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(54) **Free stroke damping**

Dämpfung der freien Bewegung

Amortissement de la course libre

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Description

[0001] At lifting trucks intended for the handling of goods on loading pallets into and out from storing racks it is known to arrange the load forks of the truck movable heightwise over the entire height of a frame or mast part that in turn is movable in a mast part fastened to the truck. It is further usual between these mast parts to arrange an intermediate mast part movable relative the other two so that the mast fastened to the truck in it self is telescopic increasing the lifting height with a minimum height of the truck. This enables a large lifting height without hindering the passage in and out through doors of for instance a warehouse. Normally the diameters of the hydraulic cylinders that take care of the movements of the different parts is chosen in such a way that with the cylinders coupled in parallel, at a lifting movement of the lifting forks at first these will be lifted in relation to the mast by a carriage carrying the forks being moved in relation to the first or inner mast part, that is the one that on the extending of the mast is situated on top. In this way the weight that has to be lifted when the lifts are low is minimized.

[0002] When the load forks and the carriage in the first or innermost mast part reach its upper end position in this mast part the carriage strikes against a stop and the corresponding hydraulic cylinder can not lift any further and thereafter the parts of the mast are lifted and this is extended upwards. This first movement of the lifting forks is called free lift or free stroke and when it reaches its upper end position there is an abrupt shock or impact before the uppermost part of the mast begins to move. This impact is disturbing to the driver, result in great tension forces in the lifting parts and can also shake the load or result in unwanted tension waves in this. It is therefor desired to eliminate or dampen this movement transition so that it becomes softer and this is the object of the invention.

[0003] Since the hydraulic cylinder giving the free stroke lift of the loading forks and the fork carriage are lockated in the principally telescopic mast parts it is neither simple nor cheap to arrange controls or sensors for the movement of the load fork carriage in the mast part. Rubber coatings or stop springs does provide a certain damping, but not enough and will also be an expensive solution when the end stop of the piston constitutes end stop for the movement.

[0004] From US-A-5022496 it is further known to monitor the the actual height of a truck platform in a telecoping mast and to restrict the speed of the platformas as it aproaches the staging traction points of the telescoping truck mast.

[0005] In accordance with the invention the above object can however be solved without any electrical or hydraulic connections having to be drawn via the lifting mast. This is in accordance with the invention done by using a free stroke lifting device including a piston for the free stroke that hangs down with the piston rod downwards, the outer end of the piston rod carrying a pulley for a lifting chain for the load forks that first runs down to the pulley and around this and up again to a pulley arranged in the mast part in which the carriage is moveable and therefrom down to the load fork carrying carriage. This known construction has among other things the advantage that a movement for the load forks is obtained that is the double of the work stroke of the hydraulic cylinder. This permits not only a short hydraulic cylinder but is also a good solution for the movement of the load forks over the entire height of the retracted mast. As the hydraulic piston comes closer to its maximally extended position also the carriage carrying the load forks gets closer to its upper end position, where it strikes against stops arranged in the mast. Alternatively the stop for the movement of the carriage may be constituted by the end position of the piston.

[0006] Since the free stroke movement take place before the mast parts start to move the lower end position of the piston will not only be the same from time to time in relation to the mast part in which it is journaled but actually also in relation to the truck itself. This means that by arranging on the lower end of the free stroke piston (the one provided with the chain pulley) suitable actuation means for the actuation of a switch situated and mounted fast in the frame of the truck, the switch in turn can for instance via an electronic control reduce the speed of the electric motor that propels the hydraulic pump of the truck that in turn provide the free stroke piston with oil. In this way the velocity of the free stroke can be retarded just before the end position is reached. In this way the following shock at contact will be essentially reduced. When then after the end of the free stroke the movable mast is extended the free stroke piston that is fastened in the inner mast part will move upwards with this and consequently the lower end of the free stroke piston will move away upwards in relation to the frame of the truck so that the actuation of said switch ceases and the pump may again be driven at full speed.

[0007] Since the control means for the motor can be placed in the above described way no long and expensive arranging of connecting leads out through and along the mast to the load fork carriage is necessary.

[0008] At the movement downwards the mast parts will always be retraced first before the free stroke is reversed, this due to the different weights and the different activation pressures of the hydraulic cylinders in the mast and the one controlling the free stroke. This means that also at a movement downwards an activation of said switch will occur before the mast part or the mast parts reach their lower end position. The shocklike contact on the movement downwards can therefor also be dampened by for instance using the engine in the lowering direction to control the oil flow from the hydraulic cylinders. A reduction of the engine speed means a braking of for the mast parts so that these have a reduced contact energy when they reach their lowest position. When then the load forks sinks further the piston rod of the free

stroke cylinder moves upwards and release said switch so that once again full speed can be used for the lowering movement.

[0009] If desired means may be arranged on the load fork carriage itself also for the cooperation with the same switch that is actuated by the free stroke piston so that this movement also is braked close to its lower end position. In order to avoid a speed reduction at lifting from the bottom position the activation of the switch may be such that reduction only exists on movement downwards of the fork carriage and not at movement upwards or movement speed restrictions may be arranged only to be active at lowering.

[0010] Instead of using the engine to control the speed reduction in the transition to and from the movement of the fork carriage in the mast this can be achieved by the activated switch or electrical sensors via for instance control electronics in these areas of movement restricting the opening degree for a corresponding proportional valve for the inlet or outlet of the oil.

[0011] Within the inventive thought one can also consider instead having a potentiometer that is controlled by a cam or ramplike part mounted on the lower end of the piston rod. In this way the movement transitions can be made even smother.

[0012] The invention is below to be described in an embodiment shown in the drawings. Fig 1 shows schematically mast and fork carriage in the lowermost position of the forks, fig 2 the position shortly before the end of the free stroke, fig 3 a started lifting of the mast and fig 4 the maximum uplifted position of the fork carriage.

[0013] The truck in the drawings includes a frame on which a mast constituted by three parts, of which one 2 is fastened to the frame. In the mast part 2 fastened to the frame an additional mast part 3 is slidable journaled heightwise and supports in turn yet another in this intermediate mast part movable mast part 4. In this way the mast can execute a telescopic movement with a great lifting height. In the mast part 4 that can be extended highest a carriage 5 is arranged carrying load forks. The carriage 5 is by means of a cylinder 7 and a chain 6 running over a pulley 8 arranged in the outer end of the piston rod movable over essentially the entire height of the inner mast section. The cylinder 7 for the movement of the load fork carriage in the mast section 4 is suspended in this up side down and the pulley carrying rod end reaches almost to the lower end of the inner mast section when it is fully extended.

[0014] In the frame of the truck or in the mast section 2 fastened in this a switch 11 is arranged, provided with a roller 12 in the end of an arm 13. The roller 12 can be actuated by a likewise in the frame or in the frame mounted mast part 2 vertically movable rod 14, that is pretensioned by means of a spring. The lower end of the free stroke piston will when the piston gets close to its lower end position act on the rod that in turn act on the switch 11 that in turn either reduce the drive speed of the hydraulic pump (at lifting) or restrict the open cross section of a proportional valve controlling the lowering flow of the hydraulic oil from the cylinder.

[0015] Through these measures a reduced speed will always be obtained when the load forks come close to their upper end position, and when the mast sections all at once are on their way towards their lower end position, this since the mast sections are so arranged that they at the extending or retraction all move in relation to each other so that they all at the same time reach their lowest position.

[0016] In fig 2 the free stroke is coming close to its end and the piston rod comes in contact with the rod 14, which means that the lifting movement is slowed down. When thereafter the free stroke is ended the mast starts to move as is shown in fig 3. Soon this movement brings the piston rod out of contact with the rod, the switch is freed and full lifting speed is again established.

[0017] At lowering the relation will be reversed and fig 3 shows the position just before the mast parts reach their lowest position. As is apparent the switch is then again activated lowering the speed until the position in fig 2 is achieved again, whereafter lowering can take place with maximum speed.

[0018] By means of only one switch, that can be arranged with simple location of the leads, not only the shock or impact that occur when the fork carriage has completed its free lift but also the shock when the mast parts reach their lowest end position is reduced or eliminated

[0019] If desired means can also be arranged on the fork carriage that act on the switch to give a reduced speed when the carriage comes closer to its lowest position in the mast, this since the fork carriage then also comes closer to the frame of the truck. In this way it is possible with only one switch or comparable control means to dampen all stops or shocks that occur at the use of the truck. The only stop remaining is that when the mast reaches its maximum extension or lifting. As is realized the truck in reality normally should never reach this position unless one has bought a truck with a too low lifting capacity. The invention is thus a very simple and practical solution to achieve the damping of movement at up to three different shocks or stops.

[0020] Within the scope of the invention one can of course instead of one switch use several switches instead, for instanceto get a ramped speed reduction.

[0021] Although some time is lost due to the speed reduction according to the invention, the avoiding of the shocks otherwise influencing the truck and that easily trigger oscillations in forks and load give an increased precision compensating and regaining this little loss of time.

[0022] The control of the movement may in an alternative embodiment include a magnetic sensor or switch means that have its status altered when a magnet on the piston rod passes the sensor.

Claims

1. Arrangement for the damping of shocks and impacts in the lifting movement at a truck of the kind that includes a load fork carriage (5) movable vertically in a mast part (4) that in turn is movable vertically, and where the fork carriage in the mast part (4) is lifted by means of a hydraulic cylinder (7) the piston rod (9) of which is extendable downwards and over which lower end over a pulley (8) a wire (6) or chain runs that from an upper fastening point in the mast part (4) runs down around the pulley and up to a pulley (15) fastened to the upper end of the mast part and from this pulley once again down to the fork carriage (5), the hydraulic cylinders belonging to the fork carriage and the mast parts are coupled in parallel but have such respective cross sections between them that the cylinder of the fork carriage has a lower pressure requirement than the cylinders of the mast, **characterized in** a sensor or switch being arranged in the frame of the truck or in the mast section fastened in this in the vicinity of the lower end position of the lower end of the piston rod (9) and for cooperation with this in such a way that when the piston rod is coming close to its lower end position, that is the lifting carriage is shortly below its upper end position in the mast part, the sensor or switch is triggered by the piston rod or means on this and the switch being coupled to the hydraulic means that feed hydraulic oil to the hydraulic cylinder for a reduction in the oil flow so that the lifting speed is retarded in the vicinity of the upper end position of the carriage in the closest mast part (4).

2. Device according to claim 1, **characterized in** the sensor or switch and means for the control of the speed reduction for the movement of the hydraulic piston being such that a smooth speed change is achieved.

3. Device according to claim 2, **characterized in** the sensor being constituted by a potentiometer.

4. Device according to claim 1, **characterized in** the load fork carriage also being provided with means that in the vicinity of the lower end position of the load fork carriage cooperate with the same sensor that is affected by the lower piston rod end of the lifting cylinder, giving a reduced speed also as the carriage come close to its bottom position.

5. Device according to any of the claims 2 to 4, **characterized in** the sensor means being constituted by a switch that is triggered by a control part that when it comes in contact with the lower end of the piston rod immediately influence the switch and that then during the continued movement of the piston rod can be deflected resiliently downwards, but retaining the switch position.

6. Device according to claim 5, **characterized in** the control part being constituted by a vertically moveable sliding part.

7. Device according to any of the previous claims 1-4 **characterized in** the sensing means being constituted by a magnetic device with a magnet fastened to the piston rod end and magnetic switch means for instance in the frame of the truck.

8. Device according to claim 7, **characterized in** the sensor, when the magnet has passed it, remain in the same state until the magnet passes in the other direction.

Patentansprüche

1. Vorrichtung zur Dämpfung von Schlag- und Stoßbelastungen bei der Hubbewegung eines Fördermittels der Bauart, welche ein Lastgabellaufwerk (5) umfaßt, welches in einem Turmteil (4) vertikal beweglich ist, welches seinerseits vertikal beweglich ist, wobei das Gabellaufwerk im Turmteil (4) mit Hilfe eines Hydraulikzylinders (7) anhebbar ist, dessen Kolbenstange (9) nach unten ausfahrbar ist, und über dessen unteres Ende über eine Seilscheibe (8) ein Seil (6) oder eine Kette läuft, welche einen oberen Befestigungspunkt im Turmteil (4) bildet, und um die Seilscheibe nach unten und zu einer Seilscheibe (15) nach oben verläuft, welche am oberen Ende des Turmteils (4) vorgesehen ist und dann von dieser Seilscheibe wiederum nach unten zu dem Gabellaufwerk (5) geht, und wobei die Hydraulikzylinder zu dem Gabellaufwerk gehören und die Turmteile parallel gekoppelt sind, aber derartige Querschnitte dazwischen haben, daß der Zylinder des Gabellaufwerks Anforderungen mit einem niedrigeren Druck als die Zylinder des Turmteils hat, **dadurch gekennzeichnet**, daß ein Sensor oder ein Schalter im Rahmen des Transportmittels oder im daran befestigten Turmteil in der Nähe der unteren Endposition des unteren Endes der Kolbenstange (9) angeordnet ist und derart mit der Anordnung zusammenarbeitet, daß dann, wenn die Kolbenstange sich der unteren Endposition annähert und das Hublaufwerk sich kurz vor der oberen Endposition im Turmteil befindet, der Sensor oder Schalter durch die Kolbenstange oder eine Einrichtung an dieser ausgelöst wird und der Schalter mit der hydraulischen Einrichtung derart verbunden ist, daß Hydrauliköl dem Hydraulikzylinder zu einer Herabsetzung des Ölstromes zugeführt wird, so daß die Hubgeschwindigkeit in der Nähe der oberen Endposition des Laufwerks im nächstliegenden Turmteil (4) verringert wird.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß der Sensor oder Schalter und die Einrichtung zum Steuern der Verminderung der Bewegungsgeschwindigkeit des Hydraulikkolbens derart beschaffen und ausgelegt sind, daß man eine gleichmäßige Geschwindigkeitsänderung erhält.

3. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet**, daß der Sensor von einem Potentiometer gebildet wird.

4. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet**, daß das Lastgabellaufwerk auch mit einer Einrichtung versehen ist, welche in der Nähe der unteren Endposition des Lastgabellaufwerks mit ein und demselben Sensor zusammenarbeitet, welcher durch das untere Kolbenstangenende des Hubzylinders beaufschlagt wird, um die Bewegungsgeschwindigkeit des Laufwerks auch in der Nähe der bodenseitigen Position zu vermindern.

5. Vorrichtung nach einem der Ansprüche 2 bis 4, **dadurch gekennzeichnet**, daß die Sensoreinrichtung von einem Schalter gebildet wird, welcher durch ein Steuerteil dann ausgelöst wird, wenn dieses in Kontakt mit dem unteren Ende der Kolbenstange kommt und hierdurch der Schalter unmittelbar beaufschlagt wird, und daß dann, wenn sich die Bewegung der Kolbenstange fortsetzt, eine federnd nachgiebige Auslenkung nach unten erfolgt, aber die Schalterposition beibehalten wird.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet**, daß das Steuerteil von einem vertikal beweglichen Gleitteil gebildet wird.

7. Vorrichtung nach einem der vorangehenden Ansprüche 1 bis 4, **dadurch gekennzeichnet**, daß die Sensoreinrichtung von einer magnetischen Einrichtung mit einem Magneten gebildet wird, welcher fest mit dem Kolbenstangenende verbunden ist, und eine magnetische Schalteinrichtung beispielsweise im Rahmen des Transportmittels aufweist.

8. Vorrichtung nach Anspruch 7, **dadurch gekennzeichnet**, daß der Sensor nach dem Vorbeigang am Magneten in demselben Zustand verharrt, bis der Magnet in der anderen Richtung vorbeigegangen ist.

Revendications

1. Dispositif d'amortissement de chocs et d'impacts dans le mouvement de levage sur un camion du type comprenant un chariot à fourche de charge (5) mobile verticalement dans une pièce formant mât (4) qui, à son tour, est mobile verticalement, et où le chariot à fourche dans la pièce formant mât (4) est soulevé au moyen d'un cylindre hydraulique (7) dont la tige de piston (9) peut s'étendre vers le bas et sur l'extrémité inférieure de laquelle un câble (6) ou une chaîne passe sur une poulie (8) en partant d'un point de fixation supérieur situé dans la partie formant mât (4), descend en passant autour de la poulie et remonte jusqu'à une poulie (15) fixée à l'extrémité supérieure de la partie formant mât et repart de cette poulie encore une fois vers le bas jusqu'au chariot à fourche (5), les cylindres hydrauliques faisant partie du chariot à fourche et les parties formant mât sont couplées parallèlement mais ont de telles sections transversales respectives entre elles que le cylindre du chariot à fourche a une exigence de pression plus faible que les cylindres du mât, caractérisé en ce qu'un détecteur ou commutateur est disposé dans le châssis du camion ou dans la section de mât fixée dans celui-ci aux environs de la position d'extrémité inférieure de l'extrémité inférieure de la tige de piston (9) et pour concourir avec celle-ci de manière telle que lorsque la tige de piston approche de sa position d'extrémité inférieure, c'est-à-dire que le chariot de levage est légèrement en dessous de sa position d'extrémité supérieure dans la partie formant mât, le détecteur ou commutateur est déclenché par la tige de piston ou un moyen situé sur celle-ci et le commutateur est couplé aux moyens hydrauliques alimentant en huile hydraulique le cylindre hydraulique afin de réduire le passage d'huile si bien que la vitesse de levage est retardée à l'approche de la position d'extrémité supérieure du chariot dans la partie formant mât la plus proche (4).

2. Dispositif selon la revendication 1, caractérisé en ce que le détecteur ou commutateur et les moyens pour commander la réduction de vitesse du mouvement du piston hydraulique sont tels qu'une modification en douceur de la vitesse est réalisée.

3. Dispositif selon la revendication 2, caractérisé en ce que le détecteur est constitué par un potentiomètre.

4. Dispositif selon la revendication 1, caractérisé en ce que le chariot à fourche de charge est également doté de moyens qui, à proximité de la position d'extrémité inférieure du chariot à fourche de charge, concourent avec le même détecteur que celui attaqué par l'extrémité inférieure de la tige de piston du cylindre de levage, ce qui donne une vitesse réduite également lorsque le chariot approche de sa position inférieure.

5. Dispositif selon l'une quelconque des revendications 2 à 4, caractérisé en ce que les moyens for-

mant détecteur sont constitués par un commutateur qui est déclenché par une partie de commande qui, lorsqu'elle vient en contact avec l'extrémité inférieure de la tige de piston, influence immédiatement le commutateur et qui, ensuite, pendant le mouvement continu de la tige de piston peut être déviée de façon élastique vers le bas, mais en gardant la position de commutation.

6. Dispositif selon la revendication 5, caractérisé en ce que la partie de commande est constituée par une partie coulissante mobile verticalement.

7. Dispositif selon l'une quelconque des revendications précédentes 1 à 4, caractérisé en ce que les moyens de détection sont constitués par un dispositif magnétique avec un aimant fixé à l'extrémité de la tige de piston et des moyens de commutation magnétiques situés, par exemple, dans le châssis du camion.

8. Dispositif selon la revendication 7, caractérisé en ce que le détecteur, lorsque l'aimant est passé devant lui, demeure dans le même état jusqu'à ce que l'aimant passe dans l'autre sens.

Fig. 3

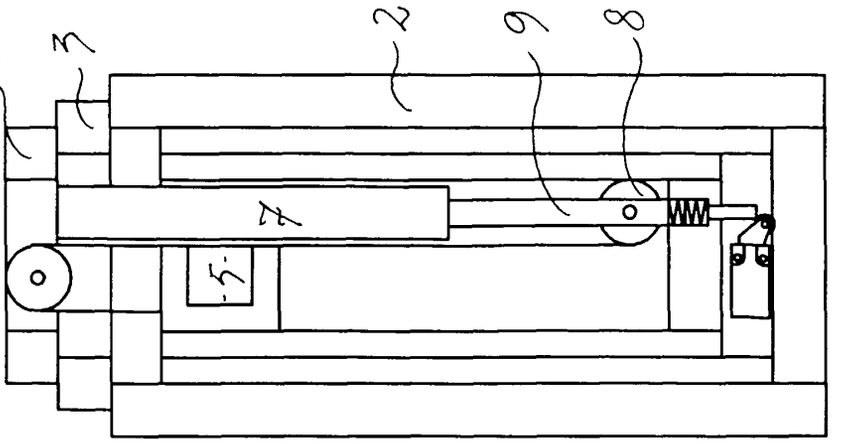

Fig. 2

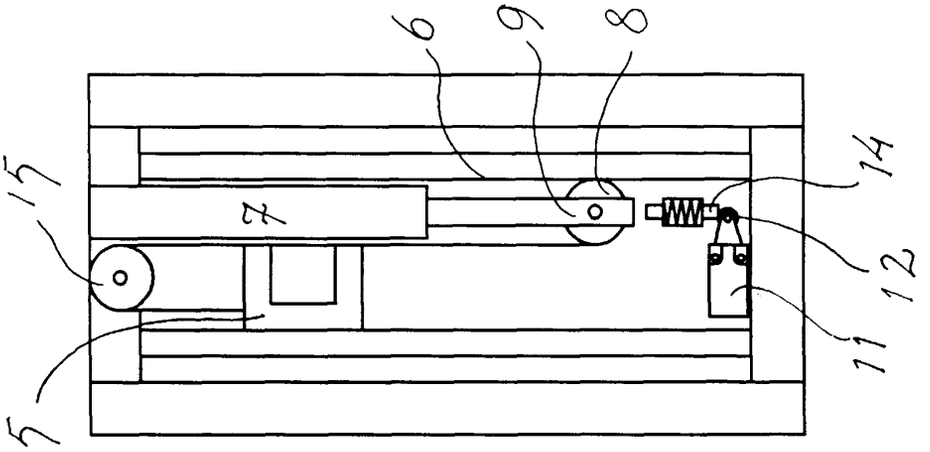

Fig. 1

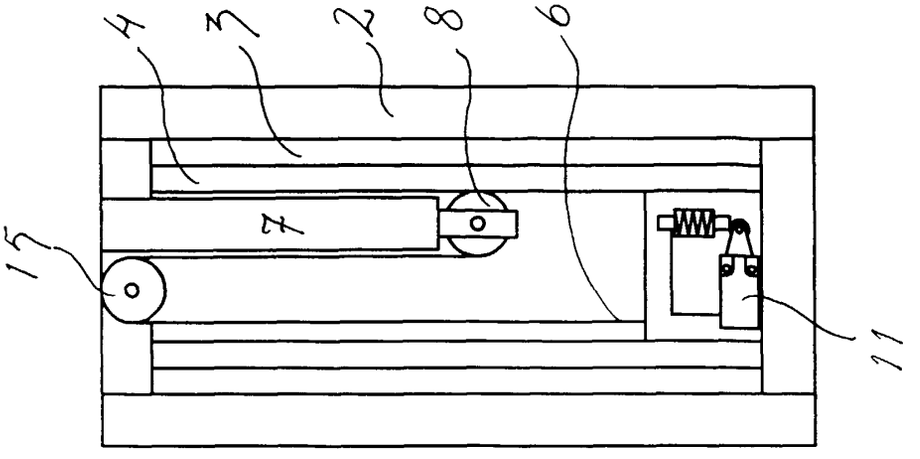

Fig. 4