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CLAMPING MECHANISM FOR LIFT TRUCKS

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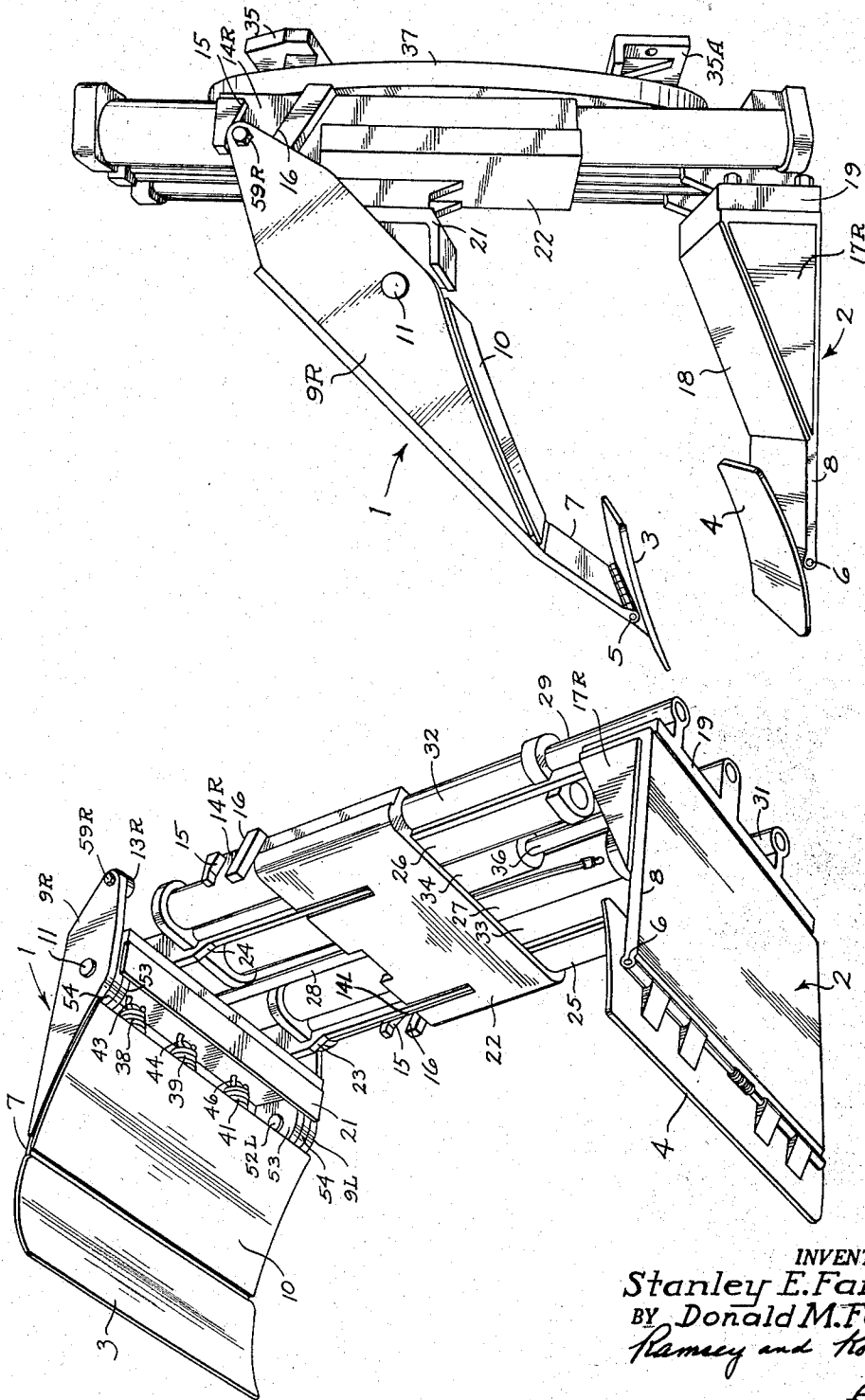


Fig. 2.

Fig. 1.

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CLAMPING MECHANISM FOR LIFT TRUCKS

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8 Claims. (Cl. 214—652)

The present invention relates to a pair of gripping means and more particularly to a slidably actuated clamping attachment for lift trucks adapted to handle articles of widely differing diameters or thicknesses.

The invention comprises a pair of coactable arms which are adapted to be moved together, and at an accelerated rate as the arms reach a certain relative spacing, in a manner to handle most expeditiously a wide variety of article sizes. An embodiment features one arm adapted to be pivoted toward the other by means of a cam-pivoting device. The relative movement provided for in the arms facilitates the handling of such articles as paper rolls, which are subject to considerable variations in diameter depending upon the amount of paper carried by the rolls.

A feature of our invention resides in a combination wherein one of the arms has means associated therewith for accelerating movement of the clamping portion of the arm toward the other arm when the arm is caused slidably to approach the other during the gripping cycle. The construction is such that the pressure exerted by the arms is greatest when they are fully extended, as required by the largest loads. This relative movement of the arms may be produced by incorporating pivot means on one of the arms which enable it to pivot toward the other after a certain amount of movement toward the other arm, and cooperating means on the frame structure carrying the arm to trigger the pivoting of the arm as it approaches within a predetermined distance of the other arm.

The slidably arms provided by the invention make possible off-the-floor handling of the small diameter rolls with no sacrifice in maximum roll range.

An embodiment of the pivoting combination resides in utilizing a cam follower on the pivotally mounted arm which cooperates with or is triggered by a cam recess on the frame, the cam recess being positioned in the path of travel of said follower. Thus, when the pivotally mounted arm is caused slidably to approach the other arm, the cam follower enters the cam recess which triggers the arm to pivot towards the other arm.

The pivotally mounted arm is preferably featured with biasing means about the pivot adapted to bias the arm in a direction opposite the pivoting direction. Thus, when the pivotally mounted arm is being retracted from the other arm, the cam follower moves along the cam recess until it finally leaves it whereupon the biasing means takes over and further retracts the arm pivotally until it assumes a transverse position substantially perpendicular to the plane of the supporting frame. In this position, the arm can be further slidably separated from the other as will be shown hereinafter.

The slidably arm combination is capable of use with revolving frame attachments of known construction so that the arms can be rotated for upending or inverting heavy cylindrical shapes.

Evenly distributed pressure is capable of being supplied to cylindrical surfaces by means of concave pressure pads pivotally mounted on the grasping end of the arms, the

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pressure pads being pivotally biased in one direction by means of a spring thus enabling the pressure pad to yield pivotally when adjusting to the curved surface of an article to be grabbed.

These and other features of the invention will more clearly appear when taken in conjunction with the following description and the drawings wherein:

Fig. 1 is a three-dimensional representation of the slidably arm assembly, with parts of the mounting structure removed, showing the arms of the assembly in an extended position;

Fig. 2 is another view of the assembly, showing the arms of the assembly in a contracted position;

Fig. 3 is a side view of a pivoting arm employed in the assembly, showing details of construction; and

Fig. 4 is a detailed plan view of the pivoting arm of Fig. 3.

Referring to the drawings, Figs. 1, 2 and 4 show an embodiment of the slidably arm assembly of this invention comprising arms 1 and 2 with pressure pads 3 and 4 pivotally mounted at the outer grasping ends of the arms at 5 and 6, respectively. The arms comprise thinly contoured plate portions 7 and 8 which enable the arms to get into a tightly stacked pile of cylindrical articles. Pivoting arm 1 is made rigid by side plates 9L and 9R and bottom plate 10, the space within the arm between the side plates and bottom plate being provided with extensible springs for biasing the arm about a pivot 11. The inner end of pivoting arm 1 has a pair of cam followers 13L and 13R, disposed one on each side of the arm, and adapted to travel in a pair of cam recesses 14R and 14L. With reference to cam recess 14R, the recess is defined by cam shoulders 15 and 16, shoulder 15 extending inwardly toward the mounting for the assembly a shorter distance than shoulder 16 so that as cam follower 13R travels down the cam recess towards the rear during upward pivoting of arm 1, it rides out from under shoulder 15, thus enabling arm 1 to free itself of the camming action of shoulders 15 and 16 and open out horizontally to the position shown in Fig. 1.

Referring again to Fig. 2, non-pivoting arm 2 is likewise made rigid by means of side plates 17R and 17L (not shown), and top plate 18. Non-pivoting arm 2, comprising plate portion 8, side plates 17R and 17L, and top plate 18 is rigidly secured to a lower mounting portion 19. Pivoting arm 1, comprising plate portion 7, side plates 9L and 9R, and bottom plate 10, is pivotally connected at pivot 11 to an upper mounting portion generally indicated at 21. Lower and upper mounting portions 19 and 21 are each slidably mounted for reciprocal movement toward and away from each other in a frame support generally indicated at 22, and suitable power means are provided for moving the mounting portions in this manner.

In the embodiment illustrated, upper mounting portion 21 has affixed to its inner edge a pair of guide bars 23 and 24 slidably contained in a pair of cylindrical guide tubes or means 25 and 26. The power means for sliding the mounting portion within the path defined by these guide bars and guide tubes comprises an hydraulically operated double acting piston-cylinder device having a cylinder 27 carried by the frame structure and a piston rod 28 connected at its outer end to upper mounting portion 21. In a similar manner, lower mounting portion 19 has affixed to its inner edge a pair of guide bars 29 and 31 slidably contained in a pair of cylindrical guide tubes or means 32 and 33. The lower mounting portion is slidably reciprocated within the path defined by bars 29, 31 and tubes 32, 33 by a second double acting piston cylinder device having a cylinder 34 carried by the frame structure and a piston rod 36 connected at its outer end to the lower mounting por-

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tion. Guide tubes 25 and 26 and guide tubes 32 and 33 constitute retainer means mounting the upper and lower arms on the frame and retaining the arms on the frame.

Attached to the frame is a circular member 37 containing bearing races and conventional mechanism interposed between circular member 37 and a pair of mounting brackets 35 and 35A which enable the entire sliding arm assembly and frame support 22 to revolve relative to the mounting brackets by actuation of suitable hydraulic motors such as hydraulic cylinders, not shown as details of this mechanism are not necessary to the understanding of the invention. Mounting brackets 35 and 35A are adapted to be fixed to the lifting device carried at the forward side of a conventional lift truck or similar device.

Suitable control apparatus is included for governing the rotation of the sliding arm assembly as provided for by circular member 37, and the reciprocation of the mounting portions 19, 21 in the paths defined by their associated guide bars and guide tubes. Details of this control apparatus and the manner of its actuation are not necessary to the understanding of this invention and it is obvious that the control mechanism employed may take any of a variety of different forms.

The construction of pivoting arm 1 is shown in more detail in Figs. 3 and 4. Within the framework of the arm defined by plates 10, 9L and 9R are located three tension springs 38, 39 and 41, hooked to a back plate 42 carried by upper mounting portion 21 at 43, 44 and 46, respectively. The forward end of the springs are connected to eye bolts 47, 48, 49, respectively, which are bolted on to a bar 51 secured in a suitable manner to plate 10. The arm is pivoted at point 11 with respect to the upper mounting portion 21 on two pivot pins 52L and 52R. The pivot connections on either side of arm 1 are similar, and only one will be described. With reference to the pivot connection at pivot pin 52R, the pivot pin extends between side plate 9R and an end support plate 53 which is fixed to and interposed between plates 7 and 10. Between side plate 9R and end support plate 53, and pivoted about pin 52R, is a plate extension 54. Plate extension 54 is rigidly secured, as by welding to back plate 42 of upper mounting assembly 21. Pin 52R is fixed in position by keeper 56 and cap screw 57.

Cam followers 13L and 13R are secured to rear extensions of side plate 9L and 9R by conventional means, such as bolts 59L and 59R.

At the forward end of arm 1, concave pressure pad 3 is pivotally mounted at 5 by a pivot pin 61 extending substantially the entire width of the pad, the pad being biased in one direction by a biasing spring 62. Pivot pin 61 projects through a series of webs 63, integral with the top of the pressure pad. Thus, pad 3 is articulated with respect to plate 7 thereby enabling it to grip uniformly the round surface of a cylindrical body. The pad is generally covered with a durable high friction surface for positive handling with minimum clamping pressures. Pad 4 carried by nonpivoting arm 2 is pivotally mounted to arm 2 in a manner similar to the pivotal mounting of pad 3.

The purpose of the springs 38, 39, 41 is to bias pivoting arm 1 about pivot pins 52L and 52R of pivot 11, when cam followers 13L and 13R are free of their respective cam recesses. The operation may best be seen with reference to Figs 1 and 2, which illustrate two extreme positions of arms 1 and 2. In Fig. 1, upper and lower mounting portions 19, 21 have been moved a maximum distance apart and cam followers 13L and 13R of arm 1 are free of their respective cam recesses 14L and 14R, so that arm 1 is biased horizontally to give it a maximum amount of spread with respect to arm 2. In Fig. 2, the upper and lower mounting portions 19, 21 have been moved together, and arm 1 is pivoted downward by virtue of cam followers 13L and 13R having contacted the rear ends of their respective recesses dur-

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ing downward motion of upper mounting portion 21. The camming action produced by the cam followers engaging the recesses causes arm 1 to pivot about pivot 11, against the biasing action of the tension springs.

The combination of slidably mounted upper and lower mounting portions, and pivoting arm 1 pivotally connected to one of these mounting portions, enables the apparatus of this invention conveniently to handle a wide variety of load sizes. For instance, mechanism may be produced according to this invention which will easily handle rolls varying from less than 10 inches to as much as 60 inches or more in diameter.

Variable load sizes may be handled readily without contributing to the over-all space requirements of the mechanism. Clamping mechanisms for lift trucks preferably should be compact in order to accommodate movement of the lift truck in the confined areas frequently encountered in warehouses, store rooms, etc. Clamping mechanisms having gripping arms which are adapted to be spread apart any appreciable distance must employ guide structure of considerable length if sufficient rigidity and clamping action is to be attained in the gripping arms of the mechanism. Thus, in the position of the parts as shown in Fig. 1, that is the extended position of the mechanism, the guide bars should project a substantial distance into their associated guide tubes if this rigidity is to be maintained. Because of the length of the guide bars, when the gripping arms are moved together, the inner ends of the guide bars tend to move toward and if movement were to be continued, outside the peripheral outline of frame 22.

Movement of the ends of the guide bars beyond the outline of the frame structure is undesirable as this tends to increase the over-all length of the mechanism when small diameter loads are handled. The length of the frame structure is usually carefully selected so that it is less than the lateral dimensions of the lift truck to permit it to be carried transversely of the lift truck without extending beyond the sides of the trucks. Therefore, guide bars which have their ends protruding beyond the frame structure have the effect of severely limiting the maneuverability of the lift truck. Further, protrusions of the guide bars beyond the frame structure seriously hamper pickup of loads such as horizontal rolls lying upon the floor, as the protruding ends prevent the lower gripping arm, as exemplified by arm 2 in Fig. 2, from being positioned adjacent the floor.

In the clamping mechanism described herein, the stroke of the piston-cylinder device associated with the nonpivoted arm limits movement of this arm upwardly beyond a position which is substantially flush with the lower end of frame structure 22. This is done so that the frame structure will not interfere with placing the arm adjacent the floor when it is desired to pick up articles such as horizontal paper rolls. The stroke of the piston-cylinder device associated with the pivoted arm limits movement of this arm downwardly from the position it occupies in Fig. 2, the ends of the guide bars for this arm lying proximate the lower end of the frame when the pivoted arm occupies this position.

The clamping mechanism contemplated herein enables small article sizes to be picked up without decreasing the maneuverability and versatility of the mechanism, as the gripping arms may be moved together to a considerably greater extent than is possible with conventional sliding arm assemblies. The pivotal arm is pivoted only after it has been moved a predetermined distance towards the other arm. This distance depends upon the positioning of cam shoulder 16 on the frame or other place. Cam 16 is positioned so that arm 1 is pivoted after coming substantially within the peripheral outline of frame 22 and before it has progressed downwardly in the frame to such an extent as to cause the guide bars for the arm to project outwardly from the lower end of the frame.

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It should be noted that movement of the end of the pivoted gripping arm towards the other arm is accelerated for a given degree of movement of the fluid motors actuating the arms when the cam followers associated with the pivoted arm engage their respective cam recesses. This concept of accelerated relative movement of the ends of the arms toward one another after the arms reach a certain relative position is of considerable importance, providing as it does for greater relative movement of the clamping portions of the arms than is present in mounting portions 21 carrying the arms. This greatly increases the range of minimum load sizes which may be handled.

For a given application, the weight of a load varies directly with the size of the load, and as a consequence, the amount of pressure which must be delivered by the gripping arms in order to grasp a load is usually greater with large diameter loads than with the small diameter loads. The construction described herein permits a maximum amount of pressure to be delivered by the gripping arms when they are in an extended position and adapted to handle large relatively heavy loads, the pressure delivered by the arms in their extended position depending directly upon the amount of force generated by the piston-cylinder devices employed. With smaller diameter and consequently lighter loads, the pressure delivered by the pivoted arm is decreased by reason of the accelerated movement provided for in the grasping portion of the arm. In this manner, movement of the piston rods of the piston-cylinder devices is used directly for generating the suitable pressures required of larger loads when the arms are extended, and converted partially to increased contraction of the arms when smaller and therefore lighter loads are handled.

Summarizing the invention, a pair of arms are provided which are capable of contracting towards one another in a manner to handle expeditiously a wide range of article sizes, the arm arrangement including mechanism wherein the relative movement of the clamping portions of the arms is accelerated after the arms have been contracted a certain predetermined amount. The arms are slidably movable towards and away from each other, one of the arms being pivotally biased about a pivot and having at one end a cam follower adapted to co-operate with a cam recess on the frame positioned in the path of the cam follower. Once the pivot arm is caused slidably to approach the other during a gripping cycle, the cam follower enters the recess resulting in the pivot arm being moved at an accelerated rate toward the other arm.

Although the invention preferably describes a clamping device for lifting cylindrical objects such as rolls of paper, it is apparent that it can be used for other shapes as well. For example, the arms can be adapted for lifting prismatic shapes, e. g. cubic or box-like structure by using flat pressure pads in place of concave ones.

Although the present invention has been described in conjunction with preferred embodiments it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and appended claims.

We claim:

1. In a clamping attachment for lift trucks and the like the combination of a frame, a pair of oppositely disposed gripping arms, means mounting the arms on the frame with the arms extending in the same direction from one side of the frame, said means including a mount for one of said arms slidably mounting said one

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arm on the frame and accommodating slidable movement of said arm towards and away from the other arm, means for imparting sliding movement to said one arm, a pivot connection connecting said one arm to said mount accommodating pivotal movement of said one arm toward the other arm, means for restraining pivotal movement of said one arm in a direction away from the other arm, and cam means for causing said one arm to pivot toward said other arm only after said one arm has been slid a predetermined distance towards the other arm.

2. The device according to claim 1 wherein both of said gripping arms are slidably mounted to permit linear movement of the arms towards and away from each other, and means for moving the second arm.

3. The device according to claim 1 wherein the cam means is mounted on the frame.

4. The device according to claim 1 wherein spring biasing means urge the slidable arm towards horizontal position to restrain pivotal movement thereof.

5. In a clamping attachment for lift trucks and the like the combination of first and second oppositely disposed gripping arms extending in the same direction, mounting means on one end of each of said arms, load engaging portions facing each other and secured to the other end of each of the arms, a frame, means pivotally securing the first arm to its mounting accommodating pivotal movement of the first arm towards the second arm, means for restraining pivotal movement of the first arm in the other direction, guide means on the frame slidably mounting the mounting means for the first arm and guiding linear motion of the first arm with respect to the second arm, the mounting means of the second arm being mounted on the frame in spaced relationship to the first arm, means connected to the first arm for moving it towards and away from the second arm, a cam follower fastened to the first arm, and cam means on the attachment adapted to engage said follower and cause pivoting of the first arm towards the second arm only after said arm has been linearly moved a predetermined distance towards the second arm.

6. The device according to claim 5 wherein the cam follower is fastened to the first arm on the mounting means end of said arm.

7. The device according to claim 5 wherein the cam means is secured to the frame.

8. The device of claim 5 wherein each of the arms is slidable in a path towards and away from each other between extended position wherein the arm is located beyond the peripheral outline of said frame, and a contracted position wherein the arm is located within the peripheral outline of said frame, and wherein said cam means engages said cam follower upon movement of said first arm to a position located substantially within the peripheral outline of the frame.

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