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**ELECTROMOTIVE REACH TYPE FORKLIFT
TRUCK WITH A TILTABLE BATTERY BED**

FIELD OF THE INVENTION

The present invention relates generally to a reach type forklift truck whose mast assembly is movable back and forth along reach legs and, more specifically to an electromotive reach type forklift truck of such construction enabling a heavy weight battery to be taken out of its storage compartment with ease.

BACKGROUND OF THE INVENTION

Forklift trucks have been used either to lift objects of relatively heavy weight up to an elevated location or to move the objects from one place to another within a limited working site. Depending on the power sources employed, the forklift trucks are classified into an engine-driven forklift truck which may usually operate in the outdoor area and an electromotive forklift truck which are suitable for indoor operation, thanks to its reduced or little emission of exhaust gas and noise. Another method of classifying the forklift trucks depends on the mobility of mast assembly with respect to a vehicle body: a standard forklift truck whose mast assembly remains fixedly attached to the front end of the vehicle body; and a reach type forklift truck whose mast assembly is movable back and forth along reach legs with respect to the vehicle body. The standard truck is typically equipped with an

internal combustion engine, while the reach type truck is provided with an electric motor and a battery feeding electricity to the motor, in which sense the latter is frequently referred to as an electromotive reach type forklift truck.

The prior art electromotive reach type truck includes a vehicle body and an overhead guard mounted on the top of the vehicle body to protect the operator from any falling objects. Extending forwards from the frontal lower edge of vehicle body are a pair of spaced-apart, parallel reach legs, each of which has a load wheel at its distal end. A drive wheel and a caster wheel are mounted to the vehicle body by way of a suspension so as to support the weight of the forklift truck on the ground in cooperation with the respective load wheel. The vehicle body is further provided with a drive unit compartment and an operator's room both arranged side to side at the rear section thereof, and with a fluid pressure control compartment and a battery storage room disposed one above the other at the front section thereof.

Welded to the respective inboard surface of the reach legs are a pair of mutually confronting rails each having a guide groove extending along the full length of the corresponding reach leg. A mast assembly, which serves to lift objects, is mounted between the rails for back and forth sliding movement, viz, reach operation, relative to the vehicle body. The reach operation of the mast assembly may be effected through the use of a reach cylinder, one end of which is secured to the vehicle body and the other end of which is affixed to the mast

assembly.

Examples of the conventional mast assembly include a two stage mast assembly and a three stage mast assembly that can lift objects up to a higher elevation than the two stage mast assembly would do. The two stage mast assembly consists of an outer mast, an inner mast telescopically fitted to the outer mast for elevational movement therealong and a carriage assembly slidable along the inner mast together with the objects loaded thereon. The elevational movement of the inner mast may be brought about by means of a lift cylinder. The inner mast carries a couple of sheaves rotatably attached to the top portion thereof. Trained over or wound around the respective sheave is a chain anchored at one end to the inner mast and secured at the other end to the carriage assembly such that the elevational movement of the inner mast may cause the carriage assembly to slide along the inner mast.

On the contrary, the three stage mast assembly includes an outer mast, an intermediate mast telescopically fitted to the outer mast for elevational movement therealong, an inner mast similarly fitted to the intermediate mast for elevational movement therealong and a carriage assembly slidable along the inner mast together with the objects to be lifted. A lift cylinder is used to cause elevational movement of the intermediate mast relative to the outer mast. The intermediate mast carries at its top portion a couple of sheaves around which chains are wound with their rear ends anchored to the outer

mast and their front end secured to the bottom of the inner mast. This will make sure that the elevational movement of the intermediate mast results in the like movement of the inner mast along the intermediate mast. The sliding movement of the carriage assembly along the inner mast may be provoked by a carriage cylinder fixedly mounted to the inner mast.

According to the prior art forklift trucks as referred to above, a battery of heavy weight, usually weighing as great as 500Kg, is to be housed within the battery storage room in the transverse direction of the vehicle for the continued supply of electric energy to the electric motor or other electric devices. The battery is placed on a bed that has a number of support rollers coming into contact with the underside of the battery and thus easing the pushing-in and pulling-out operation of the battery. A side guard and a front guard are removably attached to the bed to hold the battery in place against any unwanted displacement which would otherwise take place in the process of truck operation.

When the electric energy charged in the battery runs dry, it should be taken out from the battery storage room and a new battery has to be pushed into the battery storage room in place thereof. Since the battery is quite heavy as noted above, it would be highly difficult and even hazardous for the operator or maintenance crew to remove the battery out of the battery storage room. In case of a woman operator, there may be such instances that she cannot taken out the

battery without resort to other person's assistance.

SUMMARY OF THE INVENTION

Taking into account the drawbacks of the conventional forklift trucks stated above, it is an object of the invention to provide an electromotive reach type forklift truck that makes it possible to taken out a battery from its storage room with ease and safely.

With the object in mind, the instant invention provides an electromotive reach type forklift truck comprising, in combination: a vehicle body having a battery storage room with a lateral access opening; a pair of spaced-apart reach legs extending forwards from the vehicle body and provided with guide rails attached to the respective one of the reach legs; a mast assembly having a base movable back and forth along the guide rails with respect to the vehicle body; a battery bed disposed at the bottom of the battery storage room and having an outer end adjacent the lateral access opening of the battery storage room and an inner end far away from the lateral access opening, the battery bed tiltable between a first position wherein the outer end of the bed remains not lower than the inner end and a second position wherein the outer end of the bed grows lower than the inner end so that the battery has a tendency to move toward the lateral access opening; and means for causing the battery bed to be tilted into the second position.

In the preferred embodiment, the tilt means includes a lift arm mounted to the battery bed for swinging movement about a pivot axis

between a folded position generally parallel to the bed and an unfolded position generally perpendicular to the bed, arm operating means for causing the lift arm to be swung into the unfolded position and push-up means for pressing the unfolded lift arm upwardly to have the battery bed tilted into the second position.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features, advantages of the invention will become apparent from a review of the following detailed description of the preferred embodiment taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a partially cut-away side elevational view of an electromotive reach type forklift truck in accordance with the invention;

Fig. 2 is an enlarged cross-sectional top view showing a battery bed and its environmental structures, with portions of the truck removed for simplification;

Fig. 3 is an exploded perspective view illustrating the battery bed and a lift arm swingably attached thereto;

Fig. 4 is a front elevational sectional view showing the battery bed in a first battery storage position and the lift arm in a folded position;

Fig. 5 is a view similar to Fig. 4 but showing the battery bed in a second battery removal position and the lift arm in an unfolded position;

Fig. 6 shows the lift arm coming into contact with a push

member of a mast base as the latter moves rearwardly toward the vehicle body; and

Fig. 7 is a view similar to Fig. 6 but illustrating the lift arm and the battery bed pushed upwardly by the camming action of the push member.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to Fig. 1, it will be noted that an electromotive forklift truck is provided with a vehicle body 10 and an overhead guard 12 mounted on the top of the vehicle body 10 to protect the operator from any falling objects. The vehicle body 10 has a battery storage room 16 that may removably receive a battery 14 feeding electric energy to various electric devices of the forklift truck, inclusive of an electric drive motor not shown in the drawings. Extending forwards from the frontal lower edge of the vehicle body are a pair of reach legs 18 and a pair of guide rails 20 each welded to the inboard side of the respective reach leg 18.

A mast assembly 22 is supported on the guide rails 20 for back and forth sliding movement with respect to the vehicle body 10 in response to the extension and retraction of a reach cylinder 24. The mast assembly 22 has object carrying forks 28 elevationally movable therealong by virtue of a lift cylinder 26. A drive wheel 30 is mounted to the vehicle body 10 through the use of a suspension(not shown), while a load wheel 32 is rotatably attached to the front distal end of the respective reach leg 18.

As clearly shown in Fig. 2, the battery storage room 16 is surrounded by a center plate 34, a front cover 36 and a side cover 38, leaving a lateral access opening 40 at the opposite side of the side cover 38. The battery 14 may be taken out from the battery storage room 16 through the lateral access opening 40 for replacement with a new one. The lateral access opening 40 may be, but does not have to be, openably closed off with a suitable cover plate. At the rear side of the center plate 34, an operator's compartment 42 and a drive unit compartment 44 are arranged in the transverse direction of the vehicle body 10.

In addition, the mast assembly 22 is provided with a mast base 46, at the flank sides of which guide rollers 48 are attached so as to make a rolling contact with the guide rails 20, assuring smooth sliding movement of the mast assembly 22 along the reach legs 18. Projecting vertically upwards from the mast base 46 is a push member 50 which has a rearwardly downwardly inclined top surface 52 whose function will be set forth later.

On the bottom of the battery storage room 16, a battery bed 54 removably supporting the battery 14 lies across the reach legs 18 and the guide rails 20 in the transverse direction of the truck. The battery bed 54 has an outer end adjacent to the lateral access opening 40 of the battery storage room 16 and an inner end far from the lateral access opening 40, namely, adjacent to the side cover 38. One of the innovative features of the invention resides in that the battery bed 54

is tiltable between a first storage position wherein the outer end of the bed 54 remains at the elevation equal to or higher than the inner end thereof and a second removal position wherein the outer end of the battery bed 54 becomes lower than its inner end. The tilting movement of the battery bed 54 will be further described later with reference to Figs. 4 and 5.

As best shown in Fig. 3, the battery bed 54 consists of a pair of parallel side beams 56, 56' extending in the transverse direction of the truck and outer and inner end beams 58, 60 fixedly secured to the longitudinal ends of the side beams 56, 56'. While the outer end beam 58 is pivotally attached to the left reach leg 18 by a hinge pin 62 as noted in Fig. 2, the inner end beam 60 lies simply on the right reach leg 18. This enables the battery bed 54 to be subjected to tilting movement about the axis of the hinge pin 62. The battery bed 54 further includes a plurality of roller shafts 64 generally equally spaced along the length of the side beams 56, 56' and a plurality of support rollers 66 held at the opposite ends of the respective one of the roller shafts 64 to slidably support the battery 14 placed on the battery bed 54. In the vicinity of the outer and inner end beams 58, 60, a pair of generally "U"-shaped brackets 68 are welded to the side beam 56.

The brackets 68 serves to detachably hold a side guard 70 restraining inadvertent displacement of the battery 14 in the forward direction of the truck. An end guard 72 is engaged at its one end with the outer end of the side guard 70 by means of a latch pin 74. The

other end of the end guard 72 inserted through the center plate 34. The end guard 72 assists in preventing the battery 14 from unwanted movement toward the lateral access opening 40 of the battery storage room 16. It will be preferred that a soft pad 76 is secured to the inside surface of the end guard 72 to absorb any shock that might occur due to lateral movement of the battery 14 in the battery storage room 16. For the battery 14 to be removed from the battery storage room 16, it would be necessary to pull out the latch pin 74 and then detach the end guard 72 either independently or together with the side guard 70.

Referring to Figs. 2 and 3, it will be appreciated that a lift arm 78 is swingably mounted to the side beams 56, 56' of the bed 54 for movement about a pivot shaft 80 between a folded position and an unfolded position. When in the folded position, the lift arm 78 is rendered substantially parallel with the battery bed 54, although the lift arm 78 becomes generally perpendicular with respect to the battery bed 54 in its unfolded position. The lift arm 78 is provided at its free end with an end roller 82, the axis of rotation 84 of which is orthogonal to the axis of the pivot shaft 80 about which the lift arm 78 rotates. A return spring 86, for instance, torsion spring, is retained on the pivot shaft 80 to normally bias the lift arm 78 into the folded position. The swing angle of the lift arm 78 is limited by a stopper block 87 welded to the side beam 56'.

As shown in Figs. 2 and 4, an arm pedal 88 is pivoted to the

center plate 34 of the vehicle body 10 and operatively connected to the lift arm 78 by way of a link 90, the opposite ends of which are joined to a lever portion 88a of the arm pedal 88 and a lug 78a of the lift arm 78 via ball joints 92 or other suitable joint means.

The procedure of taking out the battery from the battery storage room will now be described with reference to Figs. 4 through 7. Initially, the battery bed 54 remains in the first storage position, as seen in Fig. 4, wherein the battery bed 54 makes an angle of α with respect to the horizontal plane, assuring that the battery 14 has a tendency to move away from the lateral access opening 40. This provides two advantages, one of which is that a new battery may be readily pushed into the battery storage room 16 and the other of which is that the battery 14 already housed in the room 16 would be hardly moved toward the lateral access opening 40 even when the forklift truck undergoes severe jerking motion. Unwanted movement of the battery 14 in the room 16 will be further restrained by the side guard 70 and the end guard 72.

To remove the battery 14 out of the battery storage room 16, the side guard 70 and the end guard 72 are first detached from the battery bed 54, after which the arm pedal 88 will be depressed to rotate counterclockwise as in Fig. 5. This would cause the lift arm 78 to swing from the folded position into the unfolded position against the resistant force of the torsion spring 86, thus allowing the lift arm 78 to make a right angle relative to the battery bed 54. The stopper block

87, at this time, will inhibit further rotation of the lift arm 78 past the right angle position.

The next step is to retract the mast base 46 toward the vehicle body 10 by way of operation the reach cylinder 24, so that the push member 50 can move up to below the lift arm 78 and then come into contact with the end roller 82 at its inclined top surface 52, as noted in Fig 7. As the mast base 46 is further retracted, the inclined top surface 52 of the push member 50 will push the lift arm 78 upwardly by way of camming action, whereby the battery bed 54 rotates about the hinge pin 62 into the second removal position, as depicted in Fig. 5, wherein the battery bed 54 would make an angle of β with respect to the horizontal plane. Thus the battery 14 has a tendency to slide toward the lateral access opening 40 on the slope of the battery bed 54. This would permit the operator to remove the battery 14 out of the battery storage room 16 with little difficulty.

At the end of battery removal operation, the mast base 46 is caused to move forwards together with the push member 50, allowing the battery bed 54 to return to the first storage position as illustrated in Fig. 4. Releasing the arm pedal 88 will enable the lift arm 78 to come back to the folded position by the biasing force of the torsion spring 86. Subsequently, a new battery may be pushed into the battery storage room 16.

While the invention has been shown and described with reference to a preferred embodiment, it should be apparent to one of

ordinary skill in the art that many changes and modifications may be made without departing from the spirit and scope of the invention as defined in the claims.



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WHAT IS CLAIMED IS:

1. An electromotive reach type forklift truck comprising, in combination:

a vehicle body having a battery storage room with a lateral access opening;

a pair of spaced-apart reach legs extending forwards from the vehicle body and provided with guide rails attached to the respective one of the reach legs;

a mast assembly having a base movable back and forth along the guide rails with respect to the vehicle body;

a battery bed disposed at the bottom of the battery storage room and having an outer end adjacent the lateral access opening of the battery storage room and an inner end far away from the lateral access opening, the battery bed tiltable between a first position wherein the outer end of the bed remains at a level equal to or higher than the inner end and a second position wherein the outer end of the bed grows lower than the inner end so that the battery has a tendency to move toward the lateral access opening; and

means for causing the battery bed to be tilted into the second position.

2. The electromotive reach type forklift truck as recited in claim 1, wherein the tilt means comprises a lift arm mounted to the battery bed for swinging movement about a pivot axis between a folded position generally parallel to the bed and an unfolded position generally



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perpendicular to the bed, arm operating means for causing the lift arm to be swung into the unfolded position and push-up means for pressing the unfolded lift arm upwardly to have the battery bed tilted into the second position.

3. The electromotive reach type forklift truck as recited in claim 2, wherein the lift arm is provided with an end roller rotatably attached to its free end, the end roller having an axis of rotation orthogonal to the pivot axis of the lift arm.

4. The electromotive reach type forklift truck as recited in claim 2, wherein the arm operating means includes an arm pedal pivoted to the vehicle body and a link operatively connected to the arm pedal so that, when the arm pedal is actuated, the lift arm can swing from the folded position toward the unfolded position.

5. The electromotive reach type forklift truck as recited in claim 3, wherein the push-up means includes a push member projecting vertically upwards from the base of the mast assembly, the push member having an inclined surface coming into contact with the end roller to push the lift arm upwardly as the mast assembly moves rearwards.

6. The electromotive reach type forklift truck as recited in claim 2, wherein the tilt means further comprises a return spring normally urging the lift arm toward the folded position.

7. The electromotive reach type forklift truck as recited in claim 1, wherein the battery bed includes a pair of parallel side beams



extending in a transverse direction of the truck, outer and inner end beams respectively secured to opposite ends of the side beams, a plurality of roller shafts disposed along the length of the side beams and a plurality of support rollers rotatably fitted to opposite ends of the respective one of the roller shafts.

8. The electromotive reach type forklift trucks as recited in claim 7, wherein the outer end beam of the battery bed is hingedly associated with the corresponding reach leg.

9. The electromotive reach type forklift truck as recited in claim 7, the battery bed further includes a side guard restraining inadvertent displacement of the battery in a forward direction of the truck and an end guard preventing the battery from moving toward the lateral access opening of the battery storage room, the end guard removably engaging with the side guard by means of a latch pin.

10. An electromotive reach type forklift truck comprising, in combination:

a vehicle body having a battery storage room with a lateral access opening;

a battery bed disposed at the bottom of the battery storage room and having an outer end adjacent the lateral access opening of the battery storage room and an inner end far away from the lateral access opening, the battery bed tiltable between a first position wherein the outer end of the bed remains at a level equal to or higher than the inner end and a second position wherein the outer end of the bed



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grows lower than the inner end so that the battery has a tendency to move toward the lateral access opening;

a lift arm mounted to the battery bed for swinging movement about a pivot axis between a folded position generally parallel to the bed and an unfolded position generally perpendicular to the bed;

arm operating means for causing the lift arm to be swung into the unfolded position; and

push-up means for pressing the unfolded lift arm upwardly to have the battery bed tilted into the second position.

11. The electromotive reach type forklift truck as recited in claim 10, wherein the arm operating means includes an arm pedal pivoted to the vehicle body and a link operatively connected to the arm pedal so that, when the arm pedal is actuated, the lift arm can swing from the folded position toward the unfolded position.

12. The electromotive reach type forklift truck as recited in claim 10, wherein the push-up means includes a push member projecting vertically upwards from the base of the mast assembly, the push member having an inclined top surface coming into contact with the lift arm to push it upwardly as the mast assembly moves rearwards.