(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 798 261 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
01.10.1997 Bulletin 1997/40

(51) Int Cl.[6]: **B66F 17/00**

(21) Application number: **97850048.6**

(22) Date of filing: **26.03.1997**

(84) Designated Contracting States:
BE DE FR GB NL

(30) Priority: **28.03.1996 SE 9601185**

(71) Applicant: **BT Industries Aktiebolag**
S-59581 Mjölby (SE)

(72) Inventor: **Eriksson, Lars**
590 20 Mantorp (SE)

(74) Representative: **Berglund, Erik Wilhelm**
Berglunds Patentbyra AB
Aspebraten
590 54 Sturefors (SE)

(54) Safety device for lifting trucks

(57) In order to increase security at lifting work with in particular high lifting trucks the inventions suggest the use of a weight indication for the driver so that he know how heavy loads he is handling. This weight indication is obtained by measuring the current to the motor of the hydraulic pump. In order to eliminate the risk that momentary variations result in a faulty measurement preferably a mean value of the current is taken for a certain time or this is added during a fixed time interval. Obtained values are them multiplied with a conversion factor so that the weight in for instance kilograms is obtained and delivered to a suitable presentation device. Obtained values may also be used for alarm with suitable sound or light signals if the load should exceed the maximum allowed values.

EP 0 798 261 A2

Description

At lifting trucks increasingly higher lifting heights have become a reality in later years since it for economical reasons is advantagous to keep the floor area of the ware house as small as possible. Since furthermore of the same reason the trucks must be able to manoeuvre in narrow alleys the support area of the trucks will be comparatively small. These factors result in increasing demands on the stability of the truck. The stability of the truck is however not only influenced by its design, dimensions, degree of wear e t c but also of the loads that are lifted. It is consequently important that the driver uses his judgement and for instance does not lift too large loads too high or execute too fast maneuvers with a too heavy load too high up. Since modern trucks are provided with increasingly more powerful engines and higher battery capacities it is not always certain that the driver notices or even considers how heavy load he is handling.

In order to increase the security in view of the above problem at lifting with in particular high lifting trucks it is in accordance with the invention suggested the arrangement of a weight indication for the driver so that he knows how heavy loads he handles. This weight indication is in accordance with the invention carried out by measuring the current to the motor of the hydraulic pump. In order to eliminate the risk that occasional variations result in an erroneous measuring preferably a mean value of the current is taken during a certain time or this is integrated during a fixed time interval. Obtained values are then multiplied with a conversion factor so that the weight in for instance kg is obtained and fed to a suitable representation device that may be digital or analogous. Possibly the calibration weight indication may automatically control the indication in kilograms, lbs e t c. The weight may of course also be presented in a percentage of allowed maximum load.

Since at lifting not only the load in itself is lifted up hydraulicly but also load forks, fork carriage e t c the measuring device is preferably set to zero or calibrated by measuring taking place during a lift without load. Since furthermore the inertia or rolling friction of the fork carriage e t c may vary from truck to truck calibration may as an alternative be done by lifting of a calibration weight. Preferably the calibration weight may be of the same size as the weights prefered to have the most correct measured value or have a slightly higher weight.

Since for instance the viscosity of the hydraulic oil may change during a work shift the 0-position may be altered during use, that is in principal the current necessary for an empty lift. If desired a corresponding adjustment of the measured value can be carried out successfully since checking and comparing can be carried out by means of a small computer or microprocessor every time that an empty lift is executed.

Preferably the weight of the load is measured during a free lift, that is the movement when the fork carriage moves in an associated extendable mast that is in its lowest position. During this movement the lifted weight associated with the truck is the lowest in relation to the load and therefor the best precision at the measuring of weight is obtained. Since it may however also be important at the lowering of a load that is situated very high up already at the lifting of this from its storing place to know its weight at least a rough weight indication may be very important. In order to achieve this compensation can be made for the weight of the lifted mast, that is the current that the engine of the hydraulic pump requires for lifting higher than the free lift without load. Since this movement essentially has the same motion pattern from time to time comparatively exact current values may be obtained that can be subtracted from the current obtained when the load initially is lifted. Alternatively the current that is then obtained is compared with the current required for the lifting of the empty forks shortly before the intended lifting position has been reached. In other words the load changes may be indicated.

The differentiation of the measuring device between a free lift or a higher lift may easily be achieved by means of a switch or other sensor placed in the vicinity of the lower end of the mast, which switch is influenced as soon the mast is in its lowest position. When the mast is in its lowest position it is a free lift and otherwise it is a lift in which the entire mast take part. Alternatively a switch may be used that react at the passing of the upper end of the free lift and that at each passage switch measuring mode. If lift height indication is present this can be used to deliver this information.

Since the current is not a direct measurement of the weight that is lifted, but also depend on the acceleration of the lifting movements, the measuring device preferably during the weight evaluation controls that the movement has a constant speed. This can for instance be done by controlling the voltage the during the measurement, which voltage is to be essentially constant in order to indicate constant velocity, alternatively a compensation can take place for the acceleration.

The constant speed at measuring is preferably chosen considerably lower than maximum speed for lifting so that the influence of hydraulic flow losses is reduced. Preferably the measurement, in any case if a good accuracy is desired, is carried out at the same speed from measurement to measurement.

To the weight indication may be coupled a warning signal that is activated if too big loads are on their way to be handled.

Since not only the weights of the loads but also the levels on which these are handled influence stability relations the presentation may also indicate to which height a particular load may be lifted. Directly when the driver lifts a load from the ground or from a lorry he thus knows which is his highest permitted storage level in the ware house. The indication may be given directly in permitted storage levels and one can consider a programming that is also adapted to other trucks working in the

ware house so that no loads get out of reach for certain trucks. Preferably the truck is also equipped with an additional indication or warning that indicates or warns if the maximum load is exceeded. By further combining the weight measure in with a device for the measurement of the position of the lifting forks one can obtain an indication or warning if one tries to take a too great load to high up. Of course the driver can keep track of this based exclusively on the weight that is lifted and his knowledge of permitted weights for different heights, but as realized a warning system increases the safety in the work. The position indication may for instance be obtained in the way that is described in a simultaneously filed Swedish patent application.

When measuring of load weights takes place the remaining hydraulic power users are disconnected and only lifting takes place with the motor at which the current is measured.

Claims

1. Method at lifting trucks for the indication of the weight of the lifted load, **characterized in** that the current to a motor delivering the power for the lifting is measured and used as a measure of the lifted load.

2. Method according to claim 1, **characterized in** that from the measured current is subtracted a current value corresponding to the current obtained at a lift without load, alternatively comparing is made with a current value that is obtained at the lift of a calibration weight.

3. Method according to claim 1 or 2, **characterized in** that the measuring takes place at a constant lifting velocity, for instance constant number of revolutions per minute for the motor delivering the lifting power.

4. Method according to any of the preceding claims, **characterized in** that measurement only takes place in the free lift zone.

5. Method according to any of the claims 1 - 3, **characterized in** detection of free lift or not and that different current values are subtracted from measured value depending on if measurement takes place in the free lift zone or above this.

6. Device for the execution of the method in accordance with claim 1, **characterized in** that it includes a current sensor arranged in the feed line to the electric motor that drives the hydraulic pump of the truck, and that it includes a computing unit comparing the obtained current with a previously registered current value at a lift of a calibration weight and/or an empty lift and a presentation device for instance a digital one.

7. Device according to claim 6, **characterized in** that it further includes a sensor that registers when the mast is in its lowest position and consequently lifting only takes place with the fork carriage and that it includes an additional memory for the current value that is obtained at an empty lift above the free lift so that it dependent on if lift takes place in the free lift zone or above this can subtract correspondingly at an empty lift obtained currents from the corresponding measured values.

8. Device according to any of the claims 6 - 7, **characterized in** that it further includes means for monitoring that during the measurement the velocity of the movement is constant, for instance a monitoring of the number of revolutions per minute or control of the current while lifting, the lifting speed preferably being chosen low at measuring and possibly also the same velocity from measurement to measurement.

9. Measurement in accordance with any of the claims 1 - 5, **characterized in** that a mean value is taken for the current or that the current is integrated for a certain time.

10. Device according to any of the claim 6 - 8, **characterized in** that it includes a signaling device, signaling to the driver that the load exceeds permitted load.