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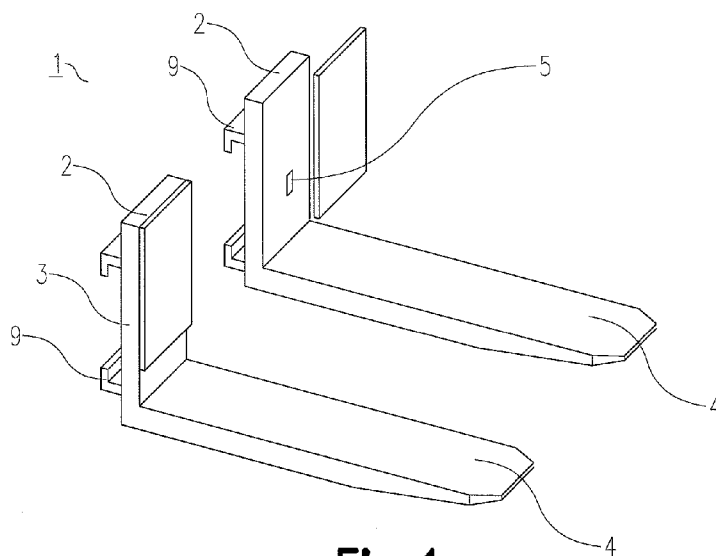


Fig. 1

(57) Abstract: A lifting device (1) for a lifting vehicle comprises a set of lifting forks (2), wherein each lift fork (2) comprises an L-shaped body with an upright part (3) and a horizontal part 4. A pressure or strain-sensitive sensor (5) is coupled against the upright part (3) to determine a mechanical deformation thereof resulting from a load moment of a cargo as a consequence of lifting and/or displacing the cargo, and to generate this as electronic signal to processing means which are able and adapted to compare the signal to a predetermined threshold value and, in the case the threshold value is exceeded, to generate a warning signal at an output.



WO 2010/140880 A2

Lifting device and lifting vehicle

The present invention relates to a lifting device for a lifting vehicle comprising at least one lifting fork for receiving a cargo thereon.

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A lifting device of the type stated in the preamble is generally known and is usually applied on lifting vehicles, such as for instance forklift trucks, for displacing goods which are presented and processed in large quantities in distribution centres, storage warehouses and other places. The at least one lift fork of the lifting device is here
10 driven under a cargo with the lifting vehicle, after which the lifting device can be set into operation to raise the cargo to greater or lesser extent from the ground surface. As soon as the cargo is clear of the ground, the whole can be moved to displace the cargo to another location.

15 Although the known lifting device is certified to lift a cargo up to a determined maximum lifting weight, this does however have the drawback that the lifting device gives no indication of a load being exerted by the cargo on the lifting device or a part thereof and of a stability of the lifting vehicle during displacement of the cargo. Even if a maximum lifting weight laid down for the lifting device is taken into account, the
20 lifting device can become overloaded and possibly collapse, or the lifting vehicle can in some cases become unstable due to an incorrect placing of the cargo on the lifting device. In an extreme case the lifting vehicle can even overturn here, with danger for the driver and damage to the cargo and/or the lifting device.

25 The present invention has for its object to provide a lifting device which obviates the stated drawback.

In order to achieve the stated objective, a lifting device of the type stated in the preamble has the feature that a pressure or strain-sensitive sensor is connected
30 functionally to a part of the at least one lift fork and is able to determine a mechanical deformation of the part and, for the purpose of indicating a load moment of the cargo on the at least one lift fork, to generate this as electronic signal to a processing unit

which is able and adapted to receive the electronic signal at an input and to compare it to a predetermined threshold value and, in the case the threshold value is exceeded, to generate a warning signal at an output. The invention is based here on the insight inter alia that a load moment of the cargo on the at least one lift fork will result in a
5 mechanical play of forces in the lifting device and that as a result thereof determined parts in the at least one lift fork will stretch or, on the contrary, be compressed to a degree which depends on a combination of the weight and placing of the cargo. A load moment on the at least one lift fork can thus be determined in simple manner and, in the possible case a predetermined maximum threshold value is exceeded, an
10 electronic warning signal can be generated.

A preferred embodiment of the lifting device according to the present invention has the feature that an input of warning means are coupled to the output of the processing unit to generate a warning alert when the warning signal is received. Because the
15 processing unit can thus activate warning means in order to generate a warning alert from the warning signal, the lifting device is able for instance to alert a driver of the lifting vehicle in good time to an imminent instability.

A further preferred embodiment of the lifting device according to the present
20 invention has the feature that the at least one lift fork comprises wireless transmitter means able and adapted to transmit the warning signal to the warning means, and that the at least one lift fork comprises a power supply for the purpose of providing at least the sensor, processing unit and the transmitter means with electronic power supply. The signal can easily be forwarded by the transmitter means to the warning means
25 which are for instance arranged in or on the lifting vehicle instead of on the lifting device itself. Particularly the use of wireless transmitter means avoids wiring having to be arranged between the lifting device and the lifting vehicle. Owing to the provision of a power supply which provides the sensor, processing unit and the transmitter means with electronic power supply the lifting device moreover forms a
30 stand-alone unit which can be mounted in simple manner on a new or already existing lifting vehicle without it being necessary for this purpose to intervene in the construction of the lifting vehicle.

In a particular embodiment the lifting device according to the present invention is characterized in that the warning means are provided on the at least one lift fork and are able and adapted, when the warning signal is received, to generate a sound alert and/or visual alert discernible to a user. The lifting device itself is therefore fully
5 equipped to determine a load moment and, when a predetermined threshold value is exceeded, to generate a warning alert to a driver of the lifting vehicle.

In a further particular embodiment hereof the lifting device according to the present invention is characterized in that the transmitter means are able and adapted to
10 communicate wirelessly with a display panel which is able and adapted to show at least a load diagram in which the load moment is displayed visually. During displacement of a cargo a driver of the lifting vehicle can continuously determine a load moment from the load diagram and, if necessary, take corrective action in the case a maximum threshold value is about to be exceeded.

15 A further preferred embodiment of the lifting device according to the present invention has the feature that height measuring means are provided to measure an actual lifting height of the at least one lift fork. An actual lifting height of the cargo can thus be determined together with a load moment. The most important factors on
20 which the stability of the lifting vehicle depends can thus be determined, so that the stability of the lifting vehicle can hereby be monitored in extremely reliable manner during a displacement of the cargo.

A further preferred embodiment of the lifting device according to the present
25 invention has the feature that the at least one lift fork comprises an L-shaped body with a horizontal part for receiving the cargo thereon and an upright part to which the sensor is connected. Since a centre of gravity of the cargo will in this case never lie on or above the sensor, irrespective of the placing of the cargo on the lifting device, the mechanical deformation is always linearly proportional to the load moment of the
30 cargo on the at least one lift fork. An attachment of the sensor against the upright part thus enhances reliability of the signal. The sensor can here be attached to a front side of the upright part facing toward the cargo, but is preferably connected to an opposite

rear side of the upright part in order to prevent the possibility of the relatively sensitive sensor being adversely affected by a cargo received on the lifting device.

In a further preferred embodiment the lifting device according to the present invention is characterized in that the horizontal part is provided with weighing means able and adapted to generate a further electronic signal for the purpose of indicating at least a weight of the cargo. By comparing the electronic signal of the sensor to the further electronic signal of the weighing means, a weight and a placing of the cargo on the lifting device can also be individually determined with high precision as well as the load moment. In a particular embodiment hereof the lifting device according to the present invention is characterized in that the weighing means comprise at least one further pressure or strain-sensitive sensor.

In order to preserve the stand-alone character, the lifting device according to the present invention is characterized in a further preferred embodiment in that the weighing means are coupled electronically to a power supply and, in yet another further preferred embodiment, that the weighing means are coupled by electronic means to the processing unit. The lifting device is thus able and adapted to also determine, in addition to a load moment, a weight of the cargo and to transmit this as electronic signal to warning means. The lifting device need only be coupled to a lifting vehicle for this purpose, so that there need be no or hardly any intervention in a construction of the lifting vehicle.

The invention further relates to a lifting vehicle comprising a lifting device according to the present invention.

A preferred embodiment of the lifting vehicle according to the present invention has the feature that anti-tilt means are provided which are able and adapted to at least initiate a safety routine when a predetermined maximum load moment is exceeded. A mobile lifting device, in particular a forklift truck, is thus provided which reduces instability.

A further preferred embodiment of the lifting vehicle according to the present invention has the feature that the safety routine comprises one or more operations chosen from the group of reducing the travel speed, decreasing the lifting height, blocking the lifting means and generating a warning alert. These operations increase safety for a driver during a displacement of a cargo with the lifting vehicle.

A particular embodiment of the lifting vehicle according to the present invention has the feature that the anti-tilt means comprise at least warning means for generating a warning alert, and that the safety routine comprises an activation of the warning means. In a further particular embodiment hereof the lifting vehicle according to the present invention is characterized in that the warning alert is an alert discernible to a driver, in particular a visually or audibly discernible alert. Because the driver can discern the alert, he/she is able to respond early in order to reduce instability of the lifting device and/or seek a place of safety.

Another further particular embodiment of the lifting vehicle according to the present invention has the feature that the warning means comprise a display panel able and adapted to display a warning alert to the driver of the lifting device. With such a display panel the driver can optionally be kept continually informed about the stability of the lifting device.

A particular embodiment of the lifting vehicle according to the present invention has the feature that the anti-tilt means comprise blocking means able and adapted to block the lifting means when a predetermined maximum load moment is exceeded. Owing to the blocking means the mobile lifting device is able to intervene directly in the case of imminent instability, so as to thus counter any risk.

The invention will now be further elucidated on the basis of a number of exemplary embodiments and an associated drawing. In the drawing:
Figure 1 is a perspective view of a first exemplary embodiment of a lifting device according to the invention.

Figure 2 is a perspective view of a second exemplary embodiment of lifting device according to the invention.

Figure 3 is a side view of an exemplary embodiment of a lifting vehicle according to the invention.

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The figures are otherwise purely schematic and not drawn to scale. Some dimensions in particular may be exaggerated to greater or lesser extent for the sake of clarity. Corresponding parts are designated as far as possible in the figures with the same reference numeral.

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As shown in figure 1 in a first exemplary embodiment of a lifting device according to the invention, lifting device 1 comprises a set of lift forks 2, wherein each lift fork 2 comprises an L-shaped body with an upright part 3 and a horizontal part 4. Using a lifting vehicle, for instance a forklift truck, intended for this purpose lift forks 2 can be driven with the horizontal part 4 under a cargo (not shown) for the purpose of receiving the cargo thereon. The lifting device can then be set into operation via the lifting vehicle in order to lift the cargo from a ground surface. A pressure or strain-sensitive sensor 5, for instance in the form of a so-called secondary transducer such as a strain gauge, is coupled against upright part 3 in order to determine a mechanical deformation thereof resulting from a load moment of the cargo as a consequence of lifting and/or displacing the cargo, and to generate this as electronic signal. Sensor 5 is connected here to a front side of upright part 3 directed toward the cargo. In order to prevent sensor 5 being adversely affected by a cargo received on the lift fork, a cover, here in the form of a protective steel plate, is provided against upright part 3 over sensor 5. Sensor 5 is thus protected behind the cover so that damage resulting from a possibly shifting cargo is prevented. In order to prevent sensor 5 being affected at all by a cargo, in a further preferred embodiment (not shown) sensor 5 can also be attached to a rear side of upright part 3. Upright part 3 itself then forms a barrier here which protects the sensor from being adversely affected by the cargo. Processing means (not shown) are provided to compare the electronic signal to a predetermined threshold value for the purpose, at least when the threshold value is exceeded, of generating a warning signal to enable determining therefrom of a load moment of the

cargo. Lifting device 1 can be provided with warning means (not shown), for instance a light source or sound source, on one of the lift forks 2 or both lift forks 2 for the purpose of generating from the warning signal a warning alert discernible to the driver, for instance a sound alert or a visual alert.

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As shown in figure 2 in a second exemplary embodiment of a lifting device according to the invention, lifting device 1 comprises a set of lift forks 2 largely corresponding to those of the first exemplary embodiment as shown in figure 1. Lifting device 1 differs however from that shown in figure 1 in that weighing means 6, in the form of a further pressure or strain-sensitive sensor such as a load cell, are provided in horizontal part 4 in order to measure the load exerted by the cargo on the weighing means as an indication of a weight of the cargo, and to generate this as further electronic signal. Processing means (not shown) are provided for the purpose of comparing the electronic signal and the further electronic signal in order to determine therefrom a weight of the cargo, a placing of the cargo and a load moment of the cargo.

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Lifting device 1 also comprises wireless transmitter means 8 which are able and adapted to transmit wirelessly a warning signal coming from the processing means to receiver means of warning means intended for this purpose. All known transmitters can be used for the wireless transmitter means, and use can be made of a known standard for the wireless transfer, such as for instance a Bluetooth connection. A power supply 7 is further provided releasably in upright part 3 to supply power to at least sensor 5, weighing means 6, the processing means and wireless transmitter means 8. Because power supply 7 is integrated releasably into upright part 3, it can be easily exchanged. An at least substantially empty power supply can then be quickly replaced with a full power supply. Use can be made for power supply 7 of all known batteries, although use is preferably made of a rechargeable accumulator. The rechargeable accumulator can be recharged for reuse in simple manner using a charger suitable for this purpose. Lifting device 1 is thus fully equipped to thereby give at least an indication of a load moment and to transmit this wirelessly as electronic signal to warning means. Lifting device 1 can here be assembled and fully calibrated separately

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of a lifting vehicle, and easily mounted as such on a lifting vehicle. For rapid and simple mounting of lifting device 1 on a lifting vehicle the upright part 3 of lift forks 2 is provided with mounting means 9. Lift forks 2 can for instance be attached by means of mounting means 9 to a lifting board of a lifting vehicle intended for the purpose.

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As shown in figure 3 in an exemplary embodiment of a lifting vehicle according to the invention, lifting vehicle 10 is a forklift truck. Forklift truck 10 comprises a mobile frame 11 to enable displacement of a cargo and is provided with lifting means 1, here a lift fork construction with two lift forks 2, for receiving thereon a cargo for displacing. Forklift truck 10 can be driven by a driver (not shown) who for this purpose takes up position in a cab 12. Forklift truck 10 comprises anti-tilt means which are able and adapted to receive a signal from the wireless transmitter means of lifting device 1 resulting from a predetermined maximum load moment being exceeded. The anti-tilt means can then perform a safety routine for the purpose of monitoring the stability of the lifting vehicle. The anti-tilt means comprise for this purpose blocking means (not shown) which intervene in the operation of the lifting vehicle. The blocking means are placed on the lifting means and block lifting of a cargo in the case the stability of the lifting device deteriorates.

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Forklift truck 10 further comprises warning means 13 in the form of a light source, such as for instance a flashing light, for generating a warning alert when a predetermined maximum load moment is exceeded. As warning means it is also possible to opt for a loudspeaker (not shown) for generating an alert audibly discernible to the driver. It is also possible to provide lifting device 1 with a plurality of warning signal sources, such as for instance a combination of a light source and a loudspeaker, for the purpose of generating both a light alert and a sound alert, or to provide it with a display panel (not shown) which displays the stability of the lifting device in optionally continuous manner, optionally in combination with a light source and/or a loudspeaker. A flat screen can for instance be used as display panel.

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Although the invention has been further elucidated on the basis of only several exemplary embodiments, it will be apparent that the invention is by no means limited

thereto. On the contrary, many variations and embodiments are still possible for a person with ordinary skill in the art within the scope of the invention.

Claims

1. Lifting device for a lifting vehicle comprising at least one lifting fork for receiving a cargo thereon, characterized in that a pressure or strain-sensitive sensor is connected functionally to a part of the at least one lift fork and is able to determine a mechanical deformation of the part and, for the purpose of indicating a load moment of the cargo on the at least one lift fork, to generate this as electronic signal to a processing unit which is able and adapted to receive the electronic signal at an input and to compare it to a predetermined threshold value and, in the case the threshold value is exceeded, to generate a warning signal at an output.
2. Lifting device as claimed in claim 1, characterized in that an input of warning means is coupled to the output of the processing unit to generate a warning alert when the warning signal is received.
3. Lifting device as claimed in claim 2, characterized in that the at least one lift fork comprises wireless transmitter means able and adapted to transmit the warning signal to the warning means, and that the at least one lift fork comprises a power supply for the purpose of providing at least the sensor, processing unit and the transmitter means with electronic power supply.
4. Lifting device as claimed in claim 2 or 3, characterized in that the warning means are provided on the at least one lift fork and are able and adapted, when the warning signal is received, to generate a sound alert and/or visual alert discernible to a user.
5. Lifting device as claimed in one or more of the claims 2-4, characterized in that the transmitter means are able and adapted to communicate wirelessly with a display panel which is able and adapted to show at least a load diagram in which the load moment is displayed visually.

6. Lifting device as claimed in one or more of the foregoing claims, characterized in that height measuring means are provided to measure an actual lifting height of the at least one lift fork.
- 5 7. Lifting device as claimed in one or more of the foregoing claims, characterized in that the at least one lift fork comprises an L-shaped body with a horizontal part for receiving the cargo thereon and an upright part to which the sensor is connected.
8. Lifting device as claimed in claim 7, characterized in that the horizontal part is
10 provided with weighing means able and adapted to generate a further electronic signal for the purpose of indicating at least a weight of the cargo.
9. Lifting device as claimed in claim 8, characterized in that the weighing means
15 comprise at least one further pressure or strain-sensitive sensor.
10. Lifting device as claimed in claim 8 or 9, characterized in that the weighing
means are coupled by electronic means to the processing unit.
11. Lifting device as claimed in one or more of the claims 8-10, characterized in
20 that the weighing means are coupled electronically to a power supply.
12. Lifting vehicle comprising a lifting device as claimed in one or more of the
foregoing claims.
- 25 13. Lifting vehicle as claimed in claim 12, characterized in that anti-tilt means are provided which are able and adapted to at least initiate a safety routine when a predetermined maximum load is exceeded.
- 30 14. Lifting vehicle as claimed in claim 13, characterized in that the safety routine comprises one or more operations chosen from the group of reducing the travel speed, decreasing the lifting height, blocking the lifting means and generating a warning alert.

15. Lifting vehicle as claimed in claim 13 or 14, characterized in that the anti-tilt means comprise at least warning means for generating a warning alert, and that the safety routine comprises an activation of the warning means.
- 5 16. Lifting vehicle as claimed in claim 15, characterized in that the warning alert is an alert discernible to a driver, in particular a visually or audibly discernible alert.
17. Lifting vehicle as claimed in claim 16, characterized in that the warning means comprise a display panel able and adapted to display the warning alert to the driver of
10 the lifting device.
18. Lifting vehicle as claimed in one or more of the claims 12-17, characterized in that the anti-tilt means comprise blocking means able and adapted to block the lifting means when a predetermined maximum load moment is exceeded.

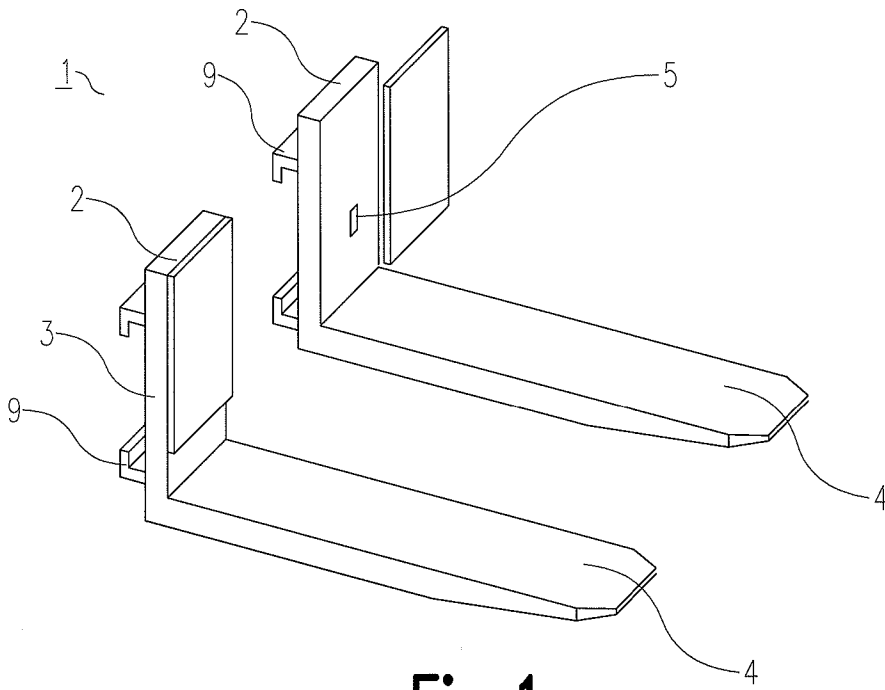


Fig. 1

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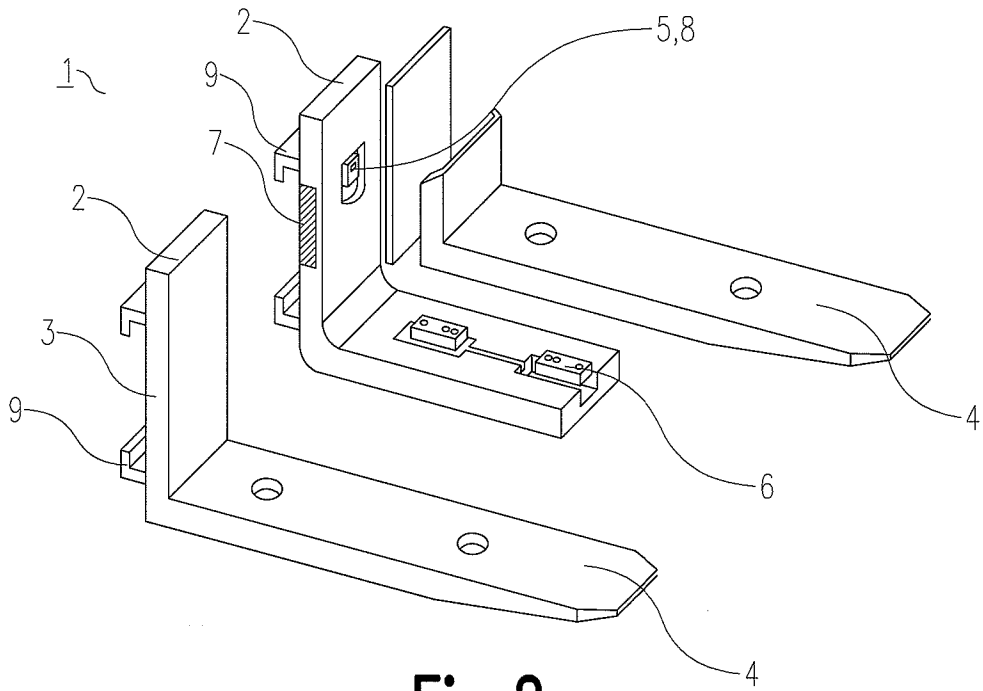


Fig.2

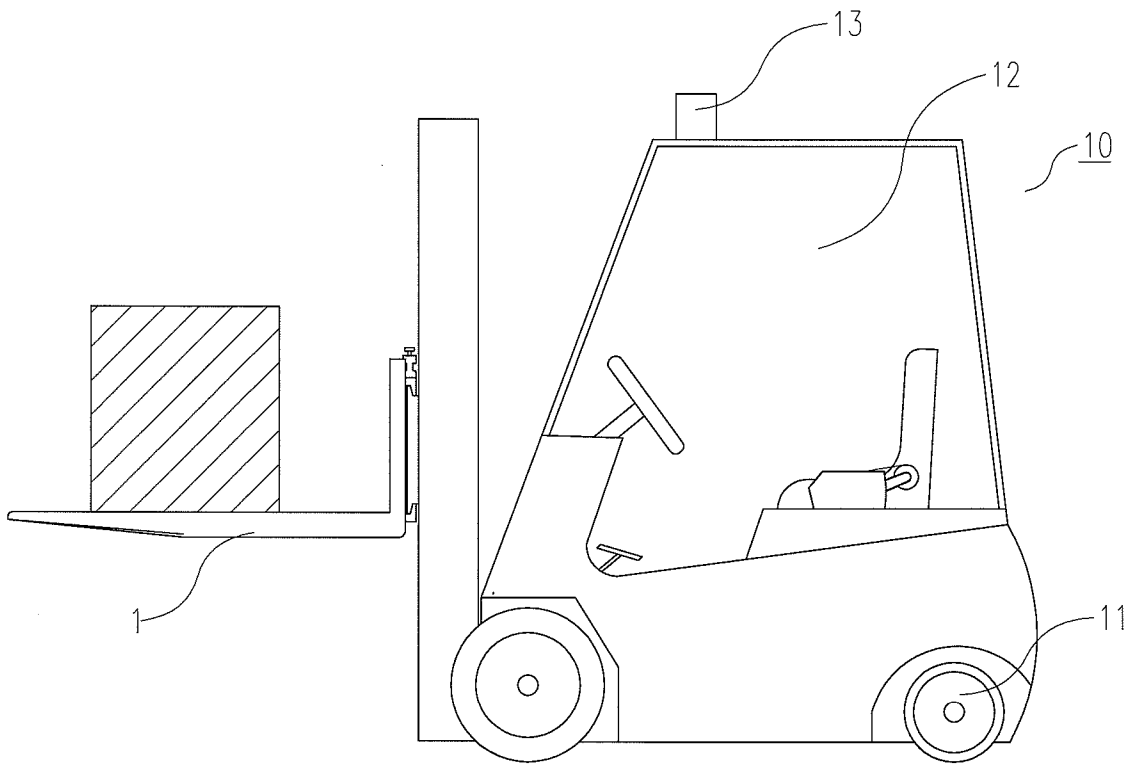


Fig.3