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(54) **Hydraulic lifting device for a telescopically extendable fork lift truck mast**

Hydraulische Hebevorrichtung für einen teleskopisch ausziehbaren Gabelstaplermast

Appareil de levage hydraulique pour le mât télescopique d'un chariot élévateur à fourches

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## Description

**[0001]** In order to enable an efficient lifting from the ground plane up to maximum height it is at fork trucks known to use two lifting devices, a telescopic mast that at high lifts is extended, and a lifting device arranged in the outmost/uppermost telescoping element in the mast for movement height-wise over the major part of the height of this telescopic element. In this way the entire height of the mast is used for lifting movement. Lifting is normally taken care of by means of hydraulic cylinders with chain exchanges and transfers in order to achieve the long stroke. Since the lifting device in the outermost mast element thus does not have to lift any part of the comparably heavy mast one saves at small lifts, for instance at lifting, transport and putting down on the ground considerable energy and thereby battery charge. An advantage is further that one can connect the hydraulic cylinders of the two lifting systems in parallel, since at movement of the mast also the weight of this has to be lifted and at for instance the same piston area of the different lifting systems always the one with the smallest load will be lifted first and the second one when the stroke of movement is over for the first system, that is the free or low lift always goes first at lifting and at lowering.

**[0002]** A problem with this use of two lifting devices is however that the shifting between low lift (free lift) and high lift (mast lift) respectively result in a shock that on one hand is unpleasant for the driver and on the other hand of course shakes the goods and result in strains in the partaking parts. This is particularly disturbing when also the driver is lifted by the two co-operating lifting systems. In order to cure this it is known to use shock absorbers and it is also known to use a position switch that via a control system at the end of the free lift or low lift movement reduce the oil flow from the pump so that the hitting force in the movement becomes smaller. However there still remain the discontinuity in the movement and also often a shock even if it is reduced.

**[0003]** Furthermore the temporary lowering of the speed means a loss of time. Further it may be make it more difficult for the driver with the varying lifting speed when the forks are to be placed close to the upper end position of the free lift.

**[0004]** From DE 197 10 556 an arrangement is known where the free-lift cylinder piston is designed so that the free-lift cylinder that is lifting the forks before the lifting cylinder for the mast starts experiences an increase in a hydraulic counter pressure so that this increase in pressure causes the cylinder for lifting the mast to start.

**[0005]** The invention has in view of the above problems as its object to make the shift between low lift and high lift softer and with reduced or entirely eliminated loss of time at the transition in a fork truck in accordance with the preamble of claim 1.

**[0006]** In accordance with the invention this object is solved in accordance with the characterizing part of claim 1. A position sensor and/or altimeter is used to initiate said valve. When the low lift or free lift movement comes close to its upper end position the sensor or the altimeter restrict the oil feed to the cylinder for the low lift. The restriction can advantageously be progressive or ramped so that it is successively reduced to zero or almost zero.

**[0007]** When the oil feed to the low lift cylinder is restricted the pressure in the hydraulic circuit is increased in the same way as when according to previous technique the low lift cylinder abuts its upper end position stop. When the pressure rise the oil will instead be pumped into the usually two high lifting cylinders so that these start to lift the frame (mast) upward. At the same time as thus the speed of the movement in the low lift part is reduced the speed of the high lift part is increased and a very soft transition is obtained that to start with can be made entirely shock free and secondly the lifting speed can be kept entirely constant. The soft transition is obtained independent of the lifting speed that is controlled by the speed of the pump motor, that is controlled by the driver by means of the lift control handle defined lifting speed. Also at maximum speed the transition will be soft. If the driver change the speed during the transition this does not have any influence either.

**[0008]** If one choose the same piston area for the two lifting systems the lifting speed is maintained entirely unchanged at constant control position and pump speed respectively also in the transition range and if the driver stops the movement by stopping the oil flow to the piston systems in the middle of the ramping transition between these the movement height-wise of the fork is stopped, but since the mast is heavier this can be allowed to sink down slowly at the same time as the forks are lifted upwards precisely in the same amount and in the same degree due to an overflow between the cylinders in the different systems.

**[0009]** I relation to the previous solutions the invention has the advantage that one does not lose any lifting time on the transition between the lifting devices as in the case with the speed lowering at the end of the low lift. Furthermore the placing of the forks in the transition area is facilitated since the fork speed is only controlled by the driver. Nor are there needed any special cylinders.

**[0010]** The use of a reduction valve in the connection tubing to the high lift cylinders allow soft breaking of the mast movement when the parts of this come close to the lower end position, which can be sensed with an altimeter and/or a position sensor. When this takes place the valve to the low lift cylinder is preferably open or opened so that when the mast is braked the low lift begin its lowering motion. In the case with the same piston areas in the same way as in the lifting case at a stop (that is a disruption in the draining of oil from the lifting cylinders) in the transition range the mast will sink down with a simultaneous lifting of the forks that thus will look as if they are standing entirely still in the height direction.

**[0011]** The valve in the connection to the high lifting cylinders also makes it possible to use cylinders in the low lifting systems with a smaller piston area and a higher

lifting pressure since it is possible to prevent the high lifting cylinders from movement by shutting off the feed to these during the entire low lift (below the transition area). This allows partly the use of less costly cylinders since they can be given smaller dimensions for the low lifting part and also reduce the amount of oil that has to be moved, which in tern reduce the losses due to flow, required oil volume in the truck etc. and furthermore the low lift cylinder or cylinders becomes easier to stow away so that the driver can obtain a better view.

**[0012]** The use of smaller piston areas in the low system also result in faster lowering movements of the low lift system, since the pressure also at lowering will be higher and the oil volume that is to be displaced becomes smaller.

**[0013]** The above mentioned restriction valves are advantageously electrically controlled proportional valves permitting together with the appropriate electronic control the use of well defined and constant maximum speeds over the entire lifting range without loss of time. If so should be desired also other movement schemes can be used then at the known devices. For instance high lift and low lift parts can in relation to each other be controlled in such a way that at a lowering movement the low lift part is always lowered first, which may provide the advantage that if movements are to take place high up in the storage rack a major part of these movements may be executed with only the low lifting part that weighs less and consequently requires less energy than if the entire mast is to be lowered and lifted again.

**[0014]** With electronic control it is further possible to control the two control systems independent of the piston areas so that the sum of their respective lift and lowering speeds becomes constant and in particular the maximally permitted. In the shifting range draining and feeding of oil respectively to the two systems take place in such a manner that the mast can sink down if it has been stopped in the ramping range by letting out oil from the high lift system, while a compensating oil volume is pumped in to the low lift cylinders. These and other movements can be controlled and checked by position switches and or altimeters. One also has the possibility to ascertain that the high lift part goes down completely at the lowering, so that not mistakenly, due to for instance a slow going low lifting part, that mast extends somewhat and thereby risk to get stuck in door openings.

**[0015]** At the use of an altimeter this can be used in combination with position sensors, but one can also consider to use two altimeters, one for the low lift and for the high lift. Within the concept of the invented thought one can also consider to use two hydraulic pumps each with its own motor, for instance one motor unit can be used to drive the low lift while the other pump can be used to drive the high lift.

**[0016]** Further advantages and characteristics of the invention are apparent from the patent claims and the following description of an embodiment shown in the enclosed drawing. In this Fig.1 and 2 schematically show a device in accordance with the invention and Fig. 3 a flow diagram of the oil feed to the two lifting systems when the transition range between the two lifting systems is passed.

**[0017]** In the schematic embodiment shown in the enclosed drawing two high lift cylinders have been referenced with 4 and two low lift cylinders with 3. The low lift cylinder or cylinders 3 are connected to the high lift part of a telescopic mast or frame 5. The frame 5 provides inertia in the system. Oil is feed from a hydraulic pump 6, 6' via two valves 1, 1' and 2, 2' from a tank 7. The valves 1, 1' and 2, 2' can both feed to, and drain oil from the lifting cylinders 3 and 4 respectively. A pressure limiter 8 is arranged after the motor and return at a to high pressure oil back to the tank 7 in sufficient amount to reduce the pressure to intended value. The valves are proportionally controlled electrically by an electronic unit that receives its commands from a lifting control and that furthermore includes a memory unit and a processor and connections for signals from position sensors and/or altimeters. The valves are separate units or built together to one unit that may be entirely separated from the lifting cylinders. Instead of an altimeter one can use a position sensor that registers when the forks come close to their end position in the outermost mast section and when the mast comes close to its bottom position respectively. When at lifting a signal comes from the position sensor for the end position of the low lift the feed passage 1, 1a' of the valve 1, 1' is successively restricted and the feed passage 2a, 2a' in the high lift valve is opened successively so that the speed of the forks in relation to the outermost mast section approaches zero when they approach the end position. In the case with an altimeter one can also consider to restrict entirely or almost entirely in the vicinity of the mechanical end position in order to reduce the mechanical strains. Advantageously one uses both altimeter and sensor for "close to end position" for the low lift movement. In particular at the use different cross sections of the lifting cylinders in the two systems it is possible at the use of altimeter to use the values from this to control not only the valves but also the pump speed in order to obtain an even (maximum) speed at movements in the height direction. The corresponding flow conditions are shown in Fig. 3. The sum of the oil flows to the two systems is constant and the transition takes place despite the comparatively short transition distance and time respectively that not even the difference in mass inertia is noticed.

**[0018]** At lowering instead the valve passages 1b and 2b are used for the draining of the oil back to the tank. At large frames (masts) alternatively at lowering the valve passages 1b' and 2b' are used that drain the oil via the pump back to the tank. The electric motor functions as a generator. A principal diagram is shown in Fig 2. The electric motor functions at lift as a usual DC or asynchronous motor. At lowering the motor working as a generator return energy to the battery package. The valve or the valves that are used are proportional valves (1', 1a', 2',

2a'). At this the valves may in addition to be used for soft transitions and end position ramping be used to keep the lowering speed even (maximum).

**[0019]** In addition to the above mentioned advantages it can be mentioned that if one choose a low lift cylinder that is thinner and works with a higher pressure and smaller oil volumes also more narrow conduits may be used which is cost reducing in it self and easier to handle since thinner hoses more easily can be bent over pulleys etc. The invention furthermore has the great advantage that it is easy to rebuild existing trucks since it is only a matter of changing valves conduits and control electronic since the invention can be used even at larger dimensions of the low lift cylinder. At service or renovation works also an older truck can be upgraded to more modem lifting comfort and even lifting speed.

**[0020]** By the use of a smaller piston dimension of the low lift cylinder or cylinders also at emptying the pressure will be higher and thereby the draining speed faster so that also the free lift lowering can take place with maximally permitted speed.

**[0021]** At movements upward the invention provides an unnoticeable transition between low lift and high lift and a soft damping of the movement when the mast comes close to the its upper most position.

**[0022]** At movement downwards the invention provides a soft transition between high lift and low lift that is at damping of the arriving of the mast to the bottom position and a softly braked lower end position of the forks in the low lift part and a fast lowering of the low lift.

## Claims

1. Fork truck where in a telescopically extendable mast in the outermost or uppermost mast section a movement journaling is arranged for the movement of the forks over a major part of the height of the uppermost mast section (5), and where lifting movements are achieved hydraulically by means of one or several high lift cylinders (4) for the lifting of the mast sections and one or several low lift cylinders (3) for the lifting of the forks in relation to the uppermost mast section (5) at which the low lift cylinder or cylinders and the high lift cylinder or cylinders in parallel are connected to one or several pumps (6) for the feeding of oil under pressure, **characterized in that** in a feed conduit to the low lift cylinder or cylinders a proportional valve (1) is arranged and for this a control is arranged that towards the end of the movement stroke of the forks upwards in the uppermost mast section successively restricts the feed of oil to the low lift cylinder or cylinders (3) so that the oil instead successively increasingly is fed to the high lift cylinder or cylinders (4) during continued lifting movement of the forks and that in a feed conduit to the high lift cylinder or cylinders a proportional valve (2) is arranged and for this a control is arranged that towards the end of a lowering movement of the mast successively restricts the oil drain from the height lift cylinder or cylinders (4) so that oil instead successively increasingly is drained from the low lift cylinders during the continued lowering movements of the forks,
so that shocks are avoided in the end positions and so that in the shifting between movement of high cylinders and low lift cylinders and reverse the shift takes place successively and without stopping the forks.

2. Fork truck in accordance with claim 1 **characterized in that** the cross sections of the cylinders and possible exchange rates are so chosen that the oil is first fed to the low lift for the forks, then the oil flows on to the high lift cylinders requiring a higher pressure so that the forks are always lifted first.

3. Forth truck according to any of the preceding claims, **characterized in that** the valves also take care of the connection to oil tank and oil pump respectively.

4. Forth truck according to any of the claims 1-3, **characterized in that** the low lifting hydraulic cylinder or cylinders are dimensioned for a lifting hydraulic pressure essentially coinciding with that of the high lift cylinder or cylinders.

5. Forth truck according to any of the claims 1 -3, **characterized in that** the low lifting hydraulic cylinder or cylinders are dimensioned for a lifting hydraulic pressure that differs from that of the high lifting cylinder or cylinders.

6. Force truck according to any of the claims 1-3, **characterized in that** the cross sections of low lift cylinder or cylinders and high lift cylinder or cylinders are the same so that a constant lifting speed can be achieved.

7. Forth truck according to any of the claims 1 - 3, **characterized in that** the area of the piston or pistons in the low lifting system is smaller than for the high lifting system so that a high lowering speed can be achieved.

8. Forth truck according to any of the preceding claims, **characterized in that** a position sensor is arranged in the proximity of the upper end position of the forks in relation to the upper mast section.

9. Forth truck according to any of the preceding claims, **characterized in that** it is provided with a lift height measuring device for low lift and/or high lift.

10. Forth truck according to any of the preceding claims, **characterised in that** a position sensor is arranged in the lower end of the movement of the forks in the

uppermost mast section.

**11.** Forth truck according to any of the preceding claims, **characterized in that** it includes two motors for the driving of the lifting cylinders.

**12.** Forth truck according to any of the preceding claims, **characterized in that** it includes a electronic control unit for the control of the valves.

**13.** Method for the control of the transition between lifting movements carried out with different lifting cylinders, low lifting and high lifting cylinders at a truck in accordance with claim 1 **characterized in that** at the initiating of a transition the feed to the presently working cylinder is restricted and fed to the other one so that a soft transition is achieved.

**14.** Method according to claim 13, **characterized in that** at stops in the transition range the high lift system is lowered to its lowermost position while the low lift part is raised in a corresponding amount.

**15.** Forth truck according to any of the claim 1 - 12, **characterized in that** it is so arranged that the oil at lowering is fed back through the pump that drives the motor that at this serves as generator and returns energy to the batteries.

**Patentansprüche**

**1.** Gabelstapler, bei dem in einem teleskopisch ausziehbarer Mast in dem äußersten oder obersten Mastteil für die Bewegung der Gabeln über einen grossen Teil der Höhe des obersten Mastteils (5) hinweg angeordnet ist, und bei dem Hubbewegungen hydraulisch mit Hilfe eines oder mehreren hohen Hubzylindern (4) zum Anheben der Mastteile und eine oder mehreren niedrigen Hubzylindern (3) zum Anheben der Gabeln in Relation zu dem obersten Mastteil (5) ausgeführt werden, wobei der niedrige Hubzylinder oder die niedrigen Hubzylinder und der hohe Hubzylinder oder die hohen Hubzylinder parallel mit einer oder mehreren Pumpen (6) zur Zuführung von Drucköl verschaltet sind, **dadurch gekennzeichnet, dass** in einer Zufuhrleitung zu dem niedrigen Hubzylinder oder den niedrigen Hubzylindern ein Proportionalventil (1) angeordnet ist und für dieses eine Steuerung derart ausgelegt ist, dass in Richtung des Endes des Bewegungshubes der Gabeln an dem obersten Mastteil nach oben sukzessive die Ölzufuhr für den niedrigen Hubzylinder oder die niedrigen Hubzylinder (3) derart gedrosselt wird, dass das Öl anstelle hiervon sukzessive zunehmend dem hohen Hubzylinder oder den hohen Hubzylindern (4) während der fortgesetzten Hubbewegung der Gabeln zugeführt wird, und dass in einer Zufuhrleitung für den hohen Hubzylinder oder den hohen Hubzylindern ein Proportionalventil (2) angeordnet ist und die Steuerung desselben derart ausgelegt ist, dass in Richtung des Endes der Absenkbewegung des Masts sukzessive die Ölableitung und dem hohen Hubzylinder oder den hohen Hubzylindern (4) derart gedrosselt wird, dass das Öl anstelle hiervon sukzessive zunehmend von den unteren Hubzylindern während der fortgesetzten Absenkbewegung der Gabeln abgeleitet wird, so dass Stöße in den Endpositionen vermieden werden, und so dass bei der Umschaltung zwischen der Bewegung der hohen Zylinder und der niedrigen Hubzylinder und umgekehrt die Umschaltung allmählich und ohne ein Stoppen der Gabeln erfolgt.

**2.** Gabelstapler nach Anspruch 1, **dadurch gekennzeichnet, dass** die Querschnitte der Zylinder und die möglichen Änderungsarten derart gewählt sind, dass das Öl zuerst zu dem niedrigen Hub für die Gabeln zugeleitet wird und das Öl dann zu den hohen Hubzylindern strömt, für die ein höherer Druck erforderlich ist, so dass die Gabeln immer zuerst angehoben werden.

**3.** Gabelstapler nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Ventile auch für die Verbindung mit dem Ölbehälter und der Ölpumpe jeweils verantwortlich sind.

**4.** Gabelstapler nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** der Hydraulikzylinder oder die Hydraulikzylinder für die niedrige Hubhöhe derart bemessen ist oder sind, dass der hydraulische Hubdruck im wesentlichen mit demjenigen des Hubzylinders oder der Hubzylinder für die hohe Hubhöhe übereinstimmt.

**5.** Gabelstapler nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** der niedrige Hydraulikhubzylinder oder die Zylinder derart bemessen sind, dass der hydraulische Hubdruck von demjenigen der hohen Hubzylinder oder den hohen Hubzylindern abweicht.

**6.** Gabelstapler nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Querschnitte des niedrigen Hubzylinders oder der niedrigen Hubzylinder und des hohen Hubzylinders oder der hohen Hubzylinder derart übereinstimmen, dass eine konstante Hubgeschwindigkeit erzielt werden kann.

**7.** Gabelstapler nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** die Querschnittsfläche des Kolbens oder der Kolben in dem niedrigen Hubsystem kleiner als diejenige für das hohe Hubsystem ist, so dass eine hohe Absenkgeschwindigkeit erzielt werden kann.

8. Gabelstapler nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Positionssensor in der Nähe der oberen Endposition der Gabeln bezüglich des oberen Mastteils angeordnet ist.

9. Gabelstapler nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** er mit einer Hubhöhen-Messeinrichtung für die niedrige Hubhöhe und/oder die hohe Hubhöhe versehen ist.

10. Gabelstapler nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** ein Positionssensor am unteren Ende der Bewegung der Gabeln in dem obersten Mastteil angeordnet ist.

11. Gabelstapler nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** er zwei Motoren zum Betreiben der Hubzylinder umfasst.

12. Gabelstapler nach einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** er eine elektronische Steuereinheit für die Steuerung der Ventile umfasst.

13. Verfahren zum Steuern des Übergangs zwischen den mit unterschiedlichen Hubzylindern, niedrigen Hubzylindern und hohen Hubzylindern, auszuführenden Hubbewegungen, für einen Gabelstapler nach Anspruch 1, **dadurch gekennzeichnet, dass** beim Einleiten eines Übergangs die Zufuhr zu dem gegenwärtigen Arbeitszylinder gedrosselt und die Zufuhr zu dem anderen Arbeitszylinder derart erfolgt, dass ein weicher Übergang erzielbar ist.

14. Verfahren nach Anspruch 13, **dadurch gekennzeichnet, dass** bei Stopps in dem Übergangsbereich das hohe Hubsystem in seine unterste Position abgesenkt wird, während das niedrige Hubteil in entsprechender Weise angehoben wird.

15. Gabelstapler nach einem der Ansprüche 1 bis 12, **dadurch gekennzeichnet, dass** er derart ausgelegt ist, dass das Öl beim Absenken durch die Pumpe zurückgeleitet wird, die den Motor antreibt, welcher als Generator dient und Energie an die Batterien zurückgibt.

**Revendications**

1. Chariot à fourches où dans un mât télescopique extensible dans la section de mât la plus extérieure ou la plus haute, une journalisation de mouvement est agencé pour le mouvement des fourches sur une majeure partie de la hauteur de la section de mât la plus haute (5), et où les mouvements de levage sont réalisés de façon hydraulique au moyen d'un ou plusieurs cylindres à grande levée (4) pour le levage des sections de mâts et un ou plusieurs cylindres à petite levée (3) pour le levage des fourches par rapport à la section de mât la plus haute (5) au niveau de laquelle le ou les cylindres à petite levée et le ou les cylindres à grande levée en parallèle sont raccordés à une ou plusieurs pompes (6) pour l'alimentation en huile sous pression, **caractérisé en ce que** dans un conduit d'alimentation vers le ou les cylindres à petite levée, une soupape proportionnelle (1) est agencée et pour cette dernière une commande est agencée qui, vers la fin de la course du mouvement des fourches vers le haut dans la section de mât la plus haute restreint successivement l'alimentation en huile vers le ou les cylindres à petite levée (3) de sorte que l'huile, est plutôt alimentée de façon successive et croissante dans le ou les cylindres à grande levée (4) pendant un mouvement de levage continu des fourches et
**en ce que** dans un conduit d'alimentation vers le ou les cylindres à grande levée, une soupape proportionnelle (2) est agencée et pour cette dernière une commande est agencée qui, vers la fin d'un mouvement d'abaissement du mât, restreint successivement le purgeur d'huile du ou des cylindres à grande levée (4) de sorte que l'huile est plutôt drainée de façon successive et croissante des cylindres à petite levée pendant les mouvements d'abaissement continus des fourches,
de sorte que les chocs sont évités dans les positions d'extrémité et de sorte que dans le changement entre un mouvement de cylindres à grande levée et de cylindres à petite levée et inversement le changement a lieu successivement et sans arrêter les fourches.

2. Chariot à fourches selon la revendication 1, **caractérisé en ce que** les sections des cylindres et des taux d'échange possibles sont choisis de sorte que l'huile est d'abord alimentée dans les cylindres à petite levée pour les fourches, l'huile s'écoule ensuite vers les cylindres à grande levée nécessitant une pression plus élevée de sorte que les fourches sont toujours levées les premières.

3. Chariot à fourches selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les soupapes assurent également le raccordement vers le réservoir d'huile et la pompe à huile respectivement.

4. Chariot à fourches selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** le ou les cylindres hydrauliques à petite levée sont dimensionnés pour une pression hydraulique de levage coïncidant essentiellement avec celle du ou des cylindres à grande levée.

**5.** Chariot à fourches selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** le ou les cylindres hydrauliques à petite levée sont dimensionnés pour une pression hydraulique de levage qui diffère de celle du ou des cylindres à grande levée.

**6.** Chariot à fourches selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** les sections du ou des cylindres à petite levée sont identiques de sorte qu'une vitesse de levage constante peut être obtenue.

**7.** Chariot à fourches selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** l'aire du ou des pistons dans le système à petite levée est inférieure à celle du système à grande levée de sorte qu'une vitesse d'abaissement élevée peut être obtenue.

**8.** Chariot à fourches selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un capteur de position est agencé à proximité de la position d'extrémité supérieure des fourches par rapport à la section de mât supérieure.

**9.** Chariot à fourches selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il est doté d'un dispositif de mesure de hauteur de levage pour une petite levée et/ou une grande levée.

**10.** Chariot à fourches selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un capteur de position est agencé dans l'extrémité inférieure du mouvement des fourches dans la section de mât la plus haute.

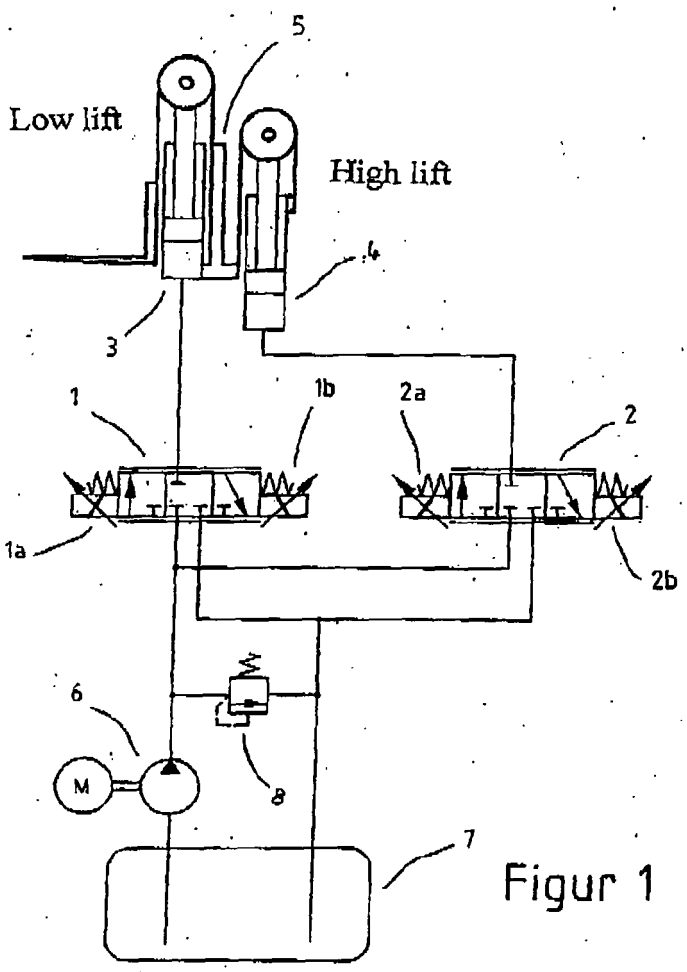
**11.** Chariot à fourches selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend deux moteurs pour l'entraînement des cylindres de levage.

**12.** Chariot à fourches selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend une unité de commande électronique pour la commande des soupapes.

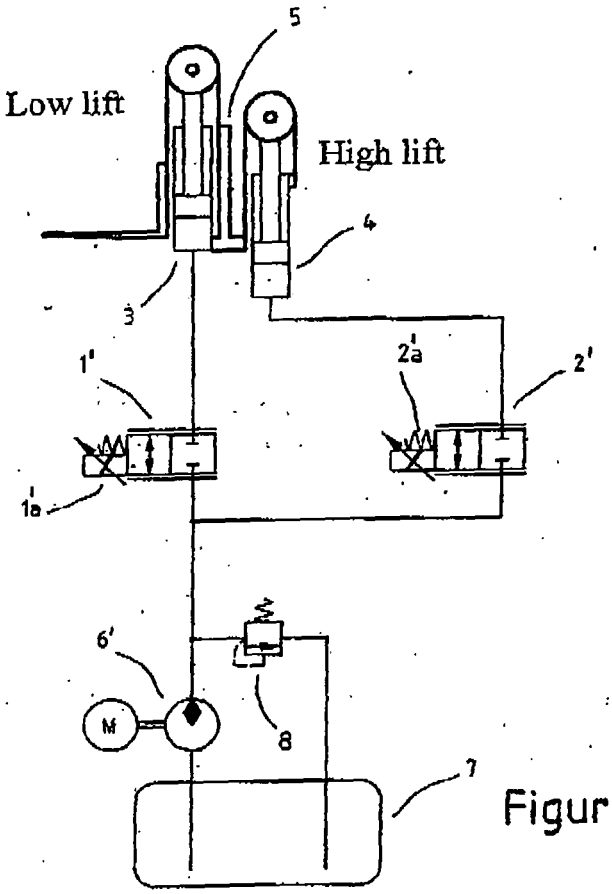
**13.** Procédé de commande de la transition entre des mouvements de levage effectués avec différents cylindres de levage, des cylindres à petite levée et à grande levée au niveau d'un chariot selon la revendication 1, **caractérisé en ce qu'**au début d'une transition, l'alimentation du cylindre en train de travailler est restreinte et délivrée à l'autre cylindre de sorte qu'une transition douce est réalisée.

**14.** Procédé selon la revendication 13, **caractérisé en ce qu'**à des arrêts dans la plage de transition, le système à grande levée est abaissé à sa position la plus basse alors que la partie à petite levée est relevée d'une quantité correspondante.

**15.** Chariot à fourches selon l'une quelconque des revendications 1 à 12, **caractérisé en ce qu'**il est agencé de sorte que l'huile à l'abaissement est alimentée en retour à travers la pompe qui entraîne le moteur qui sert de générateur et renvoie de l'énergie vers les batteries.

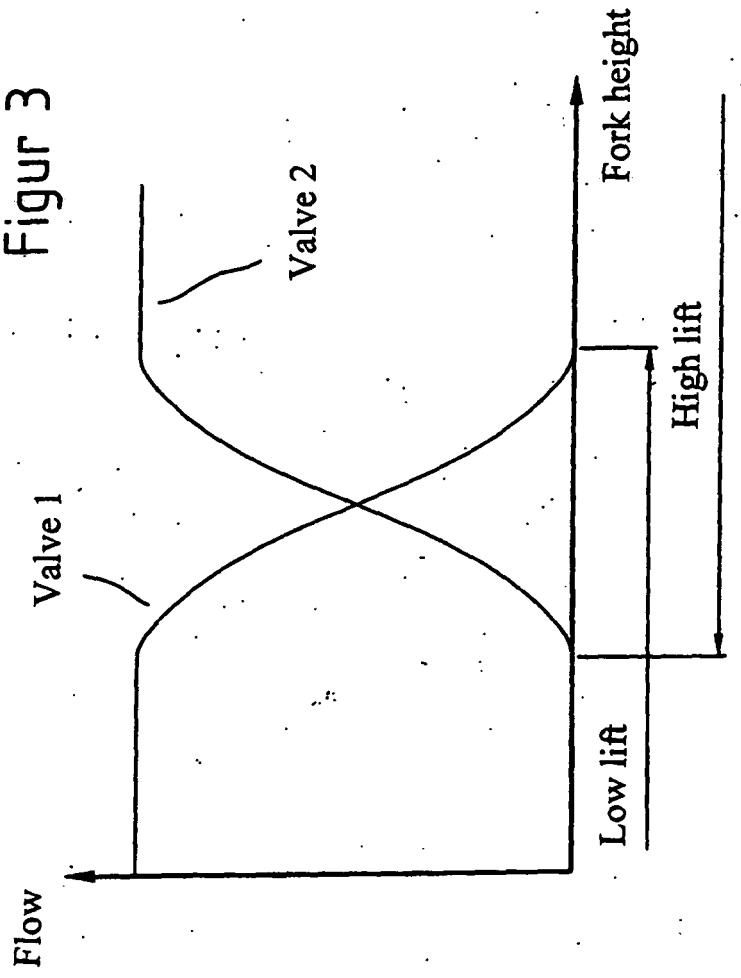



Figur 1




Figur 2

Figur 3



## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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