Nov. 14, 1961 R. F. OSTER 3,008,596

ROLL CLAMP FOR LIFT TRUCK

Filed Jan. 27, 1958 5 Sheets-Sheet 1

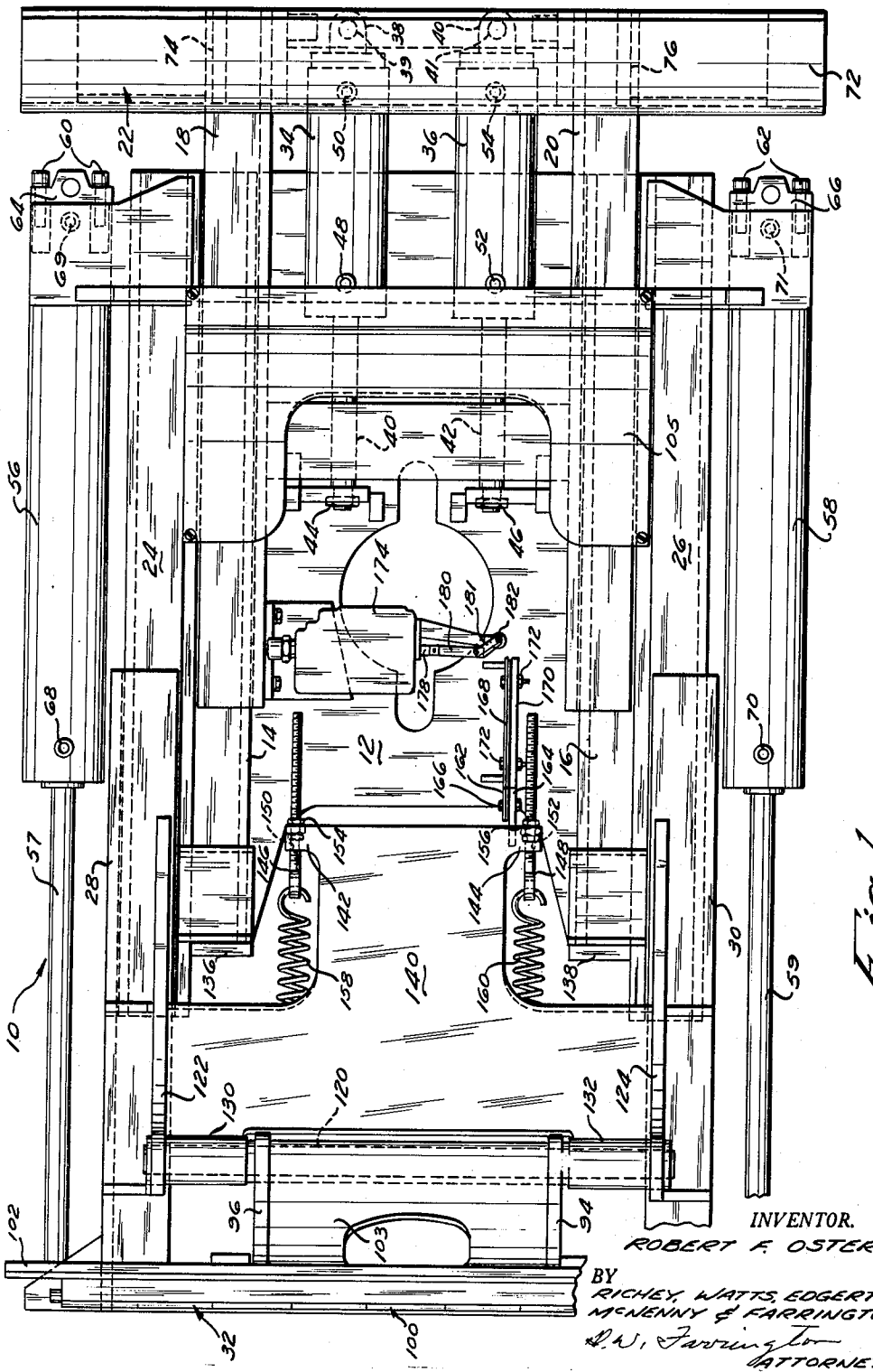

Fig. 1

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ROLL CLAMP FOR LIFT TRUCK

Filed Jan. 27, 1958 5 Sheets-Sheet 2

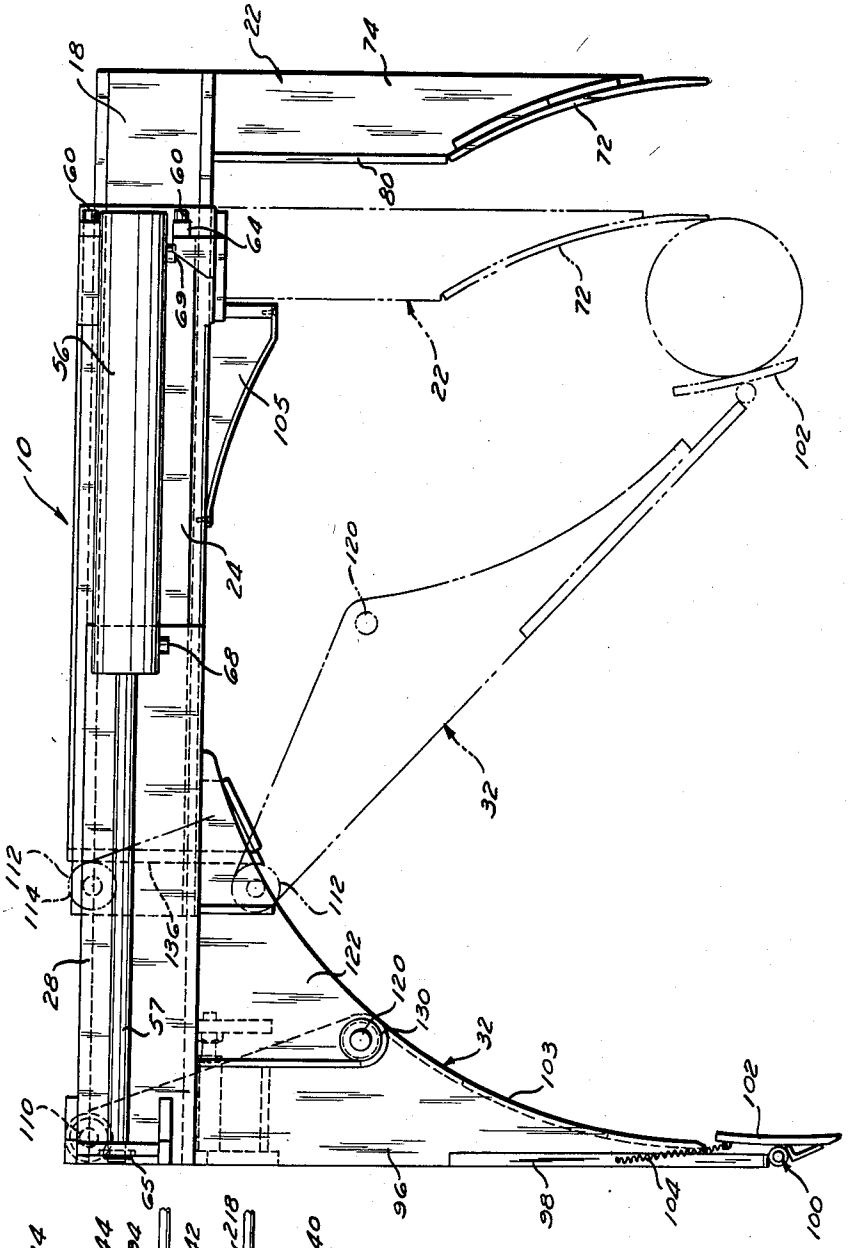

Fig. 2

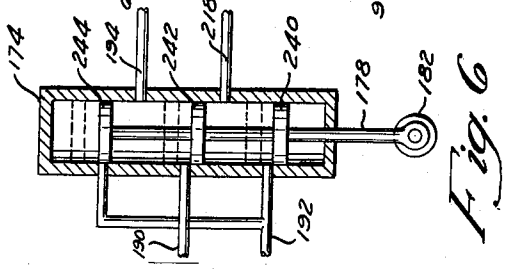

Fig. 6

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ROLL CLAMP FOR LIFT TRUCK

Filed Jan. 27, 1958 5 Sheets-Sheet 3

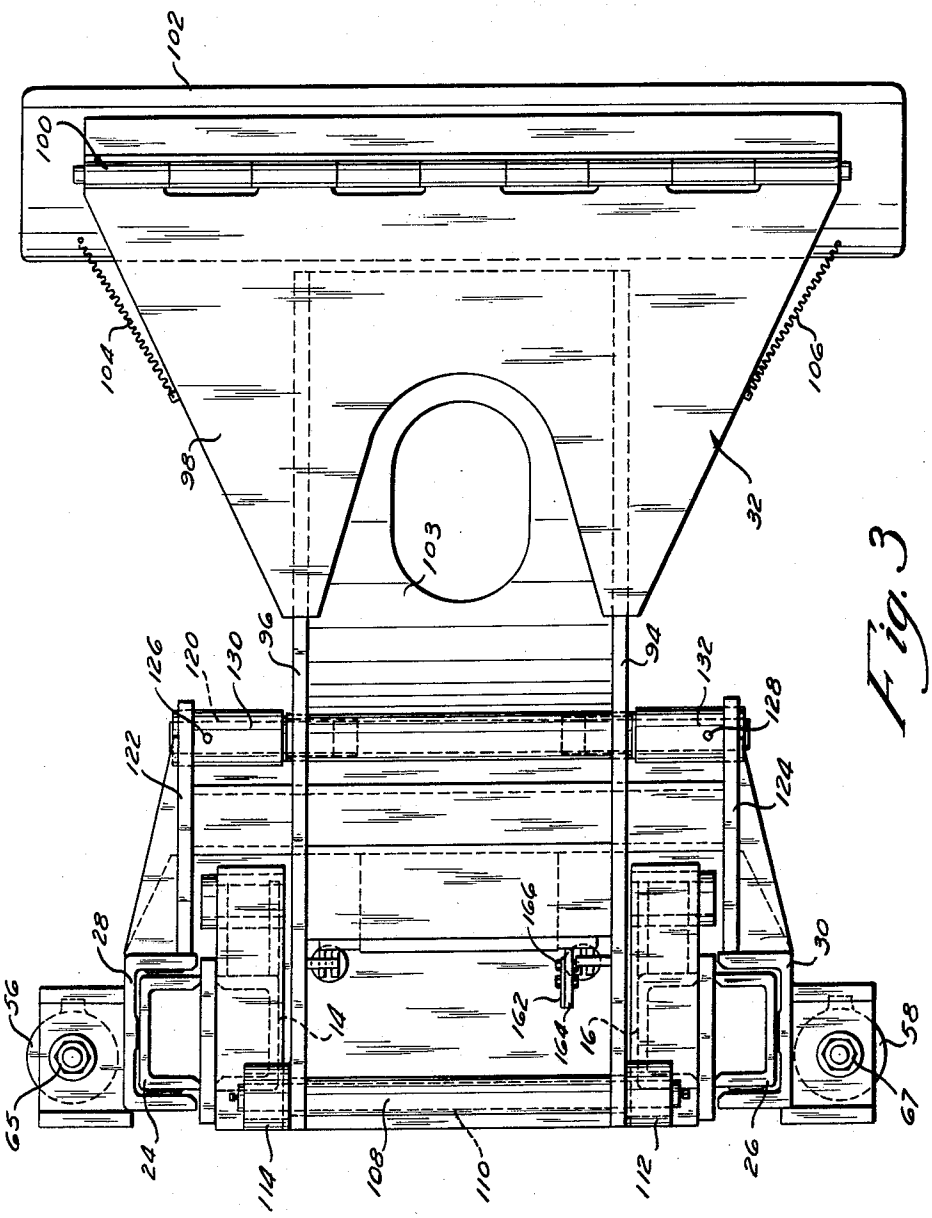

Fig. 3

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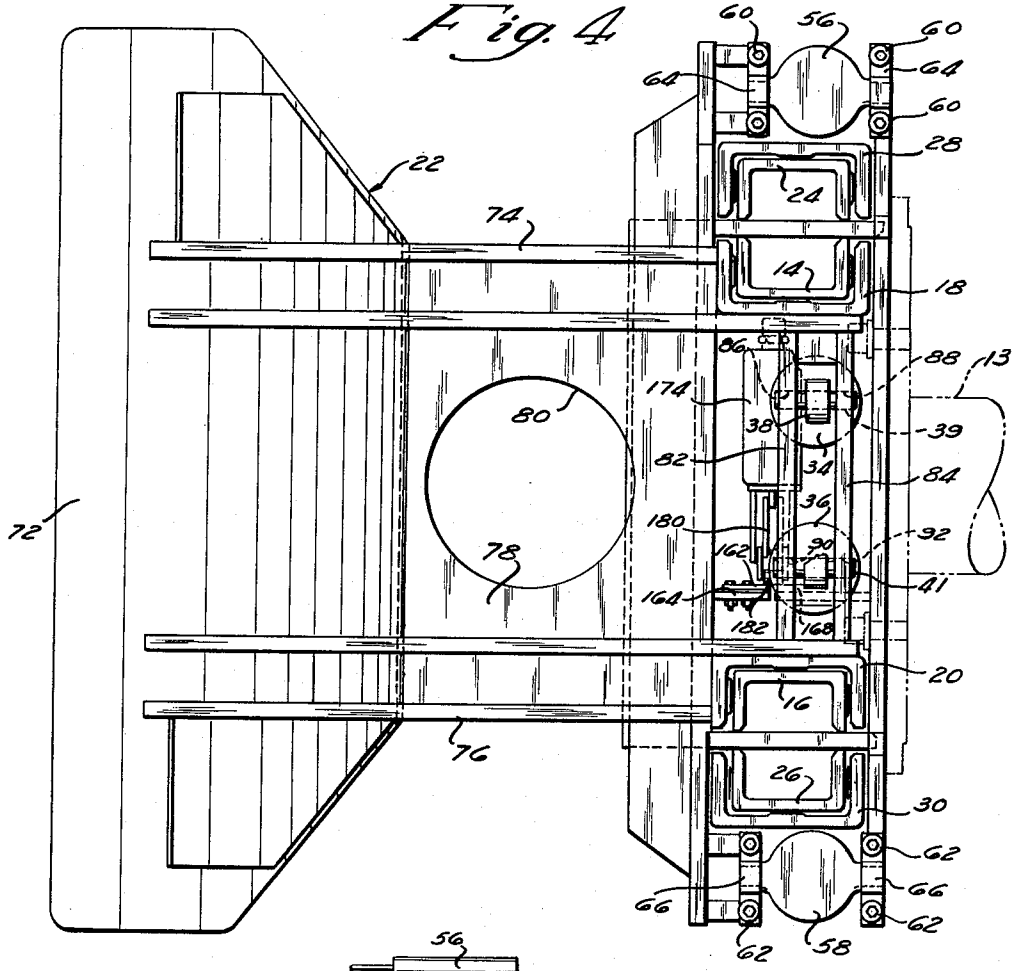
ROLL CLAMP FOR LIFT TRUCK

Filed Jan. 27, 1958 5 Sheets-Sheet 4

Fig. 4



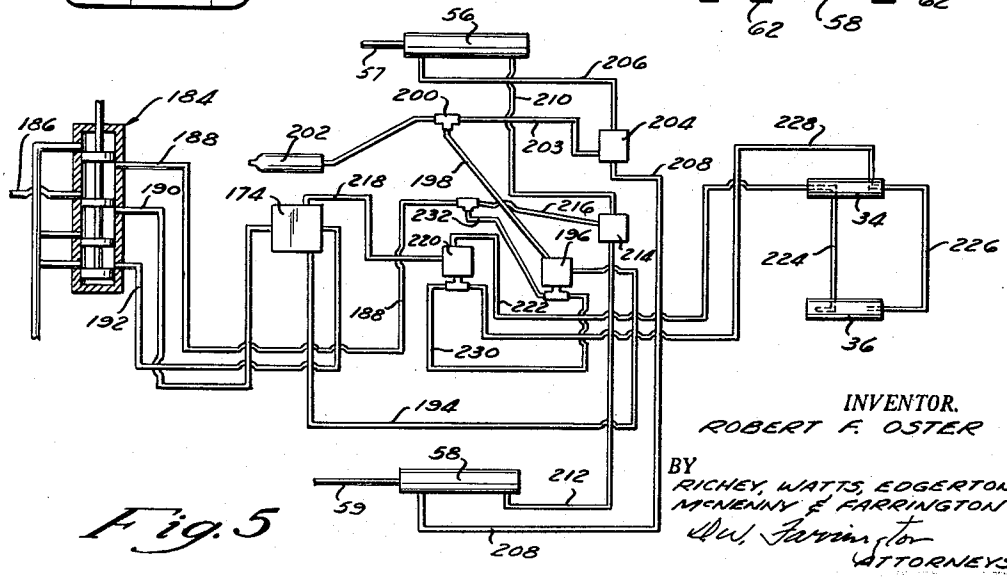


Fig. 5

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ROLL CLAMP FOR LIFT TRUCK

Filed Jan. 27, 1958 5 Sheets-Sheet 5

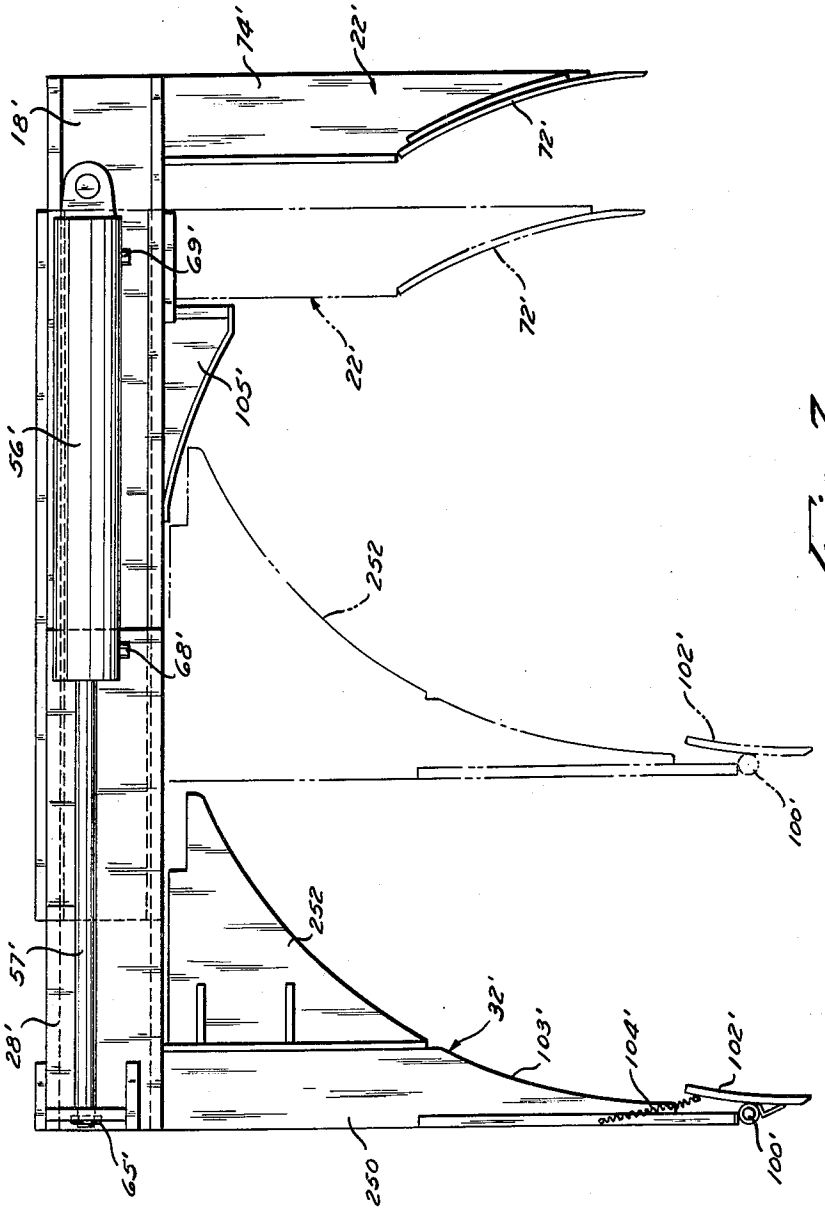

Fig. 7

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3,008,596

ROLL CLAMP FOR LIFT TRUCK

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Filed Jan. 27, 1958, Ser. No. 711,525
2 Claims. (Cl. 214—653)

This invention relates to an industrial lift truck and more particularly to a novel roll clamping apparatus for lift trucks including clamping jaws and arms actuable by novel control apparatus for handling heavy articles, such as rolls of paper.

In the handling of large and heavy cylindrical articles such as rolls of paper by industrial lift trucks, it is advantageous for such a truck to be readily adaptable to handle objects of a rather wide range of sizes since in most cases such a wide range will be encountered, thus eliminating the need for separate trucks for handling the various articles. To accommodate articles of such a wide range of sizes, according to a novel feature of one embodiment of this invention one of clamping jaws of a lift truck is adapted for compound linear and pivotal movement relative to a linearly movable clamping jaw whereby handling of roll shaped articles of a wide range of sizes is enabled by a relatively short linear movement of either of the jaws. According to this feature, linear movement of the clamping jaws is minimized and furthermore the time required in movement of the jaws from any one position to any other position in their range is greatly decreased. According to another embodiment of the invention, gripping jaws that are movable strictly in a linear direction may be provided. In this case the structure of the jaws is somewhat simplified in that provision for pivotal movement of one of the jaws is not made.

As another feature of the invention the compound movable jaw is of greater length than the linearly movable jaw whereby cylindrical or roll articles lying horizontally may be gripped by positioning the linearly movable jaw beneath the roll and in engagement therewith at a point near its contact with the floor, and by positioning the compound movable jaw above the roll, and in contact therewith at a point substantially diametrically opposite the point of contact of the linearly movable jaw.

In the one embodiment of this invention a pair of opposed, cooperable, gripping or clamping jaws movable with respect to each other in either of two directions in a particular orderly sequence to effect gripping of a roll load, is provided. In retractive gripping movement from extended position, the sequential movement of the jaws for a small roll, comprises a linear movement of a first jaw toward the second jaw, a linear movement of the second jaw toward the first jaw and finally a pivotal movement of the first jaw in the motion of a third class lever forcing the roll into engagement with the second jaw. For larger loads the amount of pivotal movement is progressively decreased until no pivotal movement at all is required by the first jaw to effect gripping. The pivotal movement of the first jaw in the motion of a third class lever provides a wide range of movement of the gripping portion thereof in response to relatively small linear movement of the first jaw. Since the clamp of this invention is rotatable about a horizontal axis, roll shaped articles may be gripped while standing on end or while lying on their side between the jaws of the present clamp and may be turned end for end or placed in any position inasmuch as the jaws frictionally engage the roll and maintain the same in position. Accordingly, the roll may be set down in the same position in which it was picked up or any other stable position.

It is an object of this invention to facilitate handling

of roll shaped articles such as rolls of paper and to provide an industrial truck apparatus adaptable to pick up or set down such an article in vertical or horizontal position.

It is another object of this invention to provide an industrial lift truck with clamping or gripping jaws and control apparatus therefore facilitating gripping and release of various roll shaped articles of a wide range of sizes.

It is another object of this invention to provide an industrial lift truck having a pair of opposed gripping or clamping jaws and control apparatus facilitating an improved orderly sequential movement of the jaws for gripping load articles.

It is another object of this invention to provide an industrial lift truck having a pair of opposed clamping or gripping jaws one of which is adapted for compound movement for gripping a roll shaped article.

It is another object of this invention to provide an industrial lift truck having a pair of opposed clamping or gripping jaws movable by respective pairs of hydraulic piston cylinder arrangements and valve means actuated by movement of one of the arms to control the sequential movement of the other arm and the one arm for clamping or gripping a load article.

It is another object of this invention to provide an industrial lift truck having a pair of opposed clamping or gripping jaws at the ends of respective arms, one of which is pivotal about an end remote from the jaw as a fulcrum, by linear force applied at a point intermediate its length.

Other and further objects and advantages will appear from a more detailed description of the invention taken with the accompanying drawings in which:

FIG. 1 is a front elevational view of the entire clamping frame assembly;

FIG. 2 is a plan view of the invention;

FIG. 3 is an elevational view of the invention taken from the right side of FIG. 1;

FIG. 4 is an elevation view of the invention taken from the left side of FIG. 1;

FIG. 5 is a schematic representation of the hydraulic circuit for operating the various components of the clamp frame assembly;

FIG. 6 is a detail view showing schematically a portion of the interior of a valve forming a part of the invention, and

FIG. 7 is a plan view of a modified embodiment of the invention.

Referring now to FIG. 1, **10** represents the over-all clamp assembly which may be pivotally mounted on the forward end of a lift truck and which may also be raised and lowered by means not shown and forming no part of this invention.

Clamp assembly **10** comprises a quasi-stationary frame **12**, supported by a rotatable shaft **13** shown in FIG. 4, and having a first pair of guideways **14** and **16** on which is slidable a pair of complementary guideways **18** and **20** supporting a first jaw assembly **22** of the clamp, and a second pair of guideways **24** and **26** on which is slidable a pair of complementary guideways **28** and **30** supporting a second jaw assembly **32**.

Arm assemblies **22** and **32** are slidable along the respective guideways under the influence of respective pairs of piston-cylinder combinations coupled between frame **12** and the appropriate arm assembly. A first pair of piston-cylinder combinations includes cylinders **34** and **36** each having one end pivotally secured to a base of jaw assembly **22** by suitable apertured lugs **38** and **40**, pins **39** and **41** and cotter pins as shown in FIG. 1. Pistons (not shown) within the cylinders **34** and **36** are connected to respective connecting rods **40** and **42**, the respective

ends of which are reduced to form shoulders abutting a portion of frame 12, and the reduced portions are threaded and secured to the frame portion by nuts 44 and 46 engaging the respective threaded ends. Communications may be established with the interior of respective ends of each cylinder 34 and 36 through openings 48 and 50 on cylinder 34 and through openings 52 and 54 on cylinder 36 for admitting or discharging hydraulic fluid to actuate the arm assembly 22. Hydraulic fluid circuit means hereinbelow set forth in detail is provided for controlling the fluid flow to and from these cylinders.

A second pair of piston-cylinder combinations for actuating jaw assembly 32 includes a pair of cylinders 56 and 58 pivotally secured at respective ends to frame 12 by sets of bolts 60 and 62 retaining apertured yokes 64 and 66 against frame 12 and in the apertures of which yokes the respective ends of cylinders 56 and 58 have opposed pins. Each cylinder 56 and 58 is provided with an internally slidable piston (not shown) connected to respective connecting rods 57 and 59 having threaded ends secured to jaw assembly 32 by nuts 65 and 67 engaging the same and shown more clearly in FIG. 3 of the drawings. Jaw assembly 32 may be actuated by the influence of hydraulic fluid admitted into cylinders 56 and 58 through apertures 68 and 69 in cylinder 56 and 70 and 71 in cylinder 58.

As shown more clearly in FIG. 2 of the drawings, jaw assembly 22 includes a curved clamping or gripping jaw 72 supported by a pair of parallel arms 74 and 76 each secured at one end to the jaw 72 and at the other end to respective guideways 18 and 20. A planar member 78, apertured at 80 is secured to arms 74 and 76 for additional strength and for providing an additional load gripping surface. A pair of brackets 82 and 84 are secured between inner end portions of arms 74 and 76 and are provided with apertures 86, 88, 90 and 92 for receiving pins 39 and 41 extending therethrough and through lugs 38 and 40 shown in FIG. 1.

Jaw assembly 32 includes a pair of arms 94 and 96 at the outer end of which is secured a flat member 98 having a hinge 100 for pivotally mounting a curved outer gripping shoe 102. A pair of springs 104 and 106 secured at their respective ends to member 98 and shoe 102 urge the inner end of member 102 toward member 98.

For automatically positioning an article to be lifted or carried in the jaws of the truck, jaw assembly 32 includes a concave curved jaw member 103 extending arcuately from gripping member 102 to the guideways of the clamp where the surface of the jaw member 103 is nearly tangent to the straight guideways. Cooperative with jaw member 103 is a corresponding jaw member 105 movable with jaw assembly 22 which is also curved and substantially tangent with the guideways of the clamp. Accordingly, rolls which may be disposed vertically and are gripped by the clamp, are cammed forward by jaw members 103 and 105 to a more central location in the clamp. In the central position, shoe 102, which preferably has a radius of curvature considerably greater than that of jaw member 103 is engageable with the roll as hereinafter more fully explained.

A tubular shaft 108 is secured between one end of arms 94 and 96 and a shaft 110 extending therethrough carries rollers 112 and 114 on the ends thereof, which rollers are preferably secured by appropriate snap rings in annular grooves in the shaft.

Arms 94 and 96 are pivotal about a shaft 120 which extends between a pair of plates 122 and 124 secured to guideways 28 and 30 and the shaft is secured in place by pins 126 and 128 extending through the shaft and through sockets 130 and 132 fixed to respective arms 122 and 124. Under the force of hydraulic fluid in cylinders 56 and 58, jaw assembly 32 is retractable to the point where rollers 112 and 114 engage a pair of cams 136 and 138 secured to the ends of guideways 14 and 16. Linear motion of rollers 112 and 114 parallel to the guideways is accordingly restricted while linear force continues to be imparted to shaft 120 through plates 122 and 124. Accordingly, rollers 112 and 114 are movable along cams 136 and 138 normal to the direction of sliding motion along the guideways whereby arms 94 and 96 are pivotal and the outer clamping portions of the jaw assembly are pivotal also.

Disposed between arms 94 and 96 is a T-shaped web member 140 shown more clearly in FIG. 1, which is provided with lug portions 142 and 144 serving as bearings for eyebolts 146 and 148 threaded and secured in holes 150 and 152 in the lugs and adjustably secured thereto by respective lock nuts 154 and 156. Each of a pair of coil springs 158 and 160 is secured at one end to one of eyebolts 146 and 148 and at the other end to lugs secured to the outer portions of the jaw assembly.

A cam plate 162 is mounted by nut and bolt combinations 166 on a cam support member 164 which in turn is secured to T-shaped web 140 by welding or other suitable means. In addition, a cam plate 168 is secured to a cam support plate 170 by bolt and nut combinations 172. Plate 170 is secured to frame 12 by welding or any other suitable means. As shown in FIG. 2 of the drawings cams 162 and 168 are somewhat spaced so as to permit relative movement therebetween.

As a component of the hydraulic system for effecting an orderly sequential movement of respective jaw assemblies 22 and 32, a valve 174 described more fully hereinbelow is secured to the inner end of guideway 18 and is provided with a valve plunger 178 actuated by links 180 and 181 which are secured to the plunger and to a roller 182 engageable in certain positions, with cams 162 and 168. Either cam 162 or 168, when positioned below valve 174, is effective to lift plunger 178.

According to the present invention hydraulic fluid is admitted to cylinders 34, 36, 56 and 58 under the control of a system shown schematically in FIG. 5 of the drawing to effect movement of jaw assemblies 22 and 32.

In the hydraulic system a hydraulic fluid pump (not shown) delivers fluid under pressure to a main control valve 184 through a supply line 186 and is distributed from valve 184 through either of two lines 188 or 190 and is returned through either of the lines 188, 190 or a line 192 as the occasion requires.

In the operation of the lift truck for clamping or gripping, valve 184 is positioned to provide communication between line 186 and line 190 whereby fluid is applied to valve 174. Assuming that the jaws of the lift truck are extended and accordingly that roller 182 is out of contact with either cam 162 or 168, valve 174 directs fluid through a line 194 to a check valve 196 and therefrom, fluid flows through line 198 to a T junction 200 to charge an accumulator 202 and through a line 203 to a terminal block 204 from where it flows equally in two directions through lines 206 and 208 to respective rod ends of cylinders 56 and 58. Fluid in opposite ends of these cylinders is exhausted at return line or low pressure, jointly through lines 210 and 212 to terminal block 214 and then through lines 216 and 188 back to the main control valve 184. Accordingly, jaw assembly 32 is retracted to a point where cam 162 reaches roller 182 and links 180, 181 and plunger 178 are actuated to operate the valve 174. In this new position of valve 174, fluid flow in line 194 is interrupted and fluid is applied through line 218. Retraction of jaw assembly 32 is consequently interrupted and retraction of jaw assembly 22 is effected by reason of fluid flow through check valve 220, lines 222 and 224 to rod ends of cylinders 34 and 36. Fluid is discharged from the opposite ends of cylinders 34 and 36 through lines 226, 228, 230, 232 and 188 to the main control valve whereby jaw assembly 22 is retracted. Guideway 18, on which valve 174 is mounted, moves with jaw assembly 22. Accordingly, roller 182 advances along

cam plate **168** until it drops off the left side to allow plunger **178** of valve **174** to stop the fluid flow through line **218** and redirect it through line **194** whereby retraction of jaw assembly **22** is terminated and retraction of jaw assembly **32** is again effected.

The initial retraction of jaw assembly **32** is effective to move the rollers **112** and **114** mounted on jaw assembly **32**, approximately half way from their outermost position toward cam plate **136**. During such movement, jaw member **103** is effective with jaw member **105** to cam the roll article to a more central position within the clamp as hereinabove explained. The continued clamping movement of jaw assembly **32** brings the rollers into contact with cam plates **136** whereby the continued retractive force of cylinders **56** and **58** causes arms **94** and **96** to be retracted and accordingly pivoted by shaft **120** to effect a pivotal clamping motion to the jaw of assembly **32**. Clamping action may be continued as herein described, sufficiently to grasp a load for handling, moving or positioning.

For releasing a load grasped by the clamping jaws of the invention, fluid under pressure is directed from valve **184** to the internal full area of cylinders **56** and **58** through lines **188** and **216**, terminal block **214** and respective lines **210** and **212**. Simultaneously therewith, fluid under pressure is applied through line **232** to operate the pilot release mechanism of check valve **196** to permit return flow of fluid from accumulator **202** and the rod ends of cylinders **56** and **58** which exhaust through lines **206**, **208**, **203**, **198**, check valves **196**, line **194** and valve **174** to the sump. It is noted that in these circumstances the plunger **178** of valve **174** is positioned so as to block flow through line **218** whereby cylinders **34** and **36** remain inactive.

The immediately aforedescribed extension of jaw assembly **32** takes place until cam **162** engages roller **182** causing an upward movement of plunger **178** as seen in FIG. 1, which again interrupts communication between lines **190** and **194** and permits return flow from line **218** to pass through line **192**. Under these circumstances, fluid under pressure is applied through lines **188**, **232**, **230**, **228** and **226** to cylinders **34** and **36**, extending the cylinders and jaw assembly **22** until roller **182** drops off the cam plate **168**, actuating plunger **178**, redirecting fluid through valve **174** whereby flow from the rod ends of cylinders **56** and **58** occurs through valve **12**. The jaws and assemblies are again fully extended and roller **182** is in a position to enable jaw assembly **32** to retract first rather than jaw assembly **22** which serves as a guide for the truck operator in positioning the truck for picking up a load.

As schematically shown in FIG. 6 of the drawings, valve **174** comprises a casing in which a plunger **178** is reciprocable to unitarily reciprocate a plurality of pistons **240**, **242** and **244** which control the flow of hydraulic fluid from pressure line **190** to either of lines **194** and **218** and from either of the lines **194** or **218** to return line **192** as the case may be. As shown in FIG. 6, the position of the pistons direct fluid from pressure line **190** to line **194** and from line **218** to line **192**. In an upper position as shown in dotted lines of the plunger, **190** would communicate with line **218** and line **194** with return line **192**.

The versatility of the clamp of the present invention enables the handling of roll articles larger than a predetermined minimum size which initially have axes horizontally disposed. Clamp assembly **10** is rotated 90° with respect to its position in the drawing in a counterclockwise direction looking forward from the rear thereof whereby jaw assembly **22** is directly beneath jaw assembly **32** and is near the floor. The valve controls are manipulated by the operator to supply fluid to valve **174**, whereby jaw assembly **32** is translated inwardly to the first automatic cut-off point and jaw assembly is translated inwardly to its cut-off point and then the valves are closed. Clamp assembly **10** is maneuvered so as to bring jaw **72** beneath the roll and jaw **103** and shoe **102** above the roll and gripping of the roll is effected by further pivotal motion of jaw **103** to bring shoe **102** tightly against the roll. It is to be observed that in positioning jaw **72** beneath the roll, the outer tip of this jaw approaches very nearly the lowermost point of the roll since the extreme outer portion of this jaw is straight to conform to a planar floor surface on which the roll is placed. Also, when jaw **72** is brought into this position, jaw **103** being considerably longer than jaw **72**, extends to a point above the roll and beyond the uppermost point of the roll whereby pivotal motion of jaw **103** brings shoe **102** into contact with the roll at a point substantially diametrically opposite the point of contact of jaw **72**. Accordingly, the roll cannot roll or slip away from the jaws.

In accordance with a somewhat simplified embodiment of the invention as shown in FIG. 7 of the drawings a pair of jaw assemblies **22'** and **32'** similar in shape and construction to jaw assemblies **22** and **32** of FIGURES 1 through 5 are mounted for strictly linear movement relative to each other and along guideways similar to guideways **18** and **20** of FIGURES 1 through 5, for gripping loads therebetween. In this embodiment of invention parts are constructed and arranged similar to those shown in FIGURES 1 through 6 with the exception that a jaw **103'** similar to jaw **103** is rigidly rather than pivotally mounted and is further free to move linearly toward or away from the other jaw within the limits as shown in full and in phantom lines since no limiting cam plate similar to cam plate **136** shown in FIGURES 1 through 5 is provided. Analogous parts are indicated by the same numbers primed.

It is to be understood that the automatic and sequential movement of the jaw assemblies **22'** and **32'** of this embodiment of invention for gripping and releasing loads is effected in a manner entirely similar to that disclosed with respect to FIGURES 1 through 6 with the exception that no pivotal movement of either jaw is provided for. The jaws are linearly movable alternatively in three steps as hereinabove described for small loads and in progressively fewer steps as the size of the load handled increases.

In FIG. 7 an arm **250** is mounted for linear movement along the guideways of the truck carriage under the influence of a hydraulically actuated piston **57'** and supports a curved shoe **102'** at its outer end for engagement with a load article. Shoe **102'** is mounted on a pivot **100'** and is biased by a spring **104'**. An inner portion of arm **250** has secured thereto a curved jaw member **252** for camming gripped articles into position for engagement by shoe **102'**.

Having thus described this invention in such full, clear, concise and exact terms as to enable any person skilled in the art to which it pertains to make and use the same, and having set forth the best mode contemplated of carrying out this invention, I state that the subject matter which I regard as being my invention is particularly pointed out and distinctly claimed in what is claimed, it being understood that equivalents or modifications of, or substitutions for, parts of the above specifically described embodiment of the invention may be made without departing from the scope of the invention as set forth in what is claimed.

I claim:

1. Hydraulic apparatus for the sequential operation of roll clamp jaws for a lift truck clamp comprising a frame, a first clamping jaw slidable on the frame, a second clamping jaw slidable on the frame, first hydraulic cylinder means for moving the first clamping jaw, second hydraulic cylinder means for moving said second clamping jaw, a manually operable valve, a source of hydraulic fluid pressure connected to said manually operable valve, a sequence valve mounted on said second clamping jaw and movable therewith relative to said frame, a sequence valve cam mounted on said first clamping jaw and movable therewith across the frame in a path adjacent to the path of movement of said sequence valve, conduit means to conduct hydraulic fluid under pressure from said manually operable valve to

said sequence valve, and conduit means connecting said sequence valve and said first hydraulic cylinder means to move said first clamping jaw across said frame and toward said second clamping jaw, a movable actuator mounted on said sequence valve, said movement of said first clamping jaw effective to bring said sequence valve cam into engagement with said movable actuator on the sequence valve, conduit means connecting said sequence valve and said second hydraulic cylinder means to direct hydraulic fluid under pressure to said second hydraulic cylinder means and move said second clamping jaw across the frame toward said first clamping jaw, said movement of said second clamping jaw being effective to move said sequence valve carried thereby relative to the sequence valve cam carried by said first clamping jaw and thus disengage said actuator with respect to said cam plate.

2. Hydraulic apparatus for the sequential operation of roll clamp jaws for a lift truck clamp comprising a frame, a first clamping jaw arranged to be extended and retracted on the frame, a second clamping jaw arranged to be extended and retracted on the frame, first hydraulic cylinder means for moving the first clamping jaw, second hydraulic cylinder means for moving said second clamping jaw, a manually operable valve, a source of hydraulic fluid pressure connected to said manually operable valve, a sequence valve mounted on said second clamping jaw and movable therewith in a reciprocating path near the mid-portion of said frame, a sequence valve cam mounted on said first clamping jaw

and movable therewith across the frame in a reciprocating path adjacent to the path of movement of said sequence valve, conduit means to conduct hydraulic fluid under pressure from said manually operable valve to said sequence valve, and conduit means connecting said sequence valve and said first hydraulic cylinder means to move said first clamping jaw across said frame and toward said second clamping jaw, a movable actuator mounted on said sequence valve, said movement of said first clamping jaw effective to bring said sequence cam into engagement with said movable actuator on the sequence valve, conduit means connecting said sequence valve and said second hydraulic cylinder means to direct hydraulic fluid under pressure to said second hydraulic cylinder means and move said second clamping jaw across the frame toward said first clamping jaw, said movement of said second clamping jaw being effective to move said sequence valve relative to the cam plate carried by said first clamping jaw.

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