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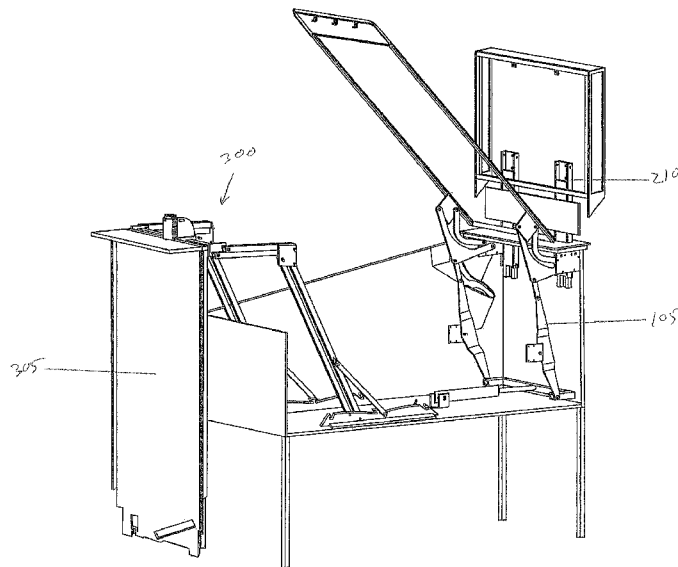


FIG. 54

(57) Abstract: A pinball cabinet and backbox having improved mechanisms for access to the playfield by lifting the glass through a four bar linkage assembly, extraction of the playfield from the cabinet into various positions by utilizing several four bar linkage assemblies to provide access to the entire playfield, and improving the folding of the backbox without interfering with the exterior surfaces of the side panels and backbox.



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TITLE OF THE INVENTION

[0001] Pinball Cabinet and Backbox

CROSS-REFERENCES TO RELATED APPLICATIONS

5 [0002] This application claims the benefit of U.S. Provisional Application Serial No. 62/479,101 filed March 30, 2017 entitled Pinball Machine Top Glass Opening and U.S. Provisional Application Serial No. 62/479,083 filed March 30, 2017 entitled Pinball Playfield Support System. The contents of the above applications are incorporated by reference herein.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

10 [0003] Not applicable.

BACKGROUND OF THE INVENTION

1. Field of the Invention.

[0004] The present invention generally applies to a pinball cabinet.

2. Background of the Related Art.

15 [0005] The structure of pinball cabinets and the associated backboxes have undergone very few design changes in the last several decades. Every pinball cabinet requires a way to remove the glass to access to the playfield and every pinball cabinet requires a way to perform service and maintenance on the playfield, including the components located on the underside of the playfield. Virtually every pinball cabinet requires the backbox to fold on top of the cabinet for shipping purposes. However, the mechanisms and procedures for removing the glass, removing
20 the playfield from the cabinet, and folding the backbox have remained relatively unchanged over the last several decades. These processes are cumbersome, inefficient, aesthetically disruptive, and in some instances unsafe.

[0006] In most pinball cabinets the glass covering the playfield is removed by opening
25 the front panel, unlocking the lockdown bar, closing the front panel, and carefully sliding the glass out of its frame. Once removed the glass must be leaned against a wall or otherwise placed away from the pinball cabinet. The glass was traditionally removed in this manner because the entire top opening of the cabinet needed to be unobstructed in order to remove the playfield. However, this process has numerous drawbacks. The removal is cumbersome especially when
30 access is only needed to retrieve a stuck ball or fix a stuck flipper. Furthermore, since the glass of a pinball cabinet is usually tempered, any nick or crack may result in the glass spidering making it impossible and unsafe to use. The spidering may also cause the glass to crumble and break apart. Additionally the propped up glass is a safety hazard. Finally, since there is usually no frame or visible colorations to the glass, it is difficult to see the glass making it easy for a person
35 to run into it or be tripped by it. A new method was needed to make access to the playfield

simpler and safer without complete removal of the glass. There is a longstanding need for a simple and efficient way to lift the glass without removing it without impacting removal of the playfield.

5 [0007] The backbox typically folds onto the pinball cabinet to provide safer and cheaper shipping. The folding is accomplished through two hinges mounted to the outside of the left and right cabinet panels. While this system works, it disrupts the aesthetics of the side panels and backbox as the hinges and other mechanisms cover artwork. There is a need to create more aesthetically pleasing pinball cabinets without giving up the functionality of a folding backbox.

10 [0008] A typical playfield is mounted onto two rails within the cabinet. When the playfield needs servicing, the glass is removed and the playfield is manually pulled up out of the cabinet. The front of the playfield is pulled up until the playfield is perpendicular to the cabinet. Upon disconnection of certain cables, the entire playfield may be removed from the cabinet. The issue of where to place the playfield becomes an issue. Playfield servicing normally requires access to all aspects of the playfield including the top and bottom of the playfield. The current
15 method of removal of the playfield, or placing it perpendicularly within the cabinet, makes it difficult for the servicer to access all components with ease. A need exists to remove the playfield easily while granting improved access to all aspects of the playfield.

SUMMARY OF THE INVENTION

20 [0009] The present invention improves the basic functions of pinball cabinets. The present invention improves the system for accessing the playfield without removing or handling glass. The glass top assembly is lifted from the front edge and rotates upwards around an axis created by a four bar linkage assembly. The use of a four bar linkage assembly lifts the glass top assembly over the top panel which provides an unobstructed area to access or remove the playfield. Furthermore, the present invention calls for an automated or power assisted lifting
25 mechanism through use of pneumatic/hydraulic cylinders.

[0010] The present invention improves the mechanism used to fold down the backbox without interfering with the artwork on the exterior surfaces of the backbox and side panels. The present invention utilizes a pillar assembly which permits an upper sleeve to slide over a lower sleeve and eventually fold over the lower sleeve. The present invention does not mount or utilize
30 any components that interfere with the exterior surfaces of the backbox or side panels.

[0011] The present invention improves access to the playfield for servicing and maintenance through utilization of two pairs of four bar linkage assemblies. The playfield exists in four positions with the first position in the cabinet ready for use. The second position exposes the playfield outside of the cabinet but partially positioned over the cabinet. The playfield is
35 positioned outside the cabinet and not above the cabinet in the third position. The playfield

remains generally level with the ground in the second and third positions. In the second and third positions, the playfield may rotate 360 degrees such that the underside of the playfield may be rotated to be in the up position. The fourth position results in the playfield rotated down where it is perpendicular to the ground. Each position provides different advantages for accessing all sides
 5 of the playfield.

[0012] Due to the limited space within a pinball cabinet that exists under the playfield, the mechanisms for the above components and systems are designed around each other as spacing for one component may interfere with spacing of other components. The present invention provides a single solution for the problems of accessing the playfield, servicing the playfield, and
 10 folding down the backbox without interfering with the artwork.

BRIEF SUMMARY OF THE DRAWINGS

- [0001] FIG. 1 is a perspective view of an embodiment of the present invention.
- [0002] FIG. 2 is a perspective view of an embodiment of the present invention with the glass top open.
- 15 [0003] FIG. 3 is a perspective view of an embodiment of the glass top opening device.
- [0004] FIG. 4 is a side view of an embodiment of the glass top opening device.
- [0005] FIG. 5 is a front view of an embodiment of the glass top opening device.
- [0006] FIG. 6 is a side view of an embodiment of the glass top opening device in a cabinet.
- 20 [0007] FIG. 7 is a perspective view of an embodiment of the glass top opening device in a cabinet with a side panel removed.
- [0008] FIG. 8 is a close-up perspective view of an embodiment glass top opening device in a cabinet.
- [0009] FIG. 9 is a close-up side view of an embodiment of the glass top opening device
 25 in a cabinet with a side panel removed.
- [0010] FIG. 10 is a cross section view of an embodiment of the glass top opening device in a cabinet through line 7-7 of Figure 7.
- [0011] FIG. 11 is a perspective view of an embodiment of the glass top opening device in a cabinet with a side panel removed and the glass top in the middle open position.
- 30 [0012] FIG. 12 is a cross section view of an embodiment of the glass top opening device in a cabinet with the glass top in the middle open position through line 11-11 of Figure 11.
- [0013] FIG. 13 is a close-up side view of an embodiment of the glass top opening device in a cabinet with a side panel removed and the glass top in the middle open position.
- [0014] FIG. 14 is a perspective view of an embodiment of the glass top opening device
 35 in a cabinet with a side panel removed and the glass top in the open position.

[0015] FIG. 15 is a cross section view of an embodiment of the glass top opening device in a cabinet with the glass top in the open position through line 14-14 of Figure 14.

[0016] FIG. 16 is a close-up side view of an embodiment of the glass top opening device in a cabinet with a side panel removed and the glass top in the open position.

5 [0017] FIG. 17 is a perspective view of an embodiment of the pinball cabinet and backbox.

[0018] FIG. 18 is a side view of an embodiment of the backbox assembly with a side panel of the cabinet removed.

10 [0019] FIG. 19 is a front view of an embodiment of the backbox assembly with the front panel of the cabinet removed.

[0020] FIG. 20 is a perspective view of an embodiment of the pinball cabinet and backbox with backbox in the up position.

[0021] FIG. 21 is a side view of an embodiment of the backbox assembly with a side panel of the cabinet removed with backbox in the up position.

15 [0022] FIG. 22 is a close up perspective view of an embodiment of the backbox assembly with backbox in the up position.

[0023] FIG. 23 is an isolated perspective view of the pillar assemblies with the upper sleeve in a raised position.

[0024] FIG. 24 is cross section view of the line 23-23 in Figure 23.

20 [0025] FIG. 25 is a perspective view of an embodiment of the pinball cabinet and backbox with the backbox in a rotation position.

[0026] FIG. 26 is a side view of an embodiment of the backbox assembly with a side panel of the cabinet removed with the backbox in a rotation position.

25 [0027] FIG. 27 is a close up perspective view of an embodiment of the backbox assembly with the backbox in a rotation position.

[0028] FIG. 28 is a perspective view of an embodiment of the pinball cabinet and backbox with the backbox in the folded position.

[0029] FIG. 29 is a side view of an embodiment of the backbox assembly with a side panel of the cabinet removed with the backbox in the folded position.

30 [0030] FIG. 30 is a perspective view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed.

[0031] FIG. 31 is a side view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed.

35 [0032] FIG. 32 is a side view of an embodiment of the playfield servicing support system.

[0033] FIG. 33 is a back view of an embodiment of the playfield servicing support system.

[0034] FIG. 34 is a rear perspective view of an embodiment of the playfield servicing support system.

5 [0035] FIG. 35 is a perspective view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield partially extracted.

[0036] FIG. 36 is a side view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield partially extracted.

10 [0037] FIG. 37 is a side view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 2.

[0038] FIG. 38 is a perspective view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 2.

[0039] FIG. 39 is a perspective view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 2.

15 [0040] FIG. 40 is a close up rear perspective view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 2.

[0041] FIG. 41 is a perspective view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 3.

20 [0042] FIG. 42 is a side view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 3.

[0043] FIG. 43 is a perspective view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 3.

[0044] FIG. 44 is a side view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 3.

25 [0045] FIG. 45 is a close up rear perspective view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 3.

[0046] FIG. 46 is a close up rear perspective view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 3.

30 [0047] FIG. 47 is a rear perspective view of an embodiment of the playfield servicing support system in a cabinet and the playfield in position 3.

[0048] FIG. 48 is a side view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 3.

[0049] FIG. 49 is a perspective view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 4.

[0050] FIG. 50 is a side view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 4.

[0051] FIG. 51 is a close up perspective view of an embodiment of the playfield servicing support system in a cabinet with a side panel removed and the playfield in position 4.

5 [0052] FIG. 52 is a rear perspective view of an embodiment of the playfield servicing support system, the glass top opening, and backbox assembly in a cabinet with the back panel removed and the playfield in position 1.

[0053] FIG. 53 is a front view of an embodiment of the playfield servicing support system, the glass top opening, and backbox assembly in a cabinet with the front panel removed
10 and the playfield in position 1.

[0054] FIG. 52 is a side perspective view of an embodiment of the playfield servicing support system, the glass top opening, and backbox assembly in a cabinet with a side panel removed and the playfield in position 1.

DETAILED DESCRIPTION

15 [0055] As shown in FIGS. 1, 2, and 7, a pinball game machine 1 comprises legs 2, audiovisual panel 3, cabinet 10, glass top assembly 100, backbox 200, and playfield 305. The cabinet 10 is a generally rectangular shaped box with open slanted top surface comprising a rectangular shaped front panel 11, rectangular shaped back panel 17, rectangular shaped bottom panel 23, rectangular shaped top panel 29, and two side panels 36. The side panels 36 are
20 connected to the front panel 11, the bottom panel 23 and the back panel 17. The top edge of the side panels consists of a top flat edge 42 and top slant edge 43. The top panel 29 is connected to the top flat edges 42 of the side panels 36 and the back panel 17. The support legs 2 extend from the bottom panel 23.

[0056] As seen in FIGS. 3 and 4, a glass top assembly 100 comprises glass 101 encased
25 by a frame 110. The front edge 111 of the frame 110 generally corresponds in length to the top edge 14 of the front panel 11. The side edges 112 of the frame 110 generally correspond in length to the top slant edges 43 of the side panels 36. The back edge 113 of the frame 110 generally corresponds in length to the front edge 32 of the top panel 29. A flap 114 extends beyond the top of the back edge 113. In the closed position as seen in FIG. 10, the flap 114 covers the junction
30 between the back edge 113 of the frame and the front edge 32 of the top panel 29. A lock down bar 115 is positioned along the front edge 111 of the frame 110. When the glass top assembly 100 is in the closed position, the front edge 111 is in contact with the top edge 14 of the front panel 11 and the side edges 112 are in contact with the top slant edges 43 of the side panels 36. When the glass top assembly 100 is in the open configuration as seen in FIG. 2, the glass top assembly 100
35 pivots near and above the front edge 32 of the top panel 29. A playfield 305 is positioned within

the cabinet 10 and is positioned between the interior surfaces 37 of the side panels 36.

[0057] The glass top opening assembly 105 is described in reference to FIGS. 1-17. FIGS. 1, 3-5, and 7-10 show the glass top assembly 100 in the closed position. FIGS. 11 - 13 show the glass top assembly 100 in a half open position. FIGS. 2, 14-17 show the glass top assembly 100 in an open configuration.

[0058] As seen in FIGS. 3-5, the glass top opening assembly 105 is isolated from the rest of the pinball machine 1. The glass top opening assembly 105 generally comprises the glass top assembly 100, a cylinder assembly 120, a torque plate 140, a linkage 150, and a four bar linkage assembly 160.

[0059] As seen in FIGS. 3-5, 7, and 10, the cylinder assembly 120 comprises a cylinder 121 with piston 122 hydraulically or pneumatically connected to the piston aperture 131 of the cylinder 121. The back end 132 of the cylinder 121 is connected to a mount 123 via a pivot point 124. The pivot point 124 permits the cylinder 121 to rotate in relation to the mount 123. The cylinder 121 is positioned in the middle of the bottom panel 23 and oriented parallel to the side panels 36 such that the back end 132 faces the front panel 11 and the piston aperture 131 faces the back panel 17. The end 125 of the piston 122 is connected to the midpoint of a cross bar 126 having terminal ends 127. The cross bar 126, the piston 122, and cylinder 121 are fixed and cannot rotate independently of each other. A rectangular spacer 128 is connected to the terminal end 127 of the cross bar 126. The spacer 128 extends perpendicularly from the cross bar 126 towards the front panel 11 and parallel with the side panels 36. In this embodiment the spacer 128 is fixed to the cross bar 126 and cannot move independently from the cross bar. It should be appreciated from the figures that the glass top opening assembly 105 is a mirror image down a central axis as shown in FIG. 7. As a result, only one reference number is utilized for many of the components even though there is a complimentary component positioned on the opposite side of the central axis. For example, there are two spacers 128 on for each of the terminal ends 127 of the singular cross bar 126.

[0060] A torque plate 140 is connected at its lower terminal end 141 to the end of each spacer 128 at the spacer pivot joint 130. This connection permits the torque plate 140 to pivot in relation to the spacer 128. The torque plate 140 is comprised of several sections: lower planar portion 142, first angled portion 143, middle planar portion 144, second angled portion 145, and upper planar portion 146. As seen in FIG. 5, the lower planar portion 142 extends generally upward and perpendicularly in relation to the cross bar 126. The first angled portion 143 extends from lower planar portion 142 generally upwards in relation to the cross bar 126 but extends away from the cylinder 121 or away from its opposing first angled portion 143. The middle planar portion 144 extends from the first angled portion 143 generally upward and perpendicularly in

relation to the cross bar 126 and the lower planar portion 142. The second angled portion 145 extends from the middle planar portion 144 generally upwards in relation to the cross bar 126 but extends away from the cylinder 121 or away from its opposing second angled portion 145. The upper planar portion 146 extends from the second angled portion 145 generally upward and perpendicularly in relation to the cross bar 126 and the lower planar portion 142 and middle planar portion 144. The torque plate 140 terminates at the upper terminal end 147. The torque plate mount 148 is connected to the middle planar portion 144 at the torque plate pivot point 149. The torque plate 140 may rotate around the axis created by the torque plate pivot point 149. As seen in FIG. 7, the first angled portion 143 and second angled portion 145 angle towards the interior surface 37 of each side panel 36.

[0061] The elongated oval shaped linkage 150 has a lower end 151 and an upper end 153. The upper terminal end 147 of the torque plate 140 connects to the lower end 151 of the linkage 150 at lower linkage pivot point 152. The torque plate 140 and the linkage 150 may pivot in relation to each other at the lower linkage pivot point 152.

[0062] The four-bar linkage assembly 160 comprises a long link 161 and a short link 165. The long link 161 is generally shaped like a right triangle with the hypotenuse of the triangle curved. The long link 161 has a right angle pivot point 162 positioned at the right angle, and a sidewall pivot point 163 and a frame pivot point 164 positioned at the other two angles respectively. The short link 165 is generally planar having an approximate ninety degree curve and a sidewall pivot point 166 and a frame pivot point 167 positioned on its opposing ends. The right angle pivot point 162 of the long link 161 connects to the upper end 153 of the linkage 150. This permits the long link 161 to pivot in relation to the linkage 150.

[0063] The sidewall pivot point 163 of the long link 161 and the sidewall pivot point 166 of the short link 165 connect to the sidewall mount 168. The sidewall mount 168 is generally rectangular shaped and connected to the interior surface 37 of the side panel 36. The sidewall mount 168 is positioned adjacent the back edge 41 and the top flat edge 42 of the side panel 36. The sidewall pivot point 163 of the long link 161 is positioned on the sidewall mount 168 in the corner adjacent the back edge 41 and the top flat edge 42. The sidewall pivot point 166 of the short link 165 is positioned on the opposite side of the sidewall pivot point 163 but remains adjacent the top flat edge 42. The sidewall mount 168 is fixed to the side panel 36 and does not move independently.

[0064] The frame pivot point 164 of the long link 161 and the frame pivot point 167 of the short link 165 connect to the frame mount 169. The frame mount 169 is generally rectangular shaped and connected to the side edge 112 of the frame 110 near the back edge 113. The frame pivot point 167 of the short link 165 is positioned on the frame mount 169 in the corner closest to

the side edge 112 and the back edge 113. The frame pivot point 164 of the long link 161 is positioned on the opposite corner from the frame pivot point 167. The frame mount 169 does not move independently from the frame 110.

[0065] As seen in FIGS. 7, 9, and 10, the mount 123 of the cylinder assembly 120 is
5 connected to the interior surface 24 of the bottom panel 23. The mount 123 is fixed and does not move in relation to the bottom panel 23. The torque plate mount 148 is connected to the interior surface 37 of the side panel 36. The location of the torque plate mount 148 on the side panel 36 is generally in line with the piston aperture 131 of the cylinder 121. The sidewall mount 168 is connected to the interior surface 37 of the side panel 36 adjacent to the back panel 17 and top
10 panel 29. The torque plate mount 148 and sidewall mount are fixed.

[0066] As seen in FIG. 6 - 9, the interior surface 37 of the side panel 36 comprises an inset surface 44 that is depressed from interior surface 37. The inset surface 44 corresponds in shape and thickness to various portions of the glass top opening assembly 105 and the movements of those components. The inset surface 44 comprises the upper planar portion inset 45, the linkage inset 46, the four bar linkage assembly inset 47, frame mount inset 48, and sidewall mount
15 inset 49. As seen in FIG. 8, the playfield 305 spans the distance between the interior surface 37 of each side panel 36. The inset surface 44 permits the upper planar portion 146 of the torque plate 140, the linkage 150 and the four-bar linkage assembly 160 to move within the inset surface 44 and not interfere with the playfield 305. The thickness of the torque plate 140, the linkage 150
20 and the four-bar linkage assembly 160 is limited such that when each respective component is within the inset surface 44, the respective component is below the interior surface 37 such that it will not come into contact with the side edge 310 of the playfield 305. Furthermore, the shape of the inset surface 44 is modified to guide or control the movement of the torque plate 140, the linkage 150 and the four-bar linkage assembly 160.

[0067] In one embodiment, the cylinder 121 is a double acting cylinder providing
25 assistance as the piston 122 extends and contracts from the cylinder 121.

[0068] In one embodiment as seen in FIGS. 3-4, 7, 10-12, and 14-15, the cylinder is in fluid communication with a compressor 180 via a compressor supply tube 181. An actuator 182 is in fluid communication with compressor 180 via an actuator tube 183. Activation of the
30 actuator causes the compressor to supply air or fluid into the cylinder 121 causing the piston 122 to extend out of the cylinder 121 which ultimately causes the glass top assembly to open.

[0069] FIGS. 7-10 show the glass top opening assembly 105 in the closed position. In the closed position, the piston 122 is not extended from the cylinder 121. In this position, the cross bar 126 is at its closest position to the front panel 11 and furthest position from the back
35 panel 17. The torque plate 140 is angled in such a position that the lower planar portion 142 is

positioned closer to the front panel 11 and the upper planar portion 146 is positioned towards the back panel 17. The linkage 150 is positioned such that the lower end 151 is closer to the back panel 17 and bottom panel 23 whereas the upper end 153 is closer to the front panel 11 and top panel 29. The long link 161 of the four bar linkage assembly is positioned with the right angle pivot point 162 towards the bottom panel 23 and directly underneath the top panel 29. The short link 165 is positioned with the apex of the curve towards the bottom panel 23 and directly underneath the top panel 29.

[0070] The operation of the glass top opening assembly is described in reference to the glass top opening starting in a closed position as shown in FIG. 1 and progressing to a fully open position as shown in FIG. 2. FIGS. 11-13 show the glass top assembly 100 in a halfway open position and FIGS. 14-16 which show the glass top assembly in the fully open position. The following description is made in reference to the piston 122 initiating the force to ultimately move the glass top assembly to the fully open position.

[0071] The actuator 182, initiated through manual input or through electronic means, activates the compressor 180 through actuator tube 183 to supply a pressurized air or fluid into the cylinder 121 through compressor supply tube 181. Once the cylinder pressurizes, the piston 122 extends from the cylinder 121 which pushes the cross bar 126 towards the back panel 17 and slightly up towards the top panel 29. The mount pivot point 124 permits the cylinder 121, piston 122, and cross bar 126 to rotate upwards towards the top panel 29 and away from the bottom panel 23. As the cross bar 126 moves towards the back panel 17, the lower terminal end 141 of the torque plate 140 is pulled towards the back panel 17 causing the torque plate 140 to rotate in a counterclockwise direction (in relation to FIG. 12) around the torque plate pivot point 149. The torque plate mount 148 prevents the torque plate 140 from moving in any direction other than rotation around the torque plate pivot point 149. The upper planar portion 146 rotates towards the front panel 11 within the upper planar portion inset 45. The rotation of the upper planar portion 146 pushes the upper end 153 of the linkage 150 towards the front panel 11 and away from the bottom panel 23. The linkage 150 moves within the linkage inset 46. The movement of linkage 150 pushes the four bar linkage assembly 160 resulting in a clockwise rotation at the right angle pivot point 162, sidewall pivot point 163 and frame pivot point 164 of the long link 161 and the sidewall pivot point 166 and frame pivot point 167 of the short link 165. The four bar linkage assembly 160 rotates within the four bar linkage inset 47. Because the sidewall mount 168 is fixed within the sidewall mount inset 49, the frame mount 169 rotates clockwise as a result of the force applied by the long link 161 and interactive force applied by the short link 165. The frame mount 169 rotates out of the frame mount inset 48. As seen in FIGS. 11-13, the force applied to the right angle pivot point 162 of the long link 161 causes an interaction between the long link

161 and short link 165 that results in the frame 110 lifting up and rotating over the front edge 32 of the top panel 29. As seen in FIGS. 14-16, the frame 110 continues to rotate until the desired extension of the piston 122 is achieved. At full extension, the glass top assembly 100 is completely disengaged from the top edge 14 of the front panel 11 and the top slant edge 43 of the side panels 36. The back edge 113 of the frame 110 is positioned above the exterior face 31 of the top panel 29.

[0072] An ordinary skilled artisan would understand the force may also be applied at the front edge 111 of the frame 110 to initiate the force to move the glass top assembly to the fully open position. Such force may be applied through lifting upwards at or near the front edge 111 or lock down bar 115. Furthermore, to push the glass top assembly 100 to the closed position, a downward manual force may be applied to the front edge 111 or lock down bar 115. In another embodiment, the actuator 182 may be activated causing the cylinder to actively depressurize and/or retract the piston 122. In another embodiment, the depressurization may of the cylinder may permit the weight of the glass top assembly, through gravity, apply the down ward force.

[0073] An ordinary skilled artisan would understand the benefits and specific designs of the glass top assembly may be modified to fit the specific needs of the cabinet. The location of the other components, such as the playfield servicing support system, backbox assemblies and other items may create space constraints that require modification of the disclosed embodiment.

[0074] An ordinary skilled artisan would understand each pivot point creates an axis of rotation and that the design above discloses nine axes of rotation: cylinder mount pivot point 124, spacer pivot point 130, torque plate pivot point 149, lower linkage pivot point 152, right angle pivot point 162, sidewall pivot point 163 and frame pivot point 164 of the long link 161, and the sidewall pivot point 166 and frame pivot point 167 of the short link 165.

[0075] If space were plentiful, a skilled artisan could modify the teachings of the present system to reduce the number of axis of rotation down to a minimum of three axis of rotation. For example, the four bar linkage assembly may be replaced with a piano hinge if it is unnecessary to raise the back edge of the frame 110 over and above the top panel 29. Similarly, it may be possible to mount the cylinder assembly to the back panel and thereby reduce the number of linkages necessary to transfer the energy.

[0076] Furthermore, the specific design and lengths of the components may be changed depending on location of playfield within the cabinet and whether there is space between the edge of the playfield and the interior face of the side panels. For example, the spacer may be eliminated depending on the mounting of the cylinder. An ordinary skilled artisan may utilize this disclosure to make adjustments to the glass top opening assembly to fit within the specific cabinet.

[0077] As seen in FIGS 17-29, the backbox 200 is a generally rectangular shaped box comprising a front panel 201, back panel 202, bottom panel 203, top panel 204, and side panels 205. The front panel 201 generally features audio and or visual components. The exterior surface 206 of the side panels 205 may feature audiovisual components and/or artwork. Similarly, the exterior surface 38 of the cabinet side panels 36 may feature artwork that is related or connected to the artwork on the surface of the backbox side panels 205.

[0078] The backbox 200 is attached to the cabinet 10 through two pillar assemblies 210. As seen in FIGS. 23 and 24, each pillar assembly comprises a lower sleeve 220 and an upper sleeve 240.

[0079] The lower sleeve 220 is generally rectangular shaped with a front panel 221, rear surface 226, and side surfaces 231. The bottom end 222 of the front surface 221 has a square shaped cutout 223 to provide access to the rear surface 226. The top end 224 of the front surface 221 has a U-shape cutout 225. The bottom end 227 of the rear surface 226 has two holes 228 in which screws, bolts or other fasteners may insert. The square cutout 223 of the front surface 221 provides access to the holes 228. The top end 229 of the rear surface 229 has a U-shape cutout 230 that matches the U-shape cutout 225 of the front surface 221. Each side surface 231 has a channel 233 that extends from just above the square cutout portion 223 of the front surface 221 to near the top end 234. The portion of the side surface 231 between the channel 233 and the top end 234 is referred to as the stopper portion 235.

[0080] The upper sleeve 240 is generally rectangular shaped with a front surface 241, rear surface 246, and side surfaces 250. A fold over gap 243 is present at the bottom end 242 of the front surface 241. An access gap 245 is present at the top end 244 of the front surface 241. The rear surface 246 has a bottom end 247 and a top end 248. Near the top end 248 are holes 249 in which screws, bolts or other fasteners may insert. The side surfaces 250 have a hole 251 disposed near the bottom end 252.

[0081] As seen in FIG. 24, the interior length and width of the upper sleeve 240 is greater than the exterior length and width of the lower sleeve 220 such that the lower sleeve may slide into the upper sleeve 240. As assembled, a bolt 255 is secured through the hole 251 of the upper sleeve 240, through the channel 233 of the lower sleeve 220 and through the hole 251 of the opposing side surface 250 of the upper sleeve 240.

[0082] As seen in FIGS. 18 and 19, the lower sleeve 220 is connected to the interior surface 18 of the back panel 17 through holes 228. The upper sleeve 240 is secured to the interior surface of the backbox 200 back panel 202 through holes 249. The pillar assemblies 210 extend through the top panel 29 through pillar assembly holes 35. The upper sleeve 240 is positioned over the lower sleeve 220 such that the bolt 255 is resting on the bottom of the channel 236. Each

pillar assembly 210 is secured to the cabinet 10 and the backbox 200 in such a manner that the bottom of the channel 236 and the stopper portion 235 in each lower sleeve are level. The bottom of the channel should be level to provide even support for the backbox 200 during operation and to keep the back box from tilting. The stopper portions 235 should be level for ease of folding the
5 backbox 200.

[0083] The lower sleeve 220 and upper sleeve 240 are made of a sturdy material that is not subject to significant bending or flexing.

[0084] Transition of the backbox 200 into the folded position is described in reference to FIGS 21 - 22 and 25-29. As seen in FIGS 21-22, the backbox 200 extends upwards allowing
10 the upper sleeve 240 to slide over the lower sleeve 220 until the bolt 255 hits the stopper portion 235 of the lower sleeve 220. As seen in FIGS 25-27, the fold over gap 243 in the upper sleeve 240 permits the upper sleeve 240, and the attached back box 200, to rotate towards the glass top assembly 100 along the axis of rotation created by the bolt 255. As seen in FIGS. 28 and 29, the backbox 200 stops rotating once something blocks its rotation such as the glass top assembly 100.

[0085] None of the functional components of the pillar assemblies are located on, or interfere with, the exterior surface 38, 206 of the side panels 36 on the cabinet 10 or the side panels 205 on the backbox 200.
15

[0086] The disclosed embodiment utilizes two pillar assemblies to support the backbox. An ordinary skilled artisan would understand from the teachings that one pillar assembly may be utilized or, conversely, more than two. Components related to the playfield,
20 glass top opening, or other components may affect whether one, two, or more pillar assemblies are utilized.

[0087] As seen in FIGS. 30-34, the playfield servicing support system 320 comprises a playfield 305, a playfield connection 320, and a pair of support legs 325. The playfield 305
25 comprises a playing field 306 and a back stop 314. The playing field 306 comprises a top surface 307, bottom surface 308, front edge 309, and side edges 310. An upper channel is positioned along the top surface 307 and adjacent each side edge 310. A lower channel 312 is positioned along the bottom surface 308 and adjacent each side edge 310. When the playfield is in the cabinet 10, the lower channel 312 rests on pins (not pictured) that extend from each side panel 36.
30 Handle openings are disposed through the playing field 306 near the front edge 309. A back stop 314 is connected to the playing portion 306 and extends along the back edge. Although not pictured, game features such as flippers, toys, lights, and other features are typically positioned on the top surface 307 with electromechanical equipment positioned on the bottom surface 308.

[0088] Each support leg 321 comprises a base 330, a long four bar linkage assembly
35 340, a connecting plate 350, and a short four bar linkage assembly 360. The base 330 is an

elongate member having a relatively flat bottom surface 331 with various features on the top surface 332. Each base 330 is mounted to the interior surface 24 of the bottom panel 23 and runs parallel to, and nearly adjacent to, the side panel 36. The front end 333 is positioned towards the front panel 11 and the back end 334 is positioned near middle of the bottom panel 23 as determined by length. The back end 334 slopes from the top surface 332 to the bottom surface 331 forming a ramp in relation to the bottom panel 23. A positioning notch 335 is formed in the top surface adjacent to the back end 334 and at the end of the ramp. A middle back slope 336 extends from the positioning notch 335 towards the front end 333 and terminates into a middle positioning notch 337.

10 [0089] A long four bar linkage assembly 340 connects to the base. The long four bar linkage assembly comprises as a top long link 341 and a bottom long link 342. The top long link 341 and a bottom long link 342 are identical in length. The top long link 341 connects at one end to the base 330 at the front long link pivot point 338 and on the other end to a connecting plate 350 at the top long link pivot point 351. The bottom long link 342 connects at one end to the base 15 330 at the back long link pivot point 339 and on the other end to a connecting plate 350 at the bottom long link pivot point 352. The front long link pivot point 338 is positioned on the base 330 near the front end 333 and the back long link pivot point 339. One end of a positioning bar 343 is attached to the outside of the bottom long link 342. A positioning pin 344 is attached to the other end of the positioning bar 343.

20 [0090] In relation to FIG. 32, the connecting plate 350 is a generally square with a front side 355, bottom side 356, top side 357, and back side 358. The top long link pivot point 351 is positioned adjacent the front side 355 just below the midpoint of the front side 355. The bottom long link pivot point 352 is positioned adjacent the bottom side 356 near the back side 357. Additionally, a short four bar linkage assembly 360, comprising a front short link 361 and back short link 362, connects to the connecting plate 350. The front short link 361 connects to the 25 connecting plate at the front short link pivot point 353 and the back short link 362 connects to the connecting plate at the back short link pivot point 354. The front short link pivot point 353 is positioned adjacent the front side 355 just above the midpoint of the front side 355. The back short link pivot point 354 is positioned in the corner adjacent to the top side 357 and back side 30 358.

[0091] The playfield connection 325 comprises a pair of sectional cross bars 370, a pivot plate 385, a rod 389 positioned within a sleeve 388, and a cross beam 395. The sectional cross bar 370 is generally rectangular having a linkage side face 371 on one end and a pivot plate connection 380 on the other end. As seen in FIG. 32, the linkage side face 371 is generally 35 rectangular having a front side 372, bottom side 373, top side 374, and back side 375. The

sectional cross bar 370 is parallel to the back stop 314. The front short link 361 and the back short link 362 connect to the linkage side face 371 at the front short link pivot point 376 and back short link pivot point 377 respectively. The front short link pivot point 376 is positioned adjacent the front side 372 and bottom side 373. The back short link pivot point 377 is positioned adjacent the top side 374 and back side 375.

[0092] A pivot plate 385 is positioned between and connected to the pivot plate connection 380 of each sectional cross bar 370. The pivot plate 385 is secured to each sectional cross bar 370 through locking pin 386 and removable locking pin 387. Mounted on top of the pivot plate 385 is a cylindrical sleeve 388. A corresponding rod 389 is secured within the sleeve 388 such that it may rotate but not slide out of the sleeve 388. A locking pin 390 may be utilized to restrict the rotational movement of the pin within the sleeve 388. A cross beam 395 is secured to the rod 388. The cross beam is secured to the rear surface 315 of the back stop 314 of the playfield 305.

[0093] Operation of the playfield service support system is described in reference to FIGS. 30, 35 - 51. In position 1, the playfield 305 is supported in the cabinet 10 through pins on the side panels 36. The glass top opening assembly 105 may be utilized to obtain access to the playfield 305. Alternatively, the glass 101 may be removed by conventional means.

[0094] To initiate the playfield servicing support system 300, the playfield 305 is pulled up using the handle openings 313. As seen in FIGS. 35 and 36, the pulling force on near the front edge 309 of the playfield 305 causes the playfield to rotate clockwise around the linkage side face 371 through the front short link pivot point 376 and the back short link pivot joint 377. The pulling force on the handle openings 313 also causes the short four bar linkage assembly 360 to rotate in the counterclockwise direction around the connecting plate 350, through front short link pivot point 353 and the back short link pivot point 354, towards the front panel 11 while lifting the entire playfield 305 up. Initially this action causes the connecting plate 350 to move closer to the bottom panel 23. As the playfield 305 continues its upward and forward movement, the long four bar linkage assembly 340 pivots counterclockwise (in relation to FIGS. 36 and 37) around the base 330. As the bottom long link 342 rotates, the positioning bar 343 rotates towards the base 330 causing the positioning pin 344 to drag across the bottom panel 23 towards the base 330. The short four bar linkage assembly 360 and the long four bar linkage assembly 340 permit the back stop 314 of the playfield 305 to move under the top panel 29 before emerging out of the cabinet.

[0095] As seen in FIGS. 37-40, the positioning pin 344 ultimately engages the ramp of the back end of the base and moves into the positioning notch 335. The positioning bar 343 and the positioning pin 344 support the long four bar linkage assembly 340 and prevent it from

rotating clockwise or back into the cabinet 10. At this position, position 2, the short four bar linkage assembly 360 is generally parallel with the bottom panel 23 and cannot rotate any further towards the bottom panel 23. As a result, the playfield 305 remains in relatively level position.

[0096] To remove the positioning bar 343 from the positioning notch 335, the playfield 5 305 is pulled forward which causes the long four bar linkage assembly 340 to rotate counterclockwise which causes the positioning pin 344 to move upwards and towards the front panel 23. Once cleared of the positioning notch 335, the user may then push the playfield towards the back panel to place the playfield back in the cabinet or continue pulling. If playfield is continued to be pulled, the long four bar linkage assembly 340 continues to rotate 10 counterclockwise. This causes the positioning pin 344 to drag across the middle back slope 336 of the base 330 and into the middle positioning notch 337 as seen in FIGS 42-45. In position 3, the short four bar linkage assembly 360 is generally parallel with the bottom panel 23 and cannot rotate any further towards the bottom panel 23. As a result, the playfield 305 remains in relatively level position.

[0097] In positions 2 and 3, the playfield may rotate 360 degrees along the rotational 15 axis of the rod 389 within the sleeve 388. To permit rotation, the locking pin 390 is removed or loosened such that the playfield 305 may be rotated. Once at the desired level of rotation as seen in FIGS 47-48, the locking pin 390 may be reinserted or tightened to prevent further rotation of the rod 389 within the sleeve 388.

[0098] In position 3, the playfield may be folded down into position 4 as seen in FIGS. 20 49-51. While in position 3, the removable locking pin 387 is removed causing the pivot plate 385 to rotate counterclockwise around the axis defined by the locking pin 386. Once the desired level of rotation is obtained, generally 90 degrees, the removable locking pin is reinserted into the pivot plate 385 to prevent further rotation.

[0099] The disclosed embodiment utilizes two pairs of support legs 320. An ordinary 25 skilled artisan would understand from the teachings that one support leg may be utilized or, conversely, more than two. A single support leg, if utilized would likely be positioned in the middle of the bottom panel in order to distribute weight equally. However, in the disclosed invention, the glass top opening utilizes a cylinder assembly that is positioned in the middle of the 30 bottom panel. Based on the space available, the disclosed embodiment of the support legs was preferred.

[00100] An ordinary skilled artisan would understand from the teachings that there may 35 be multiple intermediary positions between position 3 and 4. Additional holes may be placed in the pivot plate and pivot mount plate such that the removable pin may be placed in multiple locations depending on the amount of fold desired.

[00101] As seen in FIGS. 52-54, the present invention must factor in the spatial relationships and movements of all the components. The glass top opening assembly 105 must be designed to not only lift the glass top assembly 100 high enough to provide clearance for removal of the playfield through the playfield servicing support system, but must also do so without cutting down the width of the playfield or interfering with the artwork on the exterior of the side panels 36. Furthermore, the pillar assemblies must be designed to avoid the playfield connection componentry that is positioned towards the back panel 17.

[00102] An ordinary skilled artisan would understand certain dimensions of one part will affect dimensions of other parts. For example, the dimensions of the top panel effect the sizes of the four bar linkage systems of the playfield servicing support system 300 and the glass top opening system 105. Similarly, the degree of slope of the top slant edge 43 of the side panel 36 effects the dimensions of the four bar linkage systems of the playfield servicing support system 300 and the height necessary to lift the glass 101. However the principals taught in the specification would educate an ordinary skilled artisan to make the changes depending on the relative dimensions and design of the cabinet 10.

[00103] The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated. It will be understood by one of ordinary skill in the art that numerous variations will be possible to the disclosed embodiments without going outside the scope of the invention as disclosed in the claims.

25

Claims

We claim:

1. A pinball machine comprising:
a cabinet;
5 a glass panel having a frame connected to a glass opening assembly comprising a four bar link assembly;
a backbox connected to the cabinet by at least one pillar assembly wherein the pillar assembly comprises an upper sleeve slidably attached to a lower sleeve; and a
playfield service support assembly comprising a playfield, a playfield connection, and at
10 least one support legs.
2. A pinball machine of claim 1 wherein the at least one support legs comprises at least one four bar linkage assembly.
3. A pinball machine of claim 1 wherein the at least one support legs comprises at least two four bar linkage assemblies.
- 15 4. A pinball machine of claim 1 wherein the playfield is rotatably connected to the playfield connection.
5. A pinball machine of claim 1 wherein the glass opening assembly has at least three axes of rotation.
- 20 6. A pinball machine of claim 1 wherein the glass opening assembly further comprises a gas cylinder mechanically connected to the four bar linkage.

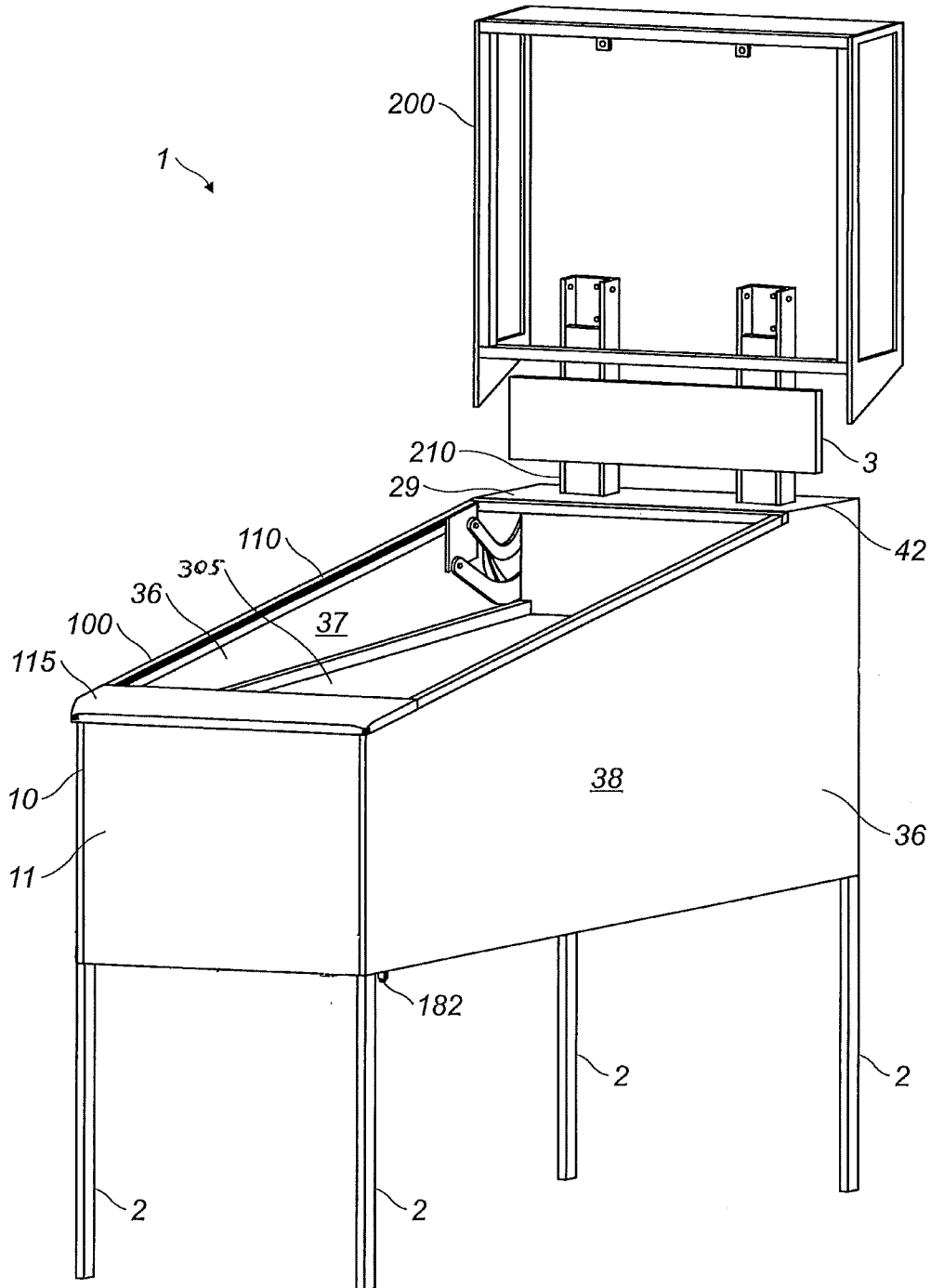


FIG. 1

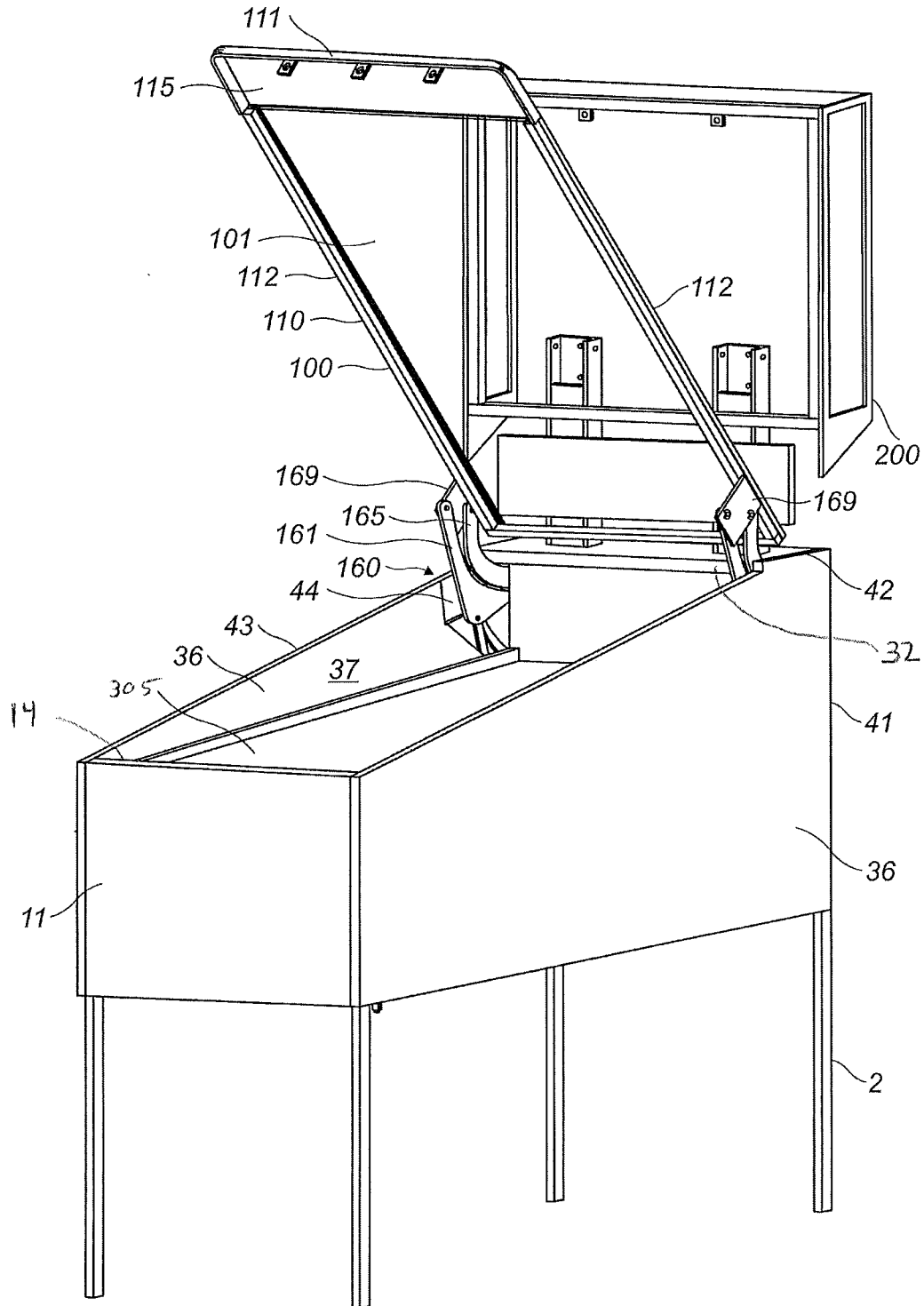


FIG. 2

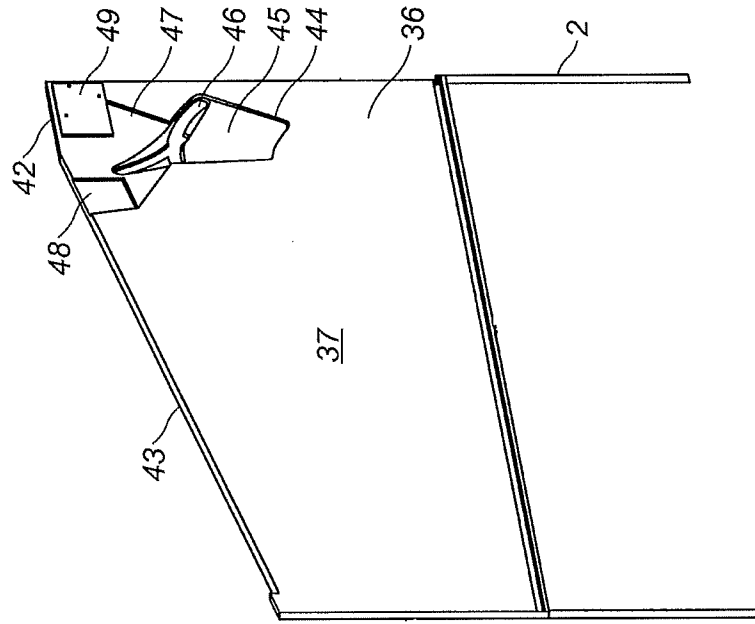


FIG. 6

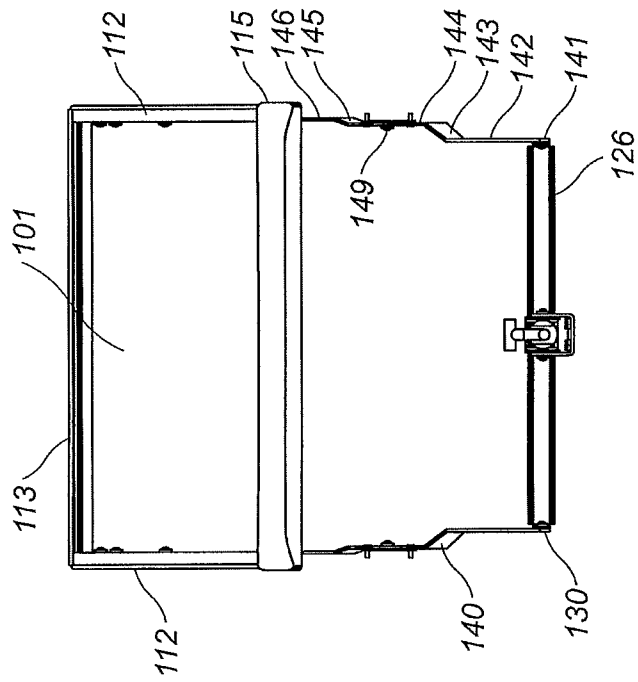


FIG. 5

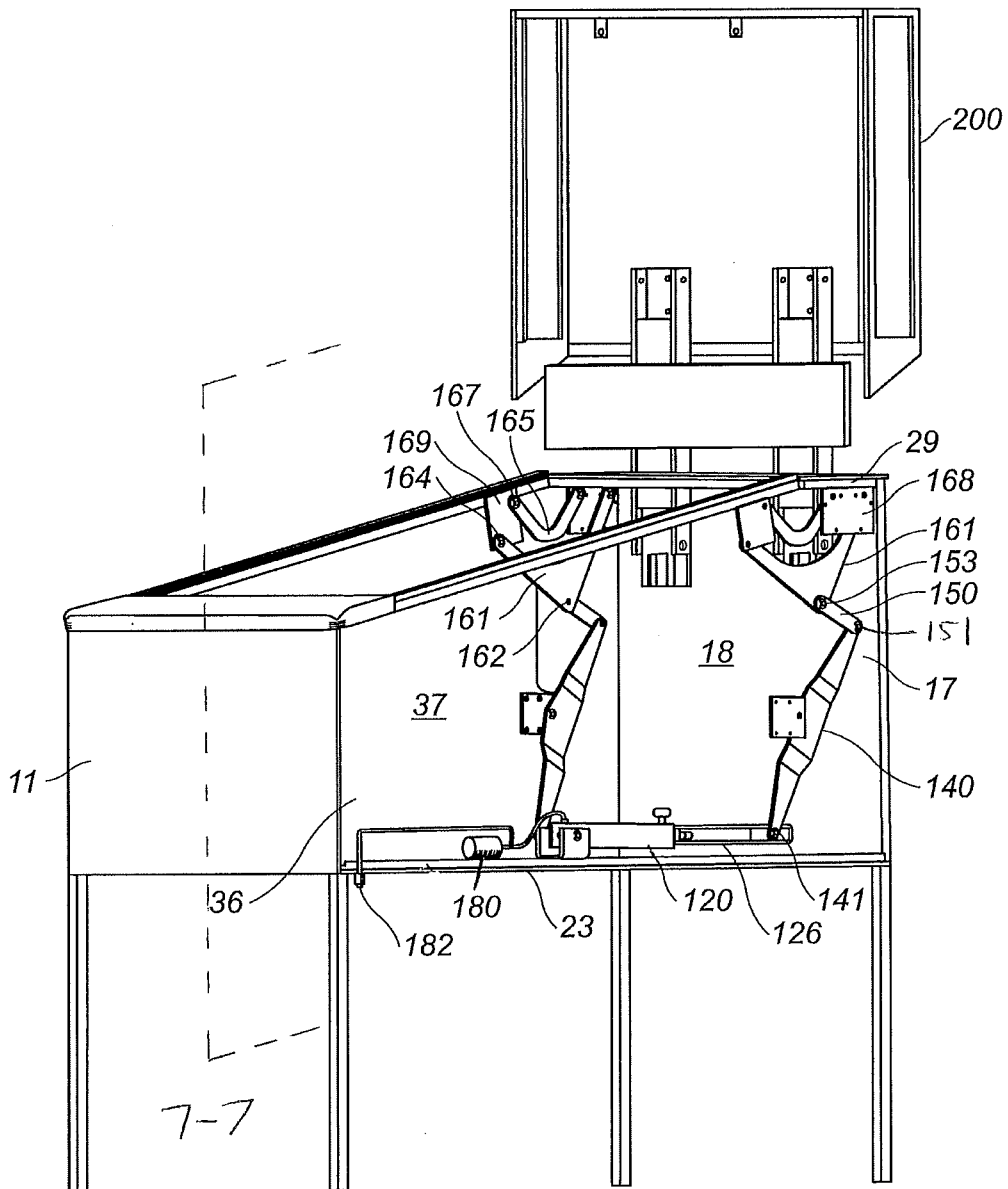


FIG. 7

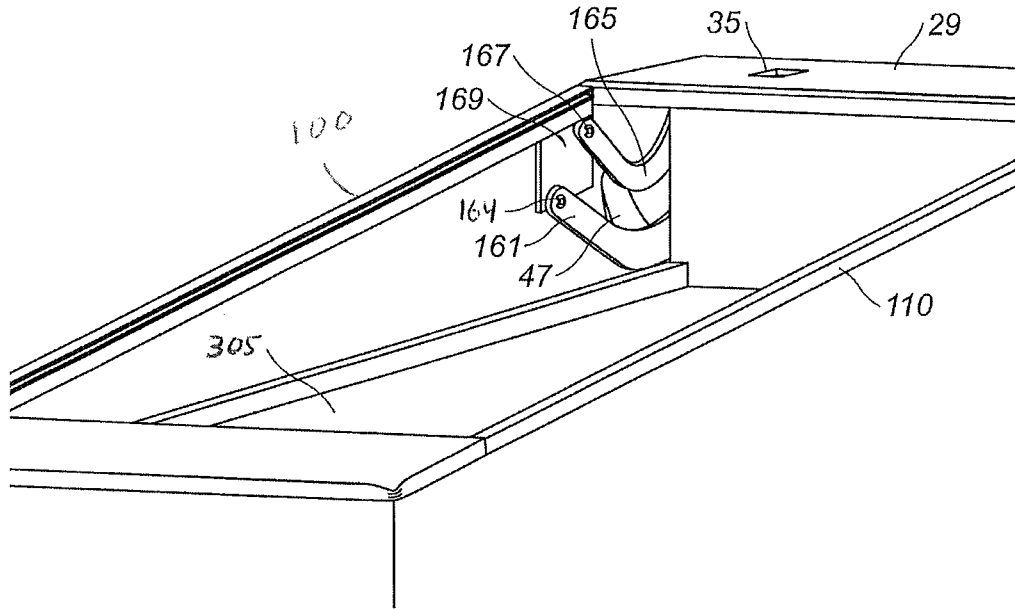


FIG. 8

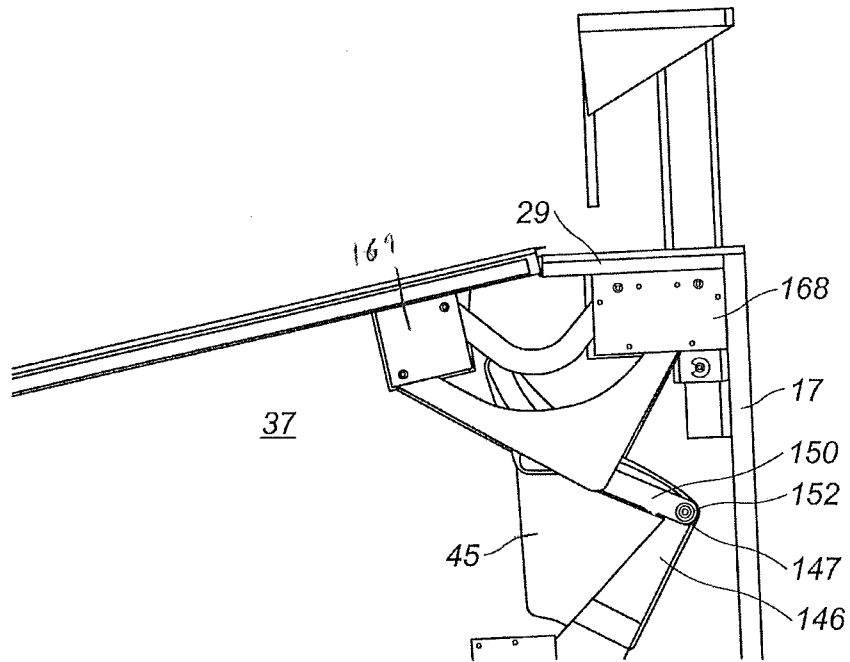


FIG. 9

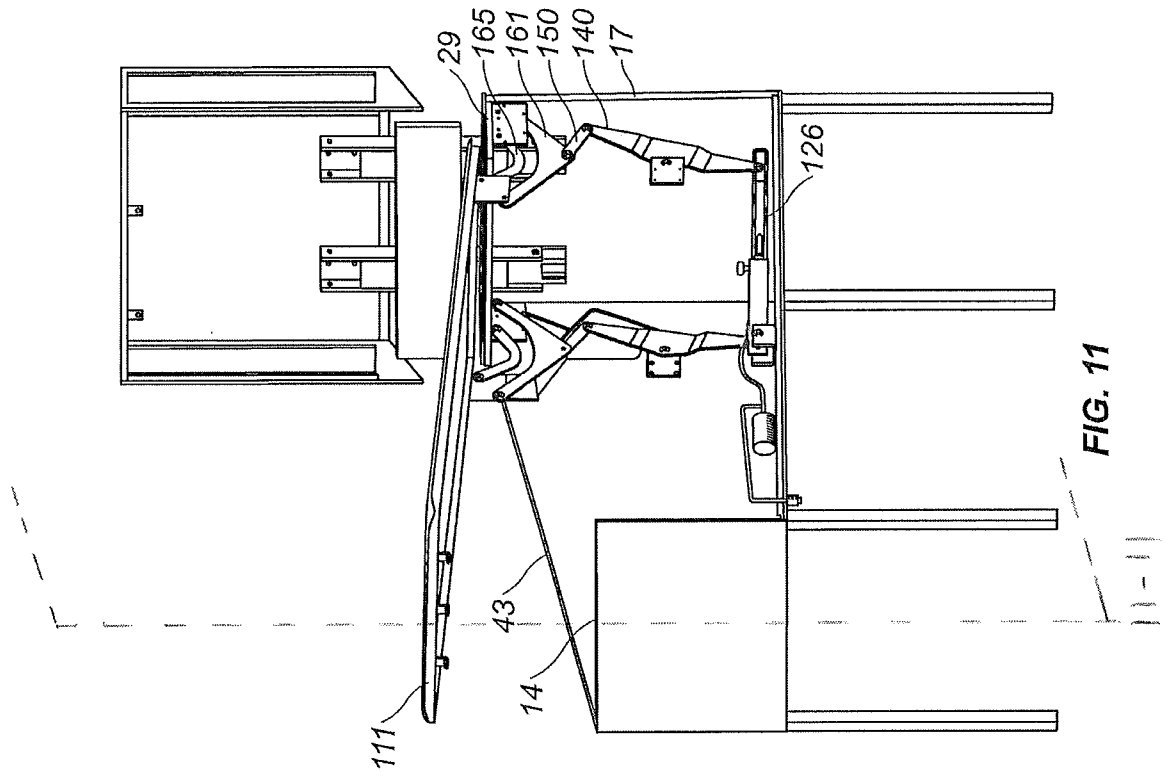


FIG. 11

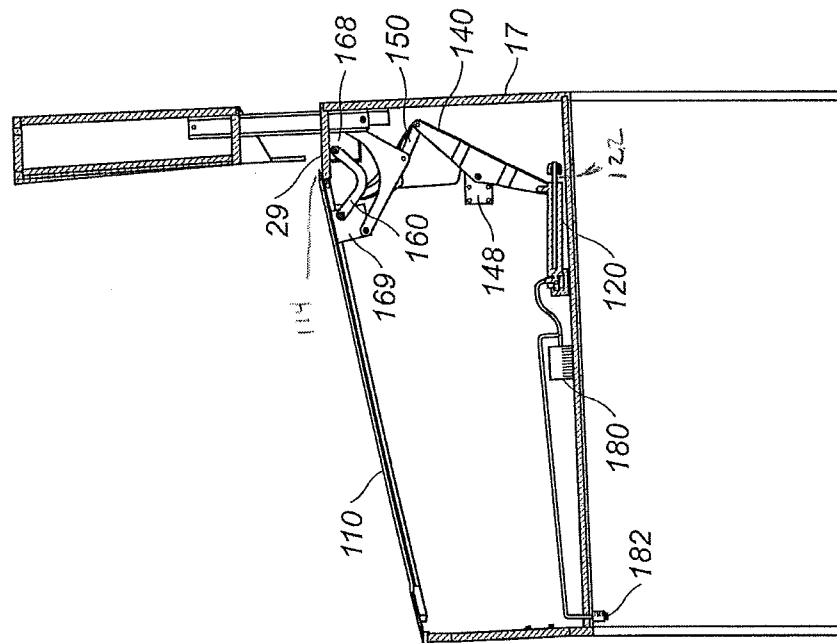


FIG. 10

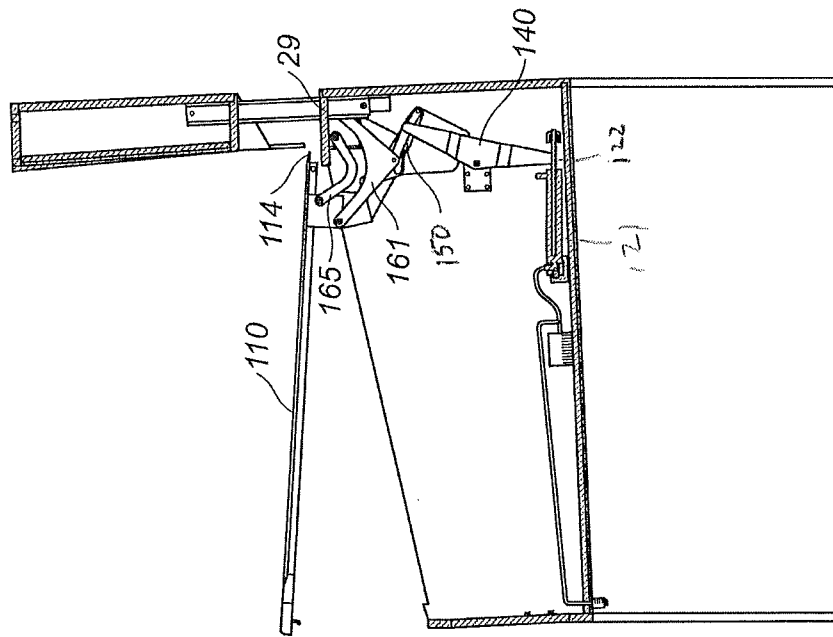


FIG. 12

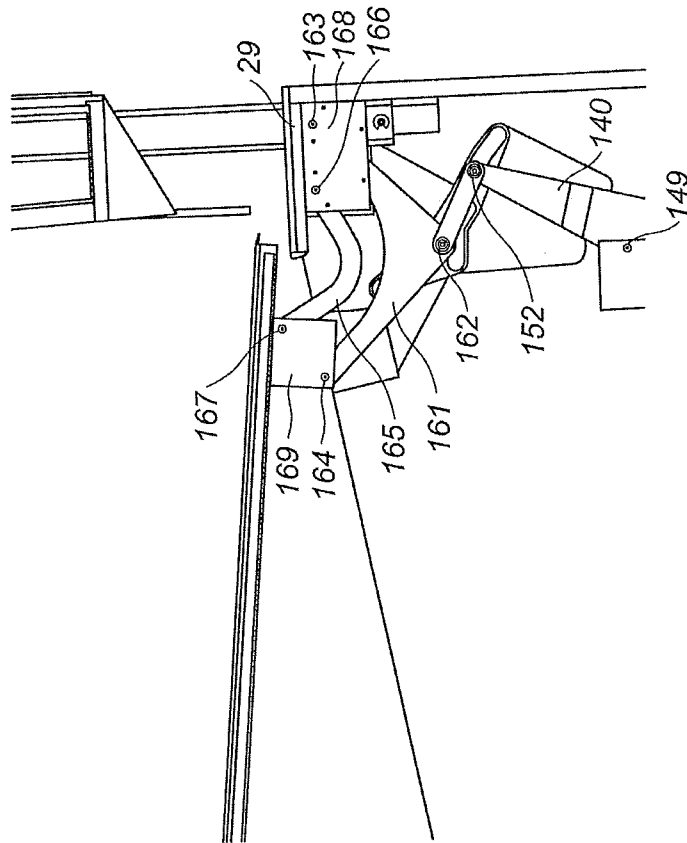


FIG. 13

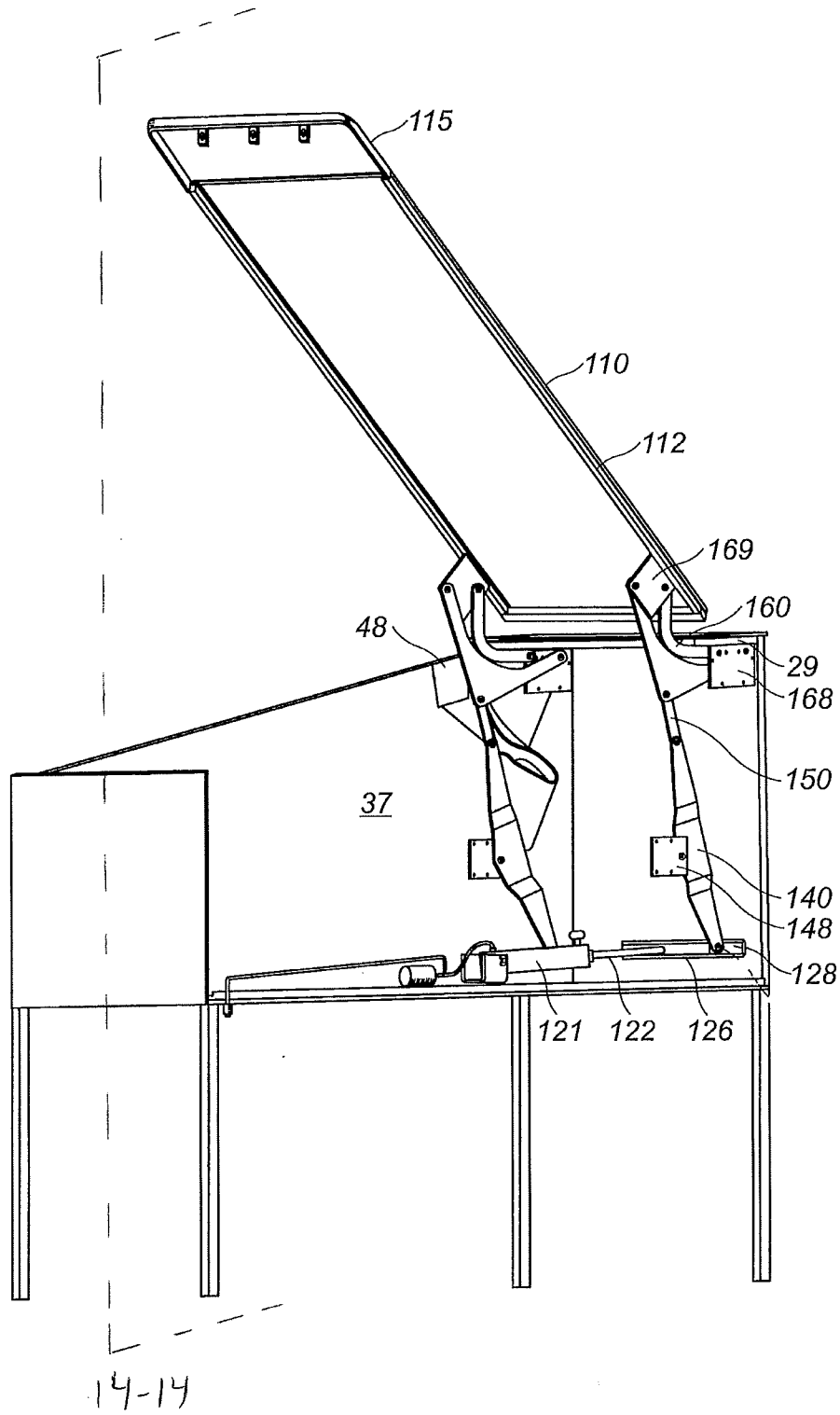


FIG. 14

9/37

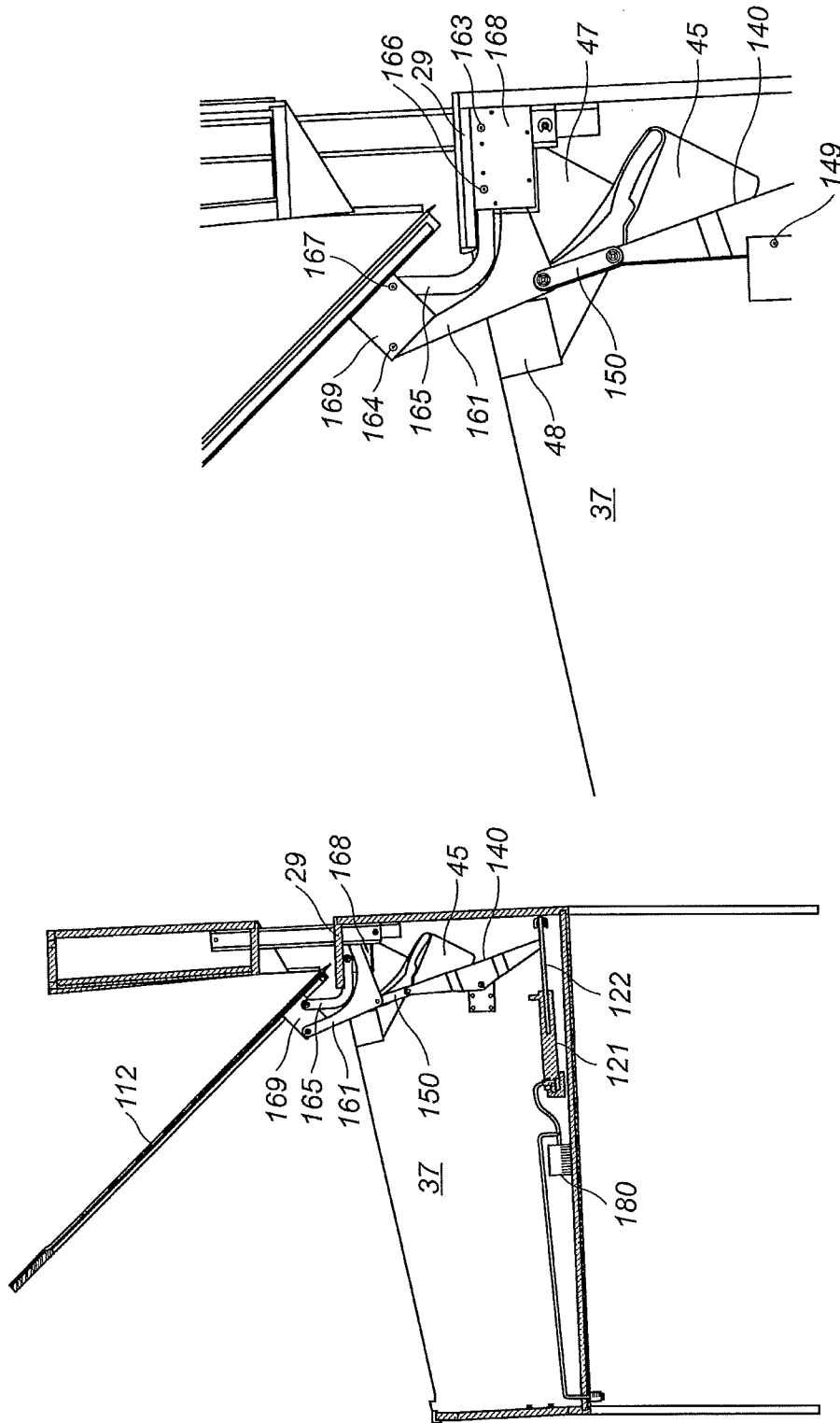


FIG. 16

FIG. 15

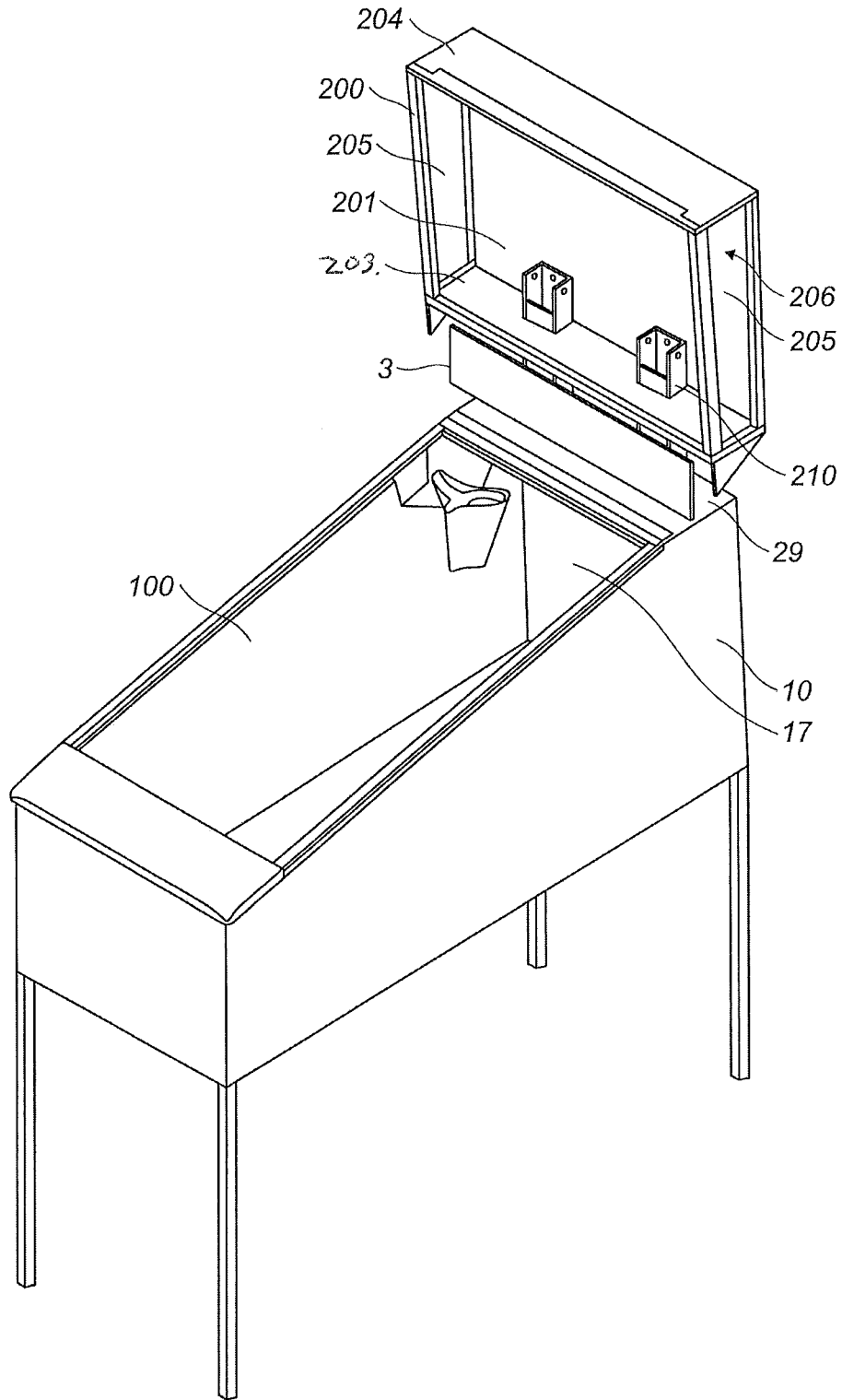


FIG. 17

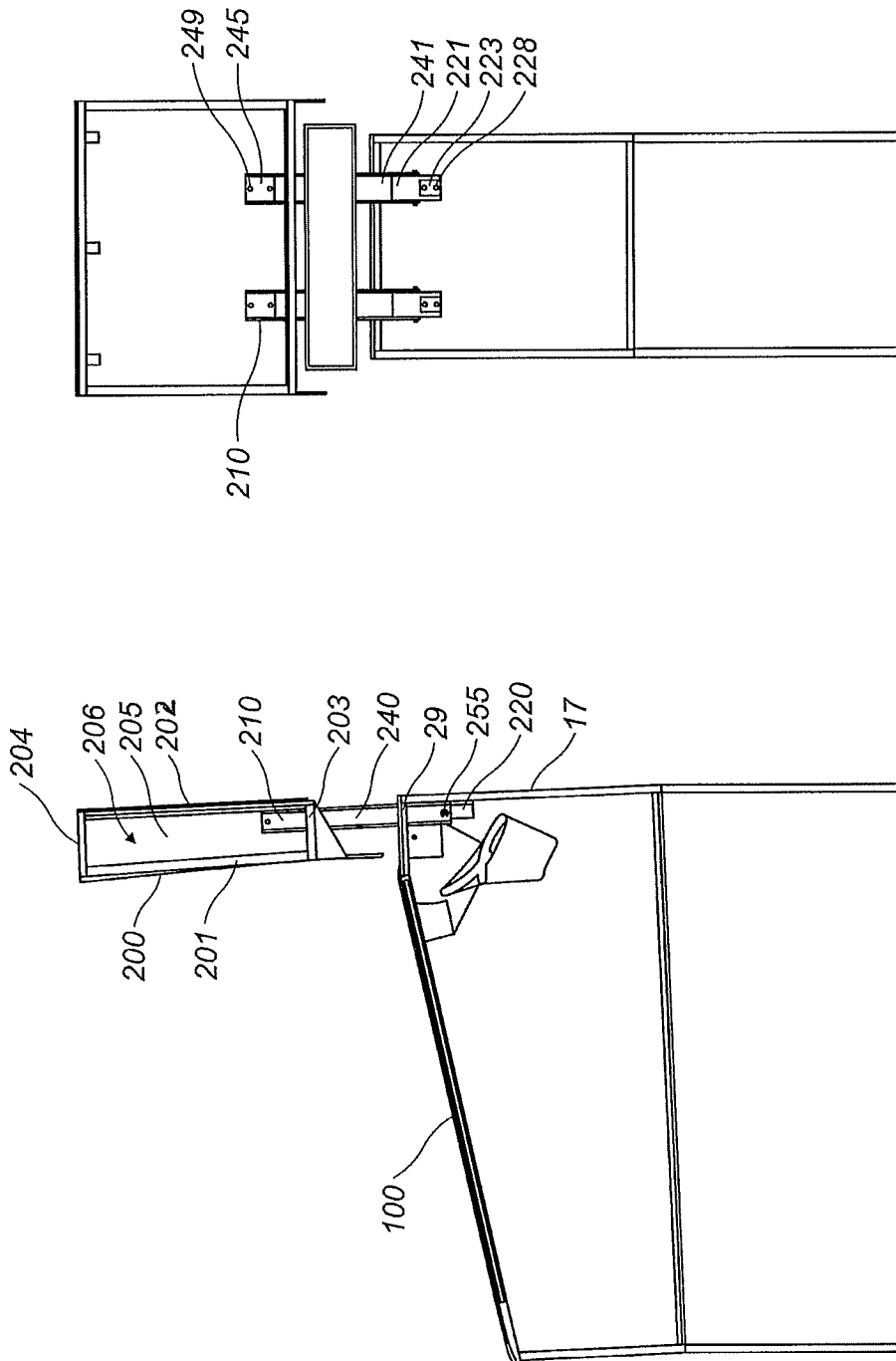


FIG. 19

FIG. 18

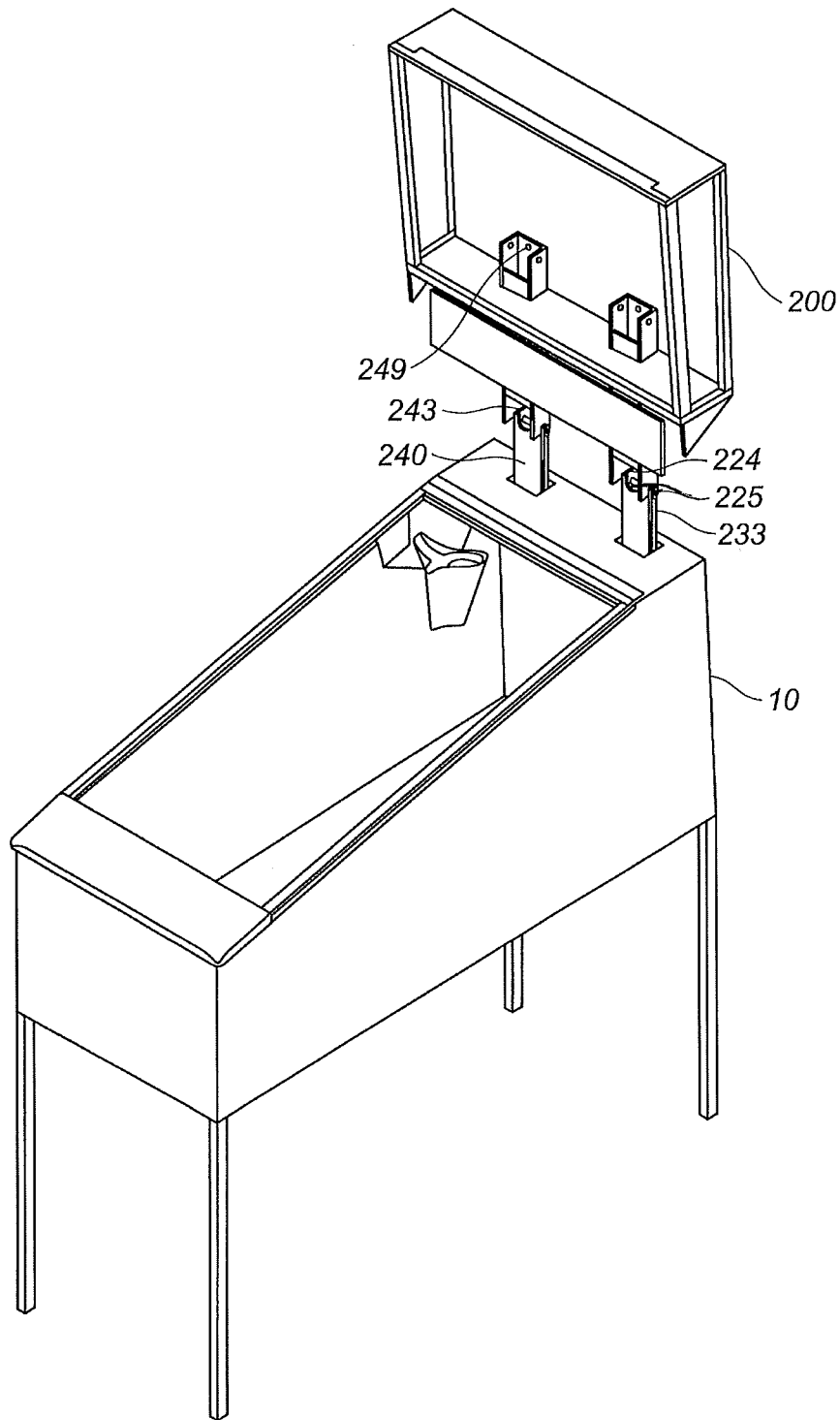


FIG. 20

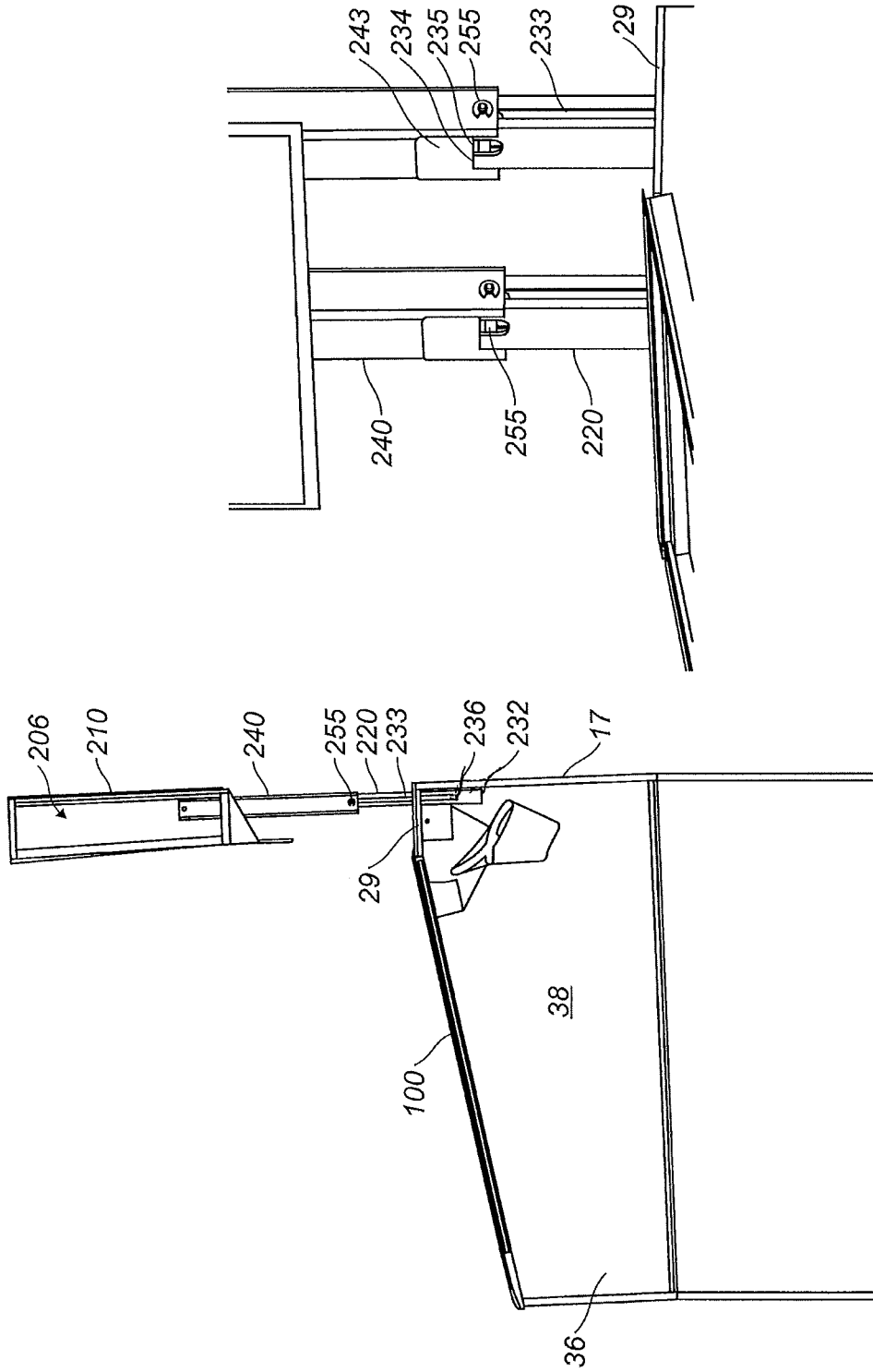


FIG. 22

FIG. 21

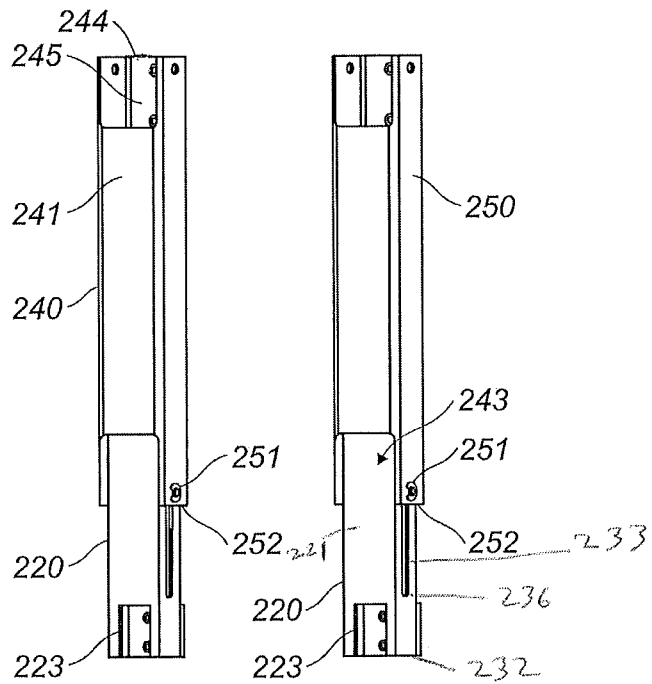


FIG. 23

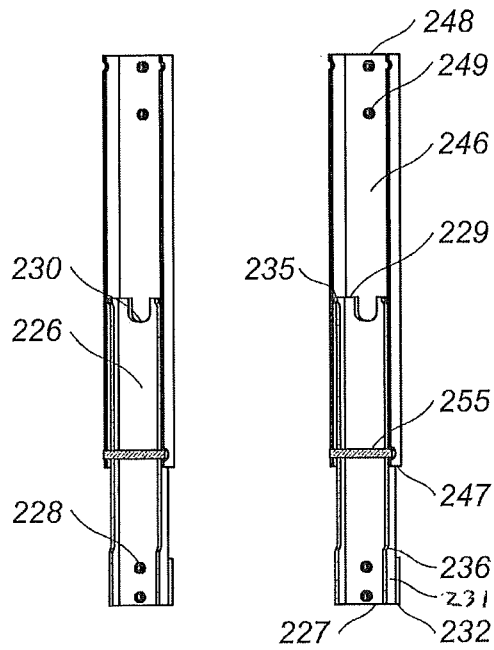


FIG. 24

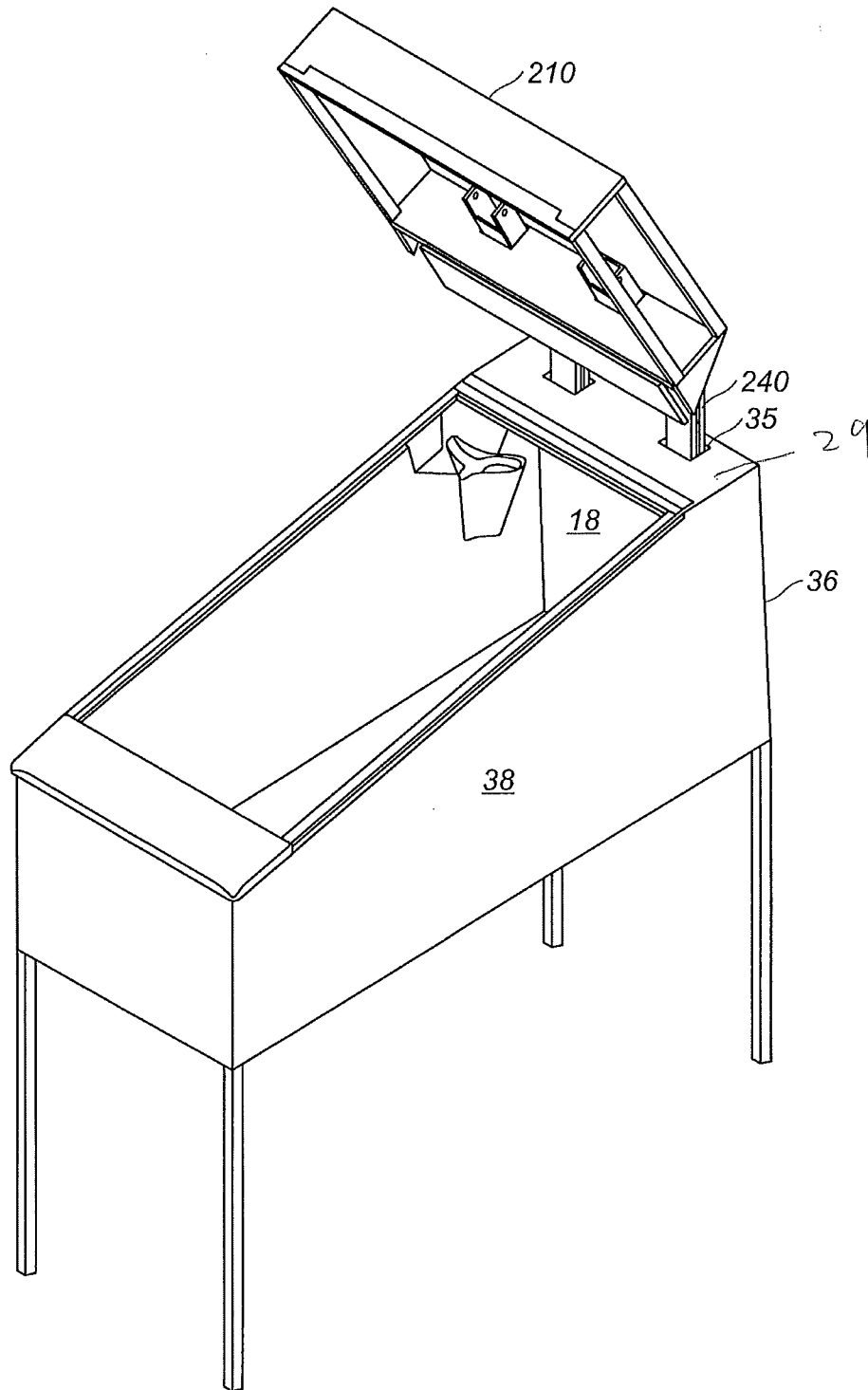


FIG. 25

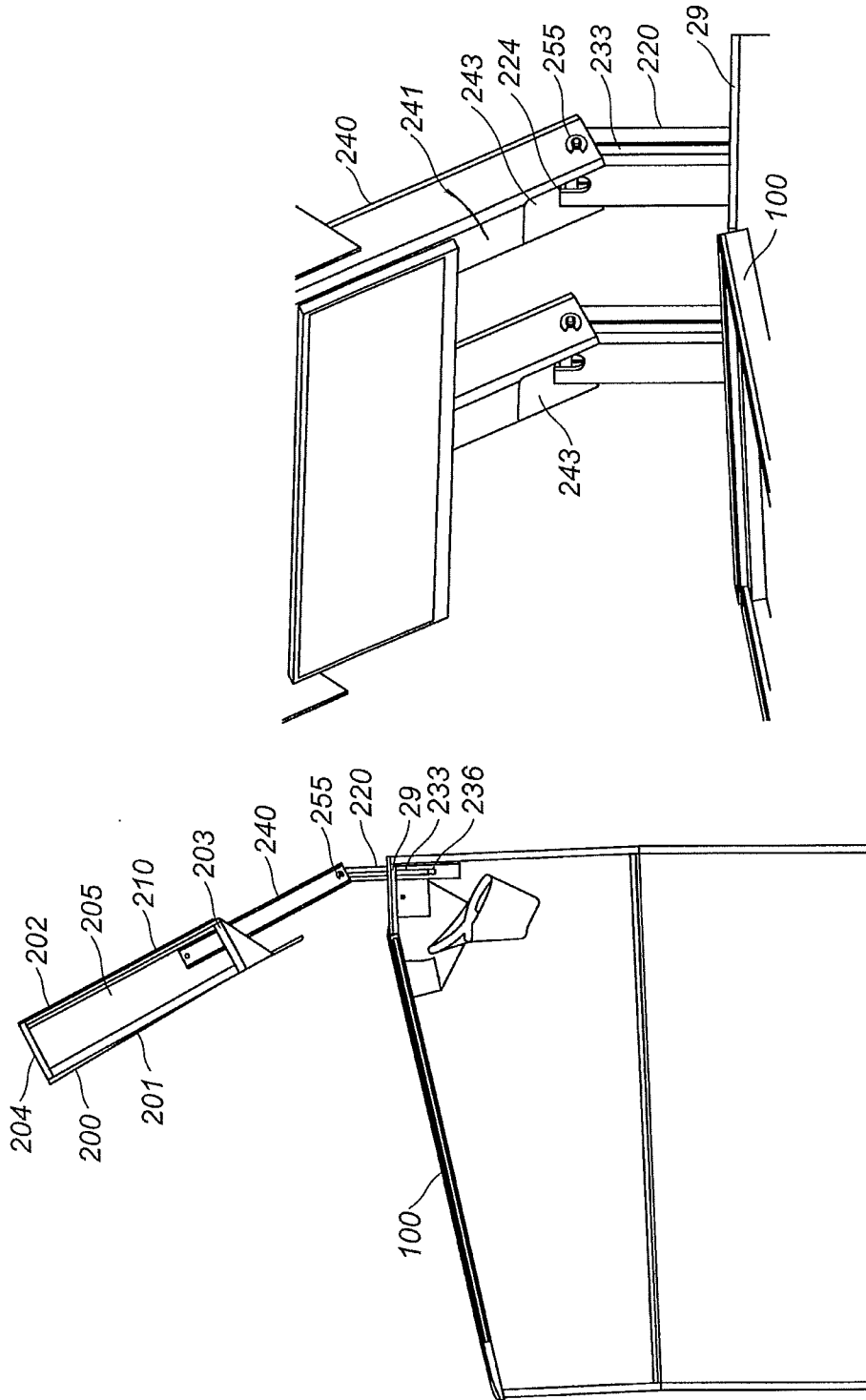


FIG. 27

FIG. 26

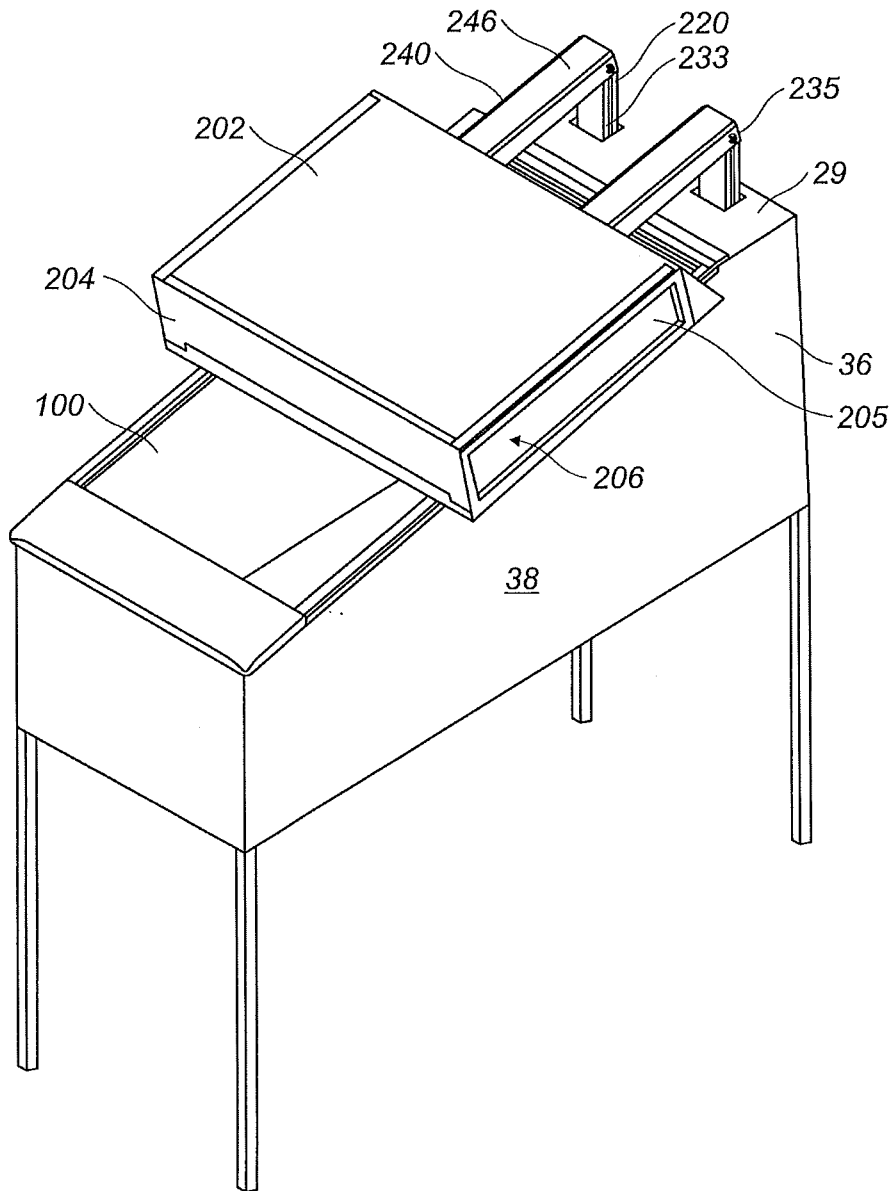


FIG. 28

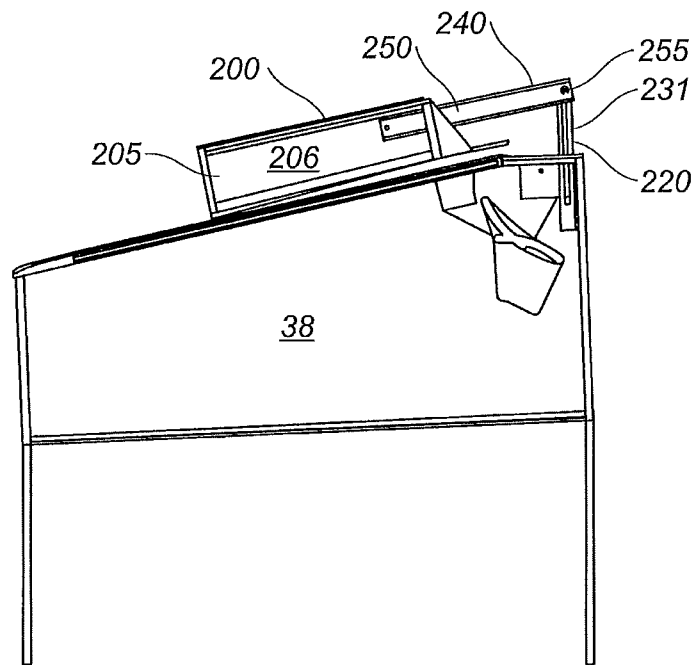


FIG. 29

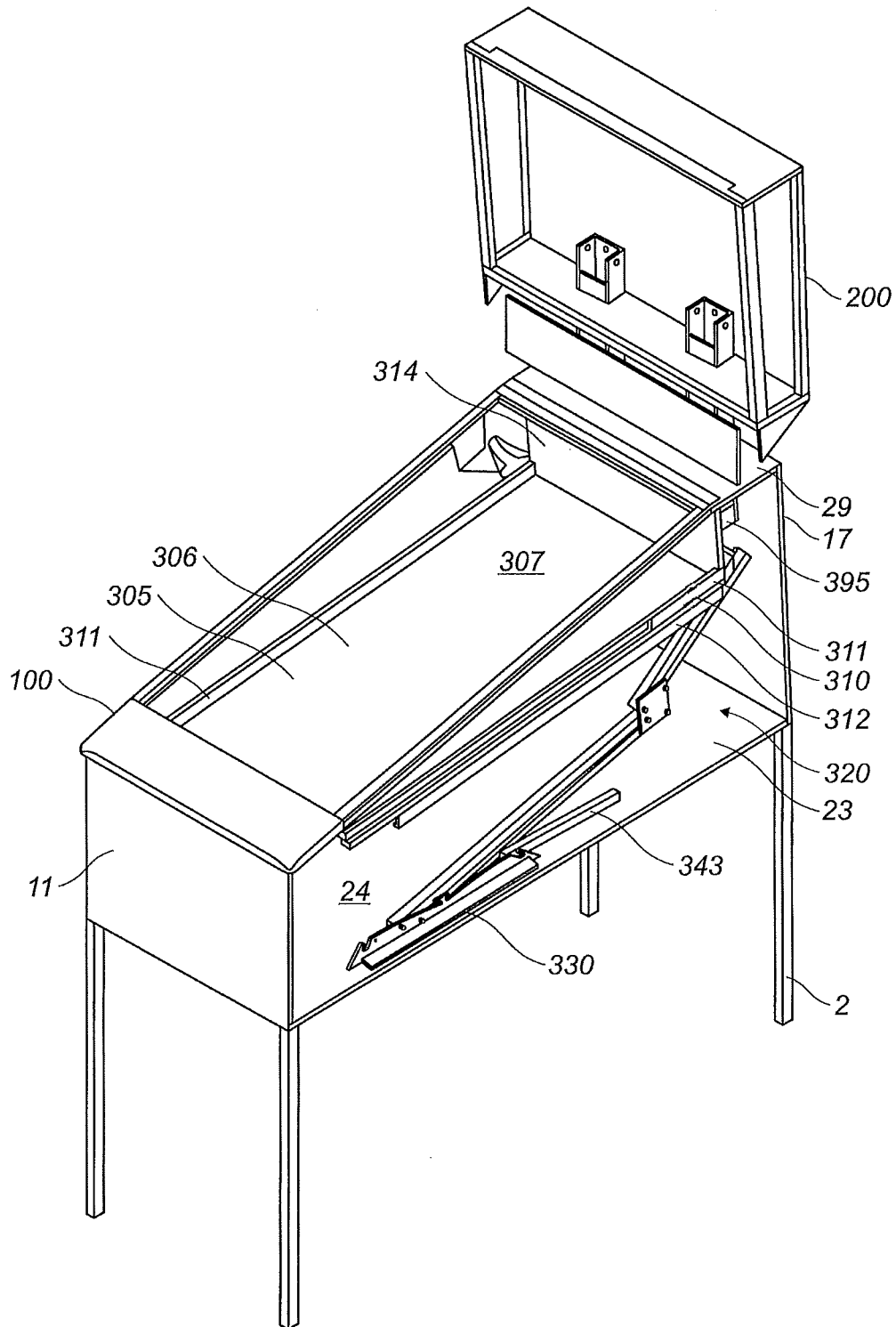


FIG. 30

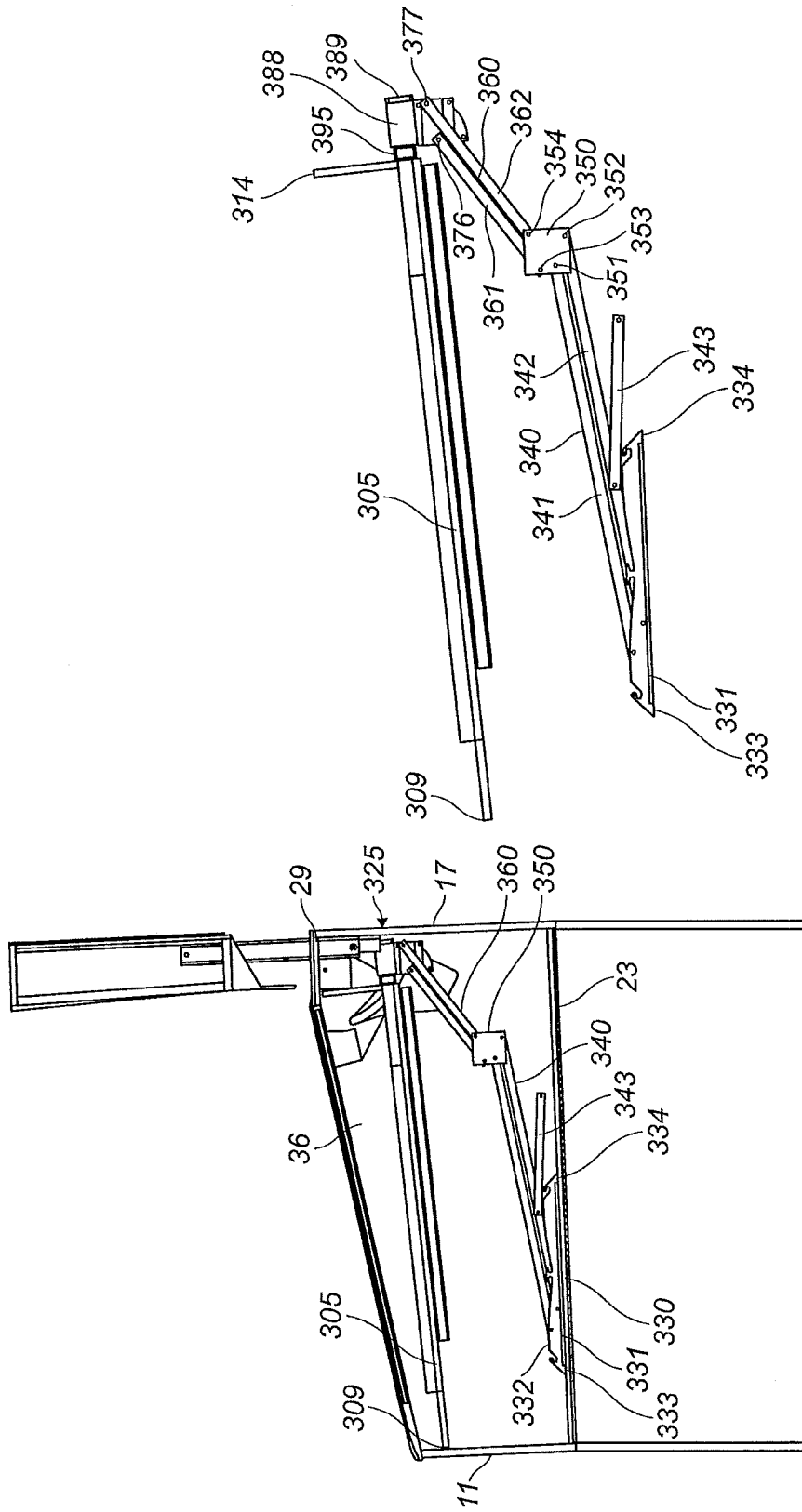


FIG. 32

FIG. 31

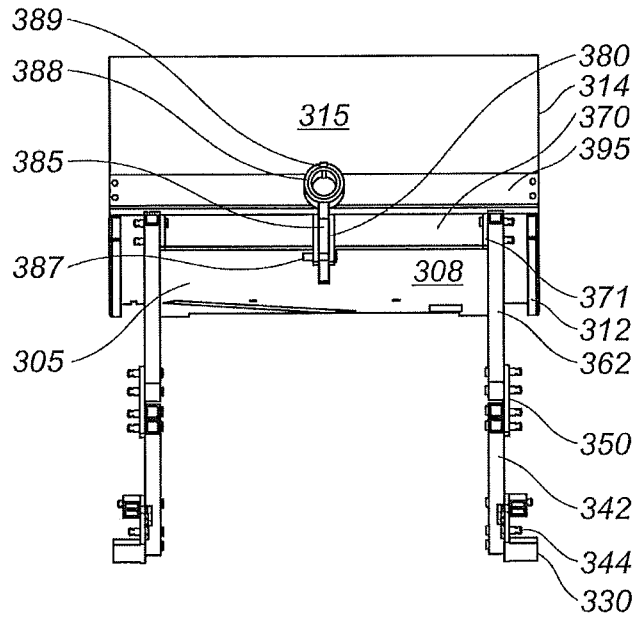


FIG. 33

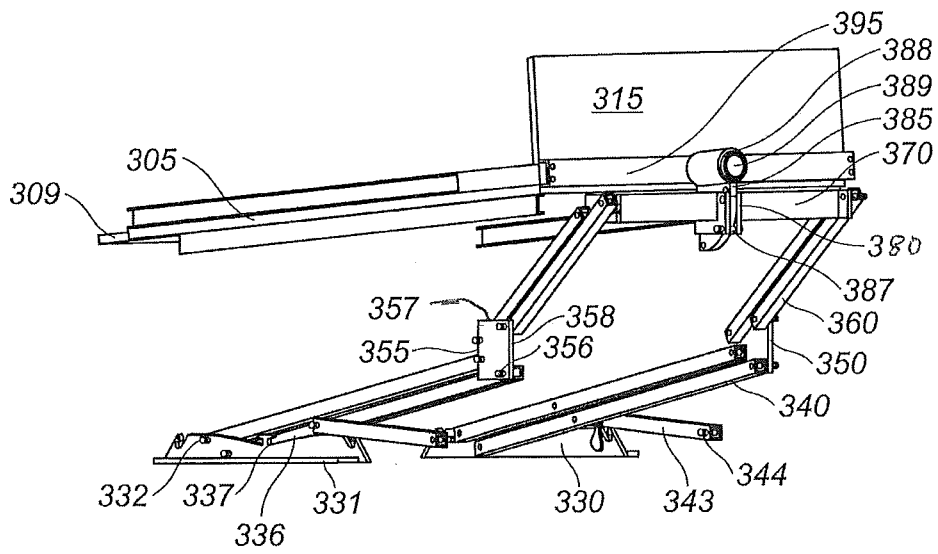


FIG. 34

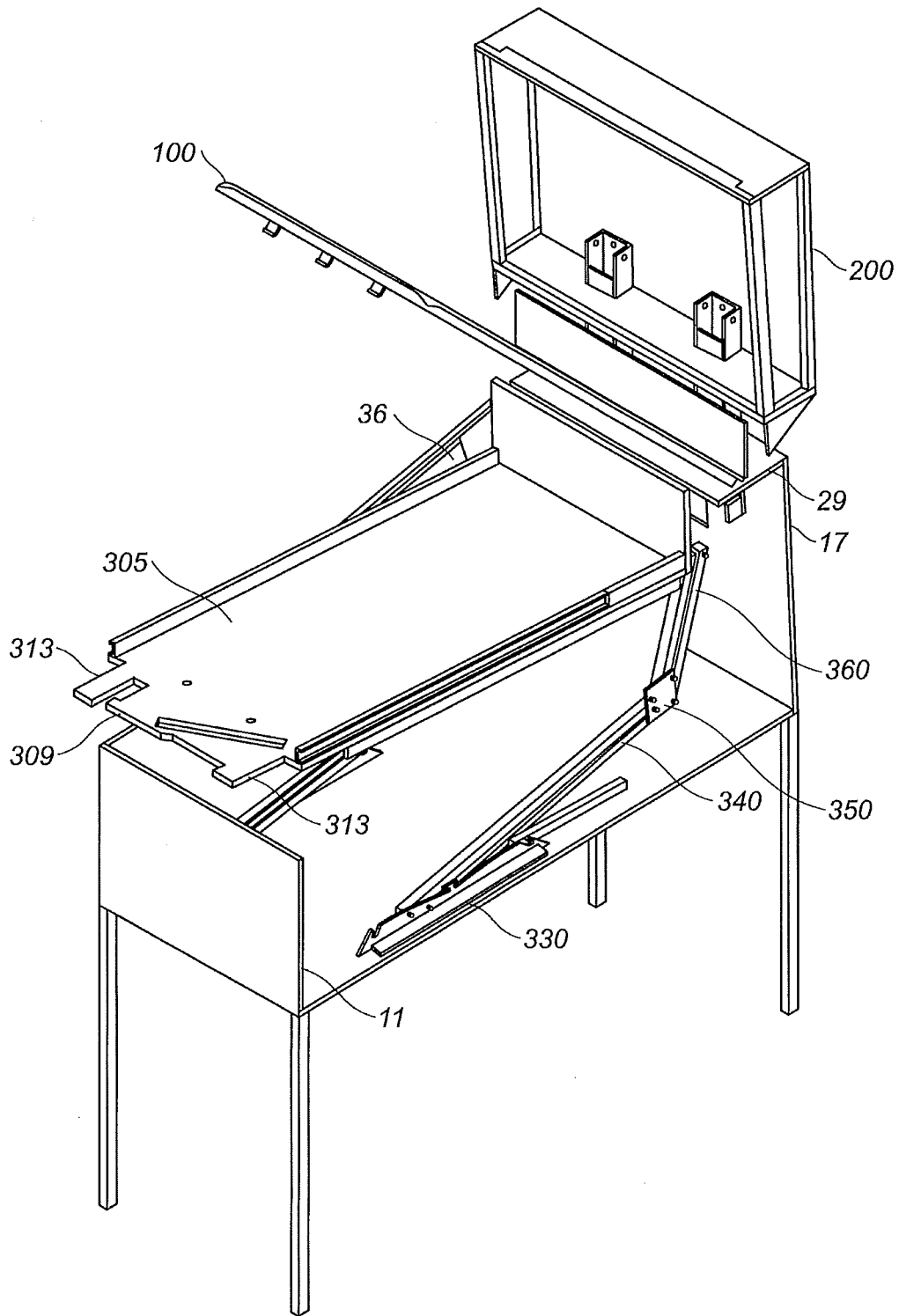


FIG. 35

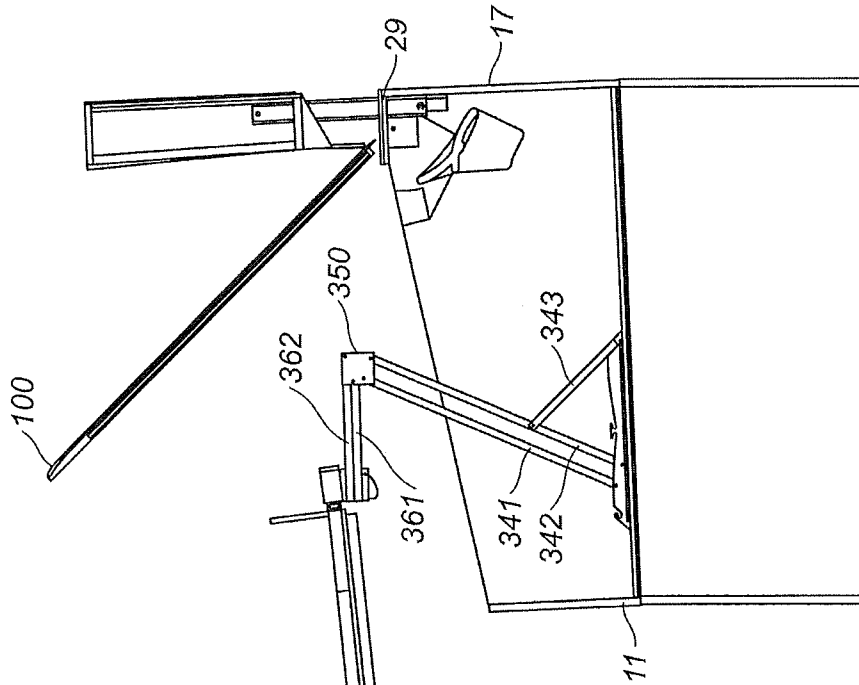


FIG. 37

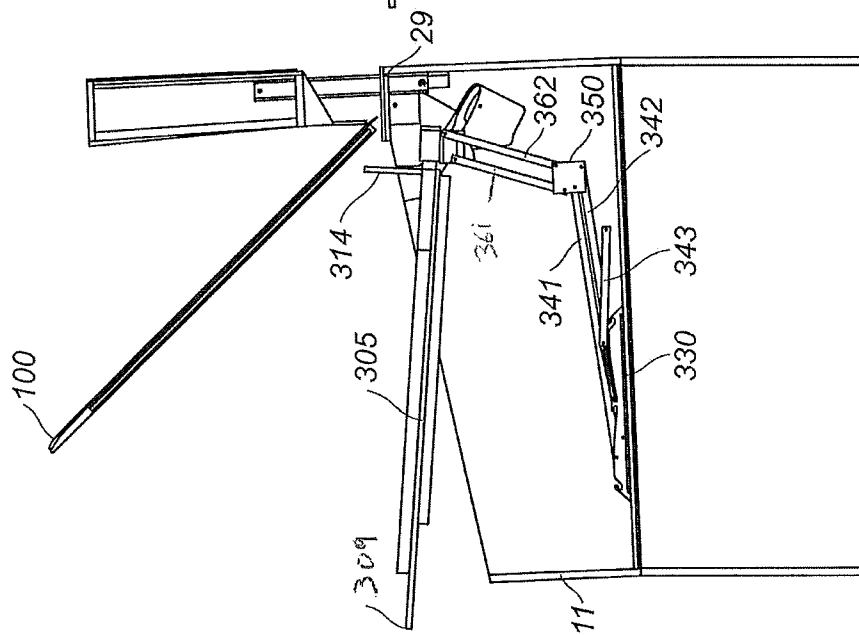


FIG. 36

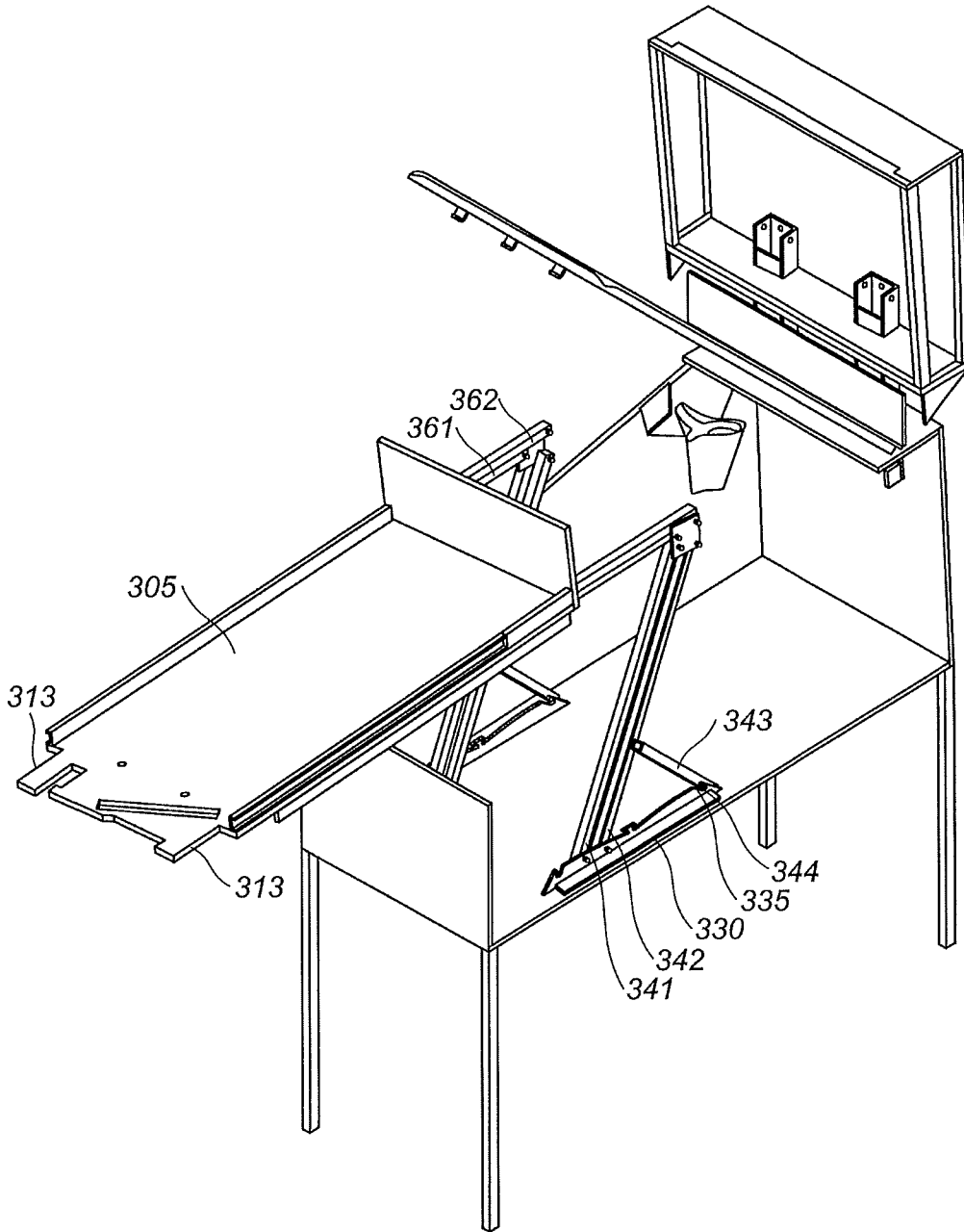


FIG. 38

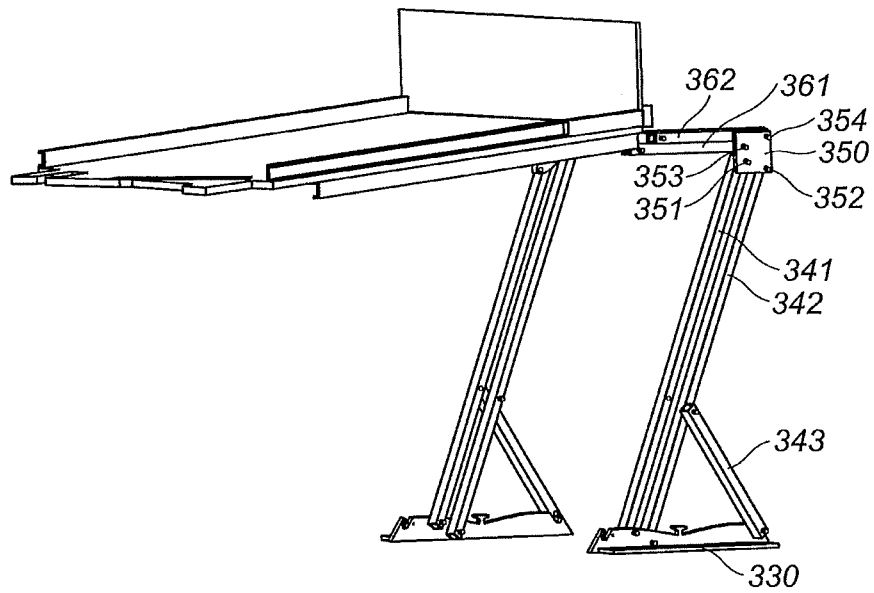


FIG. 39

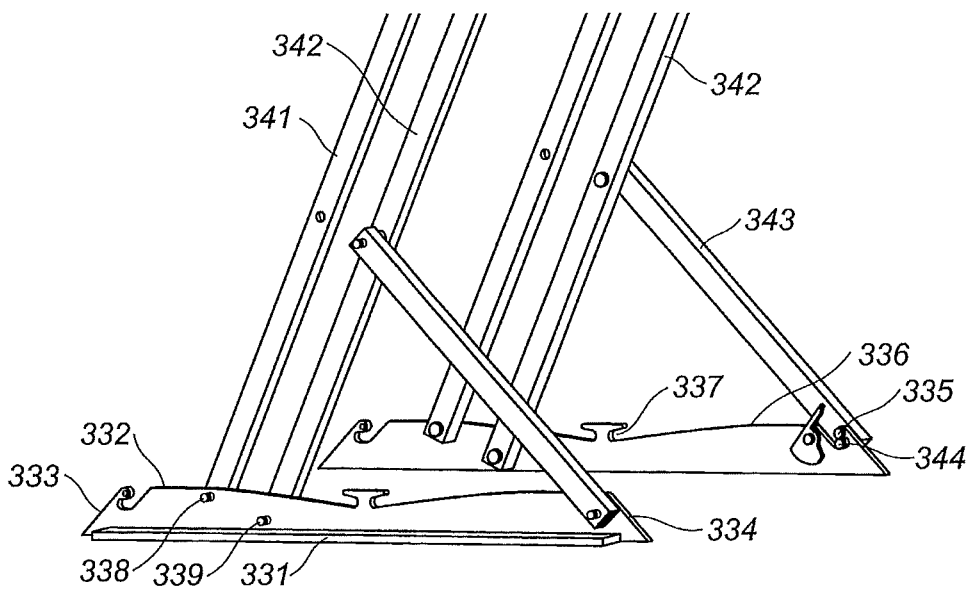


FIG. 40

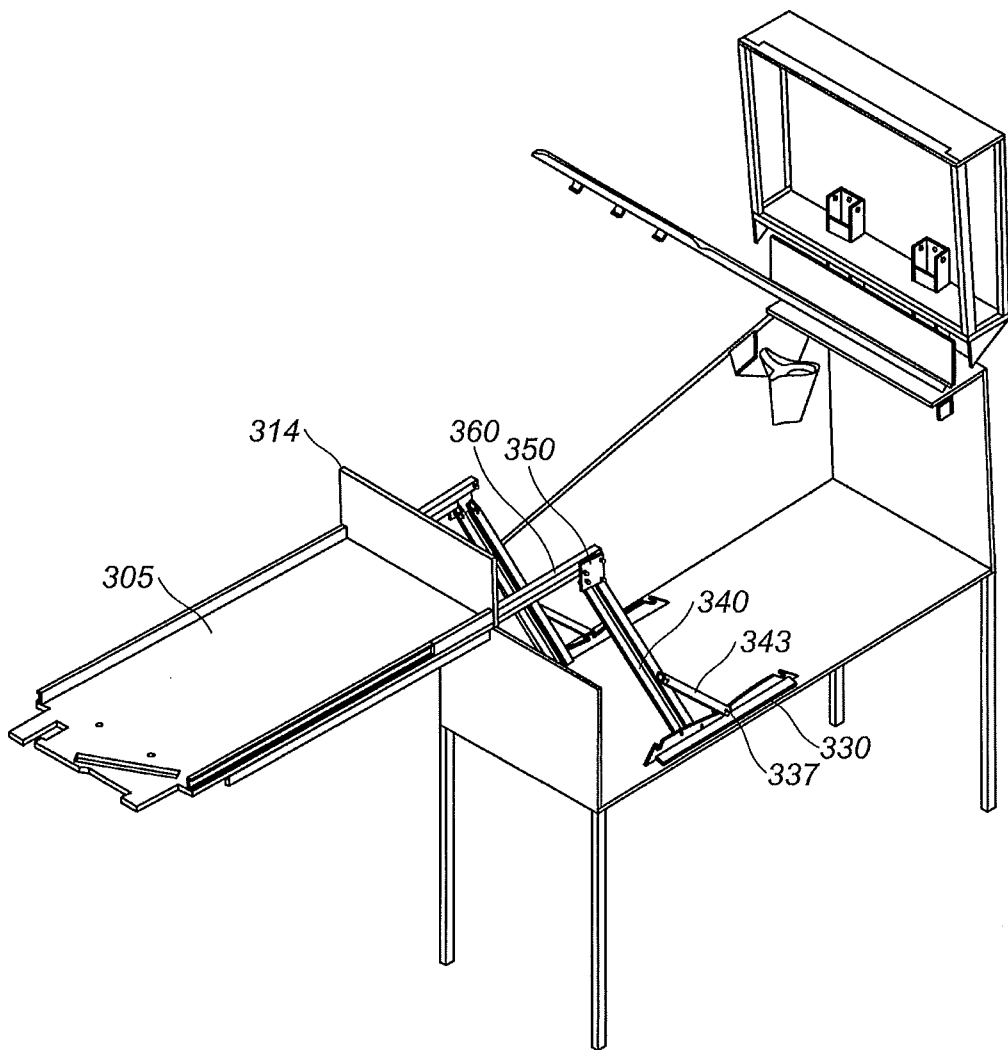


FIG. 41

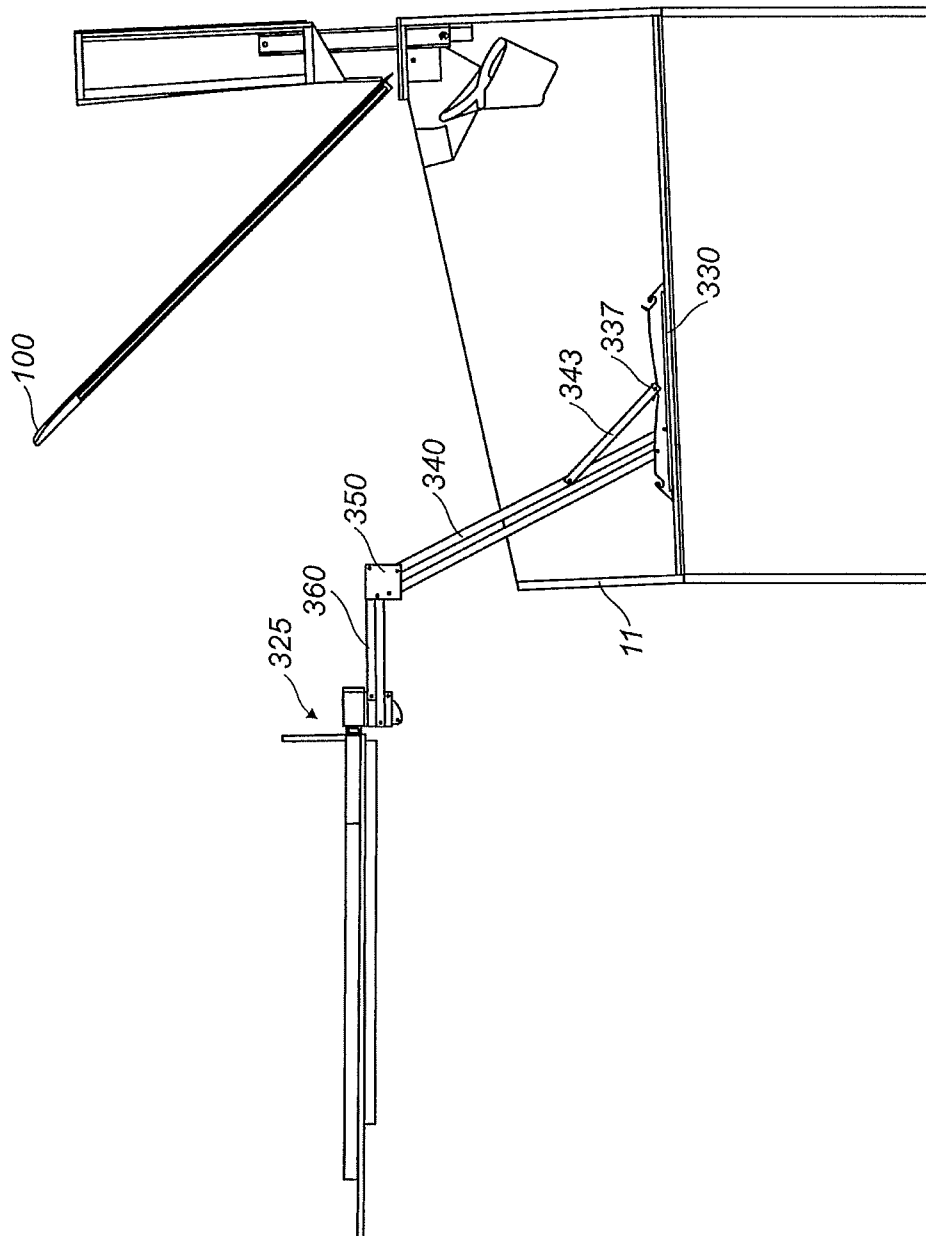


FIG. 42

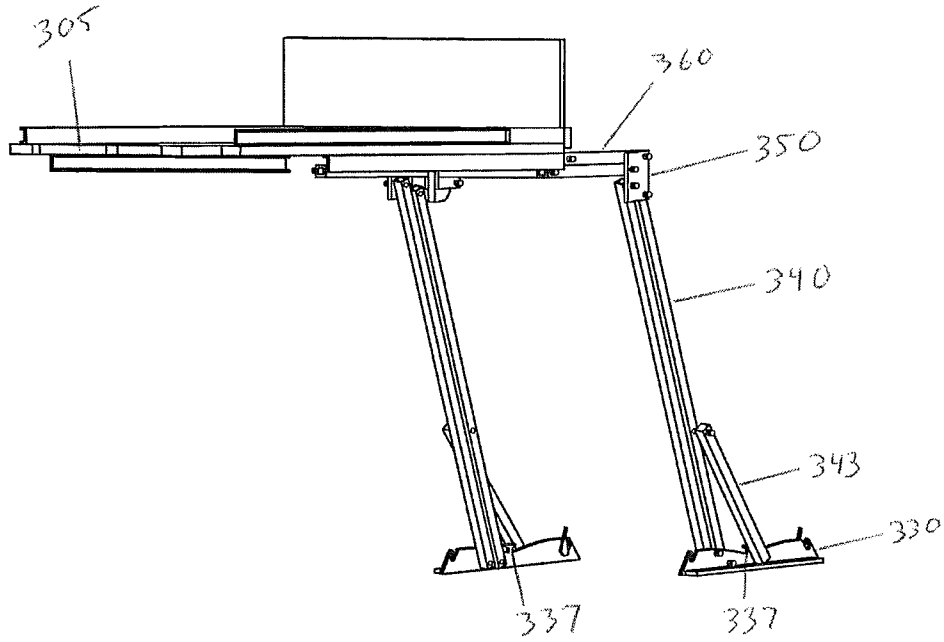


FIG. 43

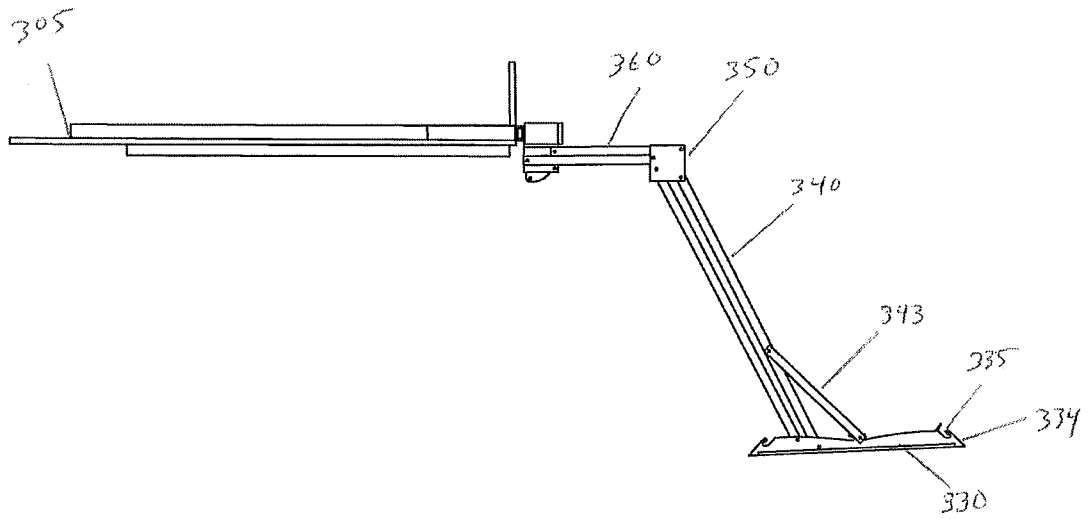


FIG. 44

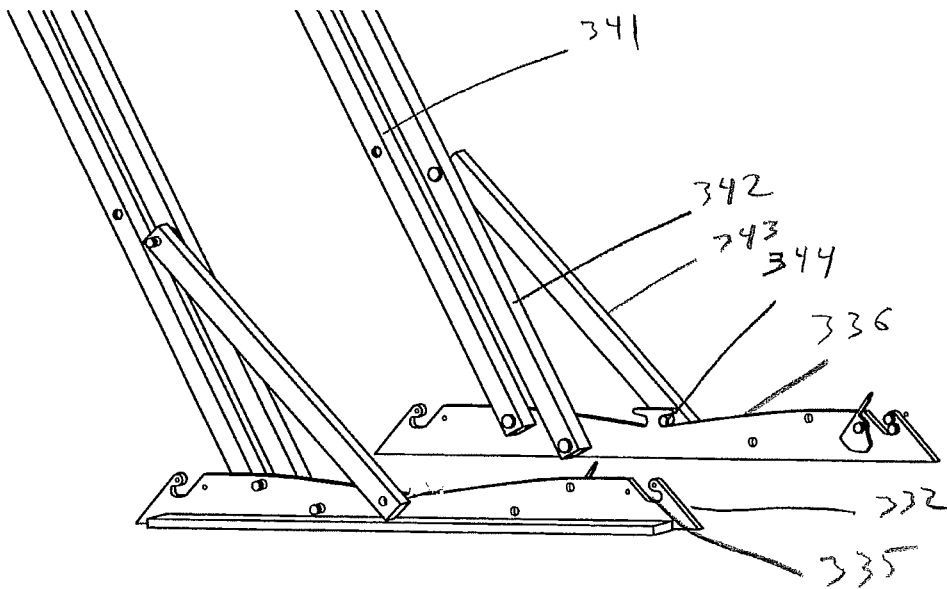


FIG. 45

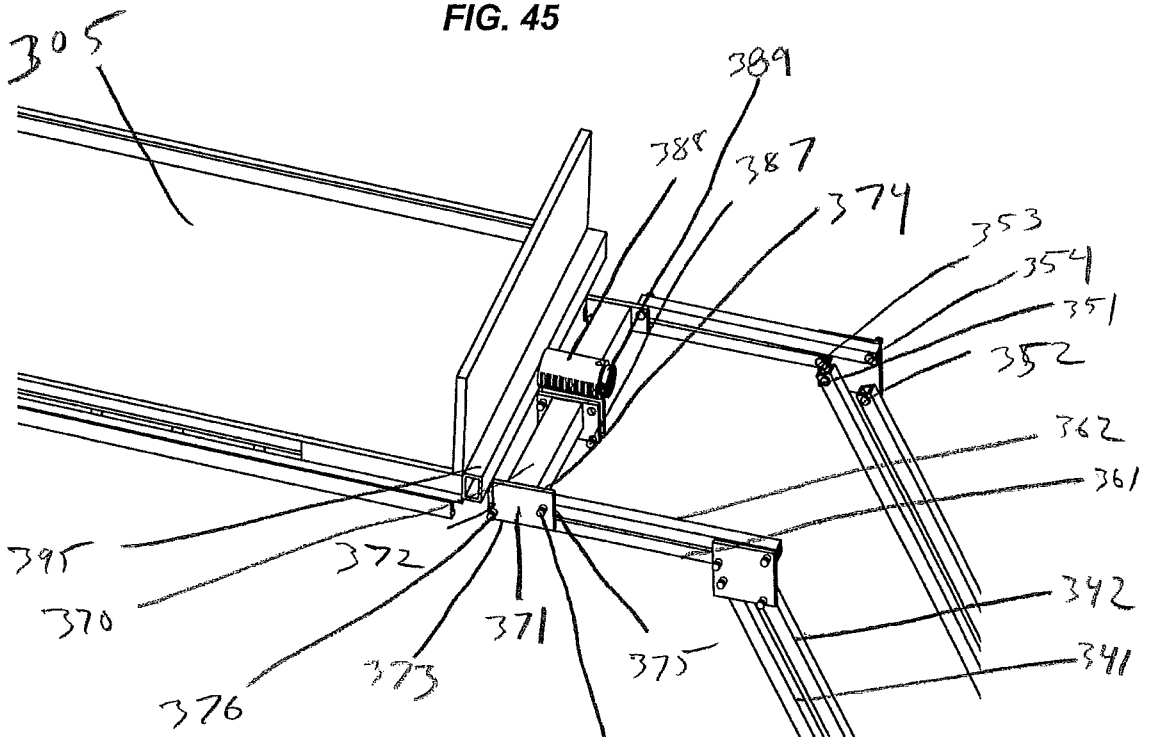


FIG. 46

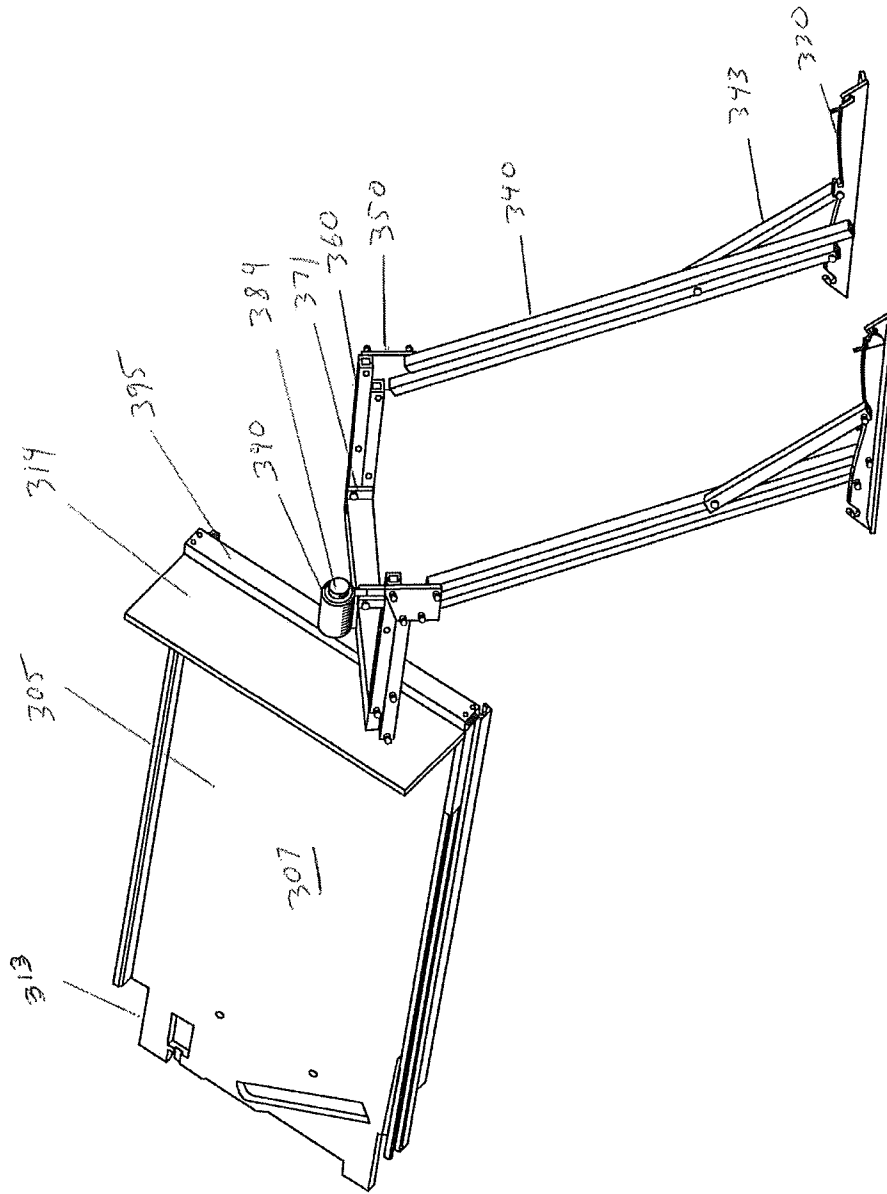


FIG. 47

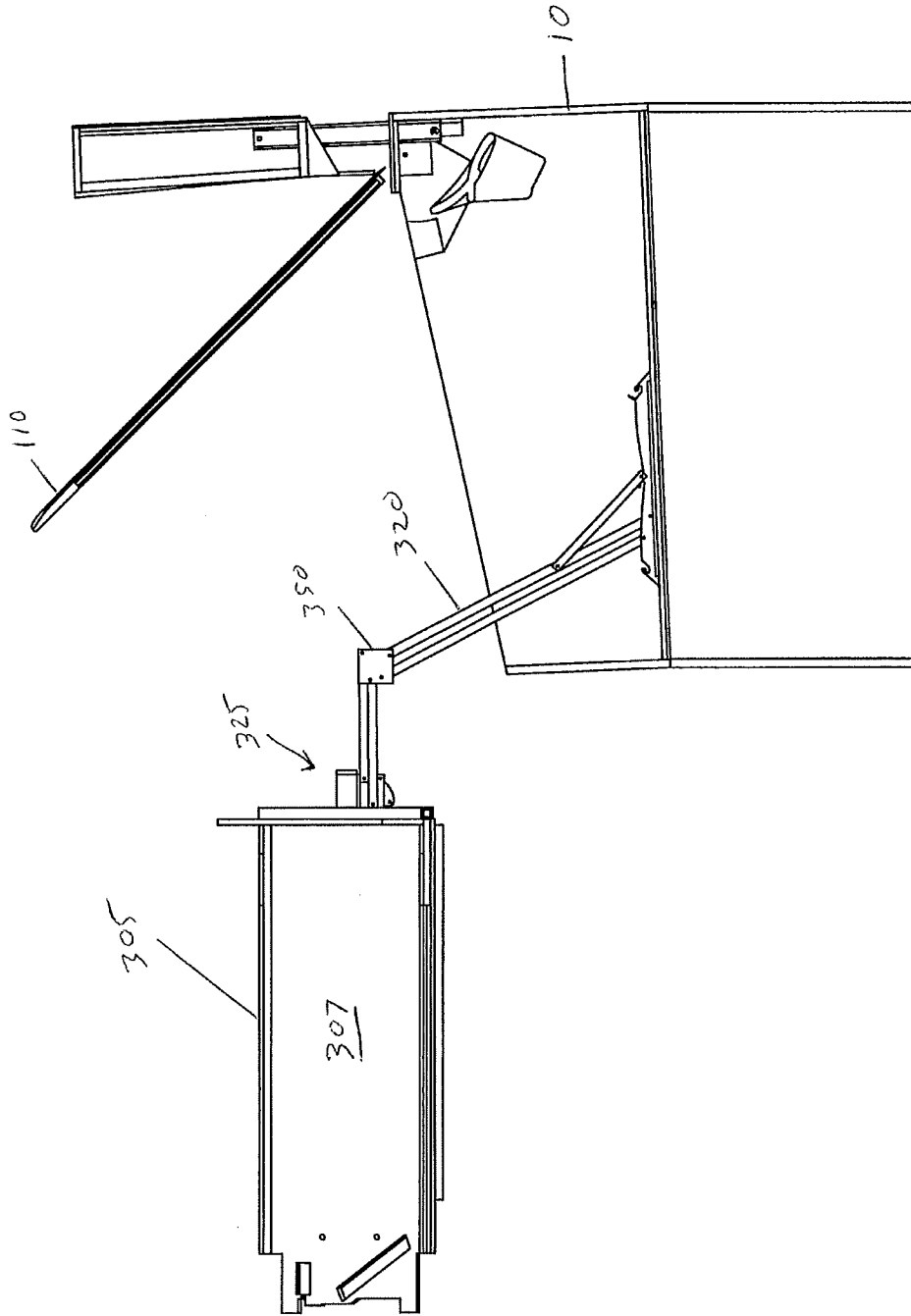


FIG. 48

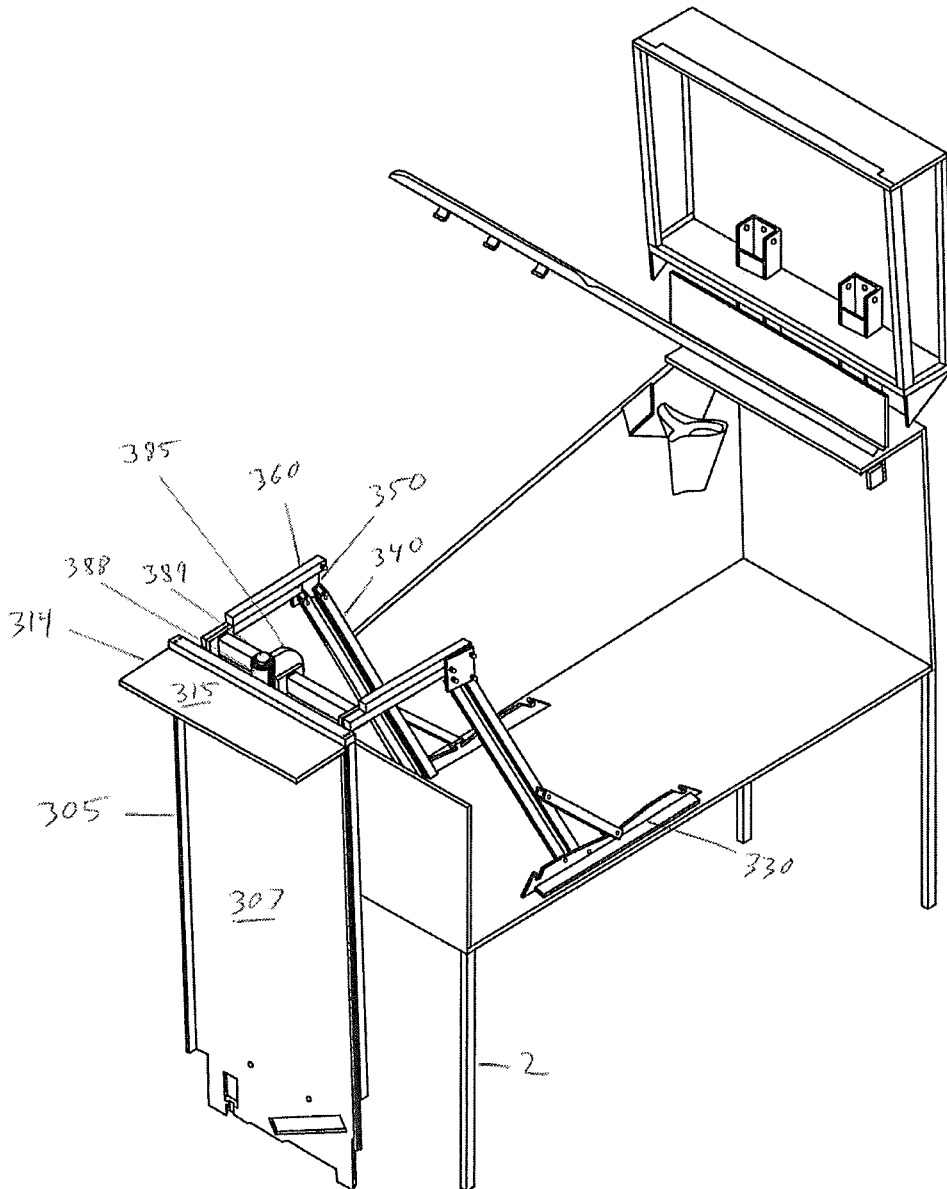


FIG. 49

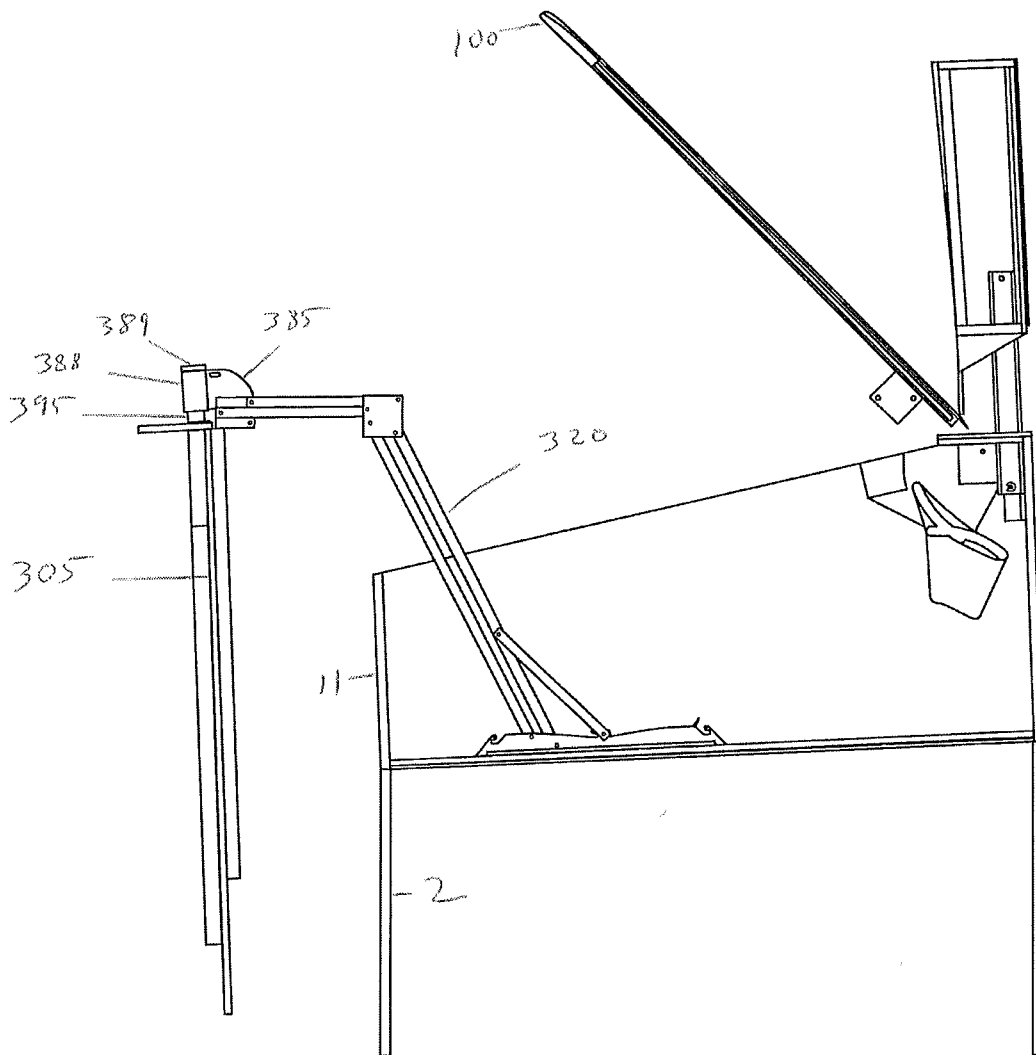


FIG. 50

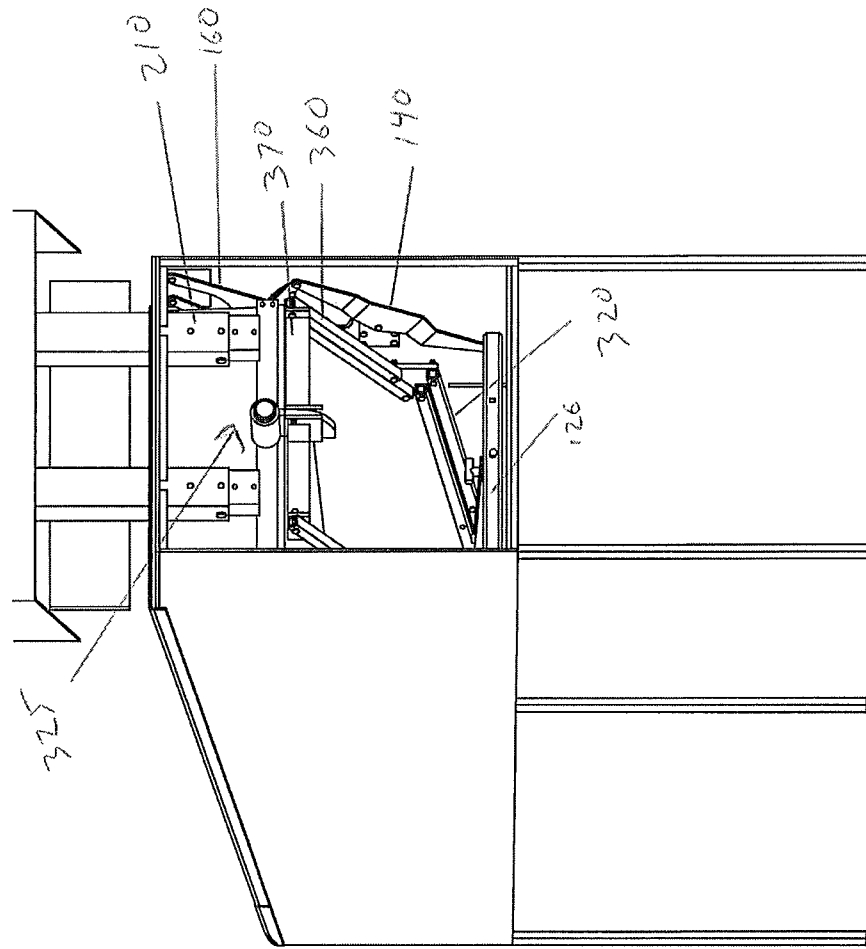


FIG. 52

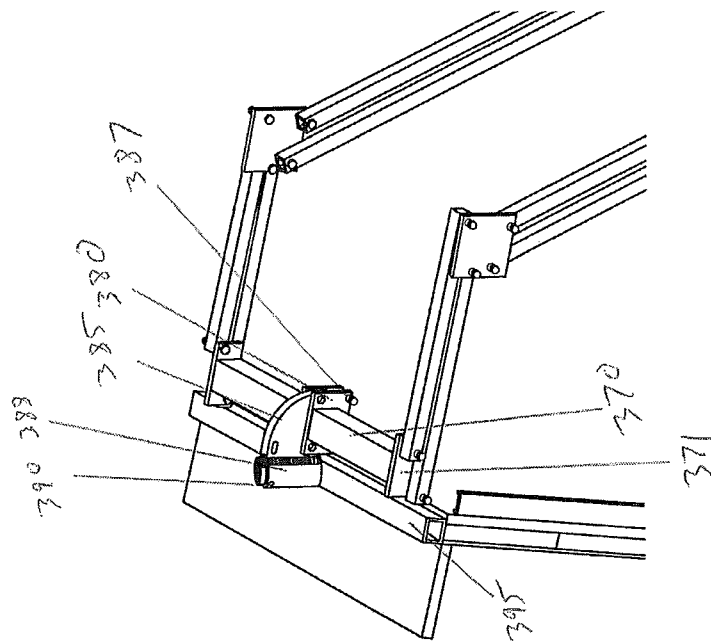


FIG. 51

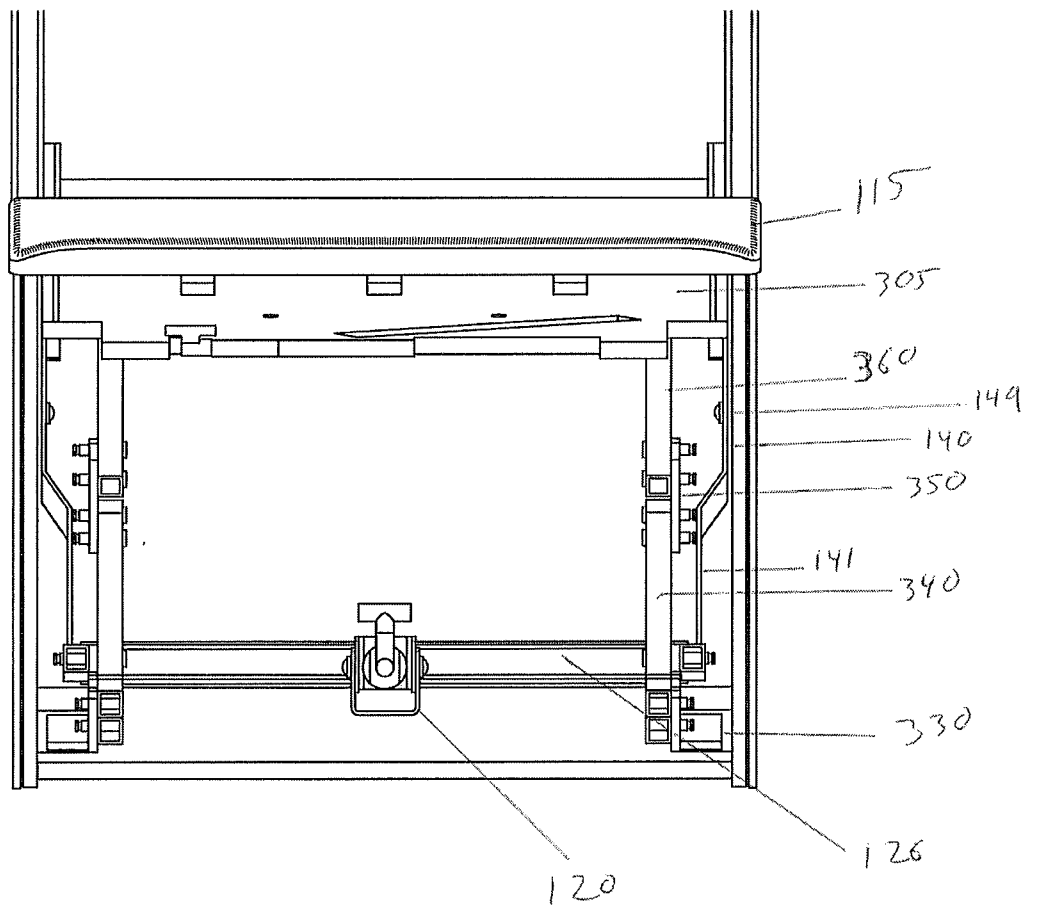


FIG. 53

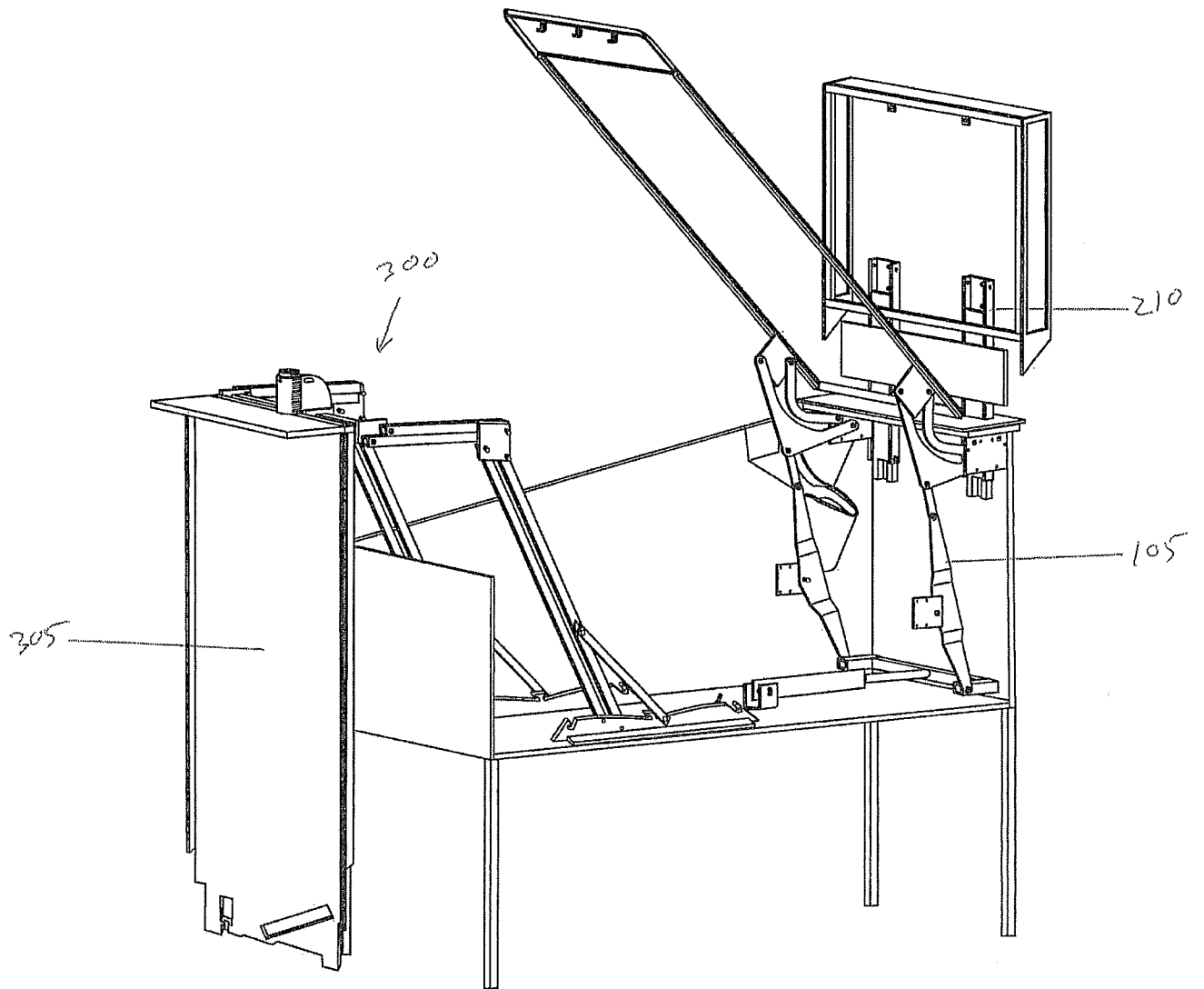


FIG. 54

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 18/25549

A. CLASSIFICATION OF SUBJECT MATTER

IPC - A47B 81/00, 88/00; A63F 7/02, 7/34, 7/36 (201 8.01)

CPC - A47B 81/00, 88/00; A63F 7/025, 7/34, 7/36

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4,647,043 (WICZER M) 03 March 1987; figures 1-4; column 3, lines 30-35; column 5, lines 5-10	1-6
Y	EP 2 338 382 B1 (HERRERA SECO F) 11 July 2012; figure 4; paragraph [0030]	1-6
Y	US 5,503,086 A (HOFFMAN DS) 02 April 1996; figures 1, 4, 5; column 5 lines 10-15	1-6
A	US 5,494,285 A (COLDEBELLA MJ) 27 February 1996; entire document	1-6
A	US 2014/0091519 A1 (STERN PINBALL, INC.) 03 April 2014; entire document	1-6

H Further documents are listed in the continuation of Box C. 1 1 See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"L" document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
06 June 2018 (06.06.2018)

Date of mailing of the international search report

26 JUN 2018

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