Oct. 1, 1968 B. I. ULINSKI 3,403,801

UNIVERSAL LIFT TRUCK

Filed July 21, 1966 2 Sheets-Sheet 1

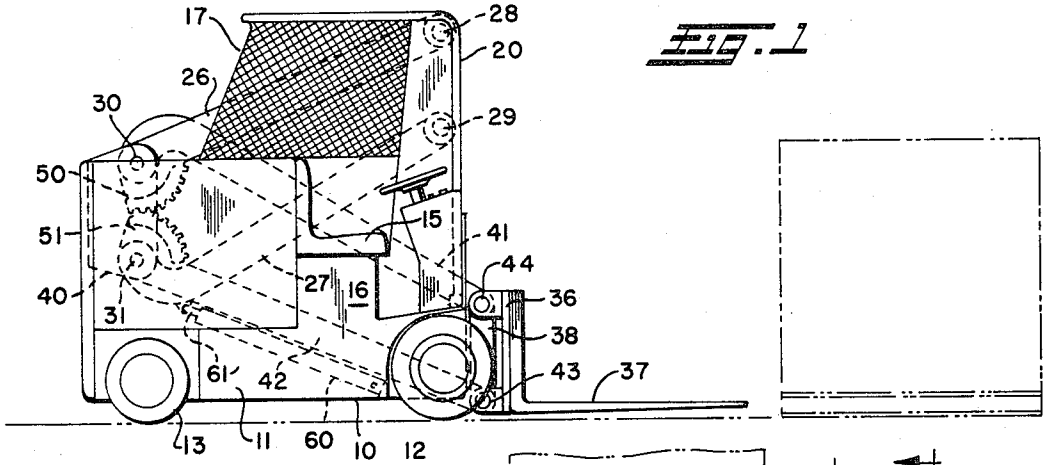

FIG. 1

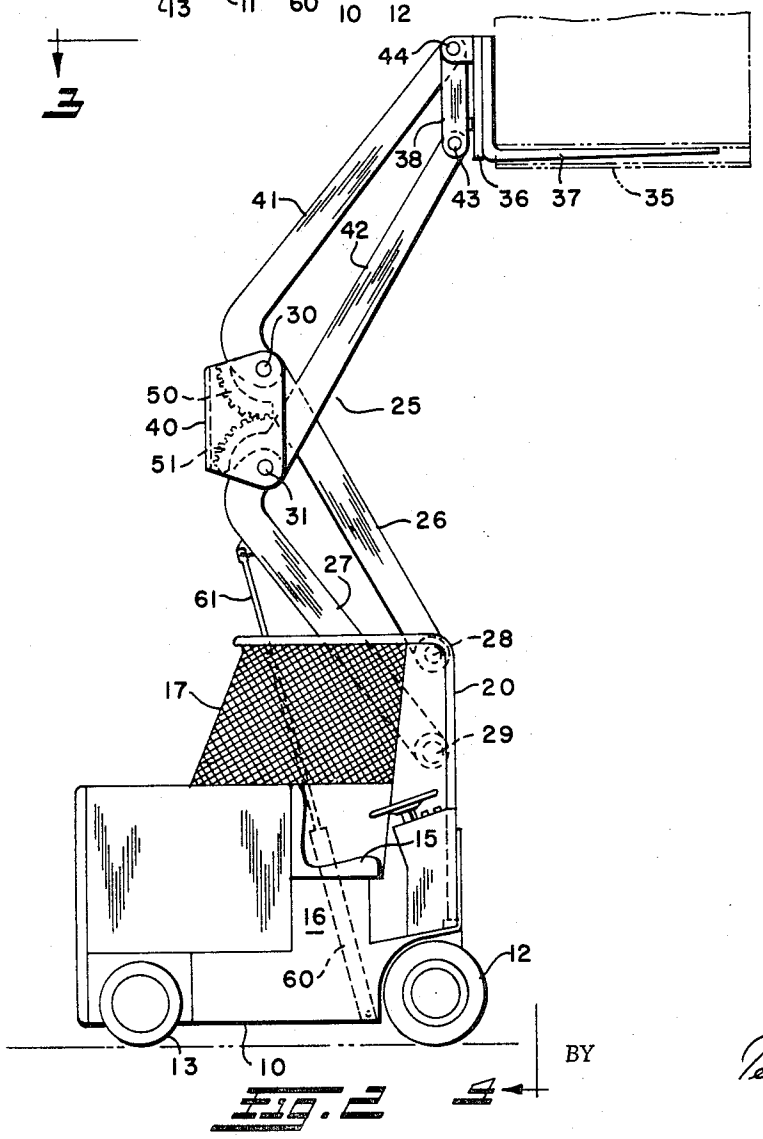

FIG. 2

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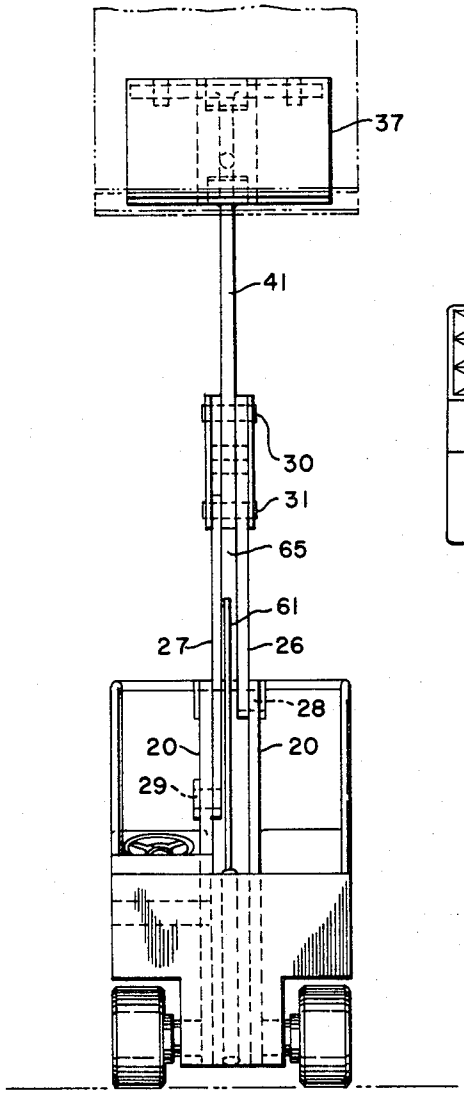

Fig. 4

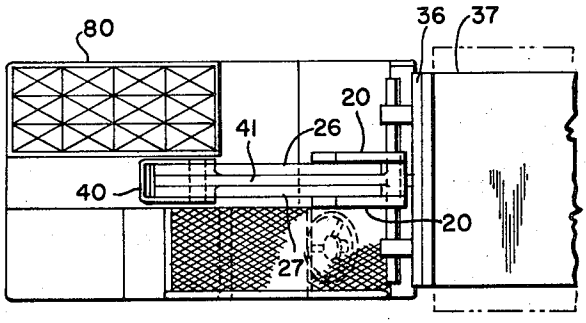

Fig. 3

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United States Patent Office 3,403,801 Patented Oct. 1, 1968

3,403,801

UNIVERSAL LIFT TRUCK

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Filed July 21, 1966, Ser. No. 566,889
4 Claims. (Cl. 214—770)

ABSTRACT OF THE DISCLOSURE

An elevating device of an industrial truck as constituted by lower and upper pair of lift links. The lift links are located centrally of the truck, said upper pair of links lying in the same plane. Gear means drives said pairs of links in opposite rotational directions.

This invention relates to lift or elevator type industrial trucks and more particularly to improvements in the leverage systems for elevating and lowering a load carriage for lift trucks and the like.

Many types of lever type lift trucks utilizing upright elevator mechanisms for engaging, elevating and transporting loads from one location to another are shown in the materials handling industry. Such lever type lift trucks were a subsequent development to the conventional lifting systems utilizing load lifting platforms or forks for movement on channeled, vertically guided uprights. In the vertical upright systems, the load was elevated through movement on the uprights while the load could be tilted through tilting movement of the uprights so as to facilitate taking the load off the truck or to move the load with the truck. The lever type lift truck was an improved design in that it located the load lifting mechanism on the truck in a position where it would help to counterbalance the load carried by the platform or the forks and to provide a substantially straight line vertical lift of the load engaging means while at the same time providing a stable upright mechanism which is supported by the truck. However, the desirable straight line vertical lift feature usually required complicated hydraulic controls including servo valve means or complicated guide mechanisms. The lift truck of the instant invention is of simple, uncomplicated design constructed to impart extreme high lift to a load carriage while moving said carriage substantially in a single vertical plane.

In achieving the aforementioned minimization of the weight of the upright mechanism and load which overhangs the front axle of the lift truck and providing a substantially straight line vertical lift of the load engaging means without complicated stabilizing structure, I have devised a novel structure which utilizes a folding upright concept which collapses into a well of the central portion of the truck frame. The well and the upright mechanism are laterally spaced from the line of sight of an operator offering maximum visibility for said operator. My invention utilizes a pair of links pivoted to the frame of the truck in vertical spaced relation and extending rearwardly of the truck to a connecting member and pivoted to said connecting member in a manner preferably so as to form a parallelogram; a second pair of links is pivoted to said connecting member and to the load carriage to form a second parallelogram. Through the utilization of particular gear sector means interconnecting the two parallelograms, I am able to effect high lift in substantially a single plane of the load carriage merely by upward swinging movement of the parallelogram assembly. The second set of links forming the second parallelogram and the connecting member are moved upwardly in relative swinging movement to the fixed pivot points connecting the first parallelogram links to the main frame. My invention also features an inherent reduction in speed of lifting of the load carriage as said load carriage approaches its upper positions. Such reduction of speed when said load carriage is nearing its highest position is desirable in the interest of stability and reduction in structural stresses in the lift truck.

In accordance with the foregoing, it is one of the primary objects of the present invention to provide a lift truck of relatively economical and simple construction having generally improved and novel load lifting means.

Another prime object of the present invention is to provide a lever type lift truck in which the lever lifting linkage means retracts within a receiving well portion of the truck frame when the load engaging means is in or near its lowermost position.

Another important object of the invention is to provide an upright for lift trucks and the like which affords unobstructed vision for the operator at all times during raising and lowering movement of the load engaging means.

A still further object of the present invention is to provide lever type lift truck lifting linkage means having a first pair of links offset laterally adjacent the longitudinal centerline of the truck between which a second pair of links operate, the first and second pairs of links being extended and retracted to effect raising and lowering of the truck load engaging means.

Yet another object of this invention is provision of a lever type lift truck linkage system as noted in the next preceeding paragraph wherein the first pair of linkage means are pivotally connected to the truck frame and symmetrically positioned relative to the longitudinal centerline of the truck and the plane of operation of the second pair of links.

A further object of the invention is to provide a load lifting mechanism of the lift truck type wherein substantially straight line vertical movement is inherently effected of the load engaging means during the total elevation of the load engaging means without the use of complicated hydraulic controls or other guide mechanisms.

An additional object of the invention is to provide a load lifting mechanism of the lift truck type wherein the speed of movement of the load carriage will decrease as said load carriage moves toward its upper positions of elevation.

Other objects, features, and advantages of the present invention will become apparent to those skilled in the art in view of the following description taken in conjunction with the drawings, wherein:

FIGURE 1 is a side elevational view of a lift truck constructed in accordance with the present invention.

FIGURE 2 is a side elevational view of the truck of FIGURE 1 showing the load carriage in an elevated position.

FIGURE 3 is a plan view of the lift truck of the present invention with parts broken away.

FIGURE 4 is a front view of the fork lift truck of FIGURE 2 with the load carriage in an elevated position.

Referring now in detail to the drawings, a lift truck chassis of generally conventional construction is shown at numeral **10** and comprises a main frame **11**, front and rear ground engaging wheels **12** and **13**, and an operator's seat **15** mounted atop a power compartment **16** which extends laterally of the truck. The various controls for operating the truck, including transmission and brake controls and valve controls for operating the lever systems, are conventional and have not been illustrated nor described in detail.

The frame is provided with safety glass of plexiglass **17** for protection of the operator while he is occupying seat **15**. The forward end of the frame **11** is also provided with a pair of upstanding portions **20** which are transversely spaced, as best shown in FIGURE 4, for receiving the lever assembly generally indicated as **25** when said lever assembly is moved into a retracted position to

lower the load carrying mechanism **35**. The load carrier **35** is constructed with a front plate **36**, somewhat like the front plate used on a conventional load lifting carriage, adapted to accept load forks **37**. It is to be understood however, that the particular construction of the load carrier **35** is not critical and the present invention is compatible with different load carriage and mounting constructions.

The load lifting mechanism of the present invention comprises a parallelogram arrangement that includes a first pair of rearwardly extending parallel arms **26** and **27**, as best shown in FIGURE 1, pivotally secured to the frame **11** at their forward ends by means of vertically spaced pivots **28** and **29**. The rear ends of the rearwardly extending arms **26** and **27** are pivotally secured to an intermediate link or connecting arm member **40** by means of vertically spaced pivots **30** and **31** which are rigidly secured to the arms **26** and **27**, but rotatably mounted on the connecting member **40**. Link arms **26** and **27** are laterally offset and symmetrically positioned relative to the longitudinal centerline of the truck frame as can be seen in FIGURE 4. Each set of link arms **26** and **27** together with the upstanding frame portion **20** and intermediate connecting member **40** associated therewith, provide a parallelogram leverage system by which the intermediate connecting member **40** is supported for vertical swinging movement relative to the truck frame **11**.

A second pair of forwardly extending parallel link arms **41** and **42** are pivotally secured at their rear ends to the intermediate connecting member **40** by vertically spaced pivots concentric with vertically spaced pivot points **30** and **31** which are rigidly secured to the link arms **41** and **42** rotatably mounted in the connecting member **40**. The forward ends of each of the forwardly extending arms **41** and **42** are secured to a load carriage **35** by means of a pair of vertically spaced pivots **43** and **44**. The link arms **41** and **42** are vertically coplanar, that is, link **42** is mounted directly below link arm **41** and they are of the same cross-section. The link arms **41** and **42** together with the intermediate connecting member **49** and the load carriage bracket **38** form a second parallelogram leverage system which supports the load carrying mechanism **35** for vertically swinging movement relative to the intermediate connecting member **40**. By this arrangement of forwardly and rearwardly extending arms, relatively high lift of the load carrying mechanism **35** can be obtained by swinging the rearwardly extending parallel arms **26** and **27** vertically upward between link arms **26** and **27** to raise the intermediate connecting member **40** relative to the truck frame **11**, and at the same time swinging the forwardly extending arms **41** and **42** vertically upward relative to the intermediate connecting member **40** as shown in FIGURE 2.

Simultaneous swinging movement of both sets of arms **26**, **27** and **41**, **42** in raising and lowering the load carriage **37** is effected and controlled through simple gear means including cooperating gear segments **50** and **51** integrally connected with link arm members **26** and **42** respectively, which are rotatable with the link arms relative to the intermediate connecting member **40**. By this simple gear arrangement, both sets of link arms **26**, **27** and **41**, **42** are connected together and must swing simultaneously in opposite directions relative to the intermediate connecting member **40** when a moving force is applied to either set of link arms.

The moving force is applied through a hydraulic ram **60** which is secured to link arm member **27**; when operated ram **60** extends a piston rod **61** to swing the rearwardly extending arms **26** and **27** vertically upwardly about pivot points **28** and **29** and the forwardly extending arms **41** and **42** swing upwardly relative to the intermediate connecting member **40** so that the load carriage is elevated to the position shown in FIGURE 2. The copolanar link arms **41** and **42** swing upwardly between the rearwardly extending link arms **26** and **27** which are laterally offset from each other and symmetrically positioned relative to the longitudinal centerline of the truck frame and the plane of operation of line arms **41** and **42** to provide clearance **65**. The path of movement of the load carriage **35** is determined by the relative lengths of the arms **26**, **27** and **41**, **42** and it will be appreciated that by proper selection of the length of the arms, various paths of movement including a substantially vertical straight line path of movement may be obtained. Furthermore, the design of the instant invention inherently brings about a reduction of travel speed of the load carrying mechanism **35** as it approaches its highest elevation during extension of the load lifting lever system from that position illustrated in FIGURE 1 to the extended position of FIGURE 2. Such a reduction of travel speed of the load carrying mechanism **35** as it nears its extended position is essential in the interest of decreasing the structural stresses of the various components of the lift truck.

The retraction process in lowering the load carrying mechanism **35** from its extended position of FIGURE 2 to its lowermost position of FIGURE 1, is the reverse of the aforedescribed extension operation. That is, the forwardly extending link arms **41** and **42** swing vertically downwardly about the intermediate connecting member **40** between the laterally spaced link arms **26** and **27** which in turn pivot in a vertically downwardly direction about pivot points **28** and **29**; the total leverage system retracts or folds back into the receiving well of the lift truck frame between vertical portions **20**. This unique arrangement whereby the load lifting system linkage means are folded or retracted back wholly within a frame well at the central portion of the frame permits unobstructed vision at all times for the operator of the lift truck. Such a compact retraction design of the leverage system also permits greater freedom of movement of the truck in confined areas during movement of the truck when the load carrying mechanism **35** is in its lowermost position as illustrated in FIGURE 1. The unobstructed vision feature of the present invention is best shown by the front view of FIGURE 4. It is to be understood that the ram **60** can also be operated to position the load carriage **35** in any intermediate position between the fully retracted position of FIGURE 1 and fully extended position of FIGURE 2.

The lift truck of the instant invention can be either gasoline engine powered or battery powered. The particular embodiment of the invention illustrated shows the lift truck to be battery operated by the bank of batteries **80** as shown in FIGURE 3. The lift truck would also be provided with a tilt ram adjacent the load carrying fork for tilting the lift fork **37** and would also have conventional means for limited lateral movement of the load carriage **35** in confined areas.

The present invention offers a more compact, simple lever load lifting assembly which requires but one set of links mounted at the central portion of the lift truck in contrast to the conventional truck lever systems which are duplicated on each side of the truck. Furthermore, the substantially straight line vertical lift of the load engaging means is effected by a simple, uncomplicated assembly without the need for servo valve means or other involved arrangements common to the art.

Having described my invention, I now claim:

1. An elevating mechanism for an industrial truck comprising:

a frame,

connecting arm means,

a single pair of first links pivotally connected at opposite ends to said frame means and arm means in vertically spaced relation for supporting said connecting arm means for swinging vertical movement relative to said frame, said links being offset laterally adjacent the longitudinal centerline of the truck,

load engaging means,

a single pair of second links pivotally connected at opposite ends to said connecting arm means and load engaging means in vertically spaced relation for supporting said load engaging means for swinging vertical movement relative to said connecting arm means, said second pair of links operating in the same plane between said first pair of links, and supporting said load engaging means centrally thereof,

one of said first links and one of said second links having cooperating gear means fixed thereto adjacent said connecting arm means,

said gear means driving said first and second pairs of links in opposite rotational directions relative to said connecting arm, and

power means for extending and retracting said pairs of links and raising and lowering said connecting arm means to effect simultaneous vertical swinging movement of said pairs of links about said frame means and connecting arm means to raise and lower said load engaging means.

2. An industrial truck elevating mechanism as set forth in claim **1** wherein:

a portion of the frame to which said first pair of links are pivotally connected comprises a pair of spaced plates between which said first and second pairs of links move between their extracted and retracted positions.

3. An industrial truck elevating mechanism as set forth in claim **2** wherein:

the said spaced plates receiving said pairs of links are located near the centerline of the truck and an operator seat is located on said frame laterally spaced from said frame spaced plates so that an operator has unobstructed vision at all times.

4. An industrial truck elevating mechanism as set forth in claim **1** wherein:

said laterally offset first pair of links pivotally connected to said frame means are symmetrically positioned relative to the longitudinal centerline of the truck and the plane of operation of said second pair of links.

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