

Description

This invention relates generally to an apparatus having first and second members movable by a chain, the tension of which can be adjusted, and particularly but not exclusively to a lift system for the mast assembly of a lift truck and more particularly to an adjustable chain anchor for selectively adjusting the tension in a chain of the lift system.

The lift system employed on a mast assembly of a conventional lift truck normally includes a pair of laterally spaced and equally tensioned chains, each having first ends anchored to a fixed upright assembly and second ends anchored to a movable upright assembly or to a movable carriage assembly. Chain tension must be periodically adjusted to ensure efficient raising and lowering of the movable assembly during operation of the lift truck. A typical adjustable chain anchor is disclosed in U.S. Patent No. 4,009,765, issued on March 1, 1977 to Edward V. Leskovec et al. Although adjustable chain anchors of this type have performed adequately, space limitations on present day "high visibility" mast assemblies dictate the need for an adjustable chain anchor that is compact and designed to be conveniently positioned adjacent to an upper end of the fixed upright assembly for ready access by a workman.

The present invention is directed to overcoming one or more of the problems as set forth above.

US-A-2 354 178 describes an arrangement in accordance with the pre-characterizing part of claim 1. Chain tension is adjusted by means of a bolt engaging approximately the mid-point of an arm pivoted at one end and carrying the chain at its other end. This arrangement is not very versatile, however, requiring the chain and bolt to be substantially aligned and both located to the same side of the pivot axis of the arm. This lack of versatility becomes particularly significant when space is at a premium, as discussed above.

Accordingly, the invention is further provided with the features of the characterizing part of claim 1. The location and orientation of the bolt is thus freed; while the cam surface supporting the chain permits a finer control of the line of the working part of the chain.

Disclosure of the Invention

In one preferred aspect of the present invention, a mast assembly has a movable assembly (upright or carriage assembly) mounted for relative movement on a fixed upright assembly and a lift system including at least the said chain having opposite ends thereof anchored to the fixed and movable assemblies.

The improved lift system provides a compact adjustment means that can be conveniently positioned at an accessible location at the upper end of the fixed upright assembly. The ability to adjust chain tension by wrapping the end of the chain about cam surface provides a closely controlled and highly leveraged system for closely calibrating chain tension.

Embodiments of the invention will now be

described with reference to the accompanying drawings wherein:

Fig. 1 is a partially sectioned side elevational view partially illustrating a lift truck having its mast assembly shown in its extended condition of operation and employing an adjustable chain anchor embodiment of the present invention therein;

Fig. 2 is an enlarged top elevational view of the mast assembly, partially sectioned to illustrate a pair of adjustable chain anchors;

Fig. 3 is a partially sectioned and enlarged side elevational view, illustrating an adjustable chain anchor; and

Fig. 4 is a view similar to Fig. 1, but illustrating application of the chain anchor to another type of mast assembly.

Best Mode of Carrying Out the Invention

Figs. 1 and 2 partially illustrate a lift truck 10 having a mast assembly 11 mounted forwardly thereon in a conventional manner. The mast assembly includes a fixed upright assembly 12, suitably mounted on the frame of the truck and having a pair of laterally-spaced uprights 13, 14 secured together by transverse tie bars. A multi-stage movable upright assembly 15 is slidably mounted on the fixed upright assembly to be selectively raised and lowered thereon by a lift system 16.

Lift system 16 includes a pair of laterally spaced lift chains 17 each having a first end securely anchored to a lower end of movable upright assembly 15 by an anchor and bracket assembly 18. The second end of each chain is securely anchored to an upper end of fixed upright assembly 12 by an adjustable chain anchor 19, mounted on a bracket assembly 20 secured between uprights 13, 14 of the fixed upright assembly. As described more fully hereinafter, adjustable chain anchor 19 exhibits a high degree of compactness and is designed to be positioned at a convenient location on the upper end of the fixed upright assembly to facilitate servicing, including periodic adjustment of the tension in chain 17.

Still referring to Figs. 1 and 2, lift system 16 further includes a pair of sheaves 21 each having a respective chain 17 entrained thereover and rotatably mounted on a bracket 22 secured to movable upright assembly 15. A pair of single stage, single-acting hydraulic cylinders 23 each has a housing 24 suitably secured on a backside of fixed upright assembly 12 and a reciprocal rod 25 suitably secured at its upper end to bracket 22. Thus, selective extension and retraction of cylinders 23 will function to raise and lower the movable upright assembly on the fixed upright assembly under control of chains 17. During such selective movement of the movable upright assembly, it is highly desirable to maintain proper and equal tensions in lift chains 17, for purposes well known in the art.

Referring to Fig. 3, the tension in each chain 17 can be precisely set by a respective adjustable

chain anchor 19. The adjustable chain anchor includes a cam member 26 pivotally mounted on a fixed pivot pin 27 for pivotal movement about a fixed axis A thereof. As shown in Fig. 2, the pin is mounted in a bifurcated bracket 28 formed integrally with bracket assembly 20 and is secured against axial movement thereon by a pair of cross-pins 29. Alternatively, cam member 26 could be secured on pin 27 with the pin being rotatably mounted on bracket 28.

Cam member 26 is in the form of a bellcrank having a first arm 30 and a circumferentially spaced second arm 31, shown as disposed at approximately a right angle relative to each other. The end portion of chain 17 anchored to fixed upright assembly 12 is secured to radially extending first arm 30 by a pin 32 of the chain. Cam member 26 has an arcuate cam surface 33 formed thereon, between arms 30 and 31, that engages the generally flat and substantially continuous outside surfaces of the adjacent chain links in bearing contact, as shown in Fig. 3.

Arm 31 extends radially outwardly and rearwardly of pin 27 to overly an adjustment means 34, shown in the form of a bolt 35 threadably mounted through a plate 36 secured beneath bracket 28. A lock nut 37 functions to lock the bolt in a preset axial position whereby an end of the bolt will engage arm 31 to retain it in an adjusted rotative position about axis A. Thus, predetermined and equalized tensions can be continuously maintained in chains 17 by periodically resetting adjustment means 34, as needed. Although cam surface 33 is preferably concentric about axis A, it should be understood that the surface could be formed eccentric, if so desired.

Referring once again to Fig. 1, multi-stage movable upright assembly 15 preferably includes a first movable upright assembly 39 slidably mounted directly on fixed upright assembly 12 and a second movable upright assembly 40 slidably mounted on the first movable upright assembly. As shown, each chain 17 is anchored at 18 to a lower end of second movable upright assembly 40 whereby extension of cylinder 23 will raise the first and second movable upright assemblies simultaneously.

A standard carriage assembly 41, having forks 42 mounted thereon, is slidably mounted on second movable upright assembly 40. The carriage assembly is adapted to be elevationally moved on the upright assembly by a single cylinder 43 and a pair of chains 44. The cylinder's housing is suitably secured on upright assembly 40 and a first end of each chain 44 is secured thereon at a standard adjustable chain anchor 45. As shown in Fig. 2, the rod end of cylinder 43 has a bracket assembly 46 secured thereon and a pair of sheaves 47 are rotatably mounted on the bracket assembly and have chains 44 entrained thereover. The second end of the chains are suitably securely anchored to a backside of carriage assembly 41 whereby selective extension and retraction of cylinder 43 will elevationally move the carriage assembly on upright assembly 40.

Fig. 4 illustrates application of adjustable chain anchor 19 to another type of mast assembly 11'. Identical numerals depict constructions corresponding to those shown in Figs. 1—3, but with a prime symbol (') accompanying numerals depicting modified constructions in Fig. 4.

In the Fig. 4 mast assembly 11', second movable upright assembly 40 has been eliminated, along with cylinder 43 and chains 44, and chains 17 are each secured to a backside of a carriage assembly 41' at a standard anchor and bracket assembly 18'. It can be seen in Fig. 4 that selected extension of cylinder 23 will function to simultaneously slide movable upright assembly 39 upwardly on fixed upright assembly 12 and carriage assembly 41' upwardly on the movable upright assembly. For purposes herein, the term "movable assembly" may be deemed to generally define a movable upright assembly or a movable carriage assembly.

Industrial Applicability

Mast assembly 11 and 11' find particular application to industrial trucks, such as a lift truck of the type partially illustrated in Figs. 1 and 4. During operation of the lift truck 10 in Fig. 1, the operator will normally retract mast assembly 15 to engage and support a load on forks 42. Thereafter, cylinders 23 and 43 can be suitably extended and retracted to position the load elevationally for transport and storage purposes.

After periodic use, lift chains 17 may tend to slacken, thus requiring readjustment to maintain the proper equalized tension therein. As shown in Fig. 3, each such adjustment can be accomplished expeditiously by backing-off lock nut 37 and rotating bolt 35 to pivot cam member 26 counter-clockwise about fixed axis A. After the proper tension has been achieved, lock nut 37 can be turned-down to secure bolt 35 in its preset axial position against arm 31 of the cam member. A like procedure could be followed to adjust the tension in the second lift chain with the tension in both chains being preferably the same.

The tensions in chains 17, employed in mast assembly 11' in Fig. 4, are adjusted in a similar manner.

Although adjustable chain anchor 19 finds particular application to the lift chains for mast assemblies, as described above, it should be understood that it has application to other apparatus wherein a pair of members are slidably mounted relative to each other and a chain is anchored between the members. It should be noted in Fig. 3 that the compact design of the adjustable chain anchor facilitates its mounting in a relatively small amount of space. In addition, the bearing loads imposed on cam member 26 by the chain are substantially absorbed by pin 27 and only a small amount of loading is transmitted to adjustment means 34. Also, the moment or lever arm provided between axis A and the point at which adjustment bolt 35 engages arm 31 provides a system for finite adjustment and a substantial mechanical advantage for rotating the cam member to tension the chain.

12

Claims

1. An apparatus having a first member (12), a second member (41/41') mounted for relative sliding movements on said first member (12), and at least one chain (17) having an end thereof anchored to said second member (40, 41'), means (19) for adjusting the tension in said chain (17) in response to selective movement of at least one end of said chain (17) about a pivot axis (A) including a chain carrying member (26) pivotally mounted on one of said first and second members (12), and a bolt (35) threadably mounted on one of said first and second members (12) and having an end thereof engaging said chain carrying member (26), characterized in that said chain carrying member is mounted on said first member (12) and comprises a cam member (26) having an arcuate cam surface (33) formed thereon, an end portion of said chain (17) being wrapped on said cam surface (33) in bearing relationship thereon, a first arm (30) secured on said cam member (26) to extend radially outwardly therefrom, the end portion of said chain (17) being attached to said first arm (30), a second arm (31) secured on said cam member (26) to extend radially outwardly therefrom and displaced circumferentially from said first arm (30) and engaged by said bolt (35).

2. A mast assembly including an apparatus as claimed in claim 1, wherein said first member comprises a fixed upright assembly (12), said second member comprises a movable assembly (15, 41') movably mounted on said fixed upright assembly (12), and said chain (17) comprises part of the lift system (16).

3. The mast assembly of claim 2 wherein said movable assembly includes a movable upright assembly (40).

4. The mast assembly of claim 2 wherein said movable assembly includes a movable carriage assembly (41').

5. A lift truck (10/10') having a mast assembly (11/11') as claimed in claims 2, 3 or 4 mounted forwardly thereon, the lift system (16) further including at least one fluid cylinder (23) interconnected between said fixed upright (12) and movable (15/41') assemblies.

6. The lift truck (10) of claim 5 when dependent on claim 2 wherein said movable assembly (15) includes a first movable upright assembly (39) slidably mounted on said fixed upright assembly (12) and a second movable upright assembly (40) slidably mounted on said first movable upright assembly (39), said chain (17) anchored to said second movable upright assembly (40).

7. The lift truck (10) of claim 6 further including a carriage (41) slidably mounted on said second movable upright assembly (40) and means (43, 44) for moving said carriage (41) on said second movable upright assembly (40).

8. The lift truck (10') of claim 5 further including a movable upright assembly (39) slidably mounted on said fixed upright assembly (12) and wherein said movable assembly includes a

carriage assembly (41') slidably mounted on said movable upright assembly (39), said chain (17) anchored to said carriage assembly (41').

Patentansprüche

1. Vorrichtung mit einem ersten Glied (12), einem zweiten Glied (41/41') angeordnet für relative Gleitbewegungen am ersten Glied (12) und mindestens eine Kette (17) mit einem Ende verankert an dem zweiten Glied (40, 41'), Mittel (19) zur Einstellung der Spannung der Kette (17) infolge selektiver Bewegung von mindestens einem Ende der Kette (17) um eine Schwenkachse (A) einschließlich eines Kettentragglieds (26) schwenkbar gelagert an einem der ersten und zweiten Glieder (12), und mit einem Bolzen (35) der gewindemäßig an einem der ersten und zweiten Glieder (12) angeordnet ist und mit einem Ende mit dem Kettentragglied (26) in Eingriff steht,

dadurch gekennzeichnet, daß das Kettentragglied an dem ersten Glied (12) angeordnet ist und ein Nockenglied (26) aufweist mit einer bogenförmigen Nockenoberfläche (33) daran ausgebildet und mit einem Endteil der Kette (17) herumgeführt um die Nockenoberfläche (33) in Lagerbeziehung damit, und mit einem ersten Arm (30) befestigt am Nockenglied (26), um sich von dort aus radial nach außen zu erstrecken, wobei der Endteil der Kette (17) am ersten Arm (30) befestigt ist, und wobei ein zweiter Arm (31) an dem Nockenglied (26) befestigt ist, um sich von dort aus radial nach außen zu erstrecken, und zwar umfangsmäßig versetzt gegenüber dem ersten Arm (30) und in Eingriff stehend mit dem Bolzen (35).

2. Mastanordnung einschließlich einer Vorrichtung nach Anspruch 1, wobei das erste Glied eine feststehende aufrechte Anordnung (12) aufweist und wobei das zweite Glied eine bewegliche Anordnung (15, 41') beweglich angeordnet auf der feststehenden aufrechten Anordnung (12) aufweist und wobei die Kette (17) einen Teil des Hubsystems (16) umfaßt.

3. Mastanordnung nach Anspruch 2, wobei die bewegliche Anordnung eine bewegliche aufrechte Anordnung (40) umfaßt.

4. Mastanordnung nach Anspruch 2, wobei die bewegliche Anordnung eine bewegliche Schlittenanordnung (41') umfaßt.

5. Hubstapler (10/10') mit einer Mastanordnung (11/11') nach den Ansprüchen 2, 3 oder 4, angeordnet nach vorne demgegenüber, wobei das Hubsystem (16) ferner mindestens einen Strömungsmittelzylinder (23) aufweist, der zwischen den feststehenden aufrechten (12) und beweglichen (15/41') Anordnungen verbunden ist.

6. Hubstapler (10) nach Anspruch 5 bei Abhängigkeit von Anspruch 2, wobei die bewegliche Anordnung (15) eine erste bewegliche aufrechte Anordnung (39) gliedend angeordnet an der festen aufrechten Anordnung (12) aufweist und mit einer zweiten beweglichen aufrechten Anordnung (40) gleitend angeordnet an der er-



sten beweglichen aufrechten Anordnung (39), wobei die Kette (17) an der zweiten beweglichen aufrechten Anordnung (40) verankert ist.

7. Hubstapler (10) nach Anspruch 6, wobei ferner ein Schlitten (41) gleitend an der zweiten beweglichen aufrechten Anordnung (40) angeordnet ist und mit Mitteln (43, 44) zur Bewegung des Schlittens (41) auf der zweiten beweglichen aufrechten Anordnung (40).

8. Hubstapler (10) nach Anspruch 5, wobei ferner eine bewegliche aufrechte Anordnung (39) gleitend an der festen aufrechten Anordnung (12) gelagert ist und wobei die bewegliche Anordnung eine Schlittenanordnung (41') aufweist, die gleitend an der beweglichen aufrechten Anordnung (39) gelagert ist, wobei die Kette (17) an der Schlittenanordnung (41') verankert ist.

Revendications

1. Dispositif pourvu d'un premier organe (12), d'un second organe (41/41') monté, en vue de mouvements de coulissement relatifs, sur ledit premier organe (12), et d'au moins une chaîne (17) dont une extrémité est ancrée sur ledit second organe (40, 41'), de moyens (19) pour ajuster la tension de ladite chaîne (17) en réponse à un mouvement sélectif d'au moins une extrémité de ladite chaîne (17) autour d'un axe de pivotement (A), comportant un organe support de chaîne (26) monté à pivotement sur l'un (12) desdits premier et second organes, et un boulon (35) vissé sur l'un (12) desdits premier et second organes et dont une extrémité met en prise ledit organe support de chaîne (26), caractérisé en ce que ledit organe support de chaîne est monté sur ledit premier organe (12) et comprend un organe formant came (26) sur lequel est formée une surface de came arquée (33), une partie d'extrémité de ladite chaîne (17) étant enroulée sur ladite surface de came (33) en relation d'appui avec celle-ci, un premier bras (30) fixé sur ledit organe formant came (26) pour s'étendre radialement vers l'extérieur depuis celui-ci, la partie d'extrémité de ladite chaîne (17) étant fixée audit premier bras (30), un second bras (31) fixé sur ledit organe formant came (26) pour s'étendre radialement vers l'extérieur depuis celui-ci, déplacé circonférentiellement à partir dudit

premier bras (30) et mis en prise par ledit boulon (35).

2. Ensemble formant mât comportant un dispositif selon la revendication 1, dans lequel ledit premier organe comprend un ensemble de montants fixe (12), le second organe comprend un ensemble mobile (15, 41') monté de manière mobile sur ledit ensemble de montants fixe (12), et ladite chaîne (17) comprend une partie du système de levage (16).

3. Ensemble formant mât selon la revendication 2, dans lequel ledit ensemble mobile comporte un ensemble de montants mobile (40).

4. Ensemble formant mât selon la revendication 2, dans lequel ledit ensemble mobile comporte un ensemble formant tablier mobile (41').

5. Chariot élévateur (10/10') pourvu d'un ensemble formant mât (11/11') selon les revendications 2, 3 ou 4 monté sur l'avant de celui-ci, le système de levage (16) comportant également au moins un vérin à fluide (23) interconnecté entre ledit ensemble de montants fixe (12) et ledit ensemble mobile (15/41').

6. Chariot élévateur (10) selon la revendication 5, lorsque celle-ci est dépendante de la revendication 2, dans lequel ledit ensemble mobile (15) comporte un premier ensemble de montants mobile (39) monté à coulissement sur ledit ensemble de montants fixe (12) et un second ensemble de montants mobile (40) monté à coulissement sur ledit premier ensemble de montants mobile (39), ladite chaîne (17) étant ancrée sur ledit second ensemble de montants mobile (40).

7. Chariot élévateur (10) selon la revendication 6, comportant également un tablier (41) monté à coulissement sur ledit second ensemble de montants mobile (40) et des moyens (43, 44) pour déplacer ledit tablier (41) sur ledit second ensemble de montants mobile (40).

8. Chariot élévateur (10') selon la revendication 5, comportant également un ensemble de montants mobile (39) monté à coulissement sur ledit ensemble de montants fixe (12) et dans lequel ledit ensemble mobile comporte un ensemble formant tablier (41') monté à coulissement sur ledit ensemble de montants mobile (39), ladite chaîne (17) étant ancrée sur ledit ensemble formant tablier (41').



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