on the side of the gap 28. The inboard edge 261 of the driving link 26 clears the upwardly pivoting cover plate 30 (see in particular FIG. 7) as the link 26 moves to stow the ramp. The cover plate 30 remains open supported by the actuating arm 29, after the ramp is completely stowed.

[0024] Referring now to FIG. 9, a second exemplary embodiment of the ramp cover mechanism is provided. In this second exemplary embodiment the cover plate 30 is moved by a flexible linkage coupled with the linear actuator. As can be appreciated from FIG. 9, the cover plate 30 is normally biased in a generally upright or vertical position and is pulled downward by the flexible linkage 70. As shown, the flexible linkage 70 includes a cable 72 that is coupled at its first inboard end with the cover plate 30 and at its second outboard end with the movable rod 18 of the linear actuator or hydraulic cylinder 16. Although the flexible linkage 70 is illustrated and discussed hereafter as including a cable 72, the linkage 70 may alternatively include a chain, rope, wire or the like. A tension member illustrated as a spring 74 such as an extension spring may be interposed between the cable’s second end and the rod 18 as shown to tension the cable 72 thereby preventing damage such as binding, fraying or catching in the moving plate 30 when the cable 72 is slack. The cover plate 30 may be biased by employing one or more springs such as torsion springs, hinge springs or the like with the cover plate hinges. Alternatively, commercially available spring-loaded hinges that are known in the art may be used. Further, the normal biasing of the cover plate
30 helps to permit continued operation of the ramp during malfunctions or the like. For example, as can be appreciated, the cover plate 30 will remain in a vertical position to allow the ramp to deploy or stow even if the flexible linkage were to malfunction, break or otherwise de-couple from the rod 18.

[0025] As shown, the inboard end of the cable 72 is attached to the inboard portion of the cover plate 30 whereas the outboard end of the cable 72 includes a loop. The spring 74 couples at one end with the loop and at the other end with the rod 18 or the aforesaid gear rack (not shown) attached to the rod 18. The spring 74 stretches as required when the slot cover 30 is down thereby allowing the fully deployed ramp 32 (FIG. 1) some degree of flexibility in contacting various different ground elevations. In addition, the spring 74 provides for smooth and consistent movement of the cover plate 30 throughout the range of motion of the rod 18. The cable 72 is a predetermined fixed length so that when the ramp 32 is completely deployed the cover plate 30 is held horizontal, the cable 72 is taut and the spring 74 is slightly stretched.

[0026] Operation of the flexible link actuated ramp cover mechanism is hereafter described. The cover plate 30 is biased in a substantially vertical position to allow deployment of the ramp 32 (FIG. 1). When ramp deployment is actuated, the hydraulic cylinder 16 begins to extend its rod 18 outward in response to the hydraulic power unit or other motive power source of the drive system 200. The arm 18 and attached gear rack move linearly outward to rotate the gear 22 disposed on the shaft 24. The gear 22 is affixed to driving link 26, which pivots arcuately upward and outward from below the vehicle floor to unfold the ramp sections 34, 36. The spring 74 that is attached to the rod 18 and/or gear rack stretches and applies tension to the resting cable 72. Subsequently, the cable 72 is drawn taut and begins to pull downward on the cover plate 30 to act against the normal (i.e., vertical) bias of the plate 30. The rod 18 continues to extend in an outboard direction to further rotate the driving link 26 and apply additional tension force on the spring 74 and cable 72 to overcome the plate bias and pull the cover plate 30 downward over the gap 28. When the rod 18 reaches the end of its travel, the ramp 32 is fully deployed and the cover plate 30 is horizontal and conceals the gap 28.

[0027] When ramp stowage is actuated, the linear actuator or hydraulic cylinder 16 moves the rod 18 in an inboard direction in response to the drive system 200. The rod 18 and attached
gear rack (not shown) rotate the gear 22 disposed on the shaft 24 to pivot the driving link 26 arcuately upward and inward to stow the ramp 32. The retraction rod 18 allows the spring 74 to gradually contract so that the tension on the cable 72 is reduced thereby allowing the cover plate 30 to move upward in response to the normal bias of the plate 30 overcoming the tension force of the flexible linkage 70. The cable 72 becomes somewhat slack as the rod 18 retracts further into the cylinder 16. When the rod 18 reaches the end of its travel and is fully retracted into the cylinder 16, the ramp 32 is fully stowed and the cover plate 30 is substantially vertical.

[0028] As known in the art, an exemplary ramp system 100 may include sensors, microswitches or the like to switch off one or more elements of the drive system 200, such as the hydraulic power unit or linear actuator, relative to the orientation of the ramp so that the ramp may stow or deploy under gravity power (known as “float-down” or “gravity-down” operation). As shown in FIG. 1 and 9, these gravity-down microswitches are positioned proximate the shaft 24 on the inside of support plate 23 and are actuated by cams or the like. The sensors or microswitches may complete a circuit, send a signal to or otherwise communicate with the ramp drive system 200 to allow unpowered (i.e., gravity) operation of the ramp. Further, to prevent damage to the ramp or injury to a ramp user, an arrangement of sensors or switches may be employed to disable the ramp from completely stowing when the cover plate 30 is detected to be in an improper orientation (e.g., an obstruction is sensed on the cover plate 30 such that it cannot be raised during ramp stowage). Particularly, to prevent damage to the driving link 26 and ramp assembly, it is important that a sensor or switch operates to detect the position of the driving link 26 prior to the inboard edge 261 of the driving link 26 contacting the inboard edge of the cover plate cutout 40. Further, it is advantageous to detect the orientation of the cover plate 30 and the rotational position of the drive link 26 with respect to the orientation of the cover plate 30 to disable the ramp from stowing when an obstruction is sensed on the cover plate 30. In one exemplary embodiment discussed hereafter, a ramp interlock (as it is known in the art) may be accomplished with switch logic or the like. A cover plate switch 80 (FIG. 9) may be attached on the side wall of the enclosure 10 for detecting the orientation of the plate 30, but the cover plate switch 80 may be oriented otherwise so that the cover plate 30 may contact it when the plate 30 is oriented in a covering (i.e., horizontal) orientation. Moreover, to determine the rotational position of the drive link 26 a drive link position switch 82 (FIG. 9) may be oriented adjacent the shaft 24. As shown, the drive link position switch 82 may be
coincident with or stacked on an existing switch such as one of the foregoing described gravity-down switches. Alternatively, the drive link position switch 82 may also operate to communicate with the ramp drive system 200 for gravity-down operation of the ramp.

[0029] Exemplary embodiments of this invention are described herein. Variations of those exemplary embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. For example, while a hydraulic drive system mentioned above is discussed, an electric drive system may be substituted as an alternative. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.
WHAT IS CLAIMED IS:

1. A ramp cover mechanism for a vehicle wheelchair ramp that is operated by a link that extends from below the vehicle floor, the mechanism comprising:
   a cam coupled with the link for detecting the position of the ramp;
   a movable cover plate having a generally vertical orientation allowing extension of the link and a horizontal orientation for concealing a gap in the vehicle floor surface when the link is extended; and
   an articulated lever assembly in communication with the cam and responsive thereto for moving the cover plate.

2. The mechanism of claim 1 wherein the cover plate comprises a bias that orients the cover plate toward the horizontal orientation.

3. The mechanism of claim 2 wherein the bias comprises gravity.

4. The mechanism of claim 2 wherein the bias comprises a spring.

5. The mechanism of claim 4 wherein the spring comprises a torsion spring.

6. The mechanism of claim 1 wherein the articulated lever assembly comprises:
   a lever arm including a cam follower at a first end for contacting the cam;
   and
   an actuating arm including a first end that couples with a second end of the lever arm and a second end that contacts the cover plate.

7. The mechanism of claim 6 wherein the lever arm further comprises a bias to maintain constant contact of the cam follower with the cam.

8. The mechanism of claim 6 wherein the lever arm is oriented generally horizontal and the actuating arm is oriented generally vertical so that rotation of the cam moves the actuating arm up and down to pivot the cover plate between the generally vertical orientation and the horizontal orientation, respectively.
9. An articulated lever assembly for moving a ramp cover plate relative to the position of a flip-over vehicle wheelchair ramp, the assembly comprising:
   a cam surface having a raised portion and a depressed portion that moves in response to the position of the ramp;
   a lever arm including a cam follower at a first end for communicating with the cam surface; and
   an actuating arm coupled to the lever arm at a second end of the lever arm opposite the first end, the actuating arm moving in response to a transition between the raised and depressed portions of the cam surface for raising and lowering the ramp cover plate.

10. The assembly of claim 9 wherein the lever arm is generally horizontal and the actuating arm is generally perpendicular to the lever arm.

11. The assembly of claim 10 wherein the lever arm comprises a bias to maintain constant contact between the cam follower and the cam surface.

12. The assembly of claim 11 wherein the bias comprises a spring.

13. The assembly of claim 12 wherein the spring comprises a torsion spring.

14. The assembly of claim 9 wherein the lever arm is fulcrumed proximate the cam follower so that the second end is levered up and down by the cam for moving the actuating arm.

15. The assembly of claim 9 wherein the actuating arm comprises an elongate member with a central lengthwise slot that permits the actuating arm to slide up and down.

16. The assembly of claim 15 wherein the actuating arm further comprises a lower end with a pin that mates with the second end.
17. The assembly of claim 16 wherein the second end comprises a second slot to accept and retain the pin.

18. The assembly of claim 17 wherein the second slot comprises an open end so that the second end comprises a forked shape.

19. A ramp cover mechanism for a vehicle wheelchair ramp that is operated by a link that extends from below the vehicle floor in response to a linear actuator having a rod, the mechanism comprising:
   a movable cover plate having a normal bias to a generally vertical orientation allowing extension of the link and a horizontal orientation for concealing a gap in the vehicle floor surface through which the link extends; and
   a flexible linkage including a first end coupled to the linear actuator and a second end coupled to the cover plate so that as the rod moves, the flexible linkage operates to overcome the normal bias to move the cover plate to the horizontal orientation.

20. The mechanism of claim 19 wherein the flexible linkage comprises a cable and a tension member coupled with the cable.

21. The mechanism of claim 20 wherein the tension member comprises a spring.

22. The mechanism of claim 21 wherein the spring comprises an extension spring.

23. The mechanism of claim 19 wherein the first end comprises the tension member.

24. The mechanism of claim 19 wherein the second end comprises the tension member.

25. The mechanism of claim 19 wherein the second end is coupled with the cover plate proximate an inboard edge of the cover plate.
26. The mechanism of claim 19 wherein the flexible member comprises a chain.

27. The mechanism of claim 19 wherein the flexible member comprises a rope.