July 27, 1954

G. H. BOYLES

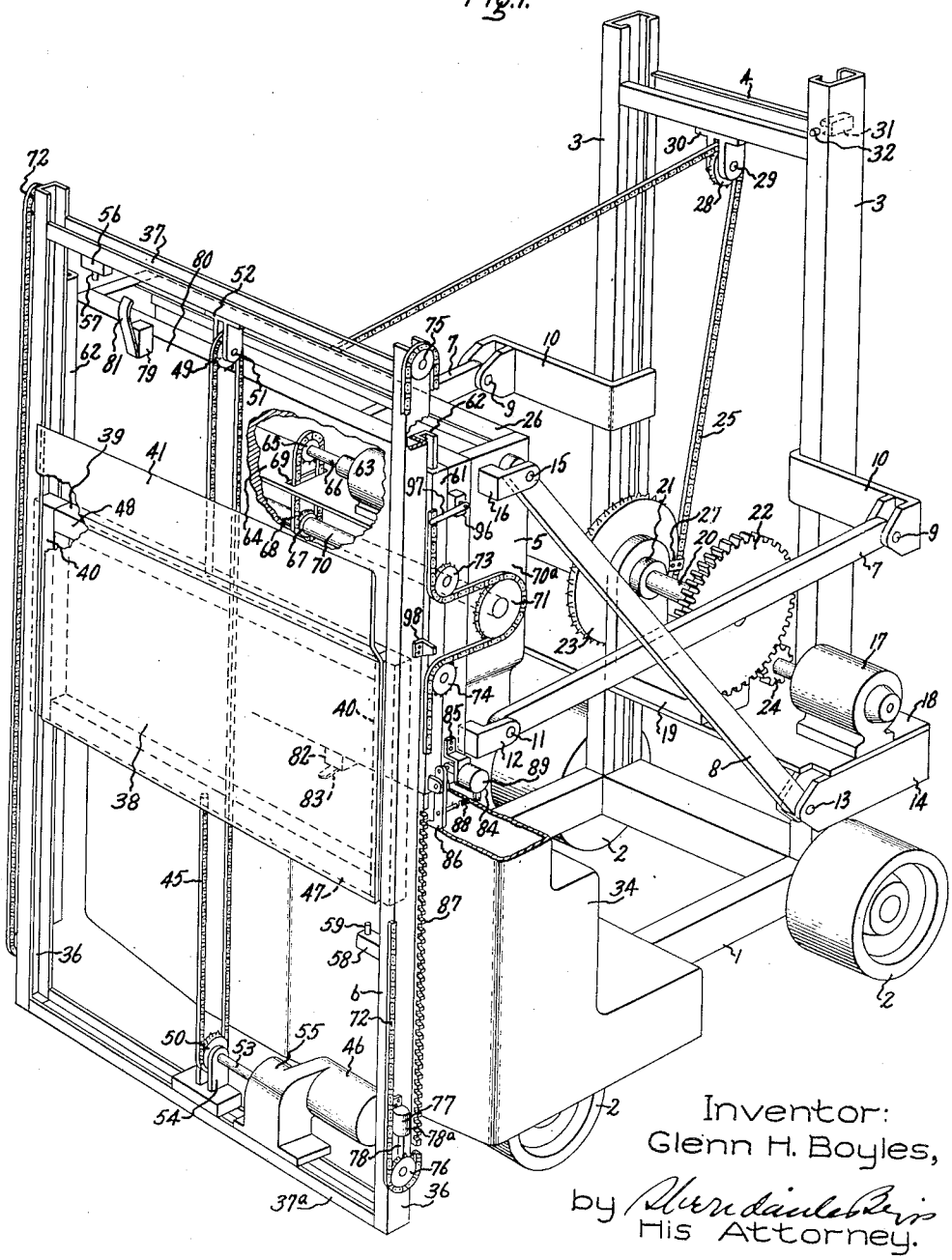
2,684,773

LIFT TRUCK

Filed March 14, 1952

4 Sheets-Sheet 1

Fig. 1.



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4 Sheets-Sheet 2

Fig. 2.

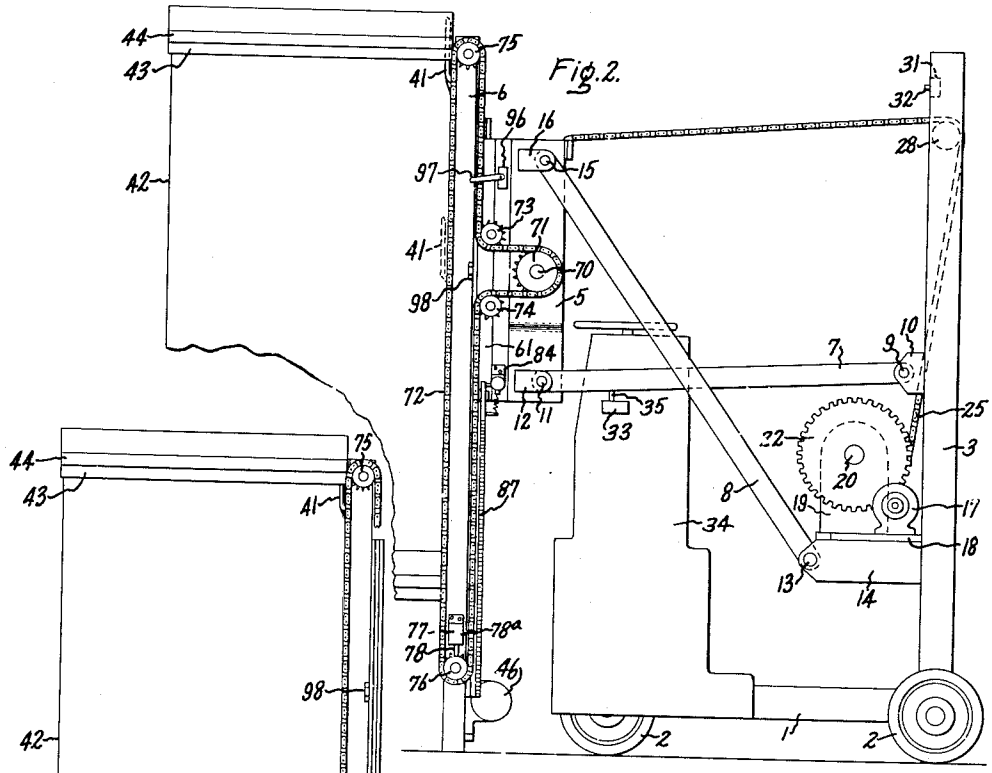


Fig. 3.

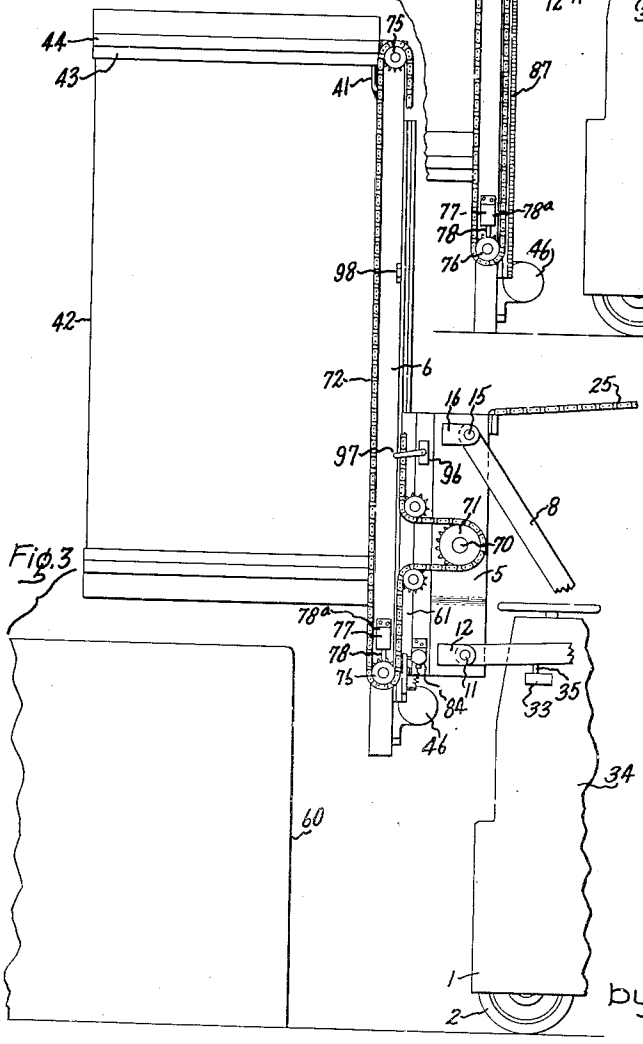
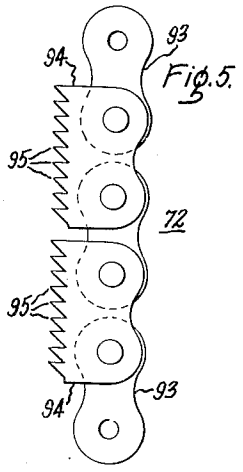


Fig. 5.



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July 27, 1954 G. H. BOYLES 2,684,773

LIFT TRUCK

Filed March 14, 1952 4 Sheets-Sheet 3

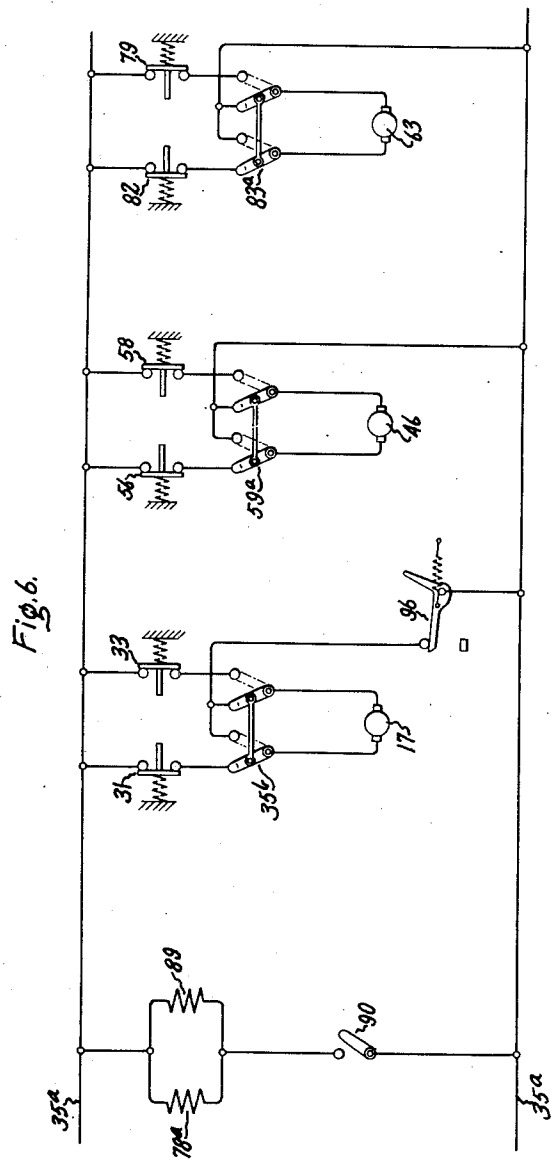

Fig. 6.

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LIFT TRUCK

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Fig. 4.

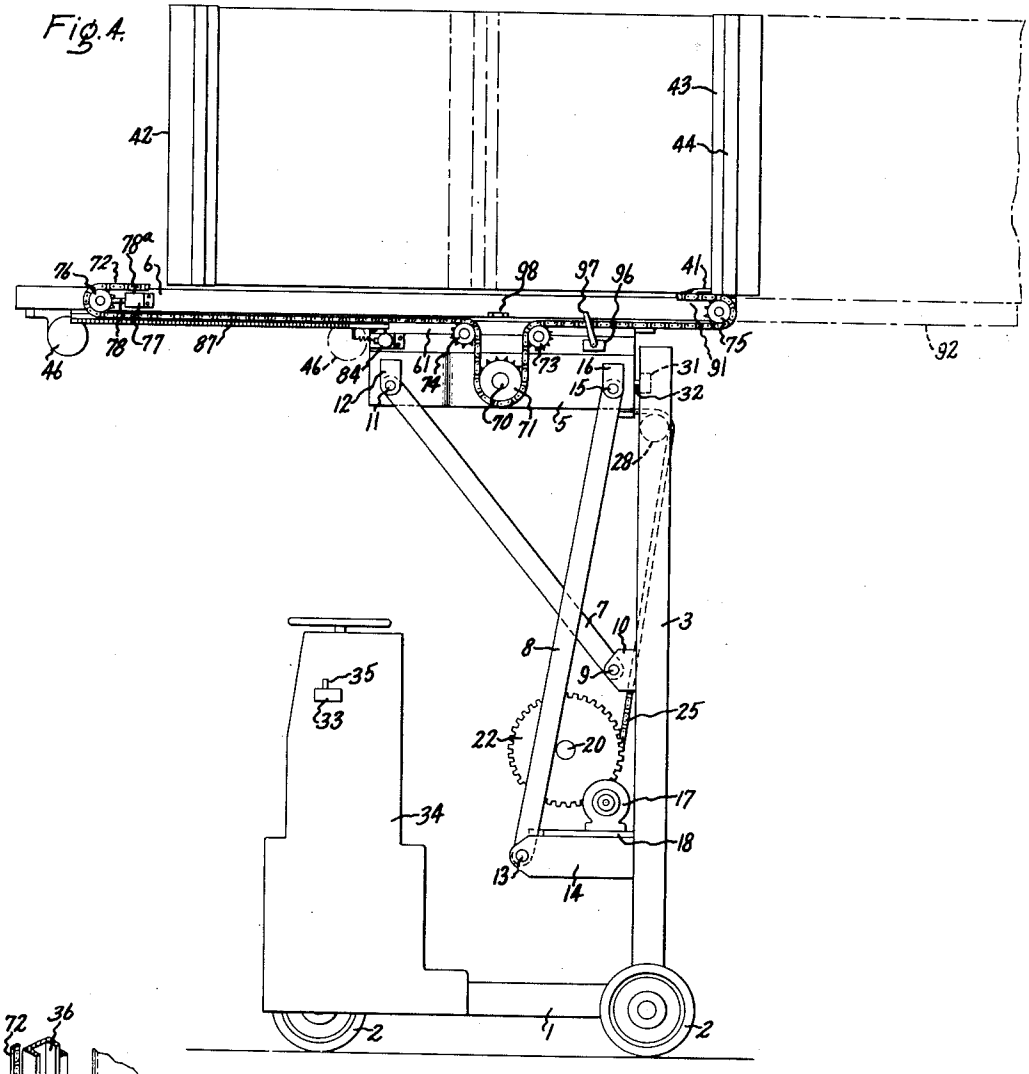
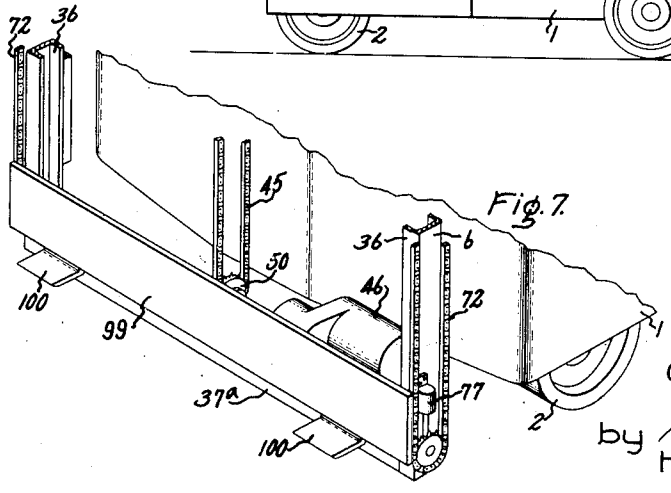


Fig. 7.



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Patented July 27, 1954

2,684,773

UNITED STATES PATENT OFFICE

2,684,773

LIFT TRUCK

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Application March 14, 1952, Serial No. 276,569

8 Claims. (Cl. 214—672)

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My invention relates to lift trucks and more particularly to lift trucks adapted for stacking articles.

In the stacking of articles having a greater height than width, it is sometimes necessary that some of the articles be placed in a vertical position and others in a horizontal position. For example in loading railroad cars with packaged refrigerators, the head room available in such cars is limited so that two vertically positioned refrigerator cartons cannot always be stacked on top of each other. It has been the practice in loading cars with such items to place a row of refrigerator cartons in a vertical position on the floor of the car and then subsequently to place on top thereof refrigerator cartons disposed in a horizontal position. Conventional lift trucks could be used for placing the vertically disposed cartons in position, but it has been necessary to use a crew of several men to place the top horizontally-disposed row of refrigerator cartons in place by hand. By my invention a versatile lift truck is provided which is capable both of placing the lower row of vertically-disposed cartons in position and then subsequently of stacking on top thereof the horizontally-disposed cartons.

Accordingly, it is an object of my invention to provide a lift truck including an improved arrangement for stacking articles.

It is another object of my invention to provide a lift truck including an improved arrangement for stacking articles, such as refrigerator cartons, in both vertical and horizontal positions.

It is a further and more specific object of my invention to provide a lift truck including an improved arrangement for stacking articles of rectangular cross-section in a horizontal position on top of similar articles arranged in a vertical position.

It is still another object of my invention to provide a lift truck including an improved arrangement for shifting articles from the vertical to the horizontal position.

It is still a further object of my invention to provide a lift truck including an improved arrangement for lifting articles, shifting articles from the vertical to the horizontal position, and for unloading the articles from the lift truck.

Further objects and advantages of my invention will become apparent as the following description proceeds and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

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In carrying out the object of my invention, a carriage support and a carriage slidable relative thereto are arranged on a frame for tilting movement between vertical and horizontal positions. A lifting element is movably mounted on the carriage for engaging the article to be lifted. An unloading mechanism is also provided on the carriage for moving articles from the carriage when it is in its horizontal position.

For a better understanding of my invention, reference may be had to the accompanying drawings in which Fig. 1 is an isometric view of the lift truck incorporating an embodiment of my invention; Fig. 2 is a side elevation view of the lift truck showing a refrigerator carton partially lifted thereby; Fig. 3 is a view of a portion of the truck of Fig. 2 showing the carton lifted still further for vertical stacking; Fig. 4 is a view of the lift truck showing the parts in a horizontal position for unloading; Fig. 5 is a detail of the unloading chain; Fig. 6 is a schematic circuit diagram; and Fig. 7 is a view of the portion of a lift truck showing a modified form of my invention.

Referring to Fig. 1, there is shown a lift truck which includes a frame 1 having a plurality of wheels 2 mounted thereon for providing mobility for the truck. The drive for the wheels, which may be of any conventional type, has not been shown since it forms no part of the present invention. The frame 1 includes vertical members 3 at the rear portion thereof connected near the top by a cross bar 4.

A structure including a carriage support 5 and a carriage 6 is pivotally mounted on the frame 1 for movement between vertical and horizontal positions. On each side of the lift truck, a pair of arms 7 and 8 are provided for mounting the carriage support 5 on the frame 1. Each of the arms 7 is pivotally connected by a pin 9 to a support or bracket 10 secured in any suitable manner, as by welding, to the vertical members 3. The other end of each of the arms 7 is connected by a pin 11 to a bracket 12 secured in any suitable manner, as by welding to the carriage support 5. Each of the other arms 8 is connected to the frame 1 by a pin 13 mounted in a bracket or support 14 secured to the vertical members 3. The other end of each of these arms 8 is pivotally mounted by a pin 15 on a bracket 16 which is secured to the carriage support 5.

For effecting movement of the carriage support 5 and, of course, its associated carriage 6, between the vertical and horizontal positions shown

in Figs. 1 and 4, for example, a mechanism including a tilt motor 17 is included. The motor 17 is mounted on a plate 18 which is secured to the brackets 14. A U-shaped support 19 is also mounted on the plate 18. A shaft 20 is rotatably mounted in bearings, one of which is shown at 21, in the support 19. This shaft includes a spur gear 22 at one end thereof and a sprocket or drum 23 at the other end. The sprocket 23 is driven by the tilt motor 17 through a pinion 24 mounted on the motor shaft and engaging the spur gear 22. For effecting movement of the carriage support 5 by the rotation of the motor 17, a chain or cable 25 is connected at one end to the upper portion or cross member 26 of the carriage support 5 and at the other end to the sprocket 23. This latter end may be secured to the sprocket 23 by a clamp 27 secured by rivets or other suitable fastening means to the sprocket 23. To facilitate movement of the carriage support, the chain 25 is passed over an idler sprocket 28. This idler sprocket 28 is mounted on a pin 29 which is positioned in a depending bracket 30 secured to the cross bar 4 in any suitable manner, as by welding.

To effect movement of the carriage support 5 and the carriage 6 from the vertical position shown in Fig. 1 to the horizontal position shown in Fig. 4, the tilt motor 17 is rotated in a counterclockwise direction, as viewed in Fig. 1, to cause the chain or cable 25 to be wound around the sprocket or drum 23. This effects a pivotal movement of the carriage support 5 by means of the crossed supporting arms 7 and 8 at each side of the lift truck. When it is desired to shift the carriage support 5 and its associated carriage 6 from the horizontal to the vertical position, the tilt motor 17 is energizes to rotate in the reverse, that is, clockwise direction, unwinding the chain 25. The center of gravity of the combined structure including carriage support 5 and carriage 6 being to the left of the pivot points provided by the pins 9 and 13, this combined structure moves by gravity toward its vertical position as the chain 25 is unwound by the tilt motor 17.

In order to limit the movement of the carriage support 5 and carriage 6 toward the horizontal position and to avoid overloading of the motor 17 when further movement toward this position is blocked by the members 3 of the frame 1, a normally closed limit switch 31 is mounted within the channel section of one of the vertical members 3 of the frame. The limit switch 31 includes an actuating plunger 32 which extends through an opening in the front face of the vertical member 3. This actuating plunger 32 is positioned to be engaged by the cross member 26 of the carriage support 5 when the carriage support reaches its horizontal position. Engagement of the actuating plunger 32 by the cross bar 26 of the carriage support 5 effects opening of the limit switch 31 to break the circuit of the motor 17, deenergizing the motor and stopping the counterclockwise rotation thereof. The limit switch has been shown only generally since it may be of any conventional structure, and the specific structure thereof is not part of the present invention. Similarly, to limit movement of the carriage support 5 and its associated carriage 6 to the vertical position, a second limit switch 33 is mounted on a portion 34 of the frame 1. The limit switch 33 includes an actuating plunger 35 which is adapted to engage the arm 7 to break the circuit of the tilt motor 17 when the carriage support 5 and carriage 6 reach the vertical position and thereby stop clockwise rotation of the motor 17.

In the schematic diagram of Fig. 6 power is shown being supplied to the motor 17 from power supply lines 35*a* through the normally closed limit switches 31 and 33 and a reversing switch 35*b* which may be manually operated by the lift truck operator. When the motor 17 is to be actuated to lift the carriage support 5, that is, when the motor 17 is to be rotated in a counterclockwise direction, the reversing switch 35*b* is positioned as indicated by the solid lines in Fig. 6. Under these conditions, power is supplied to the motor 17 until the cross bar 26 engages the actuating plunger 32 of the normally closed limit switch 31. This engagement opens the limit switch 31 and prevents further rotation of the motor in the counterclockwise direction. Should it then be desired to return the carriage support 5 to the horizontal position, the reversing switch 35*b* is shifted to the dotted line position shown in Fig. 6, thereby completing a circuit to the motor 17 through the normally closed limit switch 33. The motor then rotates in a clockwise direction to effect lowering of the carriage support 5 toward the vertical position. At the desired limit of movement of the carriage in this direction, the actuating plunger 35 of the limit switch 33 is engaged by the arm 7, as described previously, opening the limit switch 33 and preventing further rotation of the motor 17 in a clockwise direction. The motor can, of course, still be rotated in a counterclockwise direction to lift the carriage support 5 under these circumstances by shifting the reversing switch 35*b* back to the solid line position shown in Fig. 6. To deenergize the tilt motor 17 regardless of the condition of the limit switches 31 and 33, the reversing switch 35*b* may be moved to a mid-position, fully interrupting the circuit to the motor 17 from the power supply lines 35*a*.

The carriage 6 includes two channel-shaped side members 36, an upper cross bar or member 37 and a lower cross bar or member 37*a*. For engaging articles to be lifted, a lifting blade or element 38 is slidably mounted on the carriage 6. This lifting blade includes a supporting frame 39 having side portions 40 which are received within the channels of the members 36. The upper end 41 of the blade 38 is offset outwardly from the face of the carriage 6 for more readily engaging an article to be lifted and stacked. This lift truck is particularly adapted for handling cartons, such as those employed for packing household refrigerators, which embody an overlapping collar at the top and bottom thereof. For example, these cartons, as illustrated at 42 in Figs. 2 and 3, may be of the type as shown in Patent 2,474,968, Beach, Jr. Such cartons, which are made from corrugated paper, include an overlapping depending collar 43 held firmly in place by a metal band 44 surrounding the collar. As can best be seen by reference to Fig. 2, the offset upper end 41 of the blade 38 is received within the space between the side wall of the main body of the carton and the overhanging depending collar 43. The collar 43 is integrated with the body of the carton to a sufficient extent that the weight of the carton and its contents can be lifted by the blade inserted under the collar.

In order to effect movement of the blade 38 for insertion beneath the collar 43 and for subsequent upward movement to effect lifting of the carton 42, a chain or cable 45 is secured to the blade 38, and this chain 45 is driven by a blade lift motor 46.

One end of the chain 45 is connected to a lower cross member 47 of the frame 39 of the lifting blade 38, and the other end of the chain 45 is connected to an upper cross member 48 of the frame 39. The chain 45 is arranged to pass over an idler sprocket 49 mounted at the upper end of the carriage 6 and a driven sprocket 50 mounted at the lower end of the carriage 6. The idler sprocket 49 is mounted by means of a pin 51 in a bracket 52 which is secured to the upper cross member 37 of the carriage 6. The driven sprocket 50 is mounted on a shaft 53 extending through bearings in a bracket 54 which is mounted on the lower cross member 37*a* of the frame 6. The driven sprocket 50 is rotated by the blade lifting motor 46 through a gear reduction unit 55 which is mounted on the lower cross bar member 37*a* of the carriage 6. It can be seen that the blade 38 may be moved upwardly or downwardly by rotating the blade lifting motor 46 in one direction or the other.

In operation, the lift truck, and specifically the carriage 6 thereof is moved adjacent the vertical wall of a carton 42 with the offset upper edge 41 of the blade 38 in the general position indicated by the lower dotted lines in Fig. 2. The blade lifting motor 46 is then energized to rotate the driven sprocket 50 in a clockwise direction, as viewed in Fig. 1, moving the blade 38 upwardly. The blade is moved upwardly to engage the offset upper edge 41 beneath the collar 43, and this upward movement may then be continued to lift the carton from the surface upon which it has been resting.

In order to limit the movement of the blade 38 in an upward direction, a normally closed limit switch 56 is mounted on the upper cross member 37 of the carriage 6. This limit switch 56 includes a depending actuating plunger 57 which is adapted to be engaged by the upper cross member 48 of the lifting blade frame 39 when the blade has reached the predetermined limit of its upward movement. Actuation of the plunger 57 by the engagement therewith of the cross member 48 opens the switch 56 and effects deenergization of the motor 46, thereby terminating clockwise rotation of the sprocket 50 and upward movement of the blade 38. Similarly, a second normally closed limit switch 58 is provided for limiting the movement of the blade 38 in a downward direction. The limit switch 58 is mounted on one of the vertical members 36 of the frame of the carriage 6 and extends into the path of the lower cross member 47 of the frame 39 of the blade 38. The limit switch includes an upwardly extending actuating plunger 59 which is adapted to be engaged by the cross member 47 of the frame 39 of the blade when the blade reaches a predetermined lower position relative to the carriage 6. Engagement of the plunger 59 by the blade opens the switch 58 and deenergizes the blade motor 46, terminating counterclockwise rotation of the sprocket 50 and downward movement of the blade.

In the schematic diagram of Fig. 6, power is shown being supplied to motor 46 through the normally closed limit switches 56 and 58 and a reversing switch 59*a* which may be manually actuated by the lift truck operator. When the blade lifting motor 46 is to be actuated to lift the blade 38, that is, when the sprocket 50 is to be rotated in a clockwise direction, the switch 59*a* is moved to the position indicated by the solid lines in Fig. 6. Under these conditions, power is supplied to the motor 46 until the upper

cross member 48 of the lifting blade frame 39 engages the actuating plunger 57 of the normally closed limit switch 56. Actuation of the plunger 57 opens the limit switch 56 and prevents further rotation of the sprocket 50 in the clockwise direction. Should it then be desired to lower the blade 38, the reversing switch 59*a* is shifted to the dotted line position shown in Fig. 6, thereby completing a circuit to the motor 46 through the normally closed limit switch 58. The motor then rotates to drive the sprocket 50 in a counterclockwise direction to lower the blade 38. At the desired lower limit of movement of the blade, the cross member 47 of the frame 39 engages the actuating plunger 59 of the limit switch 58, opening the limit switch 58 and preventing further rotation of the sprocket 50 in a counterclockwise direction. The motor can, of course, still be rotated in a clockwise direction to lift the blade under these circumstances by shifting the reversing switch 59*a* back to the solid line position shown in Fig. 6. To deenergize the motor 46 regardless of the position of the limit switches 56 and 58, the reversing switch 59*a* may be moved to a mid-position, fully interrupting the circuit to the motor 46 from the power supply lines 35*a*.

The movement of the lifting blade 38 is sufficient to move the carton 42 only a limited distance from the surface upon which it has been resting. In order to effect a substantially greater upward movement of the carton, for example for vertically stacking the carton on another object or carton 60 in the manner illustrated in Fig. 3, and also for assisting in positioning and unloading cartons in the horizontal position, the carriage 6 is mounted for a substantial sliding movement relative to the carriage support 5. To provide for this movement, the carriage support 5 includes two parallel inwardly extending channels, one of which is shown at 61 in Fig. 1. These channels 61 provide guides or ways for receiving outwardly facing channel members 62. As can be seen in Fig. 1, the members 61 and 62 interlock to provide for sliding movement of the carriage 6 relative to the carriage support 5.

In order to effect movement of the carriage 6 relative to the carriage support 5, a carriage lifting motor 63 is provided. Although for simplicity no gear reduction unit has been illustrated in connection with motors 63 and 17, it will be apparent that a gear reduction unit similar to that shown at 55 would normally be employed in order that the motors 17 and 63 may satisfactorily handle the relatively large loads involved. The motor 63 is mounted on a horizontal plate 64 which is secured to the carriage support 5 in any suitable manner, as by welding. The motor 63 drives a sprocket 65 mounted on a shaft 66 of the motor. A second sprocket 67 is driven from the sprocket 65 by an endless chain 68 which engages both sprockets. An opening 69 is provided in the plate 64 to allow passage of the chain 68 therethrough. The sprocket 67 is mounted on a shaft 70 which extends through bearings provided in the vertical side members 70*a* of the carriage support 5. A sprocket, one of which is shown at 71, is rigidly mounted on each end of the shaft 70 so as to be driven by this shaft. In order to translate rotation of the sprockets 71 into sliding movement of the carriage 6 relative to the carriage support 5, two endless conveyor chains 72 are provided. For guiding each of the chains 72 two sprockets 73 and 74 are rotatably mounted on the carriage

support 5 and two additional sprockets 75 and 76 are rotatably mounted at the upper and lower ends respectively of the vertical side members 36 of the carriage 6. Also mounted on each of the side members 36 of the carriage 6 at the lower portion thereof is a solenoid-actuated locking device, one such device being shown at 77. Each locking device 77 includes a plunger 78 which is normally, that is, when the solenoid 78*a* is deenergized, spring-biased into engagement with the teeth of the corresponding sprocket 76 so as to prevent rotation of this sprocket. With rotation of the sprocket 76 being normally blocked by the engagement of the locking device 77 therewith, it can be seen that energization of the carriage lifting rotor 63 to effect, for example, counterclockwise rotation of the sprocket 71, as viewed in Fig. 1, is effective to cause a lifting of the carriage 6 relative to the carriage support 5. In this manner the carriage can be lifted, for example, from the position shown in Fig. 2 to that shown in Fig. 3, this substantial upward movement of the carriage affording stacking of a carton 42 in a vertical position on a lower object 60. Conversely, energization of the carriage lifting motor 63 for rotation in a clockwise direction to effect clockwise rotation of sprocket 71 is effective to move the carriage 6 downwardly relative to the carriage support 5.

In order to limit the downward movement of the carriage 6 relative to the carriage support 5 in a lower direction, a normally closed limit switch 79 is mounted on the forward face 60 of the carriage support 5. The limit switch 79 includes an actuating element 81 which is adapted to be engaged by the upper cross member 37 of the frame of the carriage 6. The limit switch 79 is moved to an open position when the actuating element 81 is engaged by the cross arm 37, thereby deenergizing the carriage lifting motor 63 and terminating the clockwise rotation of the motor 63 and the downward movement of the carriage 6 relative to the carriage support 5. For limiting the upward movement of the carriage 6 a normally closed limit switch 82 is mounted on the lower surface of the carriage support 5. This limit switch 82 includes a forwardly extending actuating element 83 adapted to be engaged by the upper surface of the gear reduction unit 55 at the limit of the desired upward movement of the carriage 6 relative to the carriage support 5. The limit switch 82 is adapted to be moved to the open position through engagement of the actuating element 83 by the gear reduction unit 55, thereby deenergizing the carriage lifting motor 63 and terminating the counterclockwise rotation of the motor 53 and the upward movement of the carriage 6 relative to the carriage support 5.

In the schematic diagram of Fig. 6, power is shown being supplied the carriage lifting motor 63 through the normally closed limit switches 79 and 82 and a reversing switch 83*a* which may be manually operated by the lift truck operator. When the motor 63 is to be actuated to lift the carriage 6 relative to the carriage support 5, that is, when the motor is to be rotated in a counterclockwise direction as shown in Fig. 1, the reversing switch 83*a* is positioned as indicated by the solid lines shown in Fig. 6. Under these conditions, power is supplied to the motor 63 through the normally closed limit switch 82 until the upper surface of the gear reduction unit 55 engages the actuating element 83 of the limit switch 82. This engagement opens the limit switch 82 and prevents further rotation of the motor 63 in a counterclockwise direction. Should it then be desired to lower the carriage 6 relative to the carriage support 5, the reversing switch 83*a* is shifted to the dotted line position shown in Fig. 6, thereby completing a circuit to the motor 63 through the normally closed limit switch 79. The motor 63 then rotates in a clockwise direction to effect lowering of the carriage 6 relative to the carriage support 5. At the desired lower limit of such movement of the carriage 6, the cross member 37 of the frame of the carriage 6 engages the actuating element 81 of the normally closed limit switch 79, opening this limit switch and preventing further rotation of the motor in a clockwise direction. The motor 63 can, of course, still be rotated in a counterclockwise direction to lift the carriage 6 under these circumstances by shifting the reversing switch 83*a* back to the solid line position shown in Fig. 6. To deenergize the motor 63 regardless of the condition of the limit switches 79 and 82, the reversing switch 83a may be moved to a mid-position, fully interrupting the circuit to the motor 63 from the power supply lines 35*a*.

Movement of the carriage 6 relative to the carriage support 5 is also employed in the horizontal positioning of cartons 42 as well as in the vertical lifting or vertical stacking thereof. Referring to Fig. 4, for example, it can be seen that this movement of the carriage 6 can be employed for shifting the carriage from the solid line position to the dotted line position shown. This enables the carton 42 to be properly positioned at least partially overhanging a lower carton or object upon which it is to be stacked before the unloading of the carton 42 is begun. Thus the carriage and the carriage support may be swung to the horizontal position in the location shown by the solid lines in Fig. 4. The carriage 6 may then be moved by energization of the carriage lifting motor 63 to shift the carriage and the carton held thereon to a position, for example, shown by the dotted lines in Fig. 4.

In order to effect unloading of the carton and movement thereof to its horizontally stacked position, the conveyor chains 72 are provided. The use of the chains 72 for effecting movement of the carriage 6 relative to the carriage support 5 has been described above. In order to afford proper movement of each of the chains 72 for unloading of cartons in the horizontal position shown in Fig. 4, the solenoid 78*a* of each locking device 77 is energized, retracting the plunger 78 out of engagement with the sprocket 76, so as to permit rotation of this sprocket 76. Energization of the motor 63 and resultant rotation of the sprockets 71 is then effective to move the conveyor chains 72 relative to the carriage 6 for unloading cartons supported on the carriage. To insure that the rotation of the sprockets 71 under the circumstances is directed entirely to movement of the chains relative to the carriage for unloading purposes and is not effective for moving the carriage 6 relative to the carriage support 5, a second locking device 84 is provided. This locking device 84 is mounted on the carriage support by rivets 85 or other suitable fastening devices. The locking device 84 includes a lever 86 adapted to engage a rack 87 secured to or formed integral with the carriage 6. This lever 86 is normally biased out of engagement with the rack 87 by a spring 88 and is adapted to be moved into engagement with the rack 87 by a solenoid 89 of the locking device. Hence, to

lock the carriage 6 against movement relative to the carriage support 5, the solenoid 89 of the locking device 84 is energized, moving lever 86 into engagement with the rack 87. The circuit supplying power to the solenoids 78a and 89 of the locking devices 77 and 84, respectively, is arranged so that both solenoids are energized and deenergized simultaneously, for example by employing a single switch 90 in series with the solenoids 78a and 89, as shown schematically in Fig. 6.

The switch 90 is normally open so the solenoids are deenergized and hence the plunger 78 engages the sprocket 76 to prevent rotation thereof and the lever 86 is out of engagement with the rack 87. Under these circumstances energization of the motor 63 is effective, as explained previously, to move the carriage 6 relative to the carriage support 5. When it is desired to unload a carton in the horizontal position shown in Fig. 4, the switch 90 is closed energizing the solenoids 78a and 89, thereby retracting the plunger 78 out of engagement with the sprocket 76 and moving the lever 86 into engagement with the rack 87. This simultaneously locks the carriage support 5 and the carriage against relative movement and initiates, when the motor 63 is energized, movement of the conveyor chains 72 around the sprockets 71, 73, 74, 75 and 76. While the upper longitudinal run of each of the conveyor chains 72 may sag to some extent in its middle portion when the carriage 6 is in the horizontal position, the chains nevertheless engage the carton 42 at least in the region 91 adjacent the forward end thereof and rotation of the sprockets 71 in a clockwise direction, as viewed in Fig. 4, is effective to cause movement of the carton 42 to the right for stacking in a horizontal position on top of another object, for example, a vertically-positioned carton. As indicated in Fig. 4, the carriage 6 may, if desired, be first advanced horizontally relative to the carriage support 5, for example to the position indicated by dotted lines 92, and then movement of the conveyor chain may be initiated for effecting unloading of the carton 42.

A detail of the conveyor chain is shown in Fig. 5. It will be noted from this figure that the links 93 of the conveyor chain have mounted thereon upwardly extending segments 94. These segments are provided at the upper edge with teeth or serrations 95 adapted to engage the carton 42 for effecting unloading thereof.

In describing the movement of the carriage support 5 and the carriage between the vertical and horizontal positions, it has previously been mentioned that this combined structure is moved from the vertical to the horizontal position by the winding of the chain 25 on the sprocket 23 and that the combined structure is returned to the vertical position by gravity as the chain is unwound upon reverse rotation of the motor 17. It was there mentioned that this gravity return is effected because the center of gravity of the combined structure including the carriage support and carriage is positioned to the left of the pivot points 9 and 13 of the arms 7 and 8 on the frame 1. However, in providing for substantial movement of the carriage 6 relative to the carriage support 5 to secure adequate vertical lifting, for example in the form of operation illustrated in Fig. 3, the permissible movement of the carriage 6 is such that, when fully extended to the right in the horizontal position shown in Fig. 4, the center of gravity of the combined structure may be to the right of the aforementioned pivot points. Under such circumstances, the unwinding of the chain 25 would, of course, have no effect in returning the combined structure to the vertical position. More importantly, it would be possible to effect a substantial unwinding of the chain 25, providing slack therein, and then a movement of the carriage 6 to the left until the center of gravity of the combined structure reached a point to the left of the pivot points 9 and 13 of the arms 7 and 8. Under these circumstances, there would then be an abrupt swing of the combined structure toward the vertical position, imposing a severe strain on the cable 25 at the time the slack was taken up. In a similar manner, should the combined structure be started from the vertical to the horizontal when the carriage 6 were in a fully extended upward position, as illustrated in Fig. 3, the center of gravity of the combined structure might be such that, when moved partially to the horizontal position by the tilt motor 17, it would swing rapidly by its own weight the remainder of the distance, causing a danger of impact damage to the mechanism.

To avoid the possibility of the above occurrences a limit switch 96 is mounted on the carriage support 5. This limit switch 96 is connected in the circuit of the tilt motor 17, as shown in Fig. 6. The switch 96 includes an actuating element 97 adapted to be engaged by a dog 98 mounted on the carriage 6. When the carriage 6 has moved upwardly, as viewed in Fig. 1, a predetermined distance relative to the carriage support 5, the dog 98 engages the actuating element 97 throwing the limit switch 96 to its open position and breaking the supply circuit to the tilt motor 17. Thus, when the carriage 6 has moved a relatively short distance which is substantially less than the upward movement permitted by the limit switch 92, the supply circuit to the tilt motor 17 is interrupted and energization of this motor is prevented. The tilt motor 17 cannot then be energized to move the combined structure of the carriage support 5 and the carriage 6 from the vertical to the horizontal position until the carriage 6 has been moved downwardly, as viewed in Fig. 1, to a sufficient extent that the dog 98 again engages the actuating element 97 throwing the limit switch 96 to its closed position. Similarly, if the carriage 6 has been extended sufficiently to the right in a position shown in Fig. 4, that the dog 98 has passed beyond the actuating element 97 of the limit switch 96, the tilt motor 17 cannot be energized to unwind the chain 25 until the carriage 6 has first been retracted to a sufficient extent that the dog 98 engages the actuating element 97 again conditioning the limit switch for providing a circuit to the tilt motor 17.

In the specific embodiment of the invention illustrated the carriage support 5, the carriage 6 and the operating mechanism associated therewith including the tilt motor 17 and its mounting and the arms 7 and 8 and their supporting brackets are shown supported on the vertical members 3 which form part of the frame 1. If, for any reason, it is desired to secure a greater vertical movement of the mechanism, this structure could alternatively be mounted on slides received in the channels formed by the vertical members 3, the entire mechanism being movable vertically in the slides by any conventional hydraulic lifting system.

A modified form of my invention is shown in Fig. 7. The structure of this modified form is the same as that of the lift truck previously described with the single exception that a positive unload bar 99 is provided in lieu of relying on the frictional engagement of the conveyor chains 72 with the carton 42. Referring to Fig. 7, it can be seen that the unload bar 99 is secured at its ends to the chains 72 so that movement of the chains 72 in the manner previously described for unloading is effective for moving the unload bar 99 along the carriage 6. The unload bar 99 includes two outwardly extending ears 100 which, in the horizontal position of the carriage 6, are adapted to engage the rear end of the carton 42 so that movement of the unload bar under those circumstances to the right, in the position of the structure corresponding to Fig. 4, is effective for pushing the carton 42 positively off the carriage 6 and stacking it in a horizontal position on top of other objects. The construction illustrated in Fig. 7 has an advantage in that the outwardly extending ears 100 of the unload bar may be employed for assisting in lifting a carton 42 vertically. Under these circumstances the entire reliance for support of the carton in its vertical position need not be placed on the blade 38, since the ears 100 may be brought into engagement with the bottom of the carton to assist in supporting the carton in the vertical position and in lifting the carton. In the form previously described the chains 72 are always driven in one direction. In the form shown in Fig. 7, it is necessary to reverse the chain-driving motor to retract the unload bar 99 in order to condition it for the next unloading operation.

While I have shown and described specific embodiments of my invention, I do not desire my invention to be limited to the particular construction shown and described and I intend by the appended claims to cover all modifications within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, a pair of crossed arms pivotally mounted on said frame and pivotally connected to said support for mounting said support on said frame and for guiding said support between elevated horizontal and vertical positions relative to said frame, a carriage slidably mounted on said support, means for moving said carriage relative to said support, a lifting element slidably mounted on said carriage and adapted to engage an article to be lifted, and means for moving said lifting element relative to said carriage.

2. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means for moving said carriage support between vertical and horizontal positions, a carriage slidably mounted on said support, a first sprocket rotatably mounted on said carriage at one end thereof, a second sprocket rotatably mounted on said carriage at the other end thereof, a drive sprocket mounted on said carriage support, an endless chain engaging said sprockets, means for rotating said drive sprocket, means for preventing rotation of one of said first-mentioned sprockets whereby rotation of said drive sprocket effects longitudinal movement of said carriage relative to said carriage support, a lifting element slidably mounted on said carriage and adapted to engage an article to be lifted, and means for moving said lifting element relative to said carriage.

3. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means for moving said carriage support between vertical and horizontal positions, a carriage slidably mounted on said support, a first sprocket rotatably mounted on said carriage at one end thereof, a second sprocket rotatably mounted on said carriage at the other end thereof, a drive sprocket mounted on said carriage support, an endless chain engaging said sprockets, means for rotating said drive sprocket, means for preventing rotation of one of said first-mentioned sprockets whereby rotation of said drive sprocket effects longitudinal movement of said carriage relative to said carriage support, a lifting blade slidably mounted on said carriage and arranged for insertion under the collar of a shipping carton for lifting the carton, and means for moving said blade relative to said carriage.

4. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means for moving said carriage support between vertical and horizontal positions, a carriage slidably mounted on said support, a first locking means mounted on said carriage support and adapted to engage said carriage for preventing relative movement of said carriage and said carriage support, said first locking means being normally disengaged from said carriage, a solenoid for actuating said means into engagement with said carriage, a first sprocket rotatably mounted on said carriage at one end thereof, and a second sprocket rotatably mounted on said carriage at the other end thereof, a drive sprocket mounted on said carriage support, an endless chain engaging said sprockets, means for rotating said drive sprocket, a second locking means normally engaging one of said first mentioned sprockets for preventing rotation thereof whereby rotation of said drive sprocket effects longitudinal movement of said carriage relative to said carriage support, a second solenoid for actuating said second locking means to its disengaged position, and means for simultaneously energizing said solenoids for moving said first locking means to its engaged position and for moving said second locking means to its disengaged position and for simultaneously deenergizing said solenoids for moving said first locking means to its disengaged position and for moving said second locking means to its engaged position.

5. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means including a motor for moving said carriage support between vertical and horizontal positions, a carriage slidably mounted on said carriage support, means for moving said carriage relative to said carriage support, a limit switch for deenergizing said motor when said carriage support reaches its vertical position, a second limit switch for deenergizing said motor when said carriage support reaches its horizontal position, a third limit switch for deenergizing said motor when said carriage has moved beyond a predetermined position relative to said carriage support.

6. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means including a first motor for moving said carriage support between vertical and horizontal positions, a limit switch for deenergizing said first motor when said carriage support reaches its vertical position, a second limit switch for deenergiz-

ing said first motor when said carriage reaches its horizontal position, a carriage slidably mounted on said support, means including a second motor for moving said carriage relative to said support, a third limit switch for deenergizing said second motor to limit movement of said carriage relative to said carriage support in one direction, a fourth limit switch for deenergizing said second motor to limit movement of said carriage relative to said carriage support in the opposite direction, a fifth limit switch for deenergizing said first motor when said carriage moves beyond a predetermined position relative to said carriage support in one direction, a lifting blade slidably mounted on said carriage and adapted to engage an article to be lifted, means including a third motor for moving said blade relative to said carriage, a sixth limit switch for deenergizing said third motor to limit movement of said blade relative to said carriage in one direction, a seventh limit switch for deenergizing said third motor to limit movement of said blade relative to said carriage in the opposite direction, a conveyor chain mounted on said carriage, and means including said second motor for driving said conveyor chain to unload articles from said carriage in the horizontal position.

7. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means including a first motor for moving said carriage support between vertical and horizontal positions, a limit switch for deenergizing said first motor when said carriage support reaches its vertical position, a second limit switch for deenergizing said first motor when said carriage reaches its horizontal position, a carriage slidably mounted on said support, a first sprocket rotatably mounted on said carriage at one end thereof, a second sprocket rotatably mounted on said carriage at the other end thereof, a drive sprocket mounted on said carriage support, an endless chain engaging said sprockets, a second motor for rotating said drive sprocket, a first locking means for preventing rotation of one of said first-mentioned sprockets whereby rotation of said drive sprocket effects longitudinal movement of said carriage relative to said support, a third limit switch for deenergizing said second motor to limit movement of said carriage relative to said carriage support in one direction, a fourth limit switch for deenergizing said second motor to limit movement of said carriage relative to said carriage support in the opposite direction, a fifth limit switch for deenergizing said first motor when said carriage moves beyond a predetermined position relative to said carriage support in one direction, a lifting blade slidably mounted on said carriage and adapted to engage an article to be lifted, means including a third motor for moving said blade relative to said carriage, a sixth limit switch for deenergizing said third motor to limit movement of said blade relative to said carriage in one direction, a seventh limit switch for deenergizing said third motor to limit movement of said blade relative to said carriage in the opposite direction, said chain being arranged to engage an article carried on said carriage in the horizontal position thereof whereby movement of said chain is effective to unload the article from said carriage, a second locking means for preventing movement of said carriage relative to said support, and means for actuating said first locking means out of engagement with said one of said first-mentioned sprockets to afford movement of said chain for unloading said carriage.

8. A lift truck comprising a frame, a carriage support pivotally mounted on said frame, means for moving said carriage support between vertical and horizontal positions, a carriage slidably mounted on said support, a first sprocket rotatably mounted on said carriage at one end thereof, a second sprocket rotatably mounted on said carriage at the other end thereof, a drive sprocket mounted on said carriage support, an endless chain engaging said sprockets, means for rotating said drive sprocket, a first locking means normally engaging one of said first-mentioned sprockets for preventing rotation thereof whereby rotation of said drive sprocket effects longitudinal movement of said carriage relative to said carriage support, said chain being arranged to engage an article to be stacked for unloading the article from said carriage in the horizontal position of said carriage, means for disengaging said first locking means for affording movement of said chain relative to said carriage for unloading, and a second locking means for preventing movement of said carriage relative to said carriage support.

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