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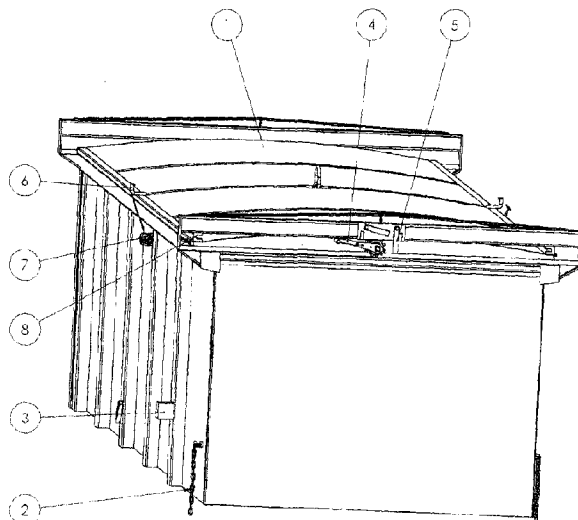
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(54) Title: MECHANICAL ROLLING ROOF



(57) Abrégé/Abstract:

The disclosure provides an improved rolling roof for various types of open top containers. The rolling roof is used to cover open top containers for any dry loads and the rolling roof may be sealed to cover containers with liquid loads. The rolling roof may be manually operated with a ratcheting handle in combination with two rolling mechanisms placed on each side of the roof. The rolling roof mechanism may be implemented by sliding the roof either to the left or to the right side of the container, and turning it from a horizontal position to a vertical position along the side wall. Such allows loading from either side of the container by using the full area of the opening. This new method may require minimum physical strength, eliminates the use of cable or winch lifting systems, and may have a higher degree of safety that is beneficial for various types of open top containers.

ABSTRACT OF THE DISCLOSURE

The disclosure provides an improved rolling roof for various types of open top containers. The rolling roof is used to cover open top containers for any dry loads and the rolling roof may be sealed to cover containers with liquid loads. The rolling roof may be manually operated with a ratcheting handle in combination with two rolling mechanisms placed on each side of the roof. The rolling roof mechanism may be implemented by sliding the roof either to the left or to the right side of the container, and turning it from a horizontal position to a vertical position along the side wall. Such allows loading from either side of the container by using the full area of the opening. This new method may require minimum physical strength, eliminates the use of cable or winch lifting systems, and may have a higher degree of safety that is beneficial for various types of open top containers.

MECHANICAL ROLLING ROOF

TECHNICAL FIELD

[0001] The present disclosure covers various types of open top containers for dry loads and liquids, for example by using a sealed rolling roof.

BACKGROUND

[0002] Roofs with a hinge lifting system are known, where the roof is hinged on one side longitudinally and lifted with a manually operated cable winch arranged to open the roof to a desired height and lock into place with the cable winch and/or assisted manual prop. This method requires a significant amount of physical strength and time to lift the metal roof, and also presents a hazard of human injuries if hand winch or lifting cable breaks in the open position.

[0003] U.S. Pat. No. 4,489,810 discloses a cable winch mechanism to open container's lid by using an electrical motor that is incompetent and inconvenient for field sites.

[0004] Some analogous hinge lifting methods use a hydraulic system instead of a cable winch, which limits to operation in low temperature regions, and may create a hazard if system failure occurs while the lid is in the open position.

[0005] Despite various types of hinge lifting system, the common disadvantage remains that these methods are complex, and the loading area of the open top container enable use from only from one side.

[0006] U.S. Pat. No. 4,934,562 "Cover construction for waste containers" and U.S. Pat. No. 5,755,351 "Lid assembly for container", disclose a lid that enables opening or closing the container by pushing it to the side. The above said patents disclose container lids with complicated mechanism designed only for sealed waste containers with hazardous liquid waste, where opening or closing the container's lid is achieved by the application of a manual pushing force.

[0007] U.S. Pat. No. 6,364,153 "Waste container with displaceable panel closure" discloses a lid for a cargo container with a panel that is movable outwardly perpendicular to a closed position. The design of the lid that covers the top of the container is also only applicable for sealed containers to transport liquid waste. The sliding mechanism of the lid has limited functional approach and allows only a partial opening of the container.

[0008] Canadian Patent No.1,072,465 issued 1980-02-26 for a balanced lid system for industrial trash bins, and Canadian Patent No.1,237,994 issued 1980-06-14 for a waste container opening lid member, disclose mechanisms that are used to open the lid of a container and are designed to open only small size containers by manually sliding the lid to the side of the container.

SUMMARY

[0009] Embodiments of the present disclosure offer a simple and affordable solution to avoid the limitations of the above.

[0010] An apparatus is disclosed comprising: an open top container; a track mounted to the open top container between opposed side walls of the open top container; a roof mounted by an axle to the track to permit the roof to, in use, slide along the track from a closed position to either side of the open top container and then be rotated about the axle into an open position, in which the axle is mounted to the roof by a compressible part that permits the roof to move in a vertical direction relative to the axle; and a tensioner for securing the roof against the open top container when the roof is in the closed position.

[0011] An apparatus is disclosed comprising: an open top container; a track mounted to the open top container between opposed side walls of the open top container; a roof mounted by an axle that rolls along the track to permit the roof to, in use, slide along the track from a closed position to either side of the open top container and then be rotated about the axle into an open position; and a ratcheting handle connected to rotate the axle relative the track to slide the roof along the track.

[0012] An apparatus is disclosed comprising: an open top container; a track assembly mounted to the open top container between opposed side walls of the open top container, the

track assembly forming a rack; and a roof mounted by a pinion assembly that rolls along the rack to permit the roof to, in use, slide along the rack from a closed position to either side of the open top container and then be rotated about the pinion assembly into an open position; and in which the track assembly comprises opposed tracks that are rigidly connected at a fixed distance relative to one another, at all positions between longitudinal ends of the rack, to retain the pinion in contact with the rack.

[0013] An apparatus is disclosed comprising: an open top container; a track mounted to the open top container between opposed side walls of the open top container; a roof mounted by an axle to the track to permit the roof to, in use, slide along the track from a closed position to either side of the open top container and then be rotated about the axle into an open position; and a bar mounted to the track to move into and out of an axle blocking position where the axle is prevented from sliding the roof out of the closed position.

[0014] An apparatus is disclosed comprising: an open top container; a plate mounted to the open top container between opposed side walls of the open top container, the plate having a series of holes that are spaced along a longitudinal length of the plate to form a rack; and a roof mounted by a pinion that rolls along the rack to permit the roof to, in use, slide along the plate from a closed position to either side of the open top container and then be rotated about the pinion into an open position.

[0015] In the present disclosure of embodiments of a rolling roof, the ratcheting handle may be applied in the operation as a lever to reduce applied manual force, and an equilibrium system may be involved to upend the entire roof in a vertical and reverse in horizontal position, which also reduces the applied manual force. Therefore, the present disclosure of embodiments of a rolling roof permit convenient manipulation of a broad range of lid sizes and weights for various container types while preserving safe operation.

[0016] According to some embodiments of the disclosure, the rolling roof comprises two identical rolling mechanisms on each side of the roof that are connected by a pipe and coupler. The rolling mechanism may include a flange-mounted bearing assembly, sprocket-wheel, and V roller, which are connected concentric to the shaft. The flange-mounted bearing assembly may bear an axle load of the shaft and facilitate rotational motion

concurrent with a sprocket-wheel and V roller. To impart longitudinal motion to the entire rolling roof, a manual turning of the ratcheting handle may be applied to activate the rotary motion of the sprocket-wheel along the structural tubing with holes, concurrent with the V roller that rotates along the L angle iron that is utilized as a guide lower track. Structural tubing with holes and L angle iron may be components of the track assembly that maintain the rolling roof alignment along the front and back end of the container. Also described are rolling mechanisms that may provide the entire rolling roof to slide to either side of the container and turn it to a vertical position to allow the use of the full loading area of the open top container.

[0017] Embodiments of the disclosure provide an improved rolling roof for various types of open top containers. The rolling roof may be used to cover open top containers for any dry loads and a sealed rolling roof may be used to cover containers with dry or liquid loads. The rolling roof may be manually operated with a ratcheting handle in combination with two rolling mechanisms placed on each side of the roof. The rolling roof mechanism may operate by sliding the roof either to the left or to the right side of the container, and turning it from a horizontal to a vertical position along the side wall. This permits loading from either side of the container with access to the full area of the opening. This method may require minimum physical strength, eliminate the use of cable or winch lifting systems, and hence may have a higher degree of safety that is beneficial for various types of open top containers.

[0018] According to some embodiments of the disclosure, a rolling roof comprises two identical rolling mechanisms on the front and back sides (ends) of the roof that are connected by a pipe and coupler.

[0019] According to some embodiments of the disclosure, the rolling roof comprises two identical rolling mechanisms on each side of the roof that connect by a pipe and coupler. The rolling mechanism includes a flange-mounted bearing assembly, sprocket-wheel, and V roller, which connected concentric to the shaft. The flange-mounted bearing assembly bears axle load of the shaft and has applied to it rotational motion concurrent with sprocket-wheel and V roller. To impart longitudinal motion to the entire rolling roof, a manual turning of the

ratcheting handle applies rotary motion to linearly drive the sprocket-wheel along the structural tubing with holes, and concurrently the V roller rotates along an L angle iron that operates as a guide lower track. Structural tubing with holes and L angle iron are components of the track assembly that maintain the rolling roof aligned along the front and back end of the container. Also described are rolling mechanisms that permit the sliding of the entire rolling roof to either side of the container and turning it in a vertical position which allows one to access and use a full loading area of the open top container.

[0020] Methods of operating a rolling roof apparatus are also disclosed.

[0021] In various embodiments, there may be included any one or more of the following features: The rolling mechanism includes a flange-mounted bearing assembly, sprocket-wheel, and V roller with integral ball bearing. The flange-mounted bearing assembly bears the axle load of a shaft and implements rotational motion. The sprocket-wheel fastens to the shaft which allows their concurrent rotation. The V roller is jointed to the shaft with integral ball bearing which allows it to rotate around the shaft. A structural tubing with holes in combination with sprocket is utilized as a rack-pinion mechanism that transmits a torque to rolling roof mechanism. To impart longitudinal motion to an entire rolling roof, a manual turning of a ratcheting handle applies which activates a rotary motion of the sprocket-wheel along the structural tubing with holes, concurrent the V roller rotates along L angle iron that utilizes as a guide lower track. The rotation of V rollers along L angle irons allows a linear motion of the rolling roof mechanisms on each roof's side that provides sliding the entire rolling roof to either side wall of the container and turning it in a vertical position. A compressible seal between the open top container and the roof when the roof is in the closed position. The compressible seal is mounted around an edge of the roof. The tensioner comprises tie down straps mounted on the side walls. The bearings are flange-mounted bearings that connect to plates to form a rigid frame, which mounts the compressible part. The compressible part comprises springs. A ratcheting handle connected to rotate the axle or pinion relative the track to slide the roof along the track. The track forms a rack; and the axle comprises a pinion that rolls along the rack. The pinion is part of a pinion assembly, and the track comprises opposed tracks that are rigidly connected at a fixed

distance relative to one another, at all positions between longitudinal ends of the rack, to retain the pinion in contact with the rack. The track or track assembly is formed by a plate, the plate having a series of holes that are spaced along a longitudinal length of the plate to form the rack. A bar is mounted to the track or track assembly to move into and out of an axle blocking position where the axle is prevented from sliding the roof out of the closed position. The track or track assembly comprises a pair of parallel tracks adjacent opposed ends of the open top container and the axle is mounted to roll along both of the pair of tracks. The roof is horizontal when in the closed position; the roof is horizontal when in a position dangling at either longitudinal end of the track or track assembly; and the roof is vertical when in the open position. When in the open position, the roof is vertical and contacts a block stopper located on an adjacent side wall of the open top container. A lock for securing the roof against an adjacent side wall of the open top container when the roof is in the open position. The lock comprises a chain and hook. The axle crosses a center of gravity of the roof. Sliding the roof from the closed position to either side of the open top container and then rotating the roof into the open position. Securing the roof to an adjacent side wall. Rotating the roof from the open position into a horizontal position and sliding the roof into the closed position. Securing the roof in the closed position. The ratcheting handle is adapted to ratchet in either direction. The ratcheting handle comprises a lever that permits the ratcheting handle to be switched between a first ratcheting direction and a second ratcheting direction. A tensioner for securing the roof against the open top container when in the closed position. The axle or pinion assembly or pinion is mounted to the roof by a compressible part that permits the roof to move in a vertical direction relative to the axle. The rack comprises a pair of parallel racks adjacent opposed ends of the open top container, and the pinion or pinion assembly comprises a pair of pinions or pinion assemblies separated by an axle and each mounted to roll along a respective rack of the pair of parallel racks. The pinion assembly crosses a center of gravity of the roof. The bar is mounted to swing into and out of the axle or pinion blocking position. The bar comprises a pair of bars located to the left and right of the axle or pinion when the roof is in the closed position. A pair of stops is located to the left and right of each of the pair of bars. Each bar hangs down across the path of the axle

or pinion when in a respective axle blocking position of the bar and each bar is mounted to swing toward the axle or pinion and up out of the path of the axle or pinion to move out of the respective axle blocking position. The pinion is a sprocket mounted by an axle to the roof. The plate is formed by a tube. A ratcheting handle connected to rotate the pinion relative the rack to slide the roof along the rack. A bar mounted to the rack to move into and out of a pinion blocking position where the pinion is prevented from sliding the roof out of the closed position.

[0022] These and other aspects of the device and method are set out in the claims, which are incorporated here by reference.

BRIEF DESCRIPTION OF THE FIGURES

[0023] Embodiments will now be described with reference to the figures, in which like reference characters denote like elements, by way of example, and in which:

[0024] Figs. 1.1 and 1.2 are perspective views of an open top container showing an embodiment of the rolling roof mechanism and related safety components.

[0025] Figs. 2.1 and 2.2 are enlarged detail perspective views of the track assembly showing parts of the rolling roof mechanism.

[0026] Fig. 3 is an exploded view of the rolling roof mechanism on each side of the rolling roof to depict components and single parts utilized in the rolling roof mechanism.

[0027] Fig. 4 are various cross-section and detail views of the rolling roof assembly.

[0028] Fig. 5 is an exploded perspective view showing components of the rolling roof mechanism in order of assembly.

[0029] Fig. 6 are a plurality of perspective, close up perspective, top plane, and side elevation views that show an embodiment of the metal bracket used for sealed rolling roof for liquids.

DETAILED DESCRIPTION

[0030] Immaterial modifications may be made to the embodiments described here without departing from what is covered by the claims.

[0031] Figure 1.

[0032] Shown is a full size open top container with a rolling roof 1 in a closed position (Figure 1.1) and an open position (Figure 1.2). As illustrated in Figure 1.2, the rolling roof mechanism allows opening of a full loading area of the container from either side. After horizontal rolling to the side, the roof may smoothly tilt to a vertical position and may be tied to the side wall with a chain 2 and hook 8 (an example of a lock for securing the roof to the adjacent side wall). To prevent any pinch points between the adjacent sidewall and tilted roof, the side wall may have a block stopper 3. The roof is also able to tighten in a top vertical position for safe transportation with a mini winch 7 and hook 6. Movement of the rolling roof to either of opposed side walls may be accomplished by turning ratcheting handle 4 to the either side of the container. In order to start this motion, one of the safety bars 5 (right or left bar, according to the moving direction) may be manually turned inward toward the axle to a horizontal position. The safety bars 5 are built into the track assembly and utilized for safety reasons such as to prevent any motion of the rolling roof out of the closed position. The right bar is hanging down in an axle blocking position where the axle is prevented from sliding to the right out of the closed position. The left bar is shown after having been swung toward the axle and up and out of the path of the axle or pinion to permit the roof to slide to the left. A pair of stops are shown located to the left and right of each the pair of bars.

[0033] Figure 2.

[0034] Shown is an enlarged view of the track assembly with mechanical components required for operation of the system that moves the entire rolling roof 1 to one side of the container and tilts the roof to a vertical position. Figure 2.1 includes views from the bottom and Figure 2.2 includes views from the top to illustrate a few embodiments of the disclosure. The track assembly 11 may consist of an L angle iron 10 welded to the frame of the container that is utilized as a bottom track for the V roller 9 and the top track (structural tubing with sprocket holes) 11a. The top and bottom tracks are opposed tracks that are rigidly connected at a fixed distance relative to one another, at all positions between longitudinal ends of the rack, to retain the pinion in contact with the rack. The track

assembly 11 may also consist of side plate 12 and brace plate 13 to establish a solid frame structure and prevent possible misalignment between L angle iron 10 and track tubing 11a. After force is applied to the ratcheting handle 4, the shaft with sprocket-wheel 8 may start rotating by using structural tubing (an example of a plate) with sprocket holes as a track to form a rack. The V roller 9 may then rotate along the L angle iron, until it reaches plate 12 which is the end point of track assembly. At that point, half of the rolling roof is dangling free in a horizontal position and is enabled to tilt into a vertical position with minimal physical strength (because the axle crosses a center of gravity of the roof), where V rollers are utilized as fulcrum for the entire system. The stopper 14 may consist of two parts (two bend plates with backing support), one part welded to the container frame and the second welded to the rolling roof assembly. As the rolling roof moves along the container frame, stopper plates placed parallel to each other in a longitudinal direction with an acceptable gap in between, may prevent displacement of the V roller 9 from its track.

[0035] Figure 3.

[0036] The drawing shows a broken view of the entire rolling roof to depict the components and single parts utilized in the rolling mechanism coordinated within the track assembly. The rolling roof may include two identical assemblies (parallel tracks adjacent opposed ends of the container), one on each side of the roof, that are connected by for example 3/4-inch pipe 15 and coupler 16 to transmit rotation from one assembly to another. Therefore, to activate the roof's longitudinal motion, only one ratcheting handle 4 may be used, for example on the front side of the container. Two mounted-bearings 18 may be bolted to rectangle bracket 17 which may comprise four metal plates. The bracket 17 may be used to bear axle load of the shaft 19 and transmit longitudinal motion to the entire roof 1 by connection brackets 17 to structural tubings 25, 26. Since the shaft 19 is fixed to brackets by flange-mounted bearings 18, the rotational motion of the unit sprocket-wheel 8 and a hub 21 may be converted to linear motion along the track 11, based on the principle of a rack and pinion gear. The V Roller 9 with inserted radial bearing 22, may also rotate with shaft 19, and supports the longitudinal rolling motion of entire roof 1 by using L angle iron 10 as a structural base for V roller 9.

[0037] Figure 4.

[0038] As illustrated in Figure 4 the components of the axle and bearings are shown in section views that explore the mechanical structure of the rolling mechanism components. The ratcheting handle 4 may be tightened to the shaft 19 against a hub 21 and fixed with a slotted nut 28. The sprocket-wheel 8 may sit tightly on hub 21 and the two may be welded together. The V roller 9 may be inserted with radial bearings 22 attached on the shaft 19. Spacer pipes 29 may be mounted to the shaft between these components to prevent misalignment from L angle iron 10. The shaft 19 may be connected to the coupler 16 with bolts and nuts, which may allow reassembling the rolling mechanism parts in case of necessary repairs. The coupler 16 may be welded to the 3/4 pipe 15 that joins the second rolling roof assembly on the other roof end. This pipe may be passed inside tubing 26, that together with four brace tubings 25, two outside tubings 30, and two end caps, are utilized as a frame for the entire roof assembly.

[0039] Figure 5.

[0040] Shown is an exploded view of all parts that accomplish motion of the rolling roof assembly, according to the order of assembly. As illustrated in Figure 5, 3/4 pipe 15 may be welded with a coupler 16, whereby a rigid coupling occurs to transmit the rotation motion to the identical rolling roof assembly on other side of the roof. This coupler may be bolted together to the shaft 19, and finally attached to ratcheting handle 4 by which this rotation is accomplished. The following parts may be mounted on the shaft 19 in the order they are assembled:

- 1) Two flange-mounted bearings 18 bolted to the metal bracket which consisted of four plates 17.
- 2) The shaft 19 slides through these bearings and attached to the coupler 16.
- 3) The V roller 9 with inserted radial bearing 22.
- 4) The sprocket-wheel 8 with a hub 21.
- 5) Ratcheting handle 4 with slotted nut 28.

[0041] Figure 6.

[0042] As illustrated in Figures 4-5, the rolling roof mechanism may include the metal bracket 17 with two flange-mounted bearings 18 bolted to this bracket. Figure 6 depicts an alternative bracket, designed for a sealed rolling roof utilized for example for containers with hazardous liquid waste. Using a modified bracket allows for the tie-down of the rolling roof with a rubber seal placed along the edge of the roof. A distinguishing feature of the bracket used for sealed rolling roofs, comparing to the bracket in previous figures where four plates welded together as a solid box, is the ability of free vertical movement of plates 33.1, 33.2 along plates 34, 35 and 36. Since plates 34, 35 and 36 are fixed to the end cap of the rolling roof 27, plate 33.1 (with flange-mounted bearings 18) has the ability to slide in a vertical direction. The rate of this movement may be around 1/2 - 1 inch, which may allow for compressing the seal of the rolling roof by tie-down straps 7 (an example of a tensioner for securing the roof), and may make the steel container hermetically sealed.

[0042] Springs 32 (an example of a compressible part) may be aligned in position by rings 31 where the ring 31b is fixed to the plate 35 by spacer bar 37, and spring 31a is fixed to plates 38 (the plates and bearings form a rigid frame). The top part of the spring 32 may be welded to the ring 31b and the bottom part to the ring 31a accordingly. Since the unit of ring 31b, plates 33, flange-mounted bearings 18, shaft 19, and V roller 9 are installed on the vertically rigid L angle iron, another unit of ring 31a, plate 34, plate 35, and end cap 27 permits the rolling roof to have the ability to move in a vertical direction relative to the axle. That allows retaining the entire bracket assembly in an immovable position, until the tie-down force is applied to seal the rolling roof to the frame of the open top container.

[0043] In the claims, the word “comprising” is used in its inclusive sense and does not exclude other elements being present. The indefinite articles “a” and “an” before a claim feature do not exclude more than one of the feature being present. Each one of the individual features described here may be used in one or more embodiments and is not, by virtue only of being described here, to be construed as essential to all embodiments as defined by the claims.

1. An apparatus comprising:
 - an open top container;
 - a track assembly mounted to the open top container between opposed side walls of the open top container, the track assembly forming a rack; and
 - a roof mounted by a pinion assembly that rolls along the rack to permit the roof to, in use, slide along the rack from a closed position to either side of the open top container and then be rotated about the pinion assembly into an open position; and
 - in which the track assembly comprises opposed tracks that are rigidly connected at a fixed distance relative to one another, at all positions between longitudinal ends of the rack, to retain the pinion in contact with the rack.
2. The apparatus of claim 1 further comprising a tensioner for securing the roof against the open top container when in the closed position, in which the pinion assembly is mounted to the roof by a compressible part that permits the roof to move in a vertical direction relative to the pinion assembly.
3. The apparatus of any one of claim 1 - 2 further comprising a ratcheting handle connected to rotate the pinion assembly relative the track assembly to slide the roof along the track assembly.
4. The apparatus of any one of claim 1 - 3 in which the track assembly is formed by a plate, the plate having a series of holes that are spaced along a longitudinal length of the plate to form the rack.
5. The apparatus of any one of claim 1 - 4 further comprising a bar mounted to the track assembly to move into and out of a pinion blocking position where the pinion assembly is prevented from sliding the roof out of the closed position.
6. The apparatus of any one of claim 1 - 5 in which the rack comprises a pair of parallel racks adjacent opposed ends of the open top container, and the pinion assembly comprises a pair

of pinion assemblies separated by an axle and each mounted to roll along a respective rack of the pair of parallel racks.

7. The apparatus of any one of claim 1 - 6 in which:
the roof is horizontal when in the closed position;
the roof is horizontal when in a position dangling at either longitudinal end of the track assembly; and
the roof is vertical when in the open position.
8. The apparatus of any one of claim 1 - 7 in which, when in the open position, the roof is vertical and contacts a block stopper located on an adjacent side wall of the open top container.
9. The apparatus of any one of claim 1 - 8 further comprising a lock for securing the roof against an adjacent side wall of the open top container when the roof is in the open position.
10. The apparatus of claim 9 in which the lock comprises a chain and hook.
11. The apparatus of any one of claim 1 - 10 in which the pinion assembly crosses a center of gravity of the roof.
12. A method comprising operating the apparatus of any one of claim 1 - 11, the method comprising sliding the roof from the closed position to either side of the open top container and then rotating the roof into the open position.
13. The method of claim 12 further comprising securing the roof to an adjacent side wall.
14. The method of any one of claim 12 - 13 further comprising rotating the roof from the open position into a horizontal position and sliding the roof into the closed position.
15. The method of claim 14 further comprising securing the roof in the closed position.
16. An apparatus comprising:

an open top container;
a plate mounted to the open top container between opposed side walls of the open top container, the plate having a series of holes that are spaced along a longitudinal length of the plate to form a rack; and
a roof mounted by a pinion that rolls along the rack to permit the roof to, in use, slide along the plate from a closed position to either side of the open top container and then be rotated about the pinion into an open position.

17. The apparatus of claim 16 in which the pinion is a sprocket mounted by an axle to the roof.

18. The apparatus of any one of claim 16 - 17 in which the plate is formed by a tube.

19. The apparatus of any one of claim 16 - 18 further comprising a tensioner for securing the roof against the open top container when in the closed position, in which the pinion is mounted to the roof by a compressible part that permits the roof to move in a vertical direction relative to the pinion.

20. The apparatus of any one of claim 16 - 19 further comprising a ratcheting handle connected to rotate the pinion relative the rack to slide the roof along the rack.

21. The apparatus of any one of claim 16 - 20 in which the pinion is part of a pinion assembly, and the plate is part of a track assembly that comprises opposed tracks that are rigidly connected at a fixed distance relative to one another, at all positions between longitudinal ends of the rack, to retain the pinion in contact with the rack.

22. The apparatus of any one of claim 16 - 21 further comprising a bar mounted to the rack to move into and out of a pinion blocking position where the pinion is prevented from sliding the roof out of the closed position.

23. The apparatus of any one of claim 16 - 22 in which the rack comprises a pair of parallel racks adjacent opposed ends of the open top container, and the pinion comprises a pair of pinions separated by an axle and each mounted to roll along a respective rack of the pair of parallel racks.
24. The apparatus of any one of claim 16 - 23 in which:
the roof is horizontal when in the closed position;
the roof is horizontal when in a position dangling at either longitudinal end of the rack;
and
the roof is vertical when in the open position.
25. The apparatus of any one of claim 16 - 24 in which, when in the open position, the roof is vertical and contacts a block stopper located on an adjacent side wall of the open top container.
26. The apparatus of any one of claim 16 - 25 further comprising a lock for securing the roof against an adjacent side wall of the open top container when the roof is in the open position.
27. The apparatus of claim 26 in which the lock comprises a chain and hook.
28. The apparatus of any one of claim 16 - 27 in which the pinion crosses a center of gravity of the roof.
29. A method comprising operating the apparatus of any one of claim 16 - 28, the method comprising sliding the roof from the closed position to either side of the open top container and then rotating the roof into the open position.
30. The method of claim 29 further comprising securing the roof to an adjacent side wall.
31. The method of any one of claim 29 - 30 further comprising rotating the roof from the open position into a horizontal position and sliding the roof into the closed position.

32. The method of claim 31 further comprising securing the roof in the closed position.

Figure 1.1

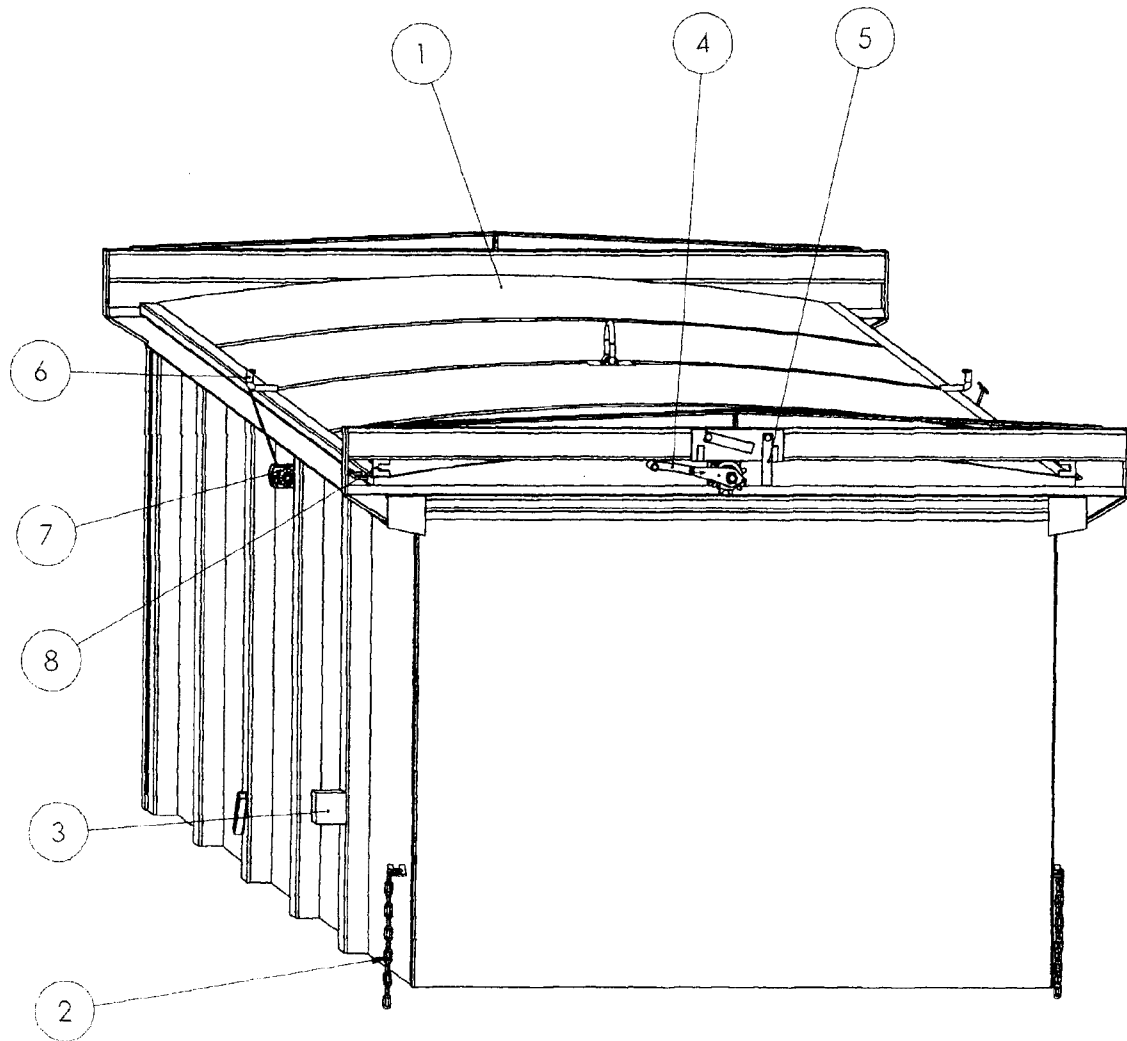
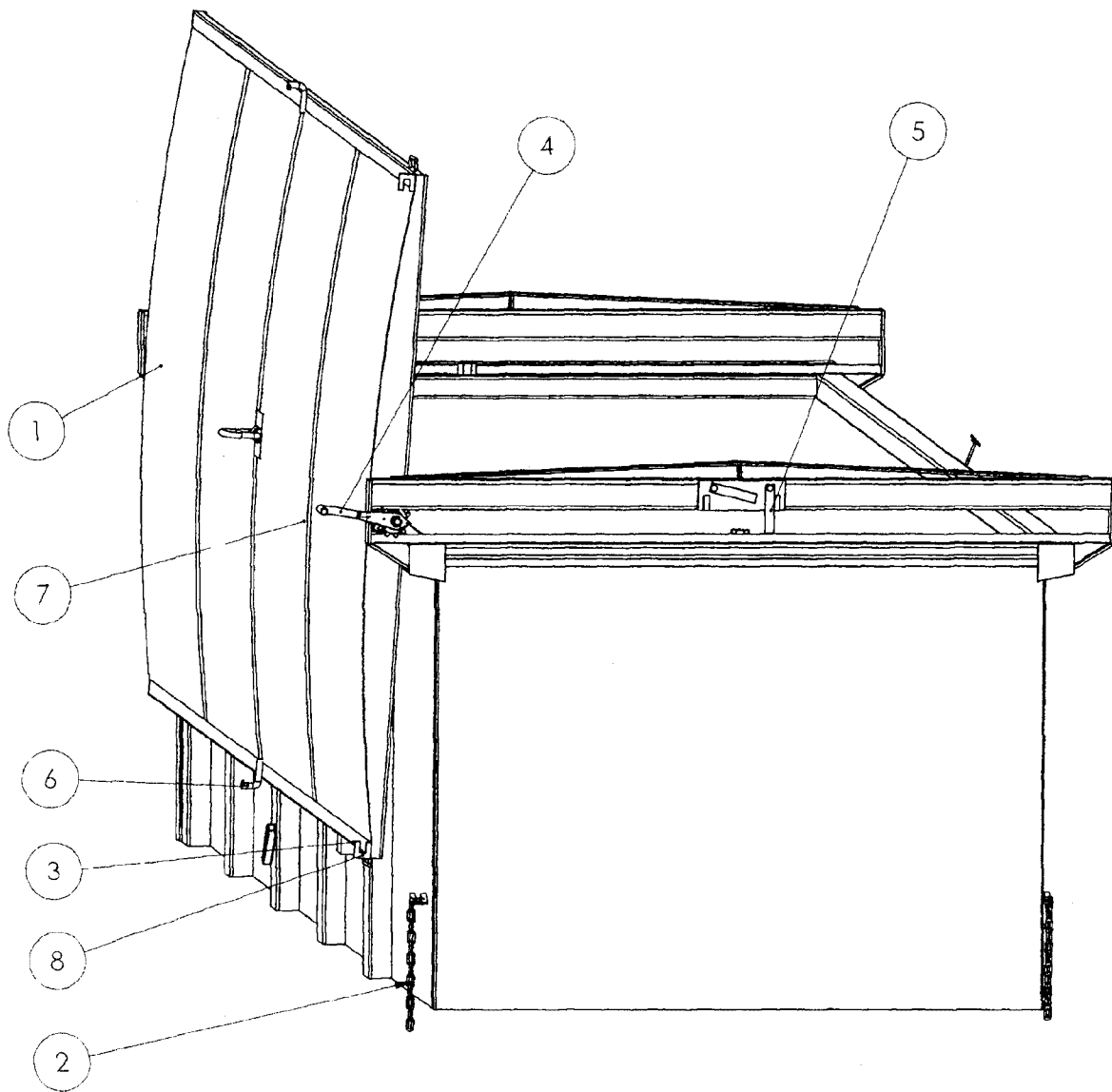


Figure 1.2



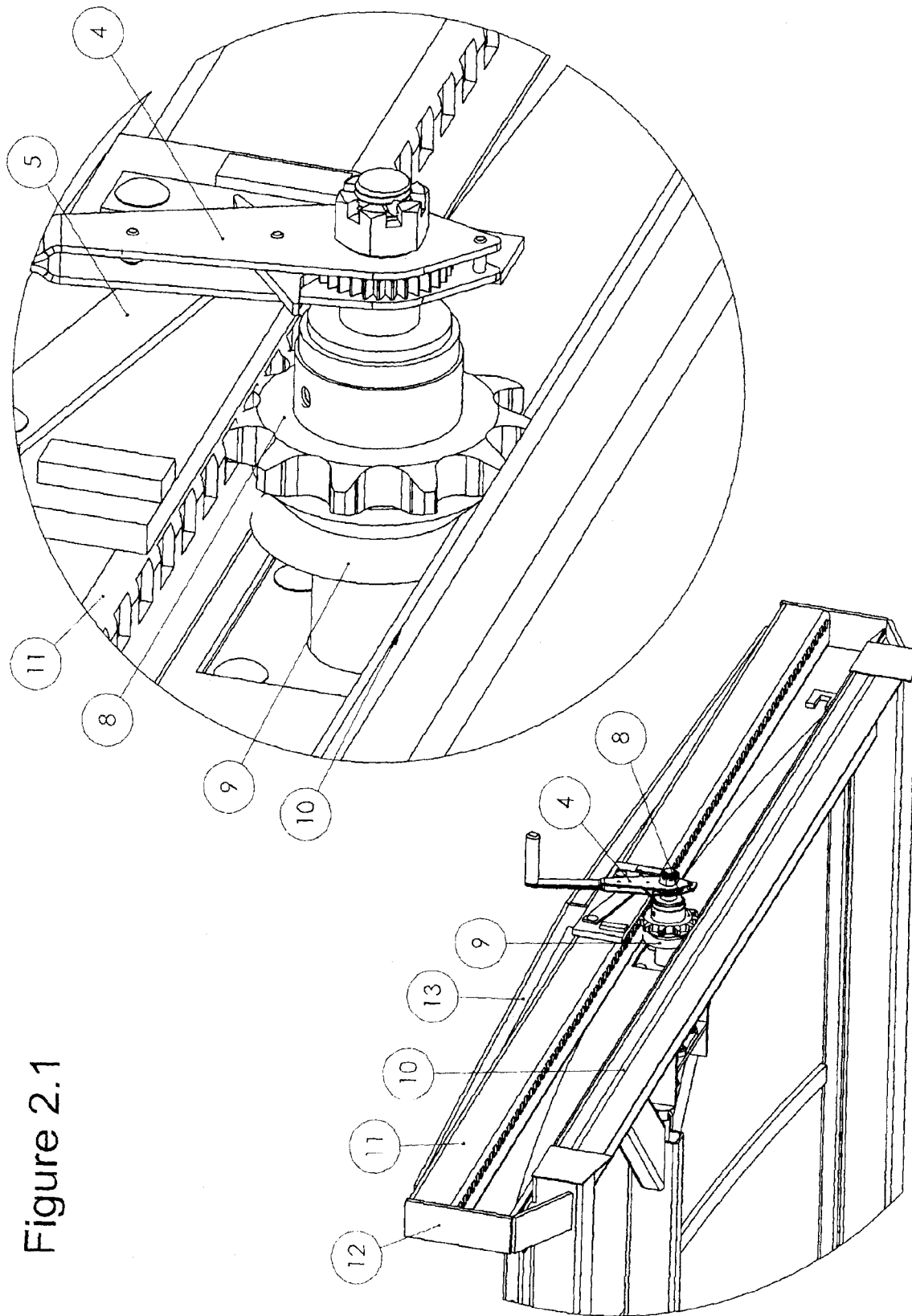


Figure 2.1

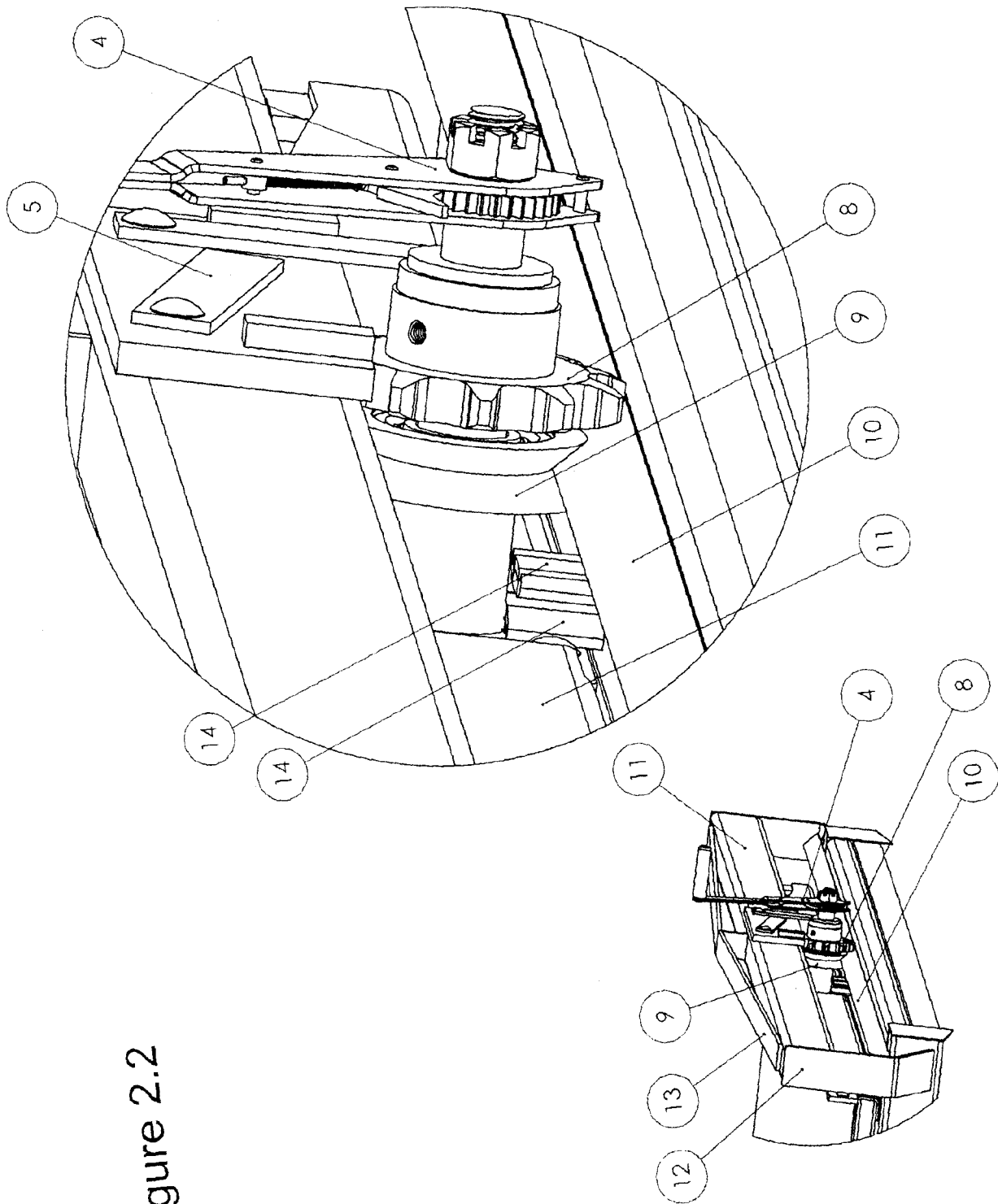


Figure 2.2

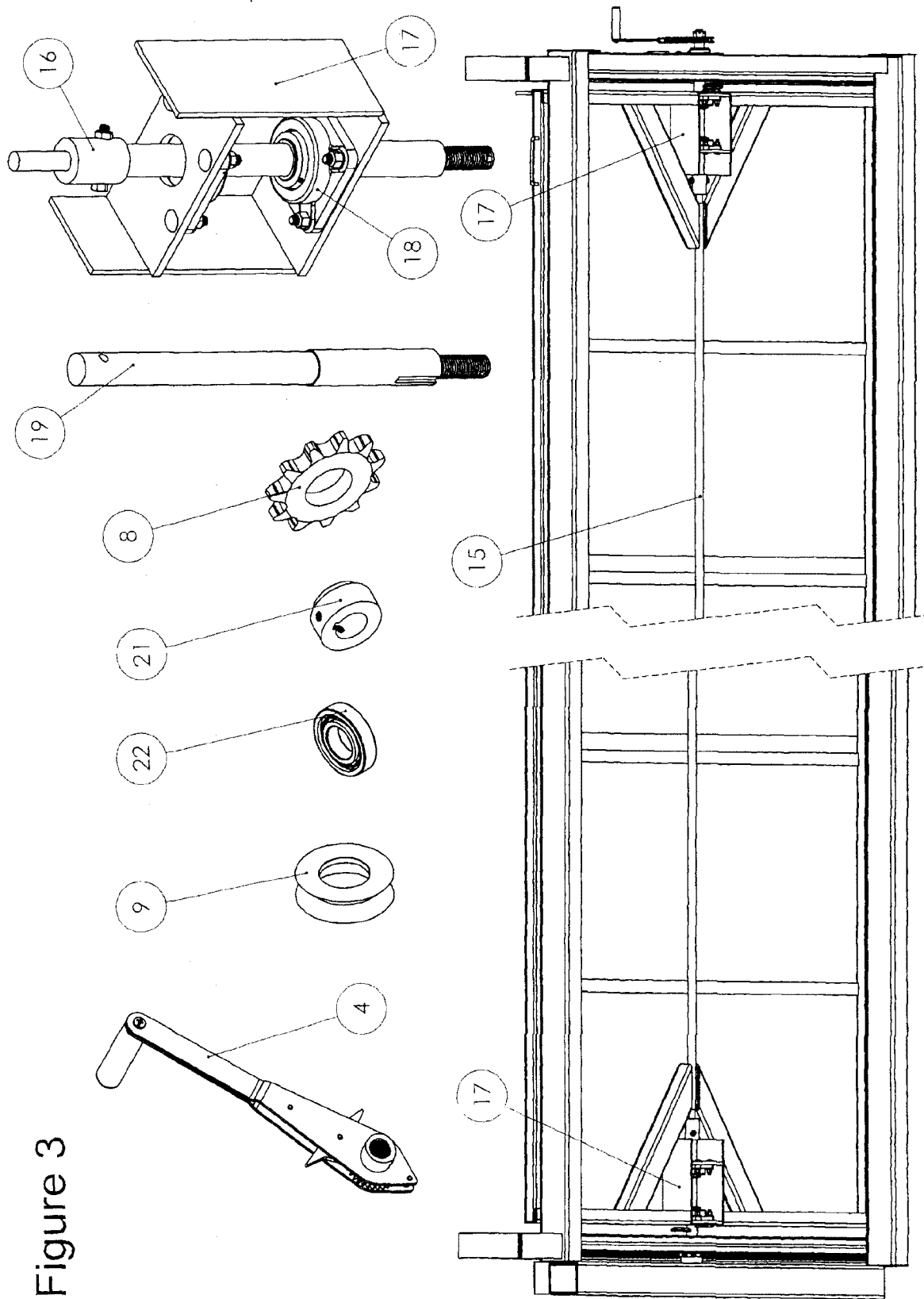


Figure 3

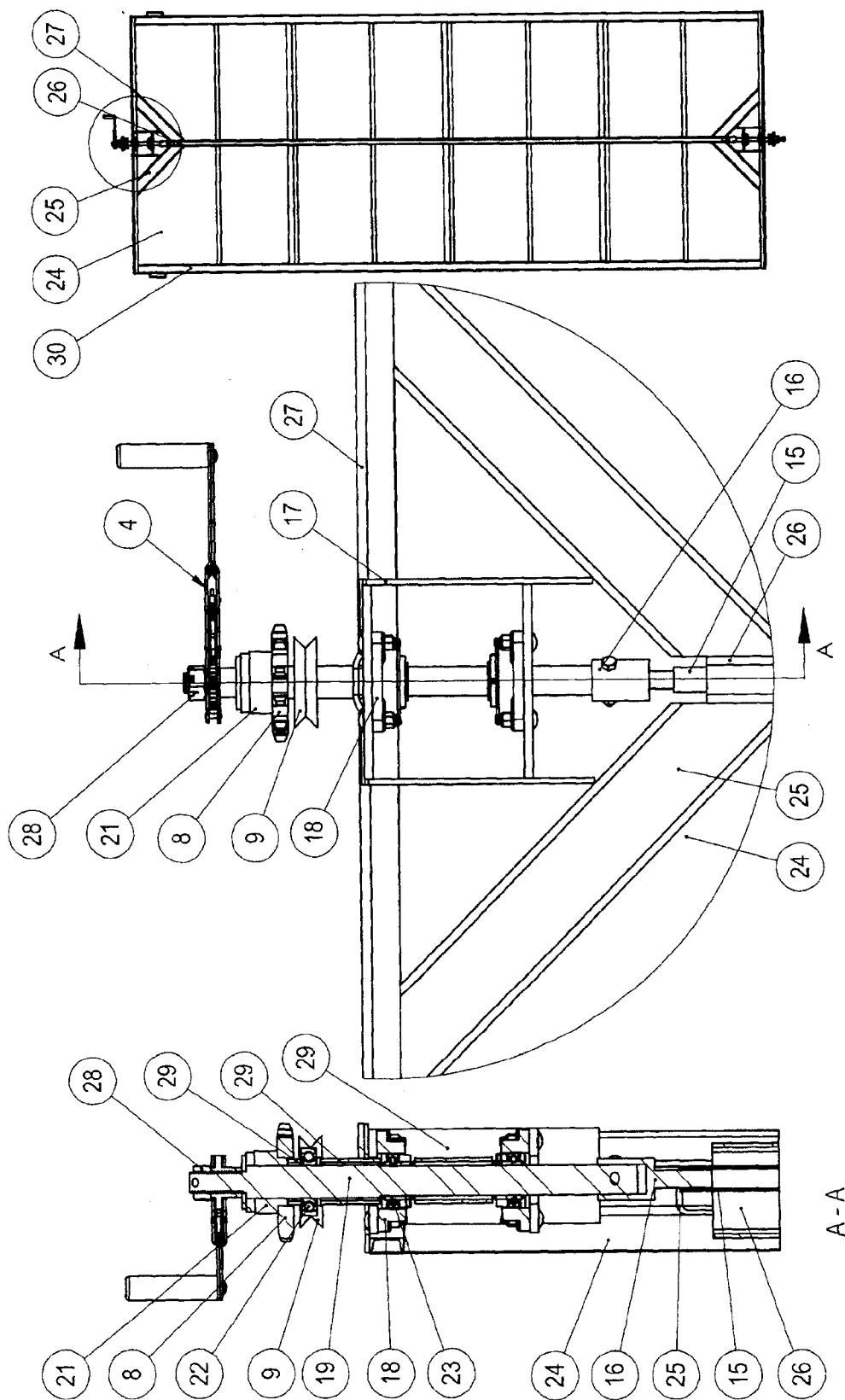
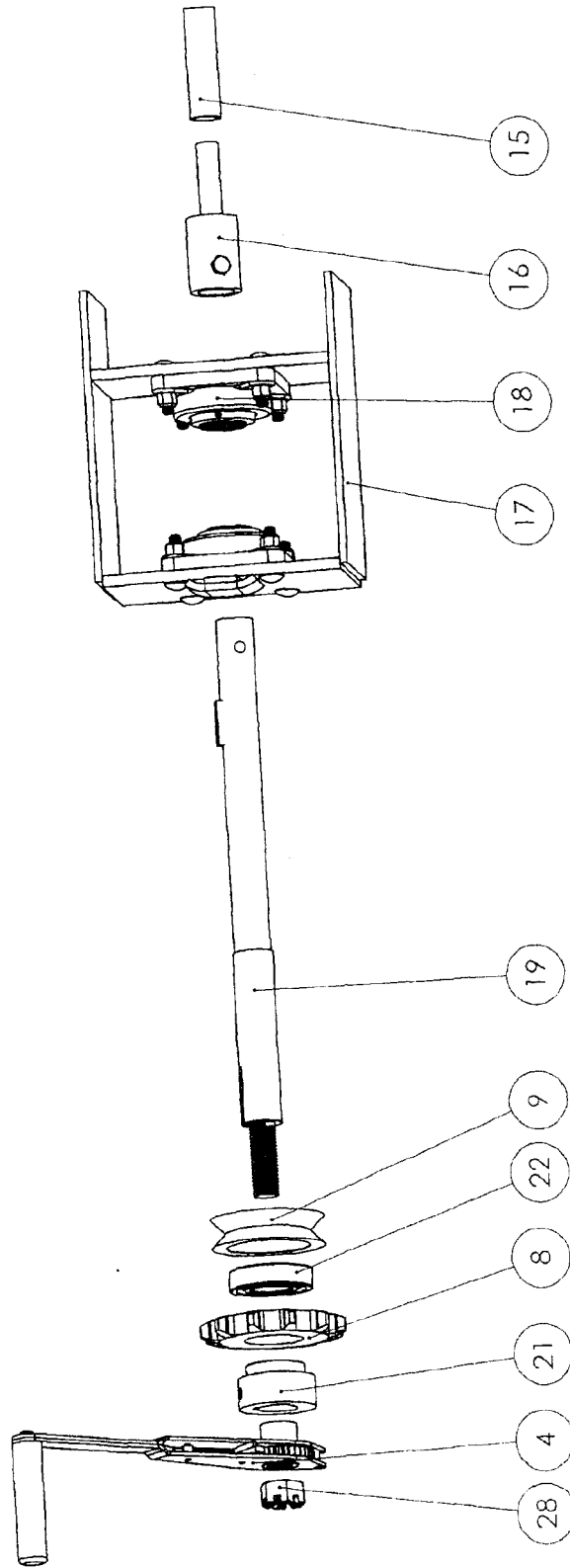


Figure 4

Figure 5



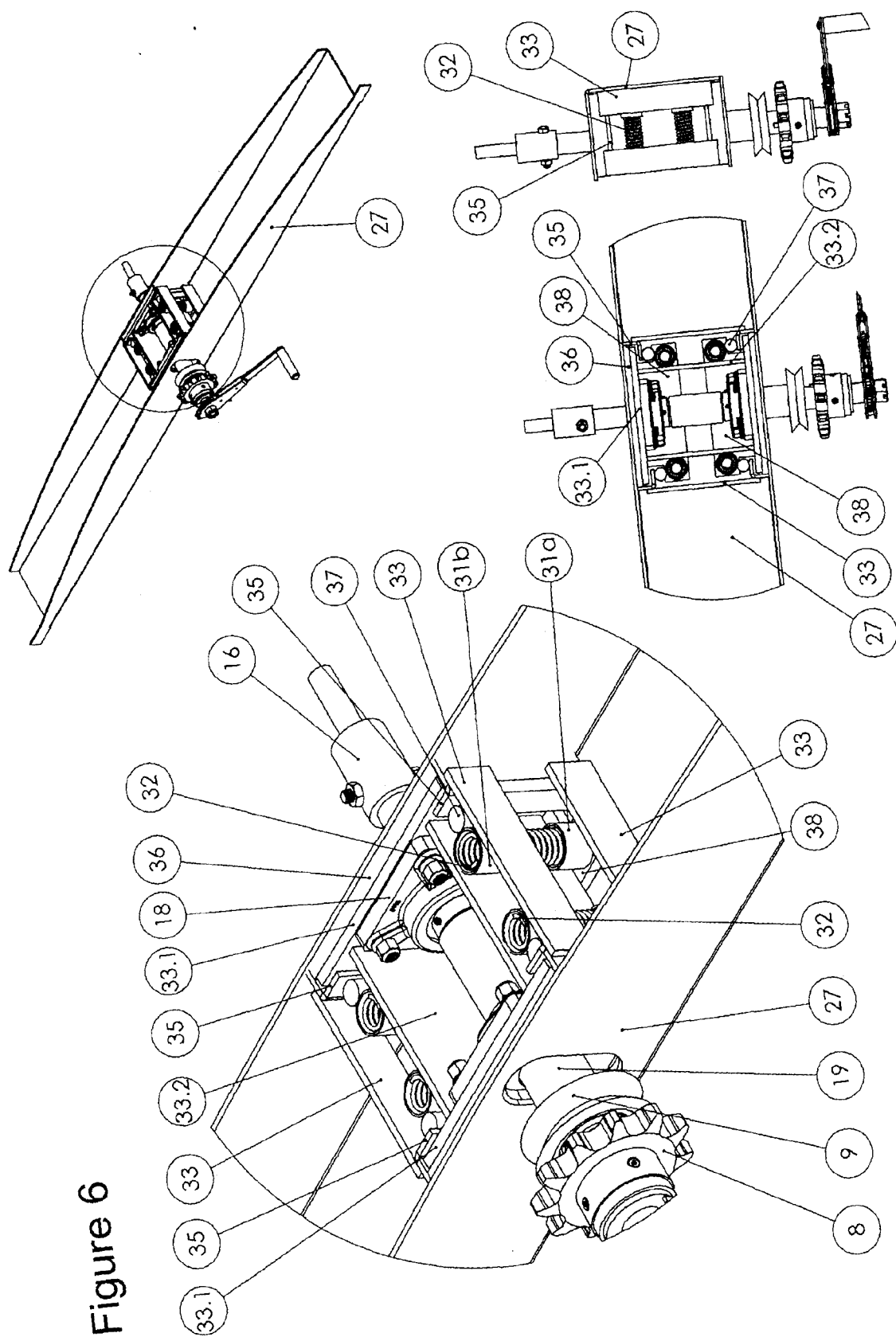


Figure 6

