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(54) Improvements in load handling vehicles.

(57) A container-handling vehicle incorporating a multi-section telescopic mast assembly (14) has a carriage (20) movable up and down the mast and a gantry (21) from which is suspended a lifting frame (30) for engaging the top corner fittings of a standard freight container (31). In order to reduce the weight carried forwards of the front wheels (11), the mast assembly (14) is mounted directly over the front axle line (15), and a mechanism (40) is provided for extending and retracting the lifting frame (30) so as to enable the vehicle to reach forward for a load, lift it, and then retract the load into a travelling position closer to the mast (14) and generally over the front wheels (15). The arrangement reduces the overall weight of the vehicle, saves on tyre and pavement wear, and gives greater stability in the travelling position.

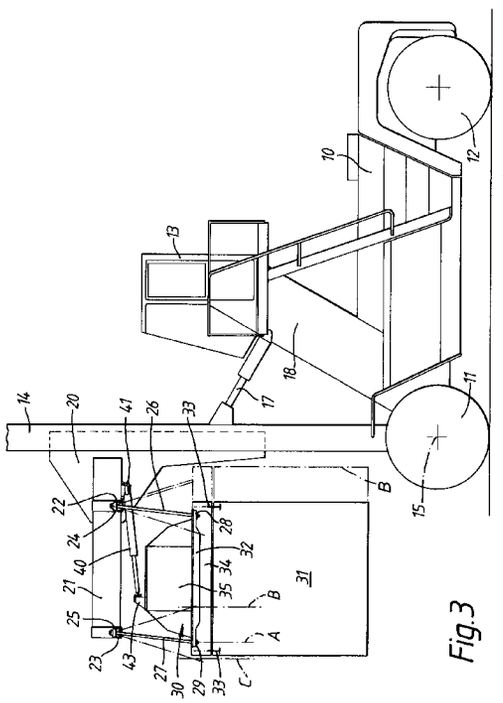

Fig.3

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This invention relates to load handling vehicles of the kind comprising a lifting mast and a lifting carriage moveable up and down the mast, the lifting carriage having mounted thereon load-engaging means.

Load handling vehicles of this kind, especially those which are designed to pick up and carry a load in front of the vehicle (so-called "front loaders"), generally have the lifting mast located close to but in front of the front axle of the vehicle. The mast usually comprises two or more telescopic sections to increase the lifting height. One common vehicle of this kind is a container-handling vehicle in which the load-engaging means mounted on the carriage comprises a frame having locks for engaging the uppermost corner fittings of a freight container.

Locating the mast in front of and below the front axle line is necessary to simplify mounting of the carriage and to enable the load-engaging means to pick up loads from ground level. In consequence, the load is carried in front of the vertical plane containing the front axle line, creating a moment about the front wheels which must be compensated by the vehicle's counter-weight. One advantage of such an arrangement is that lateral stability of the vehicle is improved by carrying the load in front of the front axle, and while this is important for a lift truck with a narrow track, this is not such an important factor with large trucks with wide front tracks, such as container-handling vehicles, which are quite stable laterally. With these vehicles, fore-and-aft stability is more important, especially in the travelling position with a load at the top of the extended mast. It will be appreciated that fore-and-aft stability is adversely affected where the load is carried in front of the front axle.

One further disadvantage of this arrangement, especially with large trucks, is the weight of the mast assembly itself. The greater the heights to which these trucks must reach, the greater the number of sections needed in the telescopic mast assembly, and the heavier the mast assembly becomes. In certain large trucks the mast assembly can comprise as much as 20% of the overall weight of the vehicle, and this weight must be counter-balanced if it falls in front of the front axle line, reducing the lifting capacity of the truck and leading to increased tyre and pavement wear.

Various proposals have been made for lift trucks which can retract a load into a position close to the front axle after the load has been picked up. Examples are shown in U.S. Patent No. 4395190, U.K. Patent No. 862,146, and U.K. Patent No. 966,227. All these prior patents show relatively small lift trucks which support a load on top of the lifting forks, and in which the weight of the mast assembly is not a significant factor.

The present invention provides a load-handling vehicle having means for suspending a load in which the mast is located in a more rearward position than previously by providing means for shifting the suspended load rearwardly once it has been lifted to clear the front wheels, to a point where it is suspended over the wheels. This results in a load-handling vehicle having greater fore-and-aft stability, and a reduced laden and unladen weight on the drive axle, thus extending the life of the tyres, the axle, and the pavement and reducing initial and running costs.

According to the present invention, there is provided a load handling vehicle of the kind comprising a chassis, front and rear wheels, a load lifting mast mounted in the chassis with its axis substantially coincident with or behind the plane containing the front axle of the vehicle, a carriage moveable up and down the mast, and a load engaging means adapted to suspend a load therefrom connected to the carriage; wherein the load engaging means is moveable relative to the carriage and drive means are provided operable to move the load engaging means longitudinally of the chassis between a load pick-up and set down position in which the load engaging means is disposed forwardly of the front wheels and a retracted travelling position in which the load engaging means is disposed rearwardly of the load pick-up and set down position and extends at least partially over the front wheels.

The preferred mechanism for the drive means comprises one or more hydraulic jacks mounted between the load-engaging means and the carriage. Preferably, the carriage incorporates a gantry and the load engaging means comprises a lifting frame freely suspended from the gantry by rods or chains, and the hydraulic jacks are mounted to move the lifting frame outwardly or inwardly relative to the gantry between the handling position and the travelling position on operation thereof. However, other forms of load-engaging frames and drive means can be employed.

Suitable mechanical, electrical or hydraulic sensing means are provided to prevent the carriage being moved downwardly of the mast when a load is being carried in the travelling position into a position in which the load fouls the front wheels. These ensure that the load can be dropped to a point below the level of the front tyres only when the hydraulic jacks have been operated to move the lifting frame forwardly of the gantry out of the travelling position and into the handling position. Similar sensing means are provided to prevent retraction of the jacks on pick-up of a load until the carriage has been lifted such that the load clears the front wheels. These sensing means can be interlocks or warning devices.

In order that the invention may be more fully understood, embodiments in accordance therewith will now be described by way of example only with reference to the accompanying drawings, in which:

Fig. 1 is a scrap view, partly in section, of a known mounting arrangement of a lift truck mast;

Fig. 2. is a similar view showing a mounting according to the invention;

Fig. 3. is a diagrammatic side elevation of a load handling vehicle according to the invention adapted for lifting and transporting standard freight containers;

Fig. 4. is a side view of a lift truck according to the invention fitted with a piggy-back attachment for handling intermodal loads such as swop bodies; and

Fig. 5. is a diagram illustrating the effect of lifting apparatus according to the invention on the centre of gravity of the truck.

Referring to the drawings, Fig. 1 shows a known arrangement in which a lifting mast 50 is mounted at its lower end to the chassis 51 of the vehicle by means of a bracket 52 and pin 53. Pin 53 is aligned with the front axle 54 which supports wheel 55, but as will be seen in the drawing, the vertical axis 56 of the mast 50 is spaced by a distance x from the front axle line 57. Since the weight of the mast assembly can be substantial, e.g. 12-16 tons, this in itself creates a substantial moment about the front wheel 55. This moment is increased by the presence of a load on the lifting carriage.

Fig. 2 shows the mounting arrangement according to the invention. In this arrangement, mast 60 is mounted on pin 61 disposed immediately above and in the vertical plane containing the front axle line 62. Wheel 63 thus carries the weight of the mast 60 directly and no counterbalancing is necessary to compensate for the weight of the mast.

The means by which the load is controlled in this arrangement is illustrated in Figs. 3 and 4. Fig. 3 shows a front-loading container handling vehicle having a chassis 10, front wheels 11, rear wheels 12, and operators cab 13. A lifting mast assembly 14 is disposed substantially over the front axle line 15 of the vehicle. This mast assembly 14 is of conventional construction, being telescopic to provide maximum lifting height and being extended by a pair of hydraulic lift jacks which are not shown in the drawing. The mast assembly 14 is pivotally mounted at its lower end to the chassis e.g. as shown in Fig. 2 and can be tilted through a small angle by a pair of hydraulic tilt jacks, one shown 17, connected between the mast assembly 14 and the support 18 for the operator's cab 13. A carriage 20 is adapted to move up and down the mast, on extension and retraction of the lift jacks by means of reeving chains, also in conventional manner. Carriage 20 has mounted thereon gantry 21.

Gantry 21 is provided with channel section supports 22,23 at each corner thereof within which are mounted spherical bearings 24,25. These bearings receive matching spherical fittings provided on upper ends of suspension rods 26,27, which are suspended from each corner of the gantry. The lower ends of suspension rods 26,27 are provided with identical spherical fittings received in matching spherical bearings 28,29 mounted in upper frame member 32 of load-engaging lifting frame 30. The lifting frame -30 is thereby suspended by the suspension rods 26,27 from the gantry 21 and the spherical bearings permit free swinging movement of the frame relative to the gantry. Chains or cables may be used to suspend frame 30 as an alternative to the suspension rods.

Load-engaging lifting frame 30 comprises a lower frame member 34, upper frame member 32 mounted on the lower frame member, and housing 35 mounted on the upper frame member. The frame is designed to be engageable with a standard container 31 by means of twistlocks 33 located at each corner of lower frame member 34. In the course of a lifting operation, the vehicle is driven up to a container 31 and the carriage and mast assembly lowered such that the lifting frame 30 rests on top of the container 31 with the twistlocks 33 disposed within the corner fittings of the container. The twistlock 33 are then operated to engage the container, and the container can then be lifted by causing carriage 20 to move up the mast by operation of the lift cylinders. Once the container is in the raised position, the vehicle can be driven to its new position where the container 31 is lowered in the reverse of the lifting sequence.

A fully loaded container imposes substantial loads on the lifting mechanism of a front loading vehicle and since the load is carried in front of the vehicle at all times, usually in a fully raised position to improve visibility for the driver, a loaded vehicle may have a reduced safety factor. This imposes certain limitations on the size of the load and the maneouverability of the truck when it is carrying a container. In order to improve the stability of the vehicle in its travelling mode, the invention provides for repositioning of the load after lifting into a more stable position permitted by the location of the mast above the front axle. For this purpose a pair of hydraulic jacks (one shown 40) are provided to perform a significant outward and inward reaching movement of the lifting frame. Jacks 40 each have one end 41 pivotally mounted to the gantry 21, and the other end connected to an attachment point 43 on housing 35 of lifting frame 30. Jacks 40 can be retracted and extended in order to shift the position of lifting frame 30 relative to the mast outwardly and inwardly about rods 26,27 in a direction longitudinally of the vehicle. The extent of this movement is shown by the broken lines in the drawing which represent the limits of angular displacement of the suspension rods 26,27. This enables a container 31 to be picked up from a rest position in the normal way, and then by retraction of the jacks 40, moved rearwardly into a travelling mode in which the container is suspended over the front wheels 11. This brings the load centre closer to the vertical centre of gravity of the truck and improves stability while travelling. This also means that the

mast 16 can be located in the desired position in the chassis since the truck can be made to "reach" for containers in the normal lift position. These various positions are shown in the drawing. In the normal lifting and lowering position, position 'A', containers can be picked up and lowered and during these operations a standard freight container 31 will clear the front wheels 11. After lifting to the level shown in the drawing, the hydraulic jacks 40 are retracted to pull the load 31 inwardly, such that the load and the rear part of frame 30 are disposed substantially over the front wheels 11. This position, position 'B', provides much greater stability for travelling than the unretracted position A equivalent to the travelling position of conventional front-loading lift trucks, and substantially reduces the axle load.

Since in the travelling position the load, as stated, is supported above the front wheels, an interlock mechanism is provided to prevent the carriage from being lowered beyond a point at which the container fouls the front wheels. This interlock mechanism comprises a mechanical, electrical, hydraulic or similar sensor which is connected to the lifting mechanism. A sensor may also be provided to prevent retraction of the jacks 40 when a container has been picked up until the carriage 20 has been raised sufficiently to enable the container to clear the front wheels of the vehicle. Instead of an interlock, a warning device such as a bell or a light may be provided for the driver so that this function can be performed manually.

A further outward movement of the hydraulic jacks 40 into position 'C' is possible in order to assist in positioning the lifting frame when lifting and lowering is carried out. For the same purpose, jacks 40 may be operable independently to cause an angular movement (slew) of the lifting frame 30 relative to the vehicle.

Fig. 4 shows a "piggy-back" and container handling vehicle 70 fitted with a telescopic mast assembly 71 with its vertical axis disposed directly over the front wheels 72. In this case, the carriage 73 supports inverted forks 74 on which is slidably mounted a "piggy-back" and intermodal attachment 75 for loads such as swap bodies and semi-trailers. Attachment 75 is slidable outwardly along forks 74 from the position shown in the drawings by means of a pair of hydraulic cylinders (one shown in broken lines at 76) into a load pick-up position, and can be retracted into the travelling position shown in the drawing by the same cylinders.

Fig. 5 shows diagramatically the effect of this arrangement on the vertical centre of gravity of the truck. The load pick-up position of a container is shown in full lines 80, the load centre of the container being shown at a. In this condition the vertical centre of gravity of the truck is located at a'. In the retracted travelling position of the container, shown in broken lines, the load centre lies at b and the vertical centre of gravity of the truck moves rearwardly to b'. The front axle line of the truck is shown at 81, coinciding with the vertical axis 82 of mast 83. The front and rear wheels are denoted by 84 and 85 respectively.

Claims

1. A load-handling vehicle comprising a chassis (10), front and rear wheels (11,12), a load lifting mast (14) mounted in the chassis with its axis substantially coincident with or behind the plane containing the front axle of the vehicle, a carriage (20) moveable up and down the mast, load-engaging means (30) adapted to suspend a load therefrom connected to the carriage for movement relative thereto; and drive means (40) operable to move the load engaging means relative to the carriage longitudinally of the chassis between a load pick-up and set down position (A) in which the load-engaging means is disposed generally forwardly of the front wheels (11) of the vehicle, and a retracted travelling position (B) in which the load-engaging means is disposed rearwardly of the load pick-up and set down position and extends at least partially over the front wheels.

2. A load-handling vehicle as claimed in Claim 1, characterised in that the drive means (40) comprise one or more hydraulic jacks mounted between the carriage (20) and the load-engaging means (30).

3. A load-handling vehicle as claimed in Claim 1, characterised in that the carriage incorporates a gantry (21) and the load-engaging means (30) comprises a lifting frame for suspending a load connected to the gantry.

4. A load-handling vehicle as claimed in Claim 3, characterised in that the lifting frame is freely suspended from the gantry (21) by rods or chains (27).

5. A load-handling vehicle as claimed in Claim 1 or Claim 2, characterised in that the load-engaging means (30) comprises a container or piggy-back load-handling attachment.

6. A load-handling vehicle as claimed in any of Claims 1 to 5, further comprising sensing means operable when a load is being carried by the vehicle to prevent operation of said drive means (40) to retract the load-handling means (30) into the travelling position until the carriage (20) has been raised sufficiently to enable the load to clear the front wheels.

7. A load-handling vehicle as claimed in Claim 6, characterised in that second sensing means are provided associated with said carriage (20) operable when a load is being carried by the vehicle to prevent lowering of the carriage (20) with the load-handling means (30) disposed in the travelling position, beyond a point at which the load contacts the front wheels (11).

8. A load-handling vehicle as claimed in Claim 6 or Claim 7, characterised in that said first and second sensing means comprises an electrical or hydraulic interlock.

9. A load-handling vehicle as claimed in Claim 6 or Claim 7, characterised in that said first and second sensing means comprise a warning device.

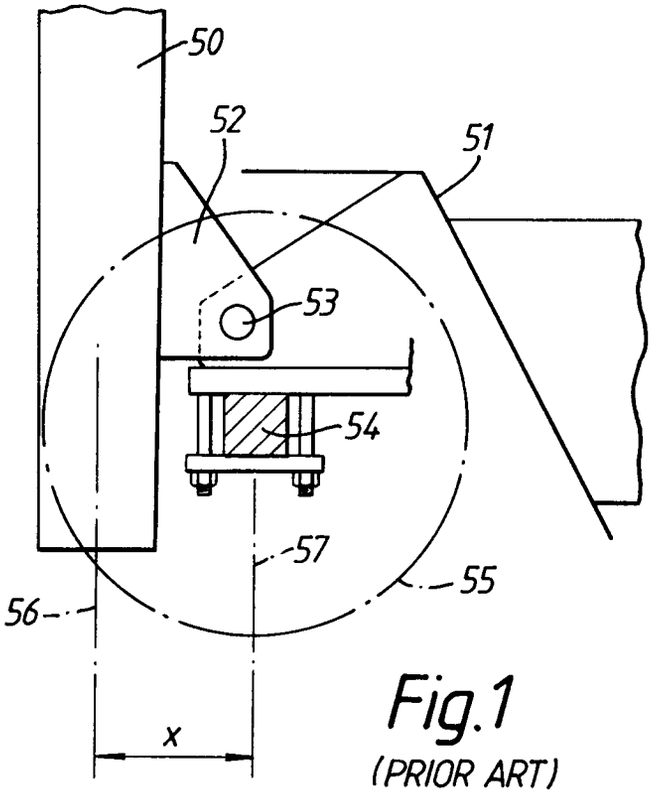

Fig.1
(PRIOR ART)

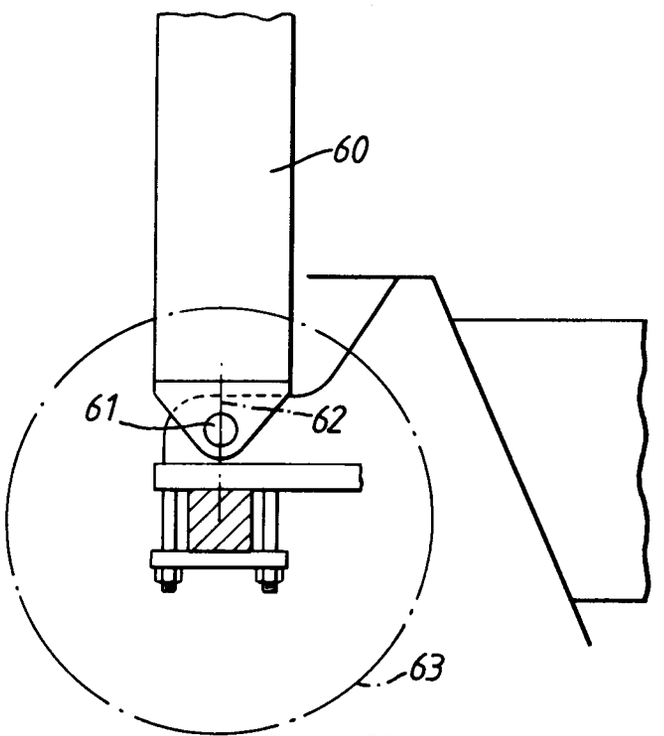

Fig.2

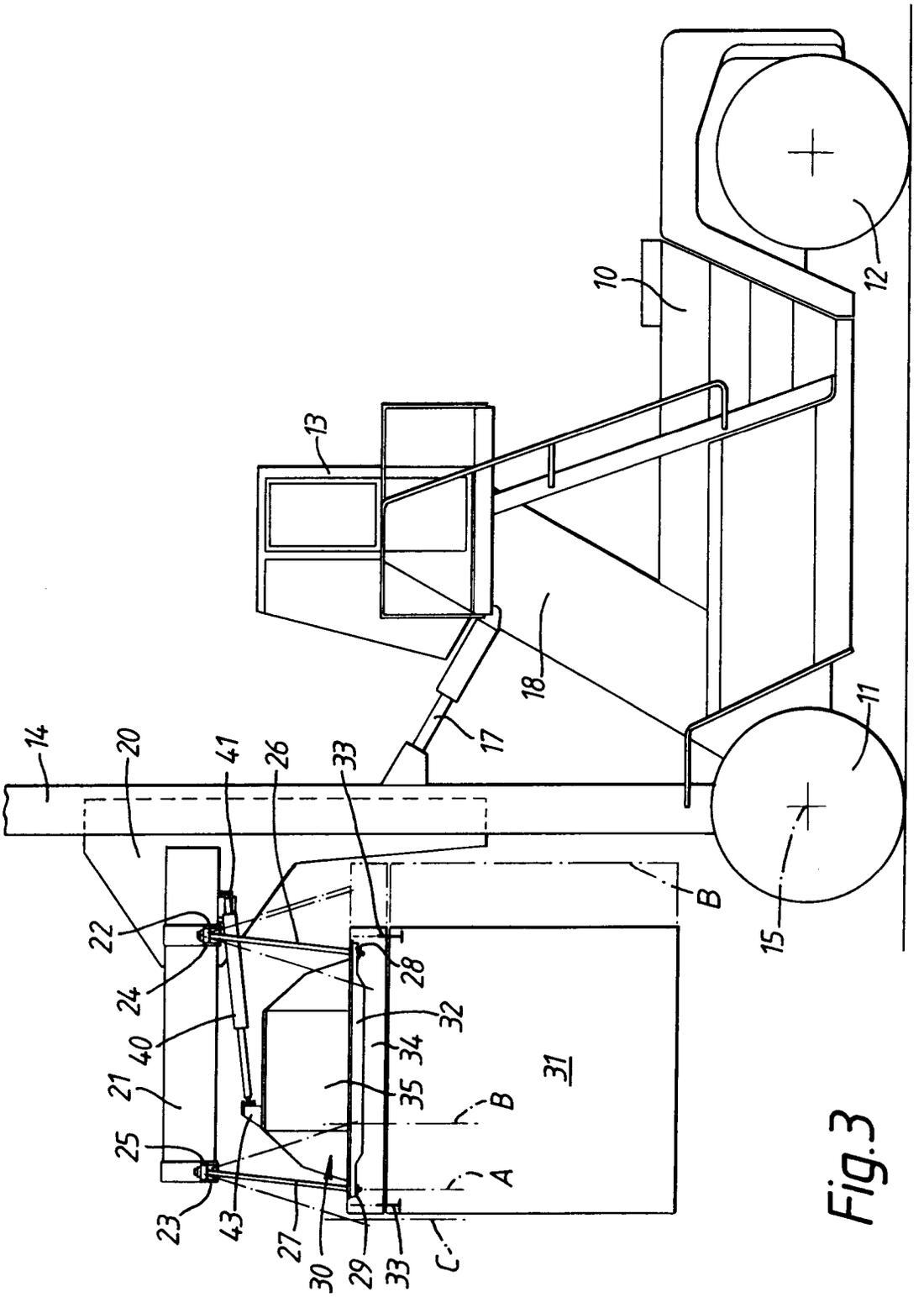
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Fig.3

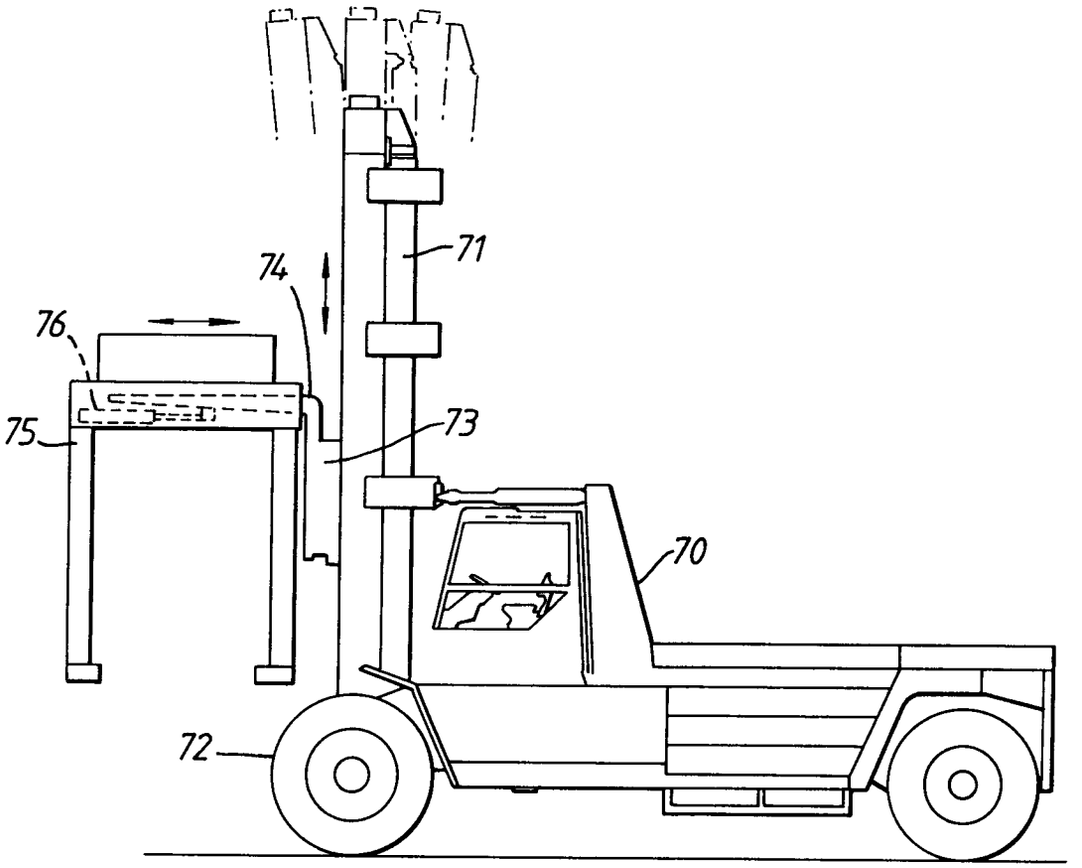

Fig.4

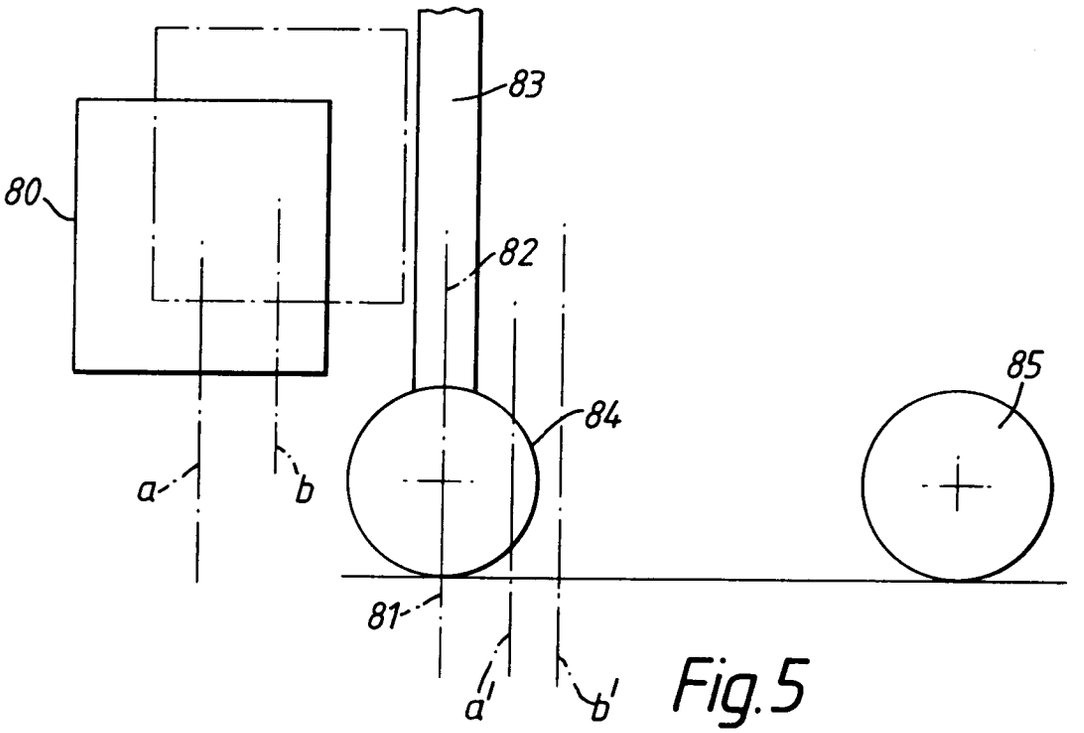

Fig.5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 8015

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	DE-A-33 00 018 (RIESCHEL) * page 11, line 6 - line 11; figures 1,5 *	1-5	B66F9/18 B66F9/08
Y	US-A-3 633 777 (MURDOCK) * column 2, line 42 - column 5, line 25 *	1-5	
Y	US-A-2 220 450 (HOWELL) * page 1, right column, line 22 - line 44 *	1-5	
Y	GB-A-1 423 513 (LANCER BOSS GROUP) * page 2, line 41 - line 107 *	1-5	
A	DE-U-80 05 631 (KAUP & CO.)		
A	WO-A-85 01995 (TOWMOTOR CORPORATION)		
A	DE-A-20 44 410 (LANCER BOSS)		

TECHNICAL FIELDS SEARCHED (Int.Cl.5)

B66F
B66C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 January 1994	VAN DEN BERGHE, E

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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