

April 15, 1969

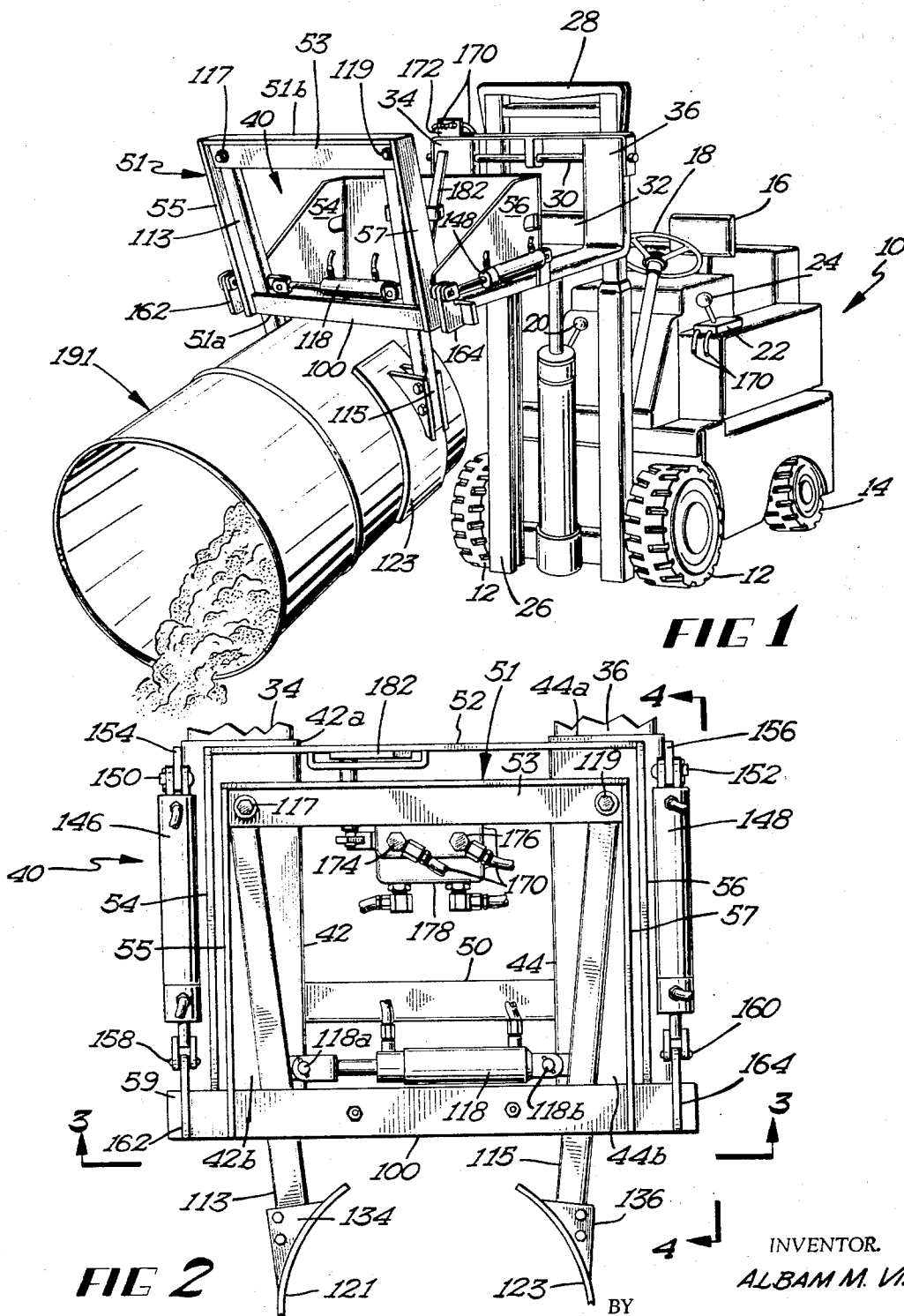
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3,438,523

LOAD CLAMPING AND ARTICULATE APPARATUS

Filed April 19, 1967

Sheet 1 of 3



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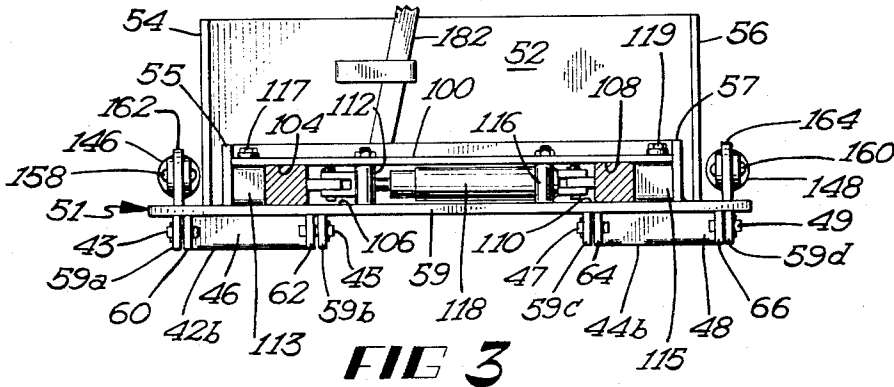


FIG 3

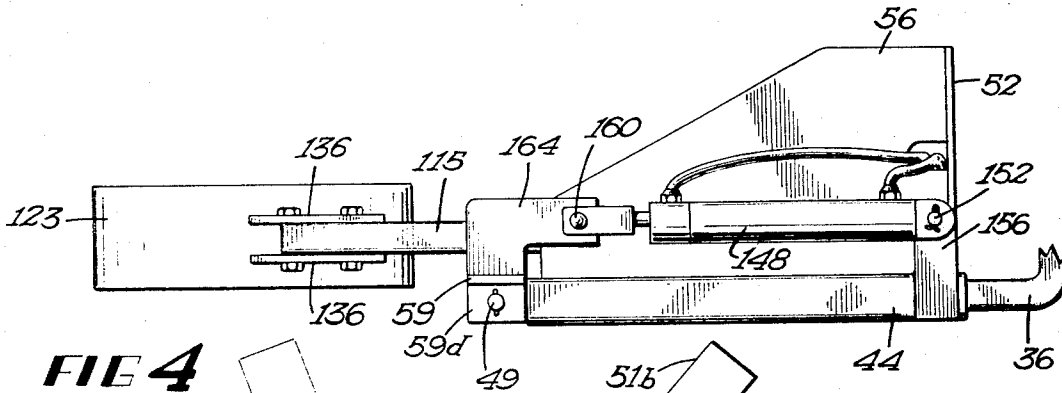


FIG 4

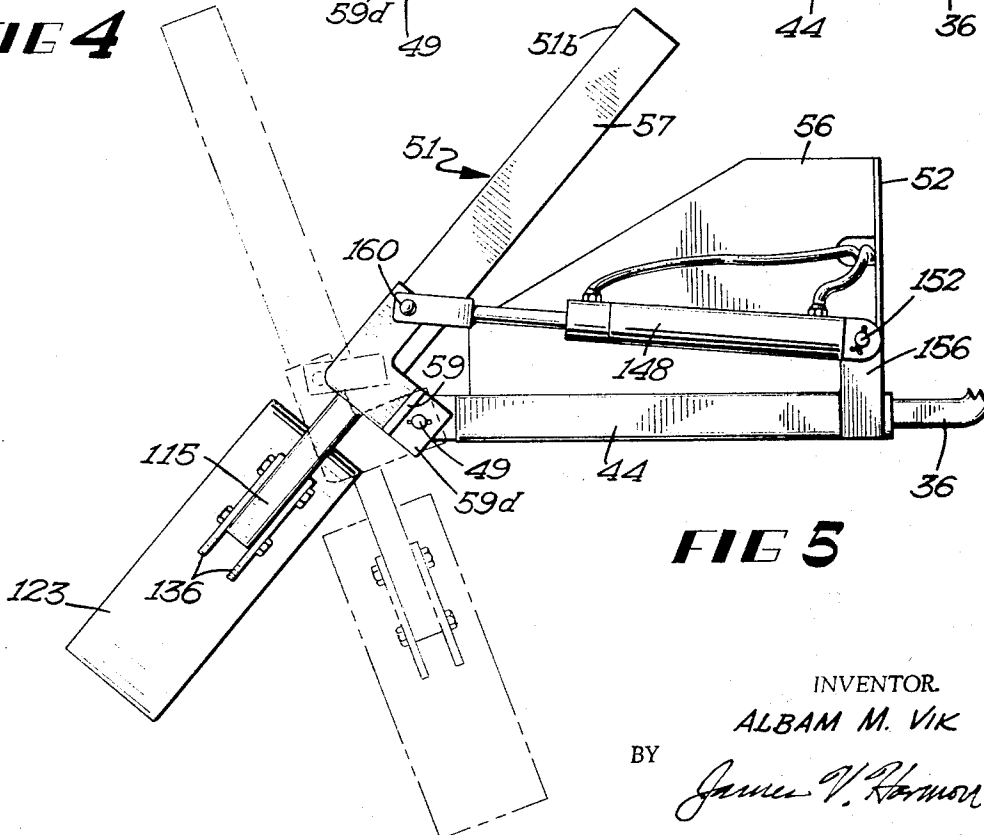


FIG 5

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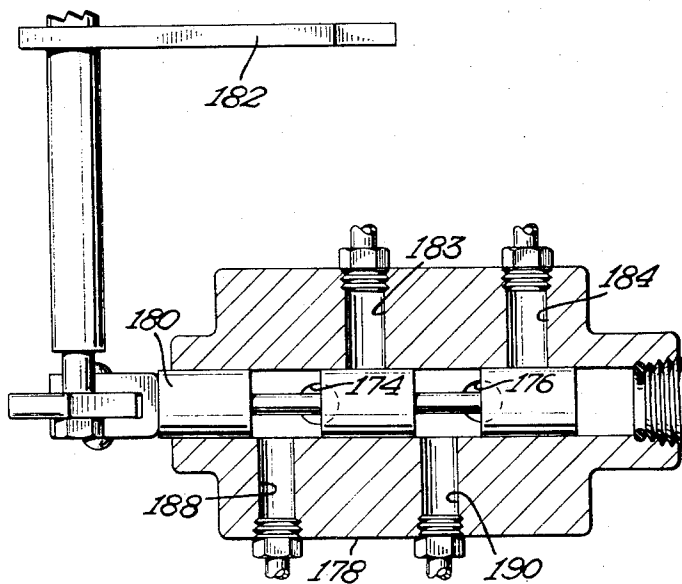


FIG 6

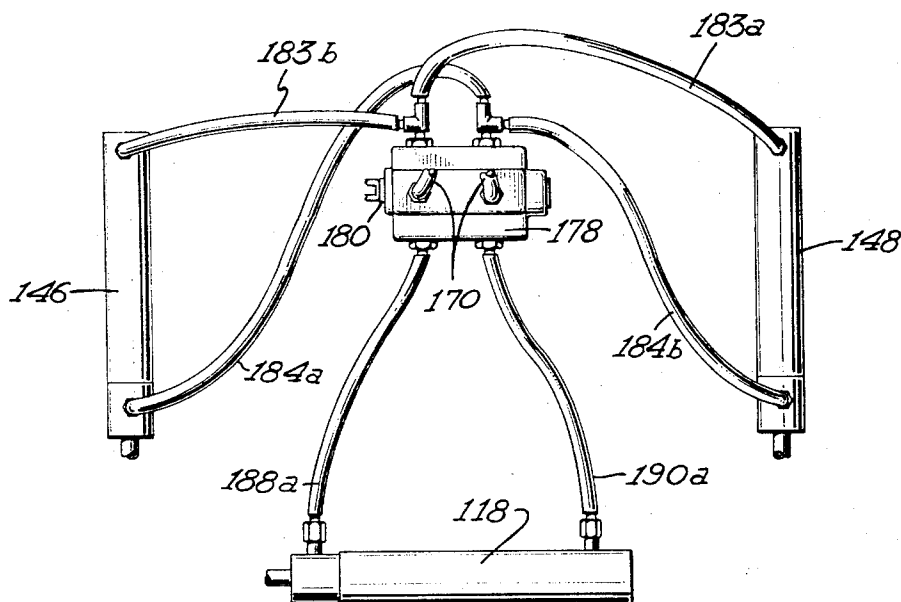


FIG 7

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LOAD CLAMPING AND ARTICULATE APPARATUS

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10 Claims

ABSTRACT OF THE DISCLOSURE

Load clamping and lifting apparatus for materials handling equipment including a fixed framework supported for example on the forks of a lift truck. A moving framework is secured by pivots at the free end of the fixed framework for tilting the load upwardly about a horizontal axis. Clamp arms are pivotally secured to the moving framework. Hydraulic cylinders operate clamp arms and articulate moving framework.

The present invention relates to equipment for loading, lifting and transporting articles and more particularly to a power operated apparatus adapted to be mounted upon a vehicle for clamping and articulating a load about a horizontal axis. The invention is especially useful in connection with materials handling equipment such as fork lift trucks.

Previous devices of the general type described have had certain inherent problems among which was their high cost and the tendency for the parts to become worn or broken. Moreover, because of their large size, some of the previous clamp devices of the general type described partially obstructed the operator's forward view. The seriousness of this disadvantage is apparent when it is recognized that the article being loaded must be clearly seen when the jaw members are placed in the engaged position on the article that is to be lifted.

A further disadvantage of many of the prior devices of the general class described is that the jaws of the clamping mechanism are supported entirely from the points about which they pivot when moving from the open to the closed position and the resultant loading of these pivots subjects them to substantial stresses which can cause excessive wear or even breakage of the pivots and their supporting structures.

Another problem associated with the prior equipment of the type described is the general inability to engage and grasp an article such as a drum in either a vertical or horizontal position and to maintain it securely in the engaged position while being tilted about a horizontal axis.

In view of the shortcomings of the prior art, it is one object of the invention to provide an improved article clamping and articulating apparatus which can be quickly mounted on a vehicle such as a fork lift truck, is capable of securely grasping articles that are to be lifted while the article is in either a horizontal or a vertical position and is suited for tilting the article through an angle of 100° about a horizontally disposed transverse axis.

Another object of the invention is the provision of and improved clamp and articulating apparatus of the type described wherein the bearings upon which the jaws are mounted are isolated from the load which is being transported and are thereby protected from excessive wear or breakage and provision is made for articulating the clamp and the load supported thereon about an axis positioned close enough to the jaws of the clamp to prevent the load from being lowered excessively when articulated about the horizontal axis.

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Another object of the invention is the provision of an improved article clamping and articulating apparatus including hydraulic actuating cylinders and a provision for performing clamping and articulating functions with a single valve mechanism.

A further object is to provide an apparatus of the type described for a lift truck wherein the articulation of the load about a horizontal axis can be accomplished without the load striking the forks of the lift truck.

Another object is to balance the load evenly about the horizontal axis of articulation.

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

FIGURE 1 is a perspective view of an apparatus embodying the invention as seen when mounted upon a fork lift truck.

FIGURE 2 is a partial plan view of the apparatus on a larger scale relative to FIGURE 1.

FIGURE 3 is a transverse sectional view taken on line 3—3 of FIGURE 2.

FIGURE 4 is a side elevational view taken on line 4—4 of FIGURE 2 with the clamps in a horizontal position.

FIGURE 5 is a side elevational view similar to FIGURE 4 with the clamp articulated at an angle of about 45° relative to the position of FIGURE 1.

FIGURE 6 is a plan view partly in section of the hydraulic control valve on a greatly enlarged scale relative to FIGURE 2.

FIGURE 7 is a semi-diagrammatic illustration of the hydraulic circuit.

Briefly, the invention provides a clamping and load articulating apparatus having a fixed supporting framework and a moving framework pivotally secured to the fixed framework at its own forward end for tilting or articulating the load about a horizontal axis and a pair of clamp arms connected for pivotal movement upon the moving framework preferably at its rearward end. Supporting members such as plates are provided at the forward end of the moving framework for supporting the forward ends of the arms upon the forward portion of the moving framework.

Refer now to the figures which illustrate one preferred form of the invention. In the figures is shown a lift truck 10 of well-known construction having a pair of front wheels 12 and a pair of rear wheels 14, an operator's seat 16, a steering wheel 18, mast control levers 20 and a clamp control valve assembly 22 having a handle 24. The lift truck 10 is provided with the usual mast 26 having a central vertically movable portion 28 as seen in FIGURE 1 to which a pair of laterally extending bars 30 and 32 are attached. Upon the bars 30 and 32 forks 34 and 36 of conventional and well-known construction are rigidly secured. During operation of the lift truck, the moving portion 28 of the mast 26 is raised and lowered conventionally carrying with it the cross members 30 and 32 and the forks 34 and 36. When the lift truck 10 is being operated without the clamp of the invention in use, the horizontal portions of the forks 34 and 36 will be inserted beneath the object that is to be carried. The mast 26 will then be pivoted rearwardly about a horizontal axis at the lower end thereof conventionally. The forks 34 and 36 are then elevated sufficiently to raise the load from the ground as it is being transported from one location to the other.

The clamp mechanism in accordance with the present invention is designated 40 and will now be described. The clamp 40 includes a framework composed of a pair of horizontally disposed parallel connecting members such as square tubes 42 and 44 having rearward ends 42a and

44a and forward ends 42b and 44b. The connecting tube members 42 and 44 can be formed from steel sheet or tubing having a width or approximately 8 inches and a height of approximately 3 inches in the event the framework is to be supported from the forks of a lift truck. The outward ends 42b and 44b are preferably sealed by end plates 46 and 48 which are welded within the open ends of the tubes. As can be seen in FIGURE 1, the tubes 42 and 44 are properly spaced laterally from each other to slide easily over the free ends of the horizontal portions of the forks 34 and 36. Thus, when the clamp 40 is to be mounted, the operator merely positions the free ends of the forks the proper distance from the floor and drives the truck forwardly thereby inserting the forks within the tubes. The mast 26, forks and the clamp assembly 40 are then raised until they are free of the floor.

The connecting members 42 and 44 are suitably affixed to each other, in this case by means of horizontally disposed forward and rearward cross members designated 50 and 52 respectively which are formed from plate or bar stock, angle iron or the like and secured as by welding to the connecting members 42 and 44. The supporting framework also includes a pair of vertically disposed and parallel longitudinally extending plates 54 and 56 welded at their rearward ends to the plate 52 and along their lower edges to the upper surface of the connecting members 42 and 44. Connected to the forward end of the framework composed of connecting members 42 and 44 by means of aligned pivots 43, 45, 47 and 49 is a moving framework 51 having forward portion 51a and a rearward portion 51b (FIGURE 1). The moving framework 51 is composed of a transversely extending rear member such as angle iron 53 to which longitudinally extending parallel side members formed from bars 55 and 57 are secured by welding. At the forward end of the moving framework 51 is welded a cross member 59 to which are secured as by welding four transversely spaced aligned and vertically disposed bearing flanges 59a, 59b, 59c and 59d that form a part of the pivots 43-49. The longitudinally extending frame members are provided with mating aligned flanges 60, 62, 64 and 66. The movable framework 51 is thus able to articulate about the common axis of pivots 43-49 on an axis positioned transversely to the axis of motion of the vehicle.

At the forward end of the moving framework are provided left and right guides defined by the bar 59 and a similar bar 100 positioned parallel to bar 59 and located above it. The guides include upper and lower horizontally and laterally disposed guide surfaces 104 and 106 on the left and 108 and 110 on the right. The bar 100 is secured to bar 54 by means of bolts over which are mounted sleeves 112 and 116 defining inward stops for a pair of transversely spaced longitudinally extending jaw support arms 113 and 115. The arms are pivotally secured by pivot pins 117 and 119 to the angle iron 53. A pair of arcuate load engaging jaws 121 and 123 are secured to the free ends of the arms. The bars 55 and 57 serve as stops for limiting the outward movement of the arms 113 and 115.

The arms 113 and 115 are formed from square bar stock to provide upper and lower parallel slide surfaces at least in the portions between the guide surfaces 104, 106, 108 and 110. By this provision three objectives are achieved. First, a load applied to the free ends of the arms is isolated from the pivot pins 117 and 119 when the movable framework is in a horizontal position. Second, the torsional movement about the longitudinal axis of each arm is resisted by each guide and finally the load supported by the jaws is transmitted directly from the jaws to the fixed framework through the pivots 43, 45, 47 and 49.

It can thus be seen that the portion of the upward surface of the cross member 59 defining each guide acts as a loading plate which can be lubricated for assuring smooth movement of the arms between the outward dis-

engaged position and a central engaged position. It should be noted that the free end of each arm will be able to move through a substantial distance thereby allowing the clamp to easily engage and grasp both large and small objects. Thus, the clamp 40 can be made to handle objects having a diameter variation of from about 8 inches to about 30 inches or even more.

A clamp actuator such as a hydraulic cylinder 118 is pivotally secured in a transverse position between arms 113 and 115 by means of pivots 118a and 118b for moving the arms toward one another.

As shown in FIGURES 1 and 2, jaws 121 and 123 are connected so that they can be removed if necessary from the free ends of the arms 42 and 44. In a typical application the jaws consist of arcuate sheet metal plates with the concave surface facing inwardly. To the inward surface of each can be bonded a resilient surface covering such as a heavy rubber sheet (not shown). To the rearward edge of each of the plates 126 and 128 are provided left and right pairs of vertically spaced parallel flanges. The free ends of the arms 113 and 115 are secured between these flanges by means of suitable fasteners such as bolts thereby enabling the jaws 121 and 123 to be quickly and easily removed and replaced in the event that they are damaged.

The jaws 121 and 123 are oriented on the free ends of the arms such that their rearward portions extend diagonally centrally and rearwardly whereas the forward portion of each of the jaws is in approximate alignment with the longitudinal axis of the lift truck 10 when the arms are in their disengaged positions. As a result, the free end of each of the jaws will be able to easily enter between closely stacked objects such as fiber drums even though the drums are spaced only a few inches apart. Even when there is no space between the drums, the free ends of the jaws when forced forwardly between the stacked drums will be able to move them apart slightly and thereby enter between them. This will enable the operator of the truck to pick up the drums without first separating them manually.

The movable framework 51 is articulated about the axis of pivots 43-49 by means of a pair of motive power devices such as hydraulic actuators 146 and 148 connected at their rearward ends by pivots 150 and 152 to brackets 154 and 156 which are welded to the fixed framework and at their forward ends by pivots 158 and 160 to brackets 162 and 164 which are rigidly affixed to the ends of the bar 59. The pivots 158 and 160 are positioned well above the pivots 43-49. Accordingly, the moving framework 51 will be articulated from the position of FIGURE 4 to the solid line position of FIGURE 5 and finally to the dotted line position of FIGURE 5 as the actuators 146 and 148 are extended.

Refer now to FIGURES 1, 5, 6 and 7 which show the hydraulic control employed in accordance with one form of the invention. The valve 22 is coupled to a source of hydraulic fluid under pressure (not shown) and has connected to it supply and return hoses 170 which extend upwardly from the valve 22 and are supported at their upward ends by means of a bracket 172 on the moving portion 28 of the mast. Hoses 170 are connected at their free ends to inlet and outlet openings 174 and 176 respectively of a spool-type selector valve 178. The movement of the spool 180 to the right by means of a control lever 182 (FIGURES 1, 2, 3 and 6) enables the inlet and outlet openings 174 and 176 to communicate with ports 183 and 184 which are themselves suitably connected by means of hoses 183a and 183b to the rearward ends of cylinders 146 and 148 and by hoses 184a and 184b to the forward ends of cylinders 146 and 148. Accordingly, when the lever 182 is shifted to the appropriate position for sliding the spool 180 toward the right as seen in FIGURE 6, the valve 22 can be used for operating the articulating cylinders 146 and 148. On the other hand, when the lever 182 is shifted to its alternate

position, the spool 180 will slide toward the left (the position shown in FIGURE 6). In this position, the valve 22 will function to control the cylinder 118 by enabling fluid to flow from valve 22 through inlet and outlet openings 174 and 176, ports 188 and 190 which are themselves connected to the cylinder 118 by means of hoses 188a and 190a.

The operation of the apparatus will now be described. First, the clamp mechanism 40 is mounted on forks 34 and 36 as described above. The selector valve 178 is then operated by moving lever 182 to position the spool as shown in FIGURE 6. By appropriately moving the lever 24 of valve 22, the hydraulic cylinder 118 is extended thereby separating arms 113 and 115 a sufficient distance to enable the object that is to be picked up such as a steel drum 191 (FIGURE 1) to be engaged. It will be assumed that the moving framework 51 is in a horizontal position. The lever 24 is then moved in the proper direction to retract the actuator 118 to the point at which the jaws 121 and 123 contact the walls of drum 191. The forks are then elevated conventionally. When it is desired to articulate the drum about the axis of pivots 43-49, for example in order to dump material from the drum 191, the lever 182 is moved so as to shift the spool 180 toward the right in FIGURE 6. The operation of valve 22 then functions to extend cylinders 146 and 148 thereby articulating the moving framework 51 in a counterclockwise direction as seen in FIGURE 5. Movement of the lever 24 in the opposite direction will return the moving framework 51 to its original position (the position of FIGURE 4).

The invention has proved highly useful in loading and transporting a variety of objects. It is suited for picking up elongated objects whether they are positioned in either a vertical or horizontal position. For example, it can be used equally well for picking up sewer pipe or shipping drums. An important feature of the invention is the isolation of the load supported upon the jaw from the pivot pins 117 and 119 to which the arms are secured. The load when the framework 51 is in a horizontal position is instead transmitted directly through the bar 59 to the pivots 43-49 to the fixed framework thereby lessening the strain on pivots 117 and 119.

The pivots 43-49 are preferably located at a relatively low elevation on the framework, preferably no higher than the elevation of the forks. This provision allows the load to be tilted upwardly without the bottom portion thereof striking either the forks or the frame members 52 and 44. It should also be noted that the pivots 43-49 are located relatively close to and below the pins 121 and 123 so that the load when it is tilted forwardly will not be lowered so much that it will contact the ground. Moreover, by locating the pivots 117 and 119 at the end of the moving framework 51 remote from pivots 43-49, the jaws will swing about a relatively long radius thereby minimizing the change in the angular relationship between the jaws themselves and allowing the jaws to reliably engage a variety of objects of different sizes. It should also be noted that the symmetrical location of cylinders 146 and 148 on each side of the clamp will cause the load to be equally distributed between them.

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. An article clamping and articulating apparatus comprising in combination a supporting framework having front and rear portions, said framework being adapted to be supported upon a vehicle with the rear portion thereof adjacent to a portion of the vehicle, the front portion of the supporting framework extending outwardly from the vehicle in a substantially horizontal plane, bearings mounted at the forward end of the frame-

work, a moving framework having forward and rearward ends, the forward end of the moving framework being mounted on the bearings for articulation about a horizontally disposed transverse axis, said moving framework being free at its rearward end, a pair of clamp arms pivotally supported at their rearward ends by a pair of spaced apart pivotal connections between the rearward end of each clamp arm and the moving framework, a jaw member mounted upon the forward end of each arm, loading plates each having a smooth upwardly facing supporting surface positioned on the forward end of the moving framework and located beneath the clamp arms with the clamp arms resting thereupon for isolating the weight of the article that is to be transported from said pivotal connections, said loading plates being adapted to transmit the weight of the article supported upon the jaws to the vehicle through the forward portion of the moving framework, a first motive power means operatively connected to the arms for moving the jaws between engaged and disengaged positions and a second motive power means operatively connected to the moving framework for articulating the moving framework about the horizontally disposed transverse axis.

2. The apparatus of claim 1 wherein the first motive power means operatively connected to the arms comprises a hydraulic cylinder pivotally secured at each end to one of the arms in a transverse position whereby extension of the cylinder will spread the arms apart and retraction of the cylinders will cause the free ends of the arms to move toward one another.

3. The apparatus according to claim 1 wherein the second motive power means comprises a pair of parallel longitudinally extending laterally located hydraulic cylinders, each said cylinder being operatively connected between the supporting framework and the moving framework whereby simultaneous extension of the hydraulic cylinders will articulate the moving framework about said horizontally disposed axis.

4. The apparatus according to claim 1 wherein the spaced pivotal connections between the clamp arms and the moving framework are located at the rearward free end of the moving framework and the forward portions of each of the arms is located adjacent to the loading plates and is positioned immediately above the bearings upon which the moving framework is mounted for articulation whereby the change in angular relationship between the jaws is minimized when the jaws move between spaced apart and relatively close together positions and the weight of the object secured between the jaws is transmitted through the loading plates to the supporting framework when the moving framework is in a horizontal position.

5. The apparatus according to claim 1 wherein the second motive power means comprises a pair of parallel longitudinally extending laterally located hydraulic cylinders, each said cylinder being operatively connected between the supporting framework and the moving framework whereby simultaneous extension of the hydraulic cylinders will articulate the moving framework about said horizontally disposed axis, said pivotal connections between the clamp arms on the moving framework being located at the rearward end of the moving framework, the forward portion of each of the arms being located adjacent to the loading plates and positioned immediately above the bearings upon which the moving framework is mounted for articulation whereby the change in angular relationship between the jaws is minimized when the jaws are moved toward or away from one another.

6. The apparatus according to claim 1 wherein the pivotal connections between the clamp arms on the moving framework are located at the rearward free end of the moving framework, the forward part of each of the arms is located adjacent to the loading plates and are positioned immediately above the bearings upon which the moving framework is mounted for articulation whereby

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the change in angular relationship between the jaws is minimized when the jaws move between positions spaced relatively far apart or close together and the weight of the object secured between the jaws is transmitted through the loading plates to the supporting framework when the moving framework is in a horizontal position and a common control means operatively associated with the first and second motive power means regulating the positions of both motive power means.

7. The apparatus according to claim 1 wherein the bearings mounted at the forward end of the framework are located at an elevation which is not substantially above the elevation of the point at which the framework is supported from said vehicle whereby objects engaged by the clamps can be tilted forwardly without the lower portion of the object striking the supporting framework or said vehicle.

8. The apparatus according to claim 1 wherein the pivots are positioned at the rear end of the moving framework whereby the change in angular relationship between the jaws is minimized when the jaws move between positions spaced relatively far apart or close together and the bearings at the forward end of the supporting framework are located at an elevation which is not substantially above the elevation of the point at which the supporting framework is secured to said vehicle whereby the object carried on the clamps can be tilted forwardly without the lower portion thereof striking the supporting framework or said vehicle and the weight of the object secured between the jaws is transmitted through said bearings to the supporting framework when the moving framework is in a horizontal position.

9. The apparatus of claim 1 wherein said second mo-

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tive power means comprises a pair of laterally located hydraulic cylinders connected between the supporting framework and the moving framework for articulating the moving framework and load about said bearings, said first motive power means comprises a hydraulic cylinder operatively connected to the arms for moving the arms toward and away from one another and a selector valve is communicatively connected to all of said cylinders, said selector valve including a movable valve member therein for diverting the flow of hydraulic fluid to either the laterally located cylinders or transversely disposed cylinder when said movable member is moved between selected positions.

10. The apparatus according to claim 1 including a manually operable control valve located upon said vehicle in position to be operated by the driver of the vehicle and a selector valve is connected between the control valve and the motive power means whereby the operation of the control valve can be employed either for articulating the load about said bearings or for moving the jaws by changing the setting of the selector valve.

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214—620, 653; 294—88, 106