April 15, 1969 A. M. VIK 3,438,669

CLAMP MECHANISM FOR A LIFTING IMPLEMENT

Filed Jan. 16, 1967 Sheet 1 of 2

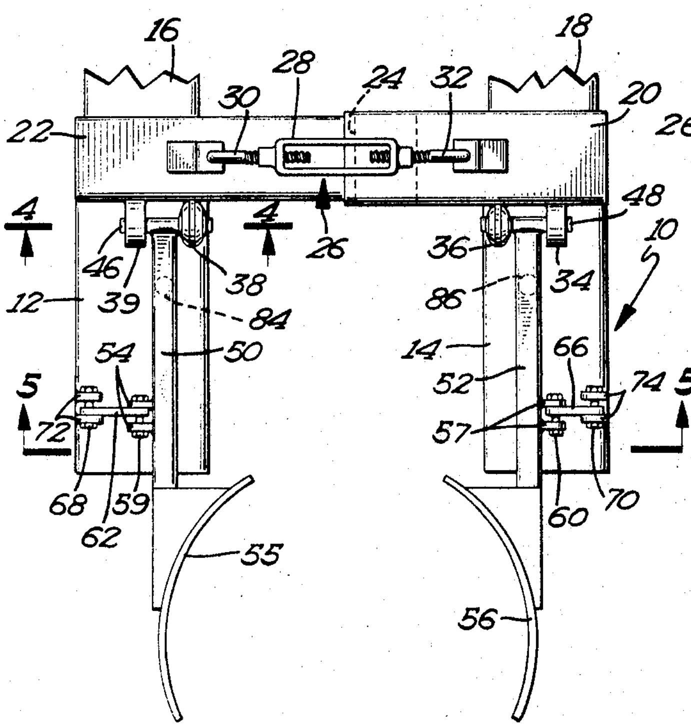

FIG 1

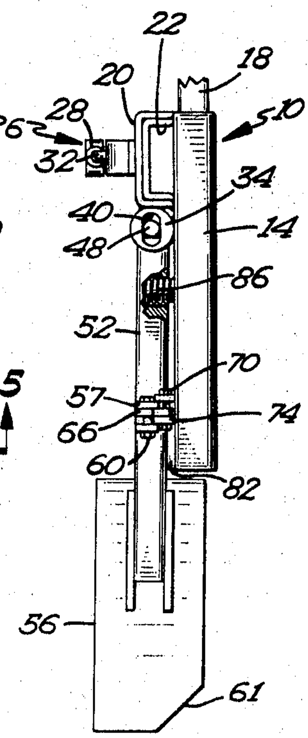

FIG 2

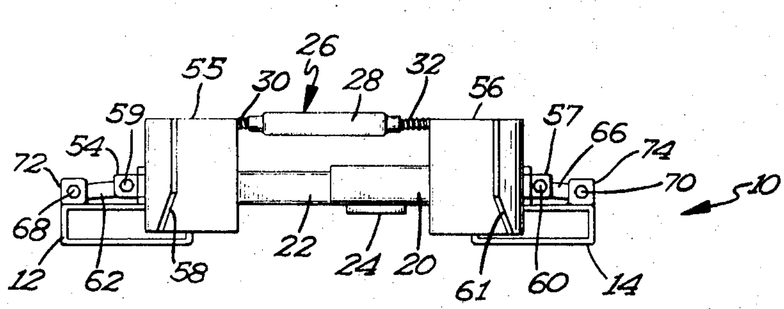

FIG 3

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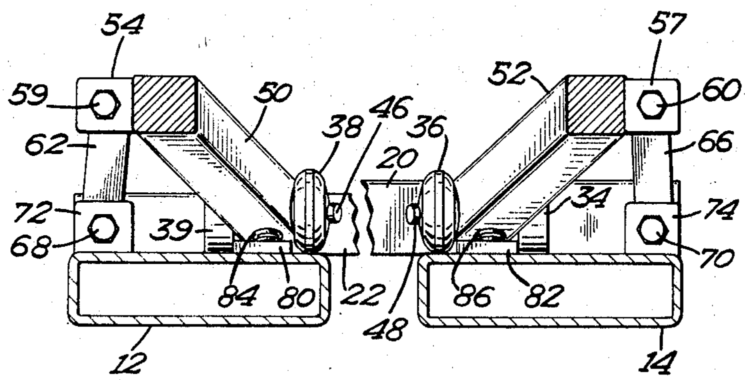

FIG 5

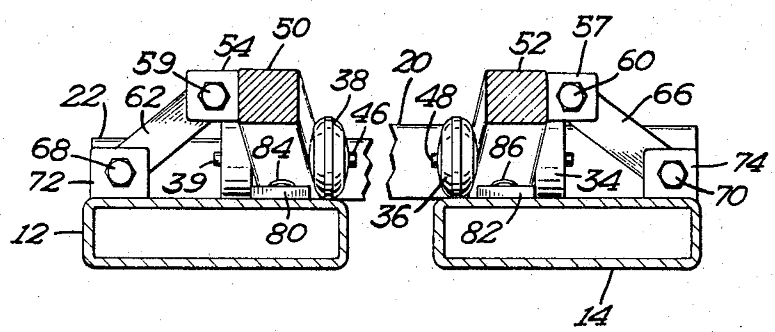

FIG 6

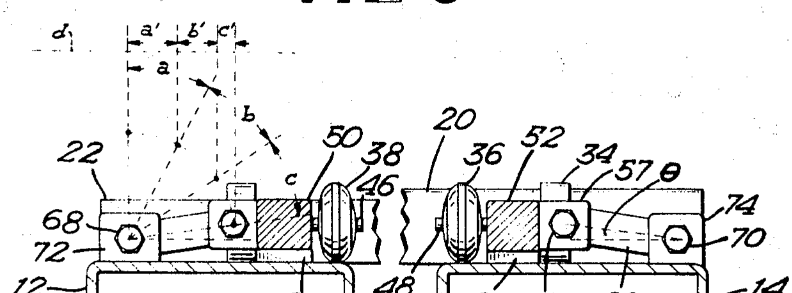

FIG 7

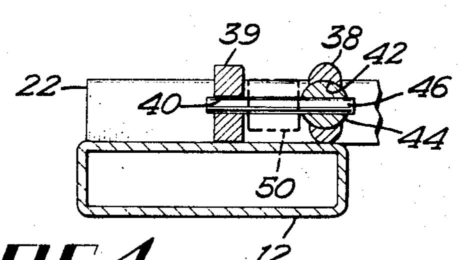

FIG 4

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United States Patent Office 3,438,669
Patented Apr. 15, 1969

3,438,669

CLAMP MECHANISM FOR A LIFTING IMPLEMENT

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Filed Jan. 16, 1967, Ser. No. 609,394
Int. Cl. B66c *1/30;* B66f *9/06, 9/18*
U.S. Cl. 294—90 9 Claims

ABSTRACT OF THE DISCLOSURE

A mechanical clamp apparatus for a lifting implement composed of a framework to which a pair of horizontal parallel arms are pivotally secured at their rearward ends. A jaw is mounted on the forward end of each arm and a link extends toward the side from each arm and is pivotally connected at its free end to the framework to confine the movement of the arms and jaws to an arcuate path extending centrally then downwardly so that the downward pressure of an object on the jaws causes the jaws to move toward one another against the object with a pressure greatly exceeding the weight of the object.

Clamp mechanism for a lifting implement

The present invention relates to article handling implements and more particularly to a clamp mechanism of the type to be used on an implement having an article supporting member adapted to raise and lower articles as they are transported from one location to another. The invention is particularly useful in connection with fork lift trucks and the like.

In many of the prior clamps of the type used in connection with a material handling implement such as a lift truck, the entire fork mechanism on the lift truck must be removed and replaced by the clamp mechanism. Making this change, of course, requires a substantial amount of time and effort. It also necessitates the attention of a skilled operator or mechanic for removing the forks and replacing them with the clamp mechanism. A further shortcoming of prior equipment of the type described is the fact that they occupy so much of the area in front of the lift truck that they obstruct the operator's vision.

In order to reliably transport a variety of articles using a clamp of the general type described without significant danger that the article being transported will inadvertently fall from the clamp mechanism, it is essential to obtain adequate clamping pressure. At the same time, jaws of the clamp must move apart a sufficient distance to easily clear the sides of the load when the jaws are being engaged as well as when the jaws are being disengaged from the load.

It has been proposed, in the Moss Patent No. 3,180,512, to provide a clamp mechansim for a lift truck composed of members adapted to engage the forks at their lower ends, a plurality of spaced columns connected by cross braces and beam members to provide a rigid rectangular framework. A pair of pivots are provided on the forward ends of the framework, an arm member mounted on each pivot and inclined guides are placed at the rearward end of the framework for receiving the rearward ends of the arms. In operation, downward pressure of the load is transmitted to the portion of the arms extending through the guides which because of their inclined position force the jaws toward one another in direct proportion to the weight of the object being lifted. These prior devices are relatively bulky and employ numerous parts which have been eliminated in the invention. Moreover, the clamping pressure is often inadequate. This deficiency can be especially troublesome when relatively heavy objects are being carried or when the side walls of the object are formed from a rigid material having a particularly smooth surface. It will also be noted that while increasing the angle of the guides will increase the clamping pressure, the distance the jaws move apart is reduced by a proportional amount. This is, of course, undesirable particularly where cylindrical or irregularly shaped objects are to be carried. It will also be seen that ball bearings or other friction-reducing means must be used at the rearward end of the arms to prevent excessive friction in the guides.

Another shortcoming of the prior art is the inability of the clamp mechanism to easily accommodate objects of different widths or at best to accommodate objects having certain predetermined sizes as for example 22 inches, 24 inches, 26 inches, in short, objects having predetermined size differences.

Still a further disadvantage of the prior art is the inability in a mechanical type clamp as opposed to a hydraulic or other power actuated clamp of varying the clamping pressure. Thus, in accordance with the Moss patent the clamping pressure is determined by the angle of the inclination of the guides and the weight of the object being carried. Accordingly, there is no opportunity for varying the clamping pressure to suit the circumstances under which the clamp is being used.

A further problem encountered in some of the prior mechanical type clamping mechanisms is the difficulty occasionally encountered in engaging the clamp members over the object that is to be carried. Thus, if the full weight of the clamp arms must be overcome to move the clamps to their upward disengaged position, it often requires considerable effort and skill on the part of the operator to force the jaws to the upward or disengaged position by engaging them with the object that is to be carried.

A still further shortcoming of some of the prior mechanical clamp mechanisms of the type described is the lack of a secure connection between the load-carrying arms and the framework of the clamp. In some cases, the pivotal connection between these members allows the arms to be shifted a short distance on the longitudinal axis of the clamp mechanism.

In view of the deficiencies of the prior art, it is thus one object of the present invention to provide an improved mechanical type clamping mechanism for load lifting and transporting implements which is characterized by being rugged in construction, reliable in operation and capable of being manufactured at a relatively low cost.

Another object is to enable the clamping pressure to be varied in accordance with the particular operating conditions encountered.

A further object of the invention is the provision of an improved clamping mechanism of the type described which can be adjusted laterally for a continuous infinite number of width settings whereby an object of any width can be easily accommodated.

A still further object of the present invention is the provision of an improved mechanical clamping mechanism of the type described wherein the clamping pressure can be varied as required.

A further object of the invention is to provide an improved mechanical clamp of the type described having the capacity to provide a relatively high clamping pressure while at the same time the jaws are free to move a sufficient distance laterally.

These and other more detailed and specific objects of the invention will be apparent in view of the accompanying specification and drawings wherein:

FIGURE 1 is a plan view of an apparatus embodying the invention.

FIGURE 2 is a side elevational view of the apparatus of FIGURE 1.

FIGURE 3 is a front elevational view of the apparatus.

FIGURE 4 is a partial transverse sectional view taken on line 4—4 of FIGURE 1.

FIGURE 5 is a transverse sectional view of the apparatus taken on line 5—5 of FIGURE 1 on a somewhat enlarged scale with the clamp arms in their raised position.

FIGURE 6 is a view similar to FIGURE 5 showing the clamp arms in a partially lowered position.

FIGURE 7 is a view similar to FIGURE 6 showing the clamp arms in their lowered position.

To the accomplishment of the foregoing and related ends, the invention then comprises the features hereinafter described in the specification setting forth one preferred form of the invention by way of example.

As can be seen in the figures, particularly FIGURES 1, 2 and 3, there is provided a supporting framework indicated generally at **10** composed of parallel longitudinally extending and horizontally disposed tubular members **12** and **14**. The member **12** is provided with side, top and bottom walls to provide a generally rectangular transverse cross section as seen in FIGURE 3. Member **14** is similarly constructed. Each of members **12** and **14** has an opening at the rearward end into which a portion of the lift truck (not shown) in this case the forks **16** and **18** are inserted. It should be understood that the portions of the forks **16** and **18** shown in the drawings are the horizontally disposed portions of the fork. Accordingly, the members **12** and **14** engaged upon and conforming to the forks **16** and **18** will also be disposed horizontally. Since the lift truck forks are well known, they will not be described in further detail herein.

During operation when the clamp apparatus of the present invention is to be used, the forks **16** and **18** are first lifted from about 1–2 inches from the ground. Their forward ends are then inserted into the openings at the rearward ends of the support members **12** and **14**. When the forks have been fully inserted they are raised the desired distance from the floor. The apparatus is then ready for use.

To the rearward end of the support member **14** is rigidly secured a transversely extending slide member **20** including a horizontally disposed upper section and downward extending side walls. A similar member **22** rigidly secured as by welding to the rearward end of the frame member **12** and is telescopically mounted for transverse sliding movement within the member **20** as can be best seen in FIGURE 2. To maintain proper orientation between parts **20** and **22**, a retainer such as a plate **24** is welded across the bottom of the slide **20**. Connected between the members **20** and **22** is a turnbuckle **26** composed of the usual center section **28** threaded upon bolts **30** and **32** which are affixed to the slide members **22** and **20** respectively. The pitch of the threads for each bolt is in the opposite direction as usual so that rotation of the member **28** will either cause the bolts to move toward one another or to move apart. As the bolts are thus moved, the slide members **20** and **22** will move accordingly as will the frame members **12** and **14**.

Suitably affixed, as by welding, to the rear of each of the frame members **12** and **14** and to the front of the slide members **20** and **22** are two pairs of laterally aligned bearing blocks **34** and **36** and **38** and **39**, the outer ones of which are provided with horizontally disposed transversely extending slots **40**, the long axis of which is oriented longitudinally of the framework, i.e. parallel to the axis of the fork engaging frame members **12** and **14** (FIGURES 2 and 4). Within the bearings **36** and **38** are provided spherical sockets **42**. In each socket is mounted a ball **44** with sufficient clearance to enable the ball to move freely. Pivot pins **46** and **48** extend through the left and right pairs of blocks respectively. To the pin **46** is secured the rearward end of a longiutdinally extending generally horizontally disposed clamp arm **50** and to the pin **48** is secured the rearward end of a longitudinally extending horizontally disposed clamp arm **52**. A pair of jaws **55** and **56** are secured to the forward ends of the arms in any convenient manner. The lower forward segment of each of the jaws **55** and **56** is cut away at a 45° angle as shown at **58** and **61** respectively.

To the side of the arms **50** and **52** are rigidly secured laterally extending longitudinally spaced flanges **54** and **57** respectively. Pins are connected between these flanges and a pair of links **62** and **66** are connected for pivotal movement thereon about a longitudinal axis. The links are connected at their outward ends to pins **68** and **70** which are themselves rigidly affixed to the frame members **12** and **14** respectively by the provision of vertically extending longitudinally spaced pairs of flanges **72** and **74**. As can be seen the flanges **72** and **74** are positioned somewhat rearwardly of the flanges **54** and **57**. The pins and links may be thought of as a means for connecting each arm at a point between its rearward end and the jaw for upward and outward swinging movement about a radius having its center spaced laterally of the arm when the arm is in its lowered position.

Secured rigidly on the free ends of the members **12** and **14** beneath each of the arms **50** and **52** are support plates designated **80** and **82** in FIGURES 5, 6 and 7. The plates **80** and **82** have an appropriate thickness to hold the arms such that the links **62** and **66** are inclined upwardly proceeding toward the center of the apparatus at a slight angle designated θ in FIGURE 7. θ can be any small angle. In practice, an angle of about 5° has been found satisfactory. The links are prevented from falling below a horizontal position in order to prevent the load from achieving an over center position which, if allowed to occur, would make the load difficult to release.

As seen in FIGURES 1, 2, 5 and 6, a resilient means such as identical springs **84** and **86** are positioned between the arms and the fork engaging members for biasing the arms upwardly. Springs **84** and **86** do not, however, have sufficient force to elevate the arms but merely exert a force sufficient to counterbalance a portion of the weight of the arms and jaws. Thus, the arms will normally rest on the plates **80** and **82**. When, however, an object is to be loaded, I have found that by counterbalancing a portion of the load as described, the arms can be much more easily shifted from the lowered to raised positions when engaged in the sides of the object being loaded. This advantage proved highly beneficial in allowing loads to be easily and quickly grasped by the clamp.

The operation of the apparatus will now be described. As a first step, the forks **16** and **18** are inserted as described at the beginning of the application. The turnbuckle **28** is turned so that the jaws **55** and **56** are spaced apart the proper distance to accommodate the object that is to be handled. The lift truck is then driven forwardly until the cut edges of the jaws contact the sides of the object that is to be loaded. When this contact has been made, the forks **16** and **18** are lowered slightly so that the jaws **55** and **56** will be elevated relative to the frame members **12** and **14** as the arms **50** and **52** pivot about the pins **46** and **48** until the position of FIGURE 5 is achieved. In this position it will be seen that the jaws are spaced relatively far apart. This is because the arms and jaws travel in a horizontal direction during the last portion of the arc about the pins **68** and **70**.

As can be best seen in FIGURE 6 in which arcs of equal size are described about pivot **68** as a center, the vertical projection of the uppermost arc a on a horizontal line d defines a horizontal distance of travel a'. However, as the arm moves downwardly through an arc b equal in size to arc a, the vertical projection d' on horizontal line d will be substantially smaller than the projection a'. Similarly, the projection c' of the arc c is very much smaller than the projection b'. It can thus be seen that in the last portion of their upward movement the arms are directed laterally. On the other hand, by virtue of the alignment of the links **62** and **66** between the jaws and the pivots **68** and **70**, the clamping force on the object suspended between the jaws is many times the downward force exerted by the object itself on the jaws. Accordingly, very high clamping forces can be achieved. It should be noted that the ball and socket joints **42** and **44** universally connect the arms to the framework while at the same time the outward ends of the pins **46** and **48** extending through the slots prevent rotation of the arms about their own axes.

For proper operation, the arms should be in contact with the plates **80** and **82** when a load is placed on the jaws. However, if they are almost in contact with the plates but spaced slightly from them, performance will almost always be satisfactory. On the other hand, if the arms are substantially off the plates, say one inch above them, it may be possible for the load to shift. The preferred practice is therefore to keep the arms in contact or almost in contact with the plates **80** and **82**. This is done with the turnbuckle **26**.

Frequently, the clamping pressure must be either increased or decreased to suit the circumstances encountered. To make this adjustment, e.g. to increase the clamping pressure, the turnbuckle member **28** is turned appropriately to draw the members **12** and **14** toward one another. When this is done, the load being carried will be partially supported by the plates **80** and **82** and partially by the links **62** and **66**.

When the entire weight of the load is just supported by the links, clamping pressure will be maximized. Care should be taken not to elevate the arms substantially above the plates **80** and **82** for the reasons given above. If the clamping pressure is to be decreased, the turnbuckle **28** is turned in the appropriate direction to force the members **12** and **14** apart, but the jaws should not be separated sufficiently so that the load is released altogether. When this adjustment is made, the load will be shifted to plates **80** and **82**. Accordingly, the clamping pressure exerted upon the object by the jaws will be decreased.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof. The specific embodiments described are given by way of example only.

I claim:

1. A clamp mechanism for lifting implement comprising in combination a supporting framework, horizontally disposed and forwardly extending arms connected to the framework by means of a universal joint at their rearward ends so that the forward ends are free to move between releasing positions spaced relatively far apart and engaged positions spaced relatively close together, jaws on the forward ends of the arms for engaging a load and link means connecting the forward ends of the arms and the framework for upward and outward swinging movement of the arms and jaws relative to the framework about two radii having centers spaced laterally of each arm when the arm is in its lowered engaged position whereby the downward force of the load on the jaws will force the jaws toward one another as the arms swing through an area defining a portion of the surface of a cone thereby clamping the load in its engaged position between the jaws.

2. The apparatus of claim **1** wherein said radii are defined by links connected to each arm at one end and to the said framework at the other end at a point located between the rearward of the arms and the jaws.

3. The apparatus according to claim **1** wherein the rearward ends of the arms are pivotally and universally connected to the supporting framework and a means is provided for preventing rotation of the arms on their own axes.

4. The apparatus according to claim **3** wherein a ball and socket joint is connected between the rearward end of each arm of the supporting framework, a bearing means is supported upon a framework laterally of each arm, each such bearing means having a horizontally disposed longitudinally extending slot therein and means secured to the rearward end of each arm extends through one such slot to thereby prevent rotation of each arm on its own axes.

5. The apparatus according to claim **3** wherein a pair of laterally spaced aligned bearing blocks is provided on the framework at the rearward end of each arm, a pin is secured to the rearward end of each arm and each such pin extends through one pair of said bearings, one bearing of each pair including a ball and socket joint having said pin extending therethrough and the other bearing of each pair includes a horizontally disposed elongated slot, the opposite end of the pin from the ball and socket joint being positioned in said slot and the axis of each slot being oriented along the longitudinal axis of the clamp whereby the arms are universally mounted at their rearward ends and prevented from rotating on their own axis by the engagement of the pin in the slot.

6. The apparatus according to claim **1** wherein said supporting framework is composed of two portions adapted to slide toward and away from one another on a lateral axis, one said arm being mounted on each portion and a means is provided for moving the two portions of the frame together or apart on said axis and for locking the two frame portions in selected positions on said axis whereby the spacing between the jaws in their clamped position can be varied as required.

7. The apparatus according to claim **6** wherein the means for changing the position of the frame portions comprises an adjustable retainer means for securing the portion of the framework in a continuous infinite number of positions whereby the jaws can be moved to a continuous infinite number of width settings and the pressure exerted by the jaws upon the object being carried can be adjusted as required.

8. The apparatus according to claim **1** wherein a resilient means is operatively connected between the framework and the arms for biasing the arms toward an upward position with sufficient force to partially counterbalance the weight of the arms and jaws.

9. The apparatus according to claim **1** wherein a pair of flanges are secured at the outside edge of each of the arms, pins are secured between the flanges, links extend from the pins laterally, the free ends of the links are connected between a pair of flanges rigidly secured to the supporting framework and the pairs of flanges secured to the supporting framework are positioned slightly rearwardly of those connected to the arms whereby the arms will be free to swing upwardly and outwardly with no tendency for the links to bind on the pivots.

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U.S. Cl. X.R.

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