Dec. 6, 1966 B. I. ULINSKI 3,289,791

HYDRAULIC RAM FOR LIFT TRUCK

Filed Nov. 1, 1963

Fig. 4.

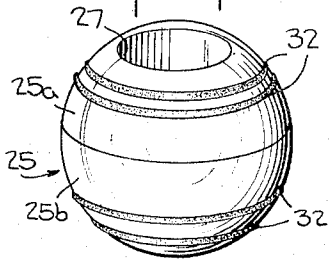


Fig. 1.

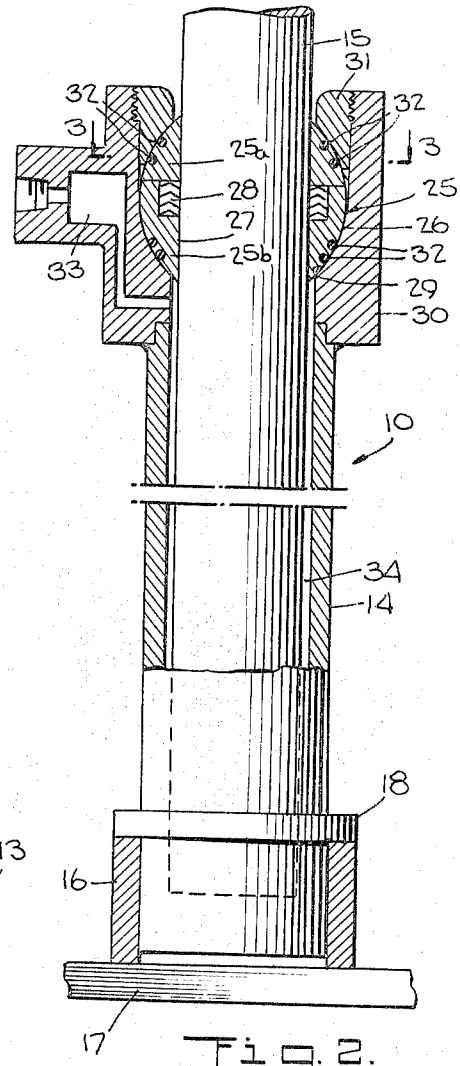
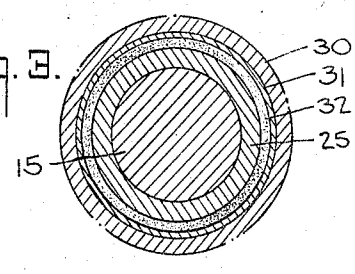


Fig. 2.

Fig. 3.



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HYDRAULIC RAM FOR LIFT TRUCK

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This invention relates to a hydraulic lift truck and more particularly, to a hydraulic ram for such a truck.

Lift trucks are commonly provided with vertical extendible uprights, a lifting load carriage mounted for vertical movement on the uprights, and a vertically extending hydraulic ram for extending the uprights and lifting the load carriage through a system of sheaves and chains or other means. When a conventional ram is used for extending the uprights and lifting the load carriage, lateral forces are imposed on the ram which cause stresses in the ram which may result in excessive wear of the ram or damage to the ram. In order to prevent such excessive wear or damage, it has been heretofore proposed to so mount the ram cylinder on the truck that the ram cylinder may move laterally to maintain a'ignment between the ram cylinder and the ram piston to prevent the setting up of stresses in the ram by lateral forces imposed on the ram. This, of course, requires a special mounting of the ram cylinder.

The patent to George F. Quayle, No. 2,791,292, further discusses the problem, indicating that the secondary uprights of an industrial truck will tilt somewhat under the weight of the load. The chains through which the ram lifts the load carriage then will exert a pull that is out of alignment with the primary uprights. The lift ram is mounted on the primary uprights and, therefore, the pull of the chains will impose lateral forces on the ram, acting in a direction to press the ram piston and cylinder away from aligned relation to each other. Lateral forces so acting will be accepted by those surfaces of the piston and cylinder that are in sliding contact, causing lateral stresses between the surfaces. As is standard in the art, the construction of the uprights on the trucks is quite rigid and will limit the tilting of the uprights to a normal amount under the load. Nevertheless, the uprights will deflect and tilt sufficiently so that the lateral forces will cause bearing stresses between the sliding surfaces of the ram piston and cylinder. Where there are merely stationary uprights that support the load carriage, the tilting of those uprights naturally will be less, but there will yet be sufficient tilting to cause the bearing stresses and those stresses are extremely injurious because they will result in undue wear and will damage the fluid seal of the lift ram.

Quayle attacked the problem by mounting a lift ram for pivotal movement, while guiding the ram by particular means so that the ram might act in an axial direction. The problem actually was recognized many years earlier and many lift trucks, as for example the one shown in Patent No. 2,428,223, were designed with lift rams that can move bodily so as to reduce as much as possible the lateral forces that must be accepted by the ram. Obviously, those earlier lift rams require special mountings. Moreover, the earlier constructions are not fully effective to eliminate lateral stresses between the ram cylinder and piston because those stresses must act in order to hold the cylinder and piston in axially aligned relation to each other.

The purpose of this invention is to provide a novel ram construction which eliminates the necessity of a special mounting for the ram cylinder, while at the same time providing the ram with greater protection against excessive wear or damage by stresses created by lateral forces imposed on the ram. To this end, the hydraulic ram of the invention is so constructed that the ram piston may give or yield freely in a lateral direction relatively to the ram cylinder thereby preventing the setting up of stresses in the ram between the ram piston and ram cylinder. This is accomplished by providing space or clearance between the inner wall of the ram cylinder and the outer surface of the piston and by providing a seal which is so mounted on the end of the cylinder that the seal and piston may pivot laterally relatively to the cylinder to allow the piston to tilt relatively to cylinder under lateral forces applied to the ram piston.

I have thus outlined rather broadly the more important features of my invention in order that the detailed description thereof that follows may be better understood, and in order that my contribution to the art may be better appreciated. There are, of course, additional features of my invention that will be described hereinafter and which will form the subject of the claims appended hereto. Those skilled in the art will appreciate that the conception on which my disclosure is based may readily be utilized as a basis for the designing of other structures for carrying out the several purposes of my invention. It is important, therefore, that the claims be regarded as including such equivalent constructions as do not depart from the spirit and scope of my invention, in order to prevent the appropriation of my invention by those skilled in the art.

In the drawing:

FIG. 1 is a partial side elevational view, partly in section, of a lift truck incorporating a hydraulic lift ram constructed in accordance with the invention;

FIG. 2 is a sectional view of the ram;

FIG. 3 is a sectional view taken on the line 3—3 of FIG. 2; and

FIG. 4 is a perspective view of the seal through which the ram piston extends and which may pivot with the piston relatively to the ram cylinder.

Referring to the drawings and in particular to FIG. 1, there is shown a lift truck T incorporating a hydraulic lift ram 10 constructed in accordance with the invention. The particular lift truck T illustrated in the drawings is of conventional construction and includes primary or stationary uprights 11 which are mounted on the truck, secondary or extendible uprights 12 which are mounted for vertical movement on the primary uprights 11 and a load carriage 13 mounted for vertical movement on the secondary uprights 12.

The lift ram 10 is positioned between the uprights and includes, as best shown in FIG. 2, a cylinder 14 which is mounted on the primary uprights 11 and a piston 15 which is secured to the upper end of the secondary uprights 12. The cylinder 14 is conveniently mounted on the primary uprights 11 through a ring or socket member 16 which receives the lower end of the ram cylinder 14. The ring or socket member 16 is secured to a cross brace 17 that extends between and is secured to the lower end of the primary uprights 11. The ram cylinder 14 is mounted on the primary uprights 11 by inserting the lower end thereof into the ring or socket member 16 until a collar 18, which is secured to the ram cylinder 14, rests on the upper surface of the ring or socket member 16, as shown in FIG. 2.

The upper end of the piston 15 is secured to the end of the secondary uprights 12 through a header member 19, shown in FIG. 1, which is secured to the upper end of the piston 15 and is also secured to a cross brace 20 which extends between and is secured to the upper ends of the secondary uprights 12. The header member 19 supports chain sheaves 21, and a pair of lift chains 22, which are anchored at one end to the load carriage 13, extend up and over the sheaves 21 and are attached at their other ends through adjustable coupling members

23 to an anchor member 24 which is secured to either the primary uprights or the ram cylinder 14.

With the arrangement as described, when the ram piston 15 is extended relatively to the ram cylinder 14, the secondary uprights are elevated relatively to the primary uprights 11 at the speed of the ram and the carriage 13 is elevated on the secondary uprights 12 through the lift chains 22 at twice the speed of the ram.

Referring now to FIG. 2, which shows the lift ram 10 in more detail, the upper end of the ram cylinder 14 is provided with a generally spherical seal member 25 having a spherical outer surface 26 and a bore 27 through which the ram piston slidably extends. The seal member 25 supports suitable packing 28 which extends into the bore 27 and engages the outer surface of the piston 15 to prevent leakage of oil between the seal member 25 and the piston 15. To facilitate the assembly of the packing 28, the seal member 25 is preferably formed of two complementary parts 25*a* and 25*b*.

The seal member 25 is rotatably mounted in a complementary spherical seat 29 formed partially in a collar member 30, which is secured to the upper end of the ram cylinder 14, and partially in an annular threaded bushing 31 which is removably threaded into the collar member 30 to permit assembly and disassembly of the seal 25. To insure that there is no leakage between the seal member 25, the collar member 30 and the threaded plug 31, the seal member 25 may be provided with O-ring seals 32 which seat in suitable grooves formed in the outer spherical surface of the seal member 25. The seal member 25 therefore prevents leakage of fluid from the cylinder 14 while allowing the piston 15 to be extended relatively to the cylinder by the introduction of fluid under pressure into the cylinder below the seal member 25. Fluid under pressure may be so introduced into the ram cylinder through a suitable passage 33 conveniently formed in the collar member 30 and communicating with the cylinder 14 below the seal 25.

Still referring to FIG. 2, it will be noted that the outer diameter of the portion of the ram piston which extends within the cylinder 14 is smaller than the inner diameter of the ram cylinder 14, so that substantial clearance or space 34 is provided between the outer surface of the ram piston 15 and the inner surface of the ram cylinder 14. This clearance or space, together with the mounting of the seal member 25 for universal pivotal movement relatively to the upper end of the ram cylinder 14, allows the piston 15 to tilt laterally in all directions relatively to the cylinder 14 when lateral forces are applied to the ram piston 15. Thus, when the upper end of the piston 15 is moved in a lateral direction by forward tilting of the secondary uprights 12, or for any other reason, during elevation of the secondary uprights 12 and the carriage 13, the piston 15 may tilt relatively to cylinder 14 so that lateral forces are not transmitted to the ram cylinder 14.

It will be noted that the permissible tilting of the piston 15 relatively to the cylinder 14 and the forward tilting of the secondary uprights both increase as the piston 15 and secondary uprights 12 are extended. Of course, the tilting never will exceed a certain amount because the uprights actually are designed to extend vertically. The tilting is merely that which is allowed by the tolerances of the construction and incidental to the deflection caused by the load.

The clearance 34 between the ram piston 15 and the inner surface of the ram cylinder 14 is adequate to allow the piston and cylinder to remain out of contact when the uprights tilt an amount which is caused by the tilting of the uprights. Therefore, the piston does not slide on the inner surface of the cylinder and this

surface of the ram cylinder 14 does not have to be finely finished, thereby providing a less expensive ram structure.

From the preceding description, it can be seen that there is provided a novel ram structure which eliminates the necessity of a special mounting of the ram cylinder while at the same time protecting the ram against excessive wear and damage by lateral forces imposed thereon. While one form of the invention has been shown and described, it will be appreciated that this is for the purpose of explanation and illustration and that changes and modifications may be made therein without departing from the spirit and scope of the invention.

I now claim:

1. In an industrial truck, stationary uprights, extendible uprights mounted for vertical movement on said stationary uprights, said extendible uprights tilting a limited amount in a lateral direction relatively to the truck due to the lateral force caused by the weight of a load supported on said extendible uprights, a load carriage mounted for vertical movement on said extendible uprights, a vertically extending hydraulic ram having a cylinder part and a piston part extendible by hydraulic pressure relatively to said cylinder part, means mounting one of said parts of said ram in position aligned with and fixed relative to said stationary uprights on said stationary uprights, connecting means operatively connecting the other of said parts to said extendible uprights and load carriage whereby relative extension of said parts effects extension of said extendible uprights and elevation of said load carriage, said lateral force being transmitted through said connecting means to tilt said other part of the ram in a lateral direction relatively to said one part when the extendible uprights tilt, said piston part of said ram being sufficiently spaced from the wall of said cylinder part whereby said piston part and cylinder wall will remain out of contact with each other while the extendible uprights tilt their limited amount, a seal member in fluid sealing relation to said piston part, and means on said cylinder part mounting said seal member for pivotal movement relatively to said cylinder part whereby said piston part and seal member may pivot together relatively to said cylinder part to allow lateral tilting of said piston part during extension of said ram.

2. A construction as set forth in claim 1, in which said one part of the ram that is mounted on the stationary uprights is said cylinder part of the ram, said piston part being the part that said connecting means connect to the extendible uprights.

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