United States Patent

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[15] **3,670,900**

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[54] LOW-DECK TRUCK FOR CARRYING AN ARTICLE TO BE TREATED

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[73] Assignee: **Katsukawa Kogyo Kabushiki Kaisha,** Tokyo, Japan

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Feb. 17, 1970 Japan.....45/13694

[52] **U.S. Cl.**.....**212/14,** 212/128, 212/1, 254/183

[51] **Int. Cl.**.....**B66c 5/04**

[58] **Field of Search**.....212/128, 14; 254/183

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[57] **ABSTRACT**

A low-deck truck for carrying an article to be treated during the treating process, adapted so as to raise the article from a liquid treating vessel as being in slanted position for dropping off the liquid therefrom at least in some part of its travel from the treating vessel up to a predetermined uppermost position. A pair of tapered drums are provided for winding up two ropes, respectively, which ropes have a pair of brackets secured to the lower ends thereof so as to be engageable with a carrier bar holding the article. The two tapered drums are so actuated as to wind the two ropes at different speeds.

1 Claim, 10 Drawing Figures

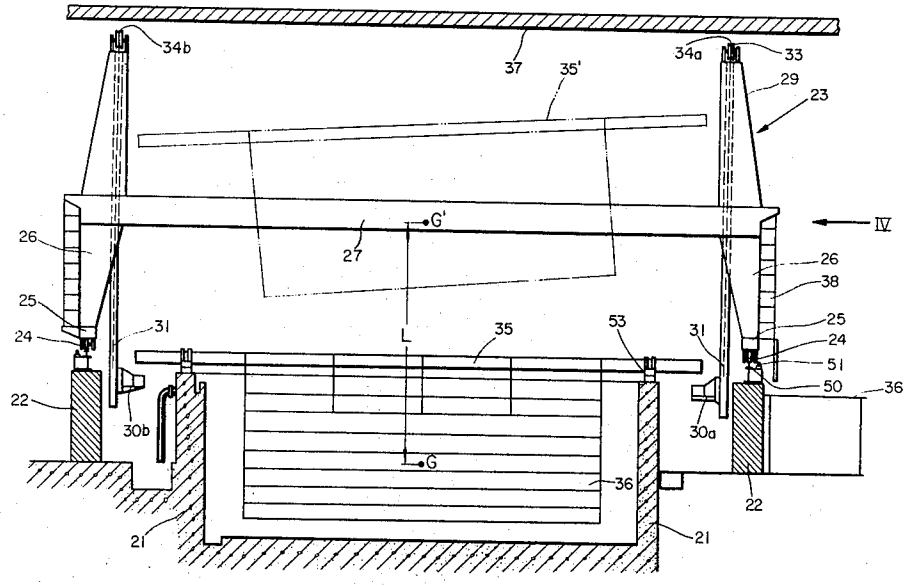


FIG. 1

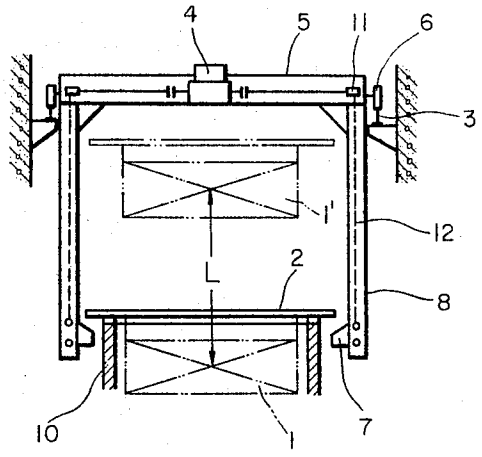


FIG. 2

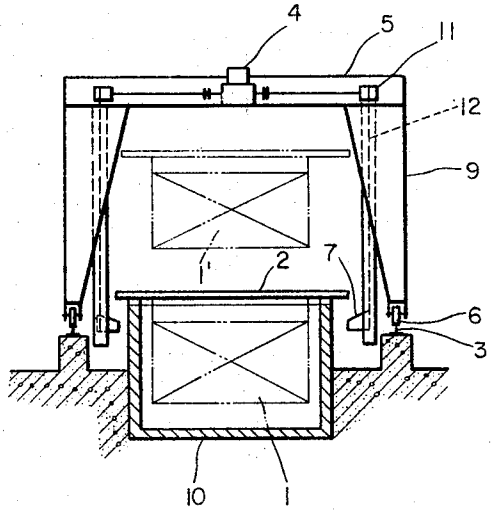


FIG. 3

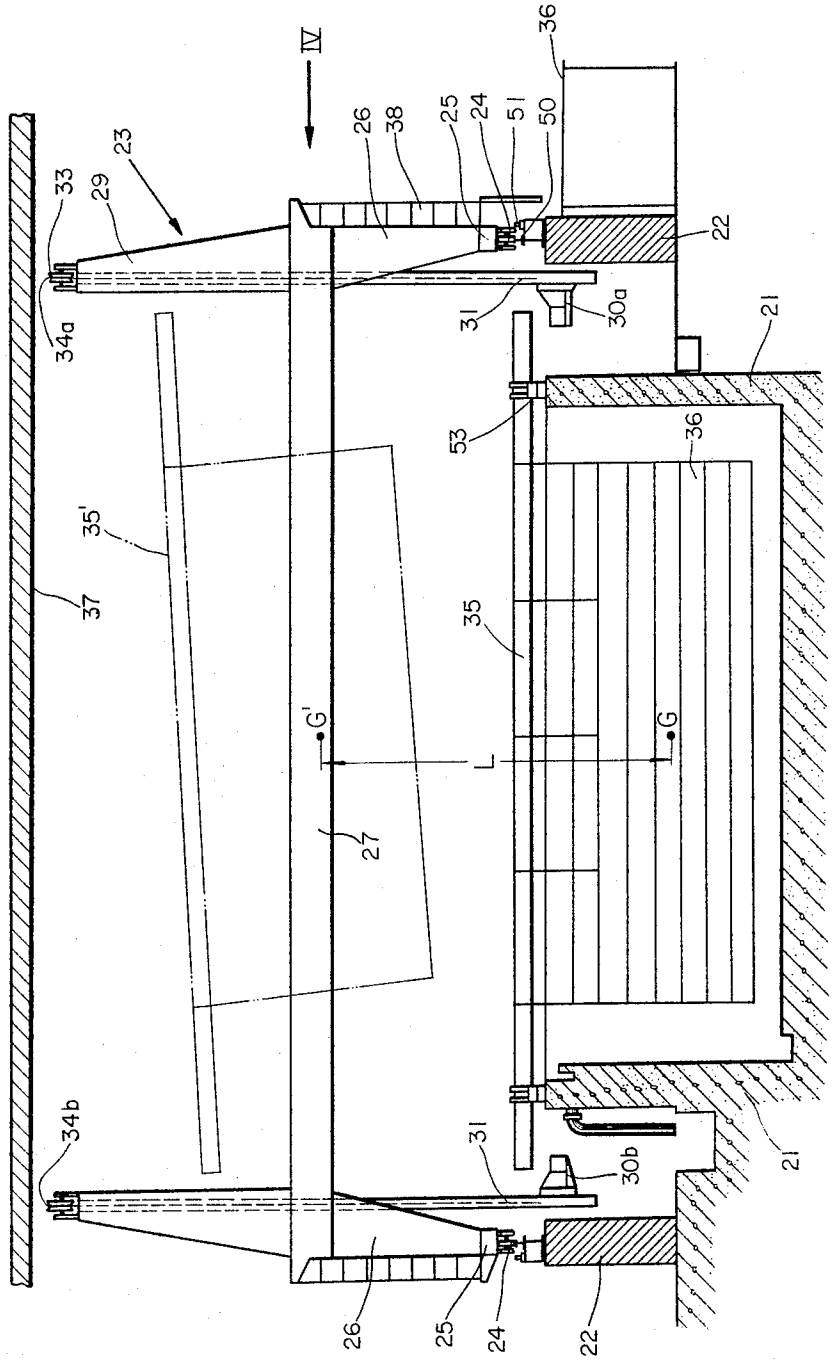
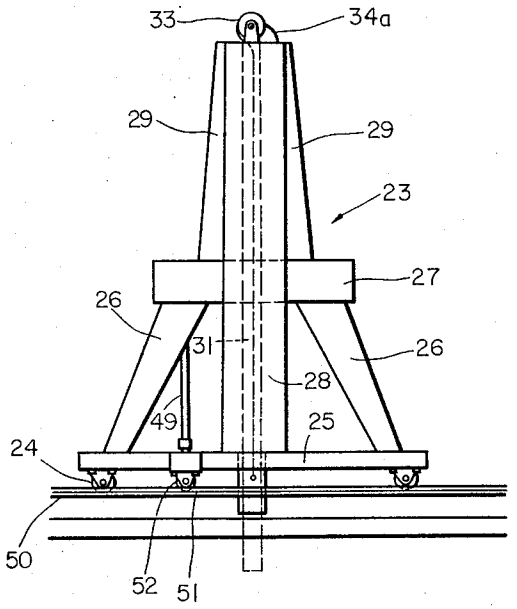

IV
36
26
38
25
24
51
50
23
33
29
22
34a
31
30a
21
53
36
35'
37
35
G'
G
L
27
34b
31
30b
21
26
25
24
22

FIG.4


33
34a
29
29
23
27
26
31
26
28
49
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24
50
52
51

FIG.5

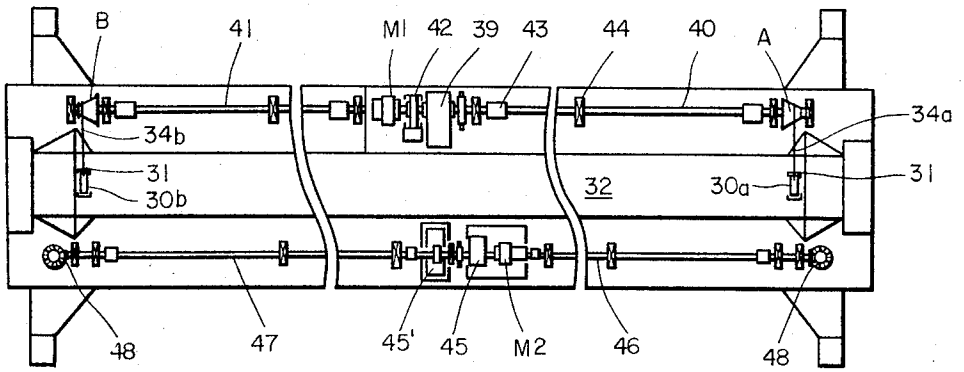

B
41
M1
42
39
43
44
40
A
34a
34b
31
30b
32
30a
31
48
47
45'
45
M2
46
48

FIG.6

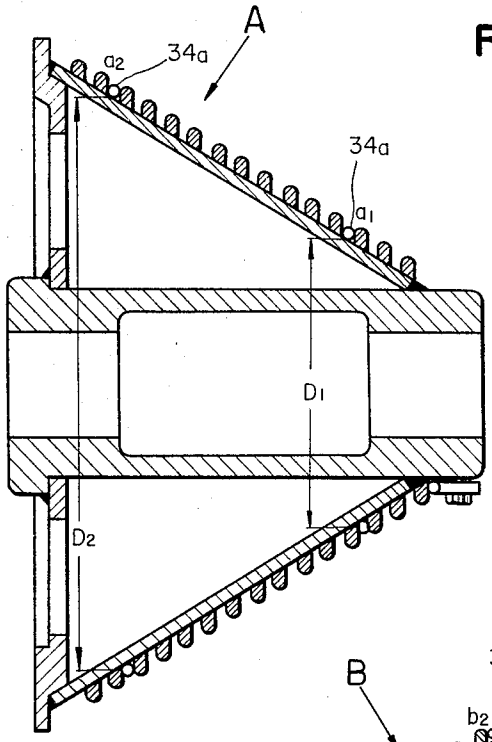


FIG.7

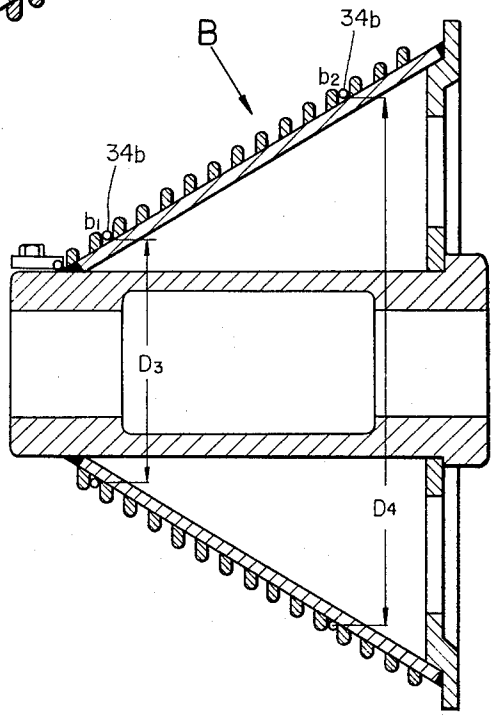


FIG. 9

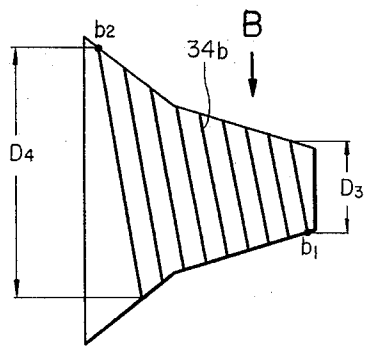


FIG. 8

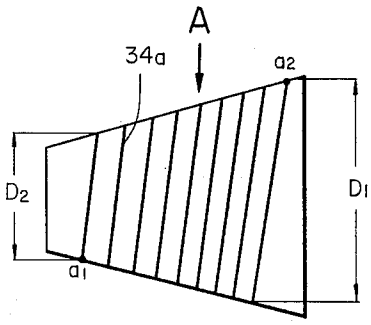
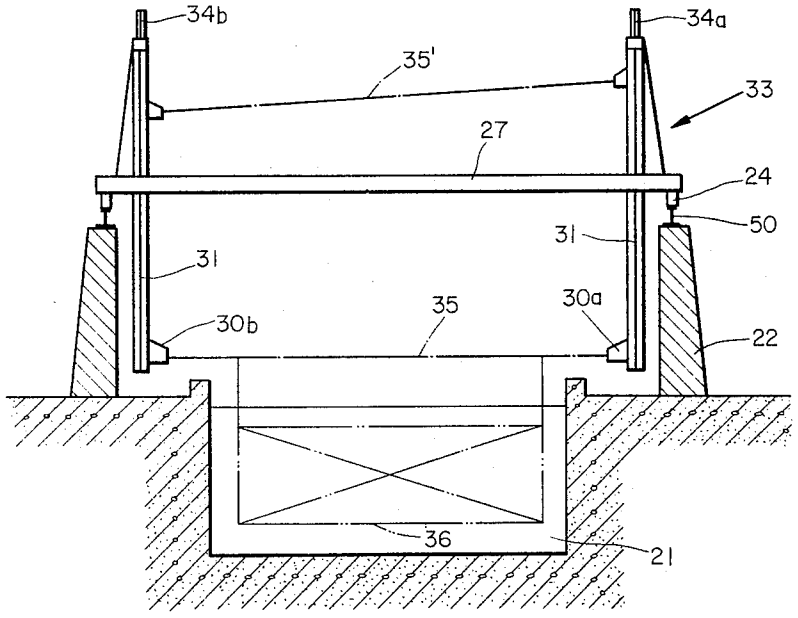


FIG. 10



LOW-DECK TRUCK FOR CARRYING AN ARTICLE TO BE TREATED

This invention relates to a low-deck truck for carrying an article to be treated during the treating process, and more particularly to an improvement of a known low-deck truck for carrying relatively large articles being processed, e.g., metal-plating, alumite-coating and the like.

Generally speaking, there are two basic types of trucks or boggies for such article carrying; namely, suspension type trucks and bridge type ground surface running trucks. Such known trucks have various disadvantages and are unsatisfiable as referred to hereinafter. The present invention can avoid and overcome such various difficulties of the known trucks.

According to the present invention, there is provided a low-deck trucks having a carrier bar for suspending an article being processed. The carrier bar is raised to a predetermined uppermost position while conveying an article, so as to bring the center of gravity of the article to the proximity of the center of gravity of the truck. A girder is provided, which carries a first and a second tapered drums and one motor for driving the two drums. Each drum suspends a bracket by a suitable means, e.g., a rope, for holding either one of the opposite ends of the carrier bar, so as to vertically reciprocate the bracket and the carrier bar in response to the rotation of the drums. In at least a part of the reciprocation of the carrier bar prior to the proximity of the uppermost position thereof, the two drums raise the backets at different speeds, respectively, so that the carrier bar is slanted by raising one end thereof faster than the other. Accordingly, the article being processed, which is kept substantially horizontal while being in a treating vessel, is slanted in the aforesaid proximity of the uppermost position as being raised, so as to drip any residual treating agent adhered to the surface of the article back to the treating vessel.

Other objects and advantages of the present invention will be appreciated referring to the following description, taken in conjunction with the accompanying drawings, in which;

FIG. 1 is a schematic front view of a known suspension type truck;

FIG. 2 is a schematic front view of a known bridge type ground surface running truck;

FIG. 3 is an elevation, with a part cut away, showing an embodiment of the low-deck truck according to the present invention;

FIG. 4 is a side view of the low-deck truck of Fig. 3, taken from the direction of the arrow IV thereof;

FIG. 5 is a simplified plan view of the truck of Fig. 3, illustrating a driving mechanism disposed on the girder thereof;

FIGS. 6 and 7 are elevations, with a part shown in vertical sections, illustrating a first tapered drum and a second tapered drum mounted on the girder of Fig. 5, respectively;

FIGS. 8 and 9 are schematic diagrams showing another embodiment of the first and second tapered drums usable in the truck of the present invention respectively; and

FIG. 10 is a diagrammatic illustration of another embodiment of the low-deck truck of the present invention.

Like parts are designated by like numerals throughout the drawings.

Referring to FIG. 1, a known suspension type truck comprises a carrier bar 2, which reciprocates vertically while suspending an article 1 being treated (L indicating the required lift). A pair of rails 3 are disposed at a height corresponding to uppermost position of the carrier bar 2, so that a girder 5 moves on the rails 3 while carrying heavy articles, inclusive of driving mechanism 4. Such known suspension type truck has shortcomings in that the overall height of the truck is comparatively high, and considerably large impulses are caused at the start and stop of the vertical movement of the article, resulting in large swing of the article 1 being treated. In the worst case, the article 1 may be dropped from the carrier bar 2. Furthermore, the maintenance and inspection of the driving mechanism 4 are difficult, and the erection of the truck, especially its alignment, is difficult, due to the high location of the rails 3. Besides, when the article 1 is raised to the predetermined uppermost position, the center of gravity of the article 1 is located considerably lower than the girder 5 and wheels 6, so that the transportation of the article becomes very unstable.

In a known bridge type ground surface running trucks, as shown in FIG. 2, a pair of inverse-V-shaped legs 9 extend downwards from opposite longitudinal ends of a girder 5 carrying heavy components mounted thereon, inclusive of a driving mechanism 4, and wheels 6 are secured to the lower ends of the legs 9, respectively, so that the truck may move along rails 3 mounted on side floors of a treating vessel 10. With the aforesaid construction, the known bridge type truck has its center of gravity located at a considerably high position, and its overturning moment becomes very large. When the article 1 being treated is raised to the uppermost position (as indicated by a reference numeral 1'), the center of gravity of the article 1 is much higher than the wheels 6. Accordingly, the spacing between the two legs 9 must be large to furnish the require resistance to the large overturning moment. As a result, the truck itself becomes bulky and heavy.

In addition, the known carrier trucks raise the article 1 while keeping it substantially horizontally. If the article is treated by a liquid (inclusive of plain water) in the vessel 10, it is usually held horizontal in the vessel. Upon completion of the treatment in the vessel 10 it is raised to a predetermined position by means of brackets 7, which are drawn upwards through ropes 12 in response to the rotation of drums 11. Since the article 1 is vertically raised while keeping itself horizontally, it tends to scoop out the treating liquid from the vessel 10. Such scooping is undesirable, because it causes loss of the treating liquid, sputtering of the treating liquid to the surroundings, and contamination of the next succeeding agent, if any, with the liquid thus scooped. Furthermore, the treating liquid thus scooped acts to increase the apparent weight of the article to increase the burden to the driving mechanism. In fact, a number of overload troubles have heretofore been experienced due to the increase of the burden by such scooping of the treating liquid.

Therefore, an object of the present invention is to mitigate the aforesaid specific difficulties of known trucks, by providing an improved low-deck truck having means for holding the article in slanted position for a while.

The invention will now be described in detail, referring to embodiments, as illustrated in FIGS. 3 to 10. Referring to FIGS. 3 to 5, a number of treating vessels 21 (of which only one is shown) are disposed on substantially the same level along the travelling direction of a truck 23. A pair of side walls 22 extend vertically along the opposing edges of the vessels 21 for supporting rails 50, on which the truck 23 traverses. The truck 23 comprises a pair of base frames 25 extending opposing edges thereof, and a pair of wheels 24 are rotatably mounted to the base frames 25, respectively.

Two inverse-V-shaped legs 26 extend upright from the base frames 25, respectively, and a girder 27 connects the upper ends of the two legs 26. A central column 28 extends vertically across the central part of each of the opposite ends of the girder 27, as best shown in FIG. 4, and a pair of upright brackets 29 are secured to the opposite surfaces of the column 28 above the girder 27.

A cross groove 32 extends the axial central portion of the girder 27 throughout the entire length thereof, as shown in FIG. 5. A pair of guide members 31 are mounted on the groove 32 at longitudinally opposite ends thereof, so as to guide the movement of the brackets 30*a* and 30*b* reciprocating vertically through the groove 32 along the central columns 28, which are reinforced by the upright brackets 29. Thus, the girder 27 is located between the legs 26 and the upright brackets 29. A pair of pulleys 33 are rotatably held by the central columns 28 at the upper ends thereof, respectively, so as to engage first and second ropes 34*a* and 34*b*, as shown in FIG. 3. One end of each rope 34*a* or 34*b* is secured to the bracket 30*a* or 30*b*, while the opposite end thereof is secured to a

tapered drum A or B mounted on the longitudinal end portion of the girder **27**, as can be seen from FIGS. **3** and **5**. The rope **30***a* or **30***b* is released from and drawn back to the drum A or B, in response to the rotation of a reversible motor M_1, as will be described hereinafter. The brackets **30***a* and **30***b* will act to hold a carrier bar **35** at opposite longitudinal ends thereof, which carrier bar suspends an article **36** being treated. The truck will be operated without colliding with a relatively low level ceiling **37** of the work house. One or more ladders **38** are provided for facilitating the maintenance and inspection of the truck.

A reversible motor M_1 drives the vertical reciprocation of the brackets by rotating the tapered drums A and B through suitable transmissions. A sped-reducing device **39** is connected to the output shaft of the motor M_1, and a pair of transmission shafts **40** and **41** extend from the speed-reducing device **39** in opposite directions. The first and second tapered drums A and B are secured to the far ends of the transmission shafts **40** and **41**, respectively. A brake **42** is engageable with the output shaft of the motor M_1. A suitable coupling **43** is provided for each of the transmission shafts **40** and **41**, which are rotatably supported by bearings **44**.

Another reversible motor M_2 is mounted on the girder **27** for actuating the traversing movement of the truck **23**. The output shaft of the motor M_2 is connected to another speed-reducing device **45**, which is engageable with a brake **45'**. A pair of transmission shafts **46** and **47** extends from the speed-reducing device **45** in opposite directions, which transmission shafts carry bevel gears **48** at far ends thereof, respectively. Each bevel gear **48** transmits the output power of the motor M_2 to each of the two vertical transmission shafts **49**, which in turn rotates each of pinions **52** operatively engaging racks **51** secured along the rails **50**, as shown in FIGS. **3** and **4**. It is apparent to those skilled in the art that the rotation of the pinions **52** causes the wheels **24** to rotate on the rails **50** for traversing the truck **23** on the vertical walls **22**.

FIGS. **6** and **7** illustrate an embodiment of the tapered drums A and B. In this embodiment, the two drums have identical taper angles, or identical slopes of the drum surface, and the ropes **34***a* and **34***b* are wound on the drums A and B at identical pitches, respectively. Furthermore, the two drums A and B are identical in shape.

When the article **36** being treated is dipped in a treating liquid (inclusive of plan water) in the vessel **21**, the carrier bar **35** rests horizontally on holders **53** mounted on the upper edges of the vessel **21**, so as to keep the article **36** substantially horizontally in the treating liquid. At this moment, the backets **30***a* and **30***b* are lowered below the resting position of the carrier bar **35**. When the brackets **30***a* and **30***b* are located at the lowermost position, as shown in FIG. **3**, the upper ends of the ropes **34***a* and **34***b*, whose ends are secured to the brackets **30***a* and **30***b*, are secured to the drums A and B at positions a_1 and b_1, respectively, as shown in FIG. **6**. Upon rotation of the drums A and B, the backets **30***a* and **30***b* start moving upwards. It should be noted here that the drum diameter D_1 of the drum A at the position a_1 is larger than the diameter D_3 of the drum B at the position b_1, namely, $D_1 > D_3$. Accordingly, as the reversible motor M_1 rotates in one direction, or the direction for winding the ropes on the drums, the rope **34***a* is wound on the drum A, starting from the position a_1 at a linear speed faster than that of the winding of the rope **34***b* on the drum B, starting from the position b_1, because $D_1 > D_3$ and the revolving speeds of the two drums are identical. Thus, the bracket **30***a* moves upwards faster than the bracket **30***b*, so that the carrier bar **35** is inclined from the horizontal rest position for raising the article **36** with a varying angle relative to the horizontal plane, until the carrier bar comes to a predetermined uppermost position **35'**, as shown in FIG. **3**. When the carrier bar reaches the uppermost position, the motor M_1 stops, for holding the carrier bar **35** at uppermost position **35'**. The position **35'** is so selected that the center of gravity G of a combination of the carrier bar **35** and the article **36** comes to a position G' close to the girder **27**, which position G' is close to the center of gravity of the entire truck **23**.

In FIGS. **6** and **7**, the symbols a_2 and b_2 represent the positions of upper ends of the vertically extending portions of the ropes **34***a* and **34***b*, when the carrier bar **35** is raised to the uppermost position **35'**. The diameters D_2 and D_4 of the drums A and B at the positions a_2 and b_2 are in the relation of $D_2 > D_4$.

Thus, when the article **36** is raised from the vessel **21**, it is suitably inclined to remove the residual treating liquid adhered to the surface of the article **36**. Besides, when the backets **30***a* and **30***b* engage the carrier bar **35** without any substantial time lag therebetween, so that there is no detrimental shock applied to the article **36** at the beginning of the raising operation. Furthermore, the raising velocity increases as the article moves higher, because the effective drum diameter increases as the carrier bar **35** comes higher. Thus, the duration of holding the article **36** in the air can be reduced, so as to improve the efficiency of the article conveyance.

When the article **36** moves upward being suspended from the carrier bar **35**, the ropes and the brackets move in a stable manner along the guides **31** extending through the groove **32** on the girder **27**. As the carrier bar comes to rest at the uppermost position **35'**, which is preselected in the aforesaid manner, the center of gravity of the assembly of the carrier bar **35** and the article **36** comes to the proximity of the center of gravity of the truck **23**, or to the poximity of the girder **27** carrying the heavy driving components of the truck **23**. Thus, the amplitude of the article swinging during the traversing of the truck **23** can be minimized.

Upon the rotation of the motor M_1 in the reverse direction, for releasing the ropes from the tapered drums, the article **36** moves down from the uppermost position through the at high speed, but the downward travelling speed becomes slow as it approaches to the holders **53**. Accordingly, there is no danger of causing shock when it comes to rest on the holders.

The tapered drums A and B of FIGS. **6** and **7** are suitable for installation in a housing having a comparatively high ceiling **37**. If, however, the ceiling **37** is comparatively low, the legs **26** and the upright brackets **29** inevitably become short, so as to reduce the overall height of the truck **23**. If articles **36** of the same magnitude as those of the preceding embodiment are to be handled by the trucks **23** whose height is thus reduced, the upper end of the article **36** being slantingly raised may hit the ceiling **37**, because the substantially the same lift must be retained due to the necessity of the treating vessel of similar depth.

FIGS. **8** and **9** illustrate a modification of the tapered drums for obviating such difficulties. With the drums thus modified, the article **36** being slantly raised from the treating vessel **21** is brought back to a horizontal arrangement as it approaches to the uppermost position thereof.

In the figures, the tapered drum A of FIG. **8** has an effective diameter D_2 larger than the effective diameter D_3 of the coacting drum B of FIG. **9** only in a certain range, starting from the beginning points a_1 and b_1 of the raising operation of the article **36** by the ropes **34***a* and **34***b* to an intermediate point (preferably close to the uppermost position), as in the case of the preceding embodiment described hereinbefore referring to FIGS. **6** and **7**. Thus, in this range, the rope **34***a* is wound faster than the other rope **34***b* for slantly raising the carrier bar **35** together with the article **36** in the aforesaid manner. After passing through the last mentioned range, however, the effective diameter of the drum B becomes greater than that of the drum A (at the end $D_4 > D_1$), so that the carrier bar **35** may come back to a horizontal disposition at the uppermost position thereof.

In the embodiment of the present invention, as shown in FIGS. **3** and **4**, the truck **23** includes a pair of legs **26** disposed between the girder **27** and the wheels **24**, while mounting the rails **50** on the top of the vertical walls **22** whose top level is substantially the same as that of the treating vessel **21**. The invention, however, is not restricted to such arrangement alone. For instance, it is possible to eliminate the legs **26**, while using tall side walls **22**, as shown in FIG. **10**. In this case, wheels **24** can be mounted directly to a girder **27** so as to allow the traversing of the truck **23** by turning the wheels **24** on rails **50** secured to the top surface of the side walls **22**.

As described in the foregoing disclosure, according to the present invention, there is provided a low-deck truck having a girder, which carries heavy driving and other components thereon and is disposed at about the middle of the required lift, so that when an article being treated is raised to a predetermined position, the center of gravity of the article comes to the proximity of the center of gravity of the truck, i.e., to the proximity of the girder. Thus, the shocks to the truck at the start and stop thereof is greatly reduced, as compared with that in the known trucks of suspension type and bridge type, wherein the center of gravity of the article raised is disposed considerably lower than the girder thereof. Thus, the magnitude of the overturning moment is also considerably reduced. Consequently, the adverse effect to the article being handled is substantially eliminated, while ensuring smooth start and stop operations. As the operation is made smooth, the shock to the auxiliary apparatuses, such as limit switches, is eliminated, for ensuring correct and reliable operation thereof. The low position of the girder makes it easy to erect the truck and to carry out the maintenance and inspection. Furthermore, the overall height of the truck of the invention can be lower than that of the known trucks of suspension type and bridge type under certain conditions, so that the height of the housing can also be low.

With the low-deck truck of the present invention, a first and a second tapered drums are disposed on a girder, so as to be driven by one reversible motor, so that an article being raised is slanted at least during its upward travel, by suitable arrangement of the two drums; namely either by using two identical tapered drums while starting the winding operation of ropes at different positions with different diameters, respectively; or by relating the two tapered drums in such a manner that the winding speed of one drum is faster than of the other drum in the beginning of the raising operation of the carrier bar, while reversing the relation of the winding speeds of the two drums when the carrier bar passes a predetermined intermediate position in its lift. As a result, the residual treating liquid (inclusive of plain water) wetting the surface of the article is dripped by the slanting of the article, back to the original treating vessel. Such dripping completely eliminates the danger of deterioration or contamination of the next succeeding treating liquid, if any, with the residual liquid on the article surface.

Furthermore, when the carrier bar leaves the holders, in response to the winding of the ropes by the tapered drums, or when the carrier bar comes to rest on the holders in response to the release of the ropes from the tapered drums, the travelling speed of the carrier bar is controlled to be very slow, so that there will be no shock to the carrier bar. After leaving the holder secured to the treating vessel, the carrier bar travels quickly through the air toward the predetermined uppermost position, so that the duration of the exposure of the article to the air is short. Accordingly, the efficiency of the truck in handling and transporting the article is very high.

One may think of suspending the article to the carrier bar in a slanted manner, to begin with. Such slanted suspension inevitably requires an increase in the size of the treating vessel and in the amount of the treating liquid. Accordingly, for a given floor space, the maximum possible size of the article to be treated by such method becomes considerably smaller than that of the present invention.

In the illustrated embodiment, the first and second tapered drums A and B are driven by one reversible motor. However, the present invention is not restricted to such arrangement. In fact, the two tapered drums may be driven by separate motors, as in the case of known trucks, for effecting the slanting of the article being treated while providing a proper time lag between the start of the two driving motors, by inserting speed change gears with different change ratios between the motors and the drums, or by using pole-changer motors. However, the driving with one motor is advantageous in that the risk of motor trouble is reduced, and the cost of the truck can be reduced.

The illustrated embodiment is for handling articles during a treating process, but the invention is not restricted to such applications alone, but it can be applied to any other suitable use.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A low-deck truck for carrying an article to be treated, comprising a carrier bar for suspending the article; an upstanding horizontally movable frame means supported at its lowermost portion; means for driving said frame means; a pair of holders holding each respectively the ends of said carrier bar; a carrier bar driving means for driving said holders along said frame means for raising or lowering the article between a lowermost treatment position and an uppermost transfer position; a horizontally extending girder supported by said frame means at an intermediate height thereof; said girder having the major portion of said carrier bar driving means and said frame driving means mounted thereon so as to raise the center of gravity of the truck to the level of the girder; the center of gravity of the article at said uppermost transfer position substantially coinciding with the center of gravity of the truck; said carrier bar driving means including a reversible motor, a pair of drums detachably connected thereto, each of said drums being arranged respectively one at each side of said motor, and a pair of cables, one end of each of said cables being fixed to a respective one of said drums and the other end thereof being fixed to a respective one of said holders; and a pair of pulleys mounted the top of the frame means, the bight of each of said cables being held on respectively one of said pulleys, each of said drums being tapered, and connection of the cables with respective tapered drums and shape of the tapered drums being operatively interrelated whereby the carrier bar and the article suspended therefrom are maintained in an inclined position between the lowermost and uppermost levels thereof.

* * * * *