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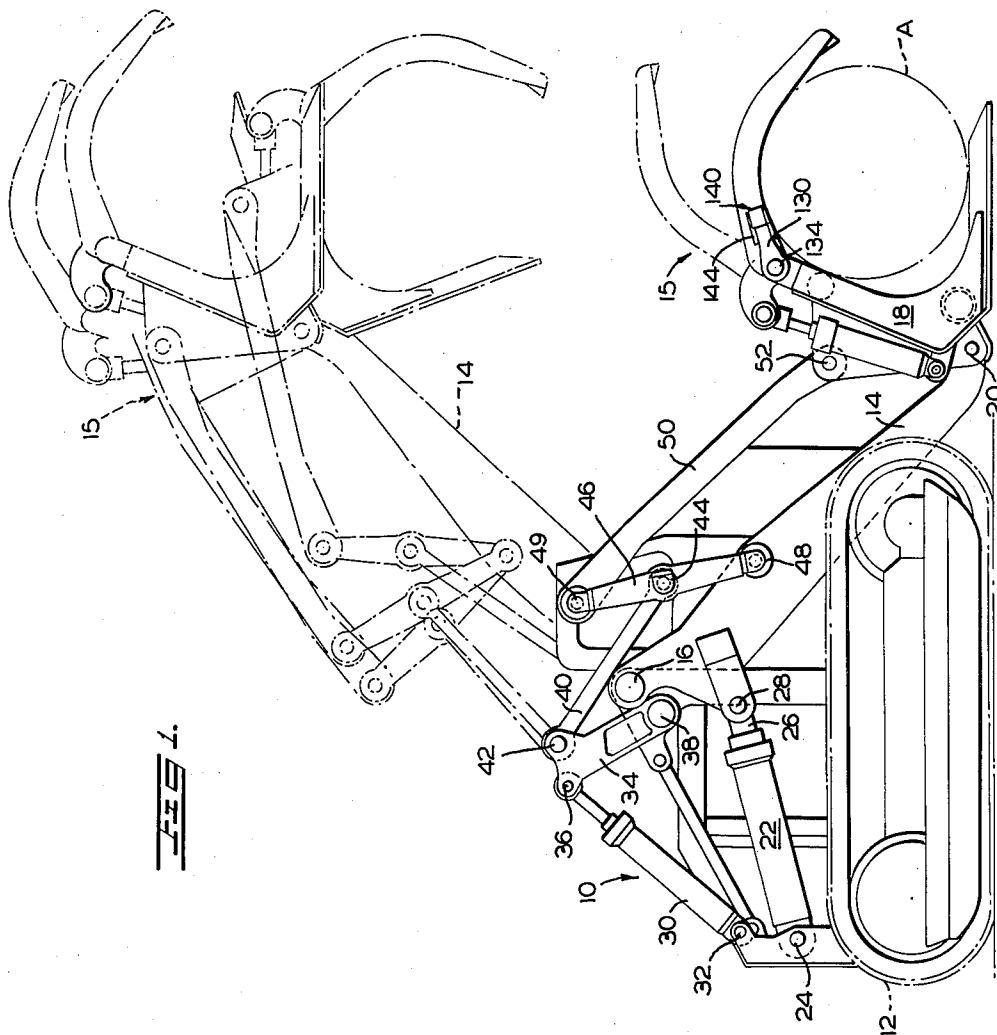
D. M. SCHWARTZ ETAL

3,034,820

MATERIAL HANDLING DEVICE

Filed Oct. 14, 1958

6 Sheets-Sheet 1

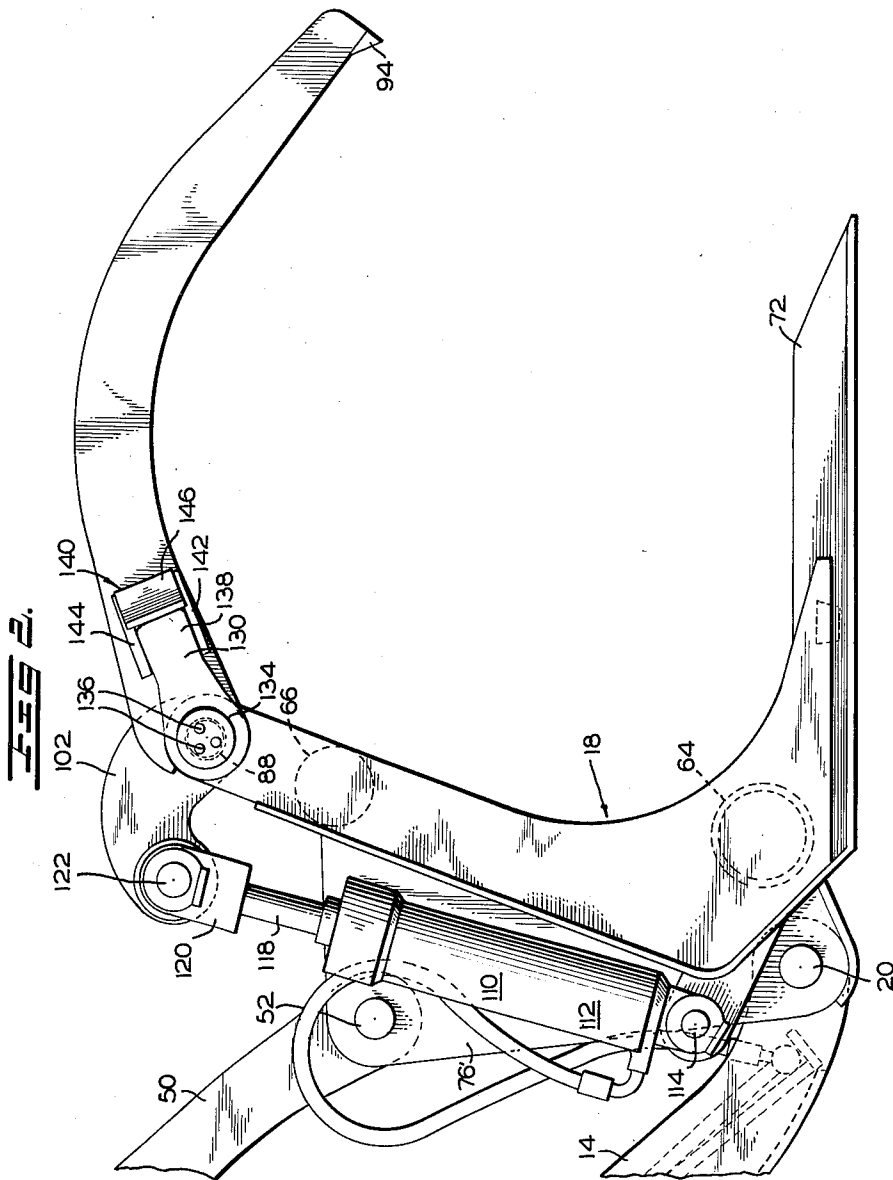


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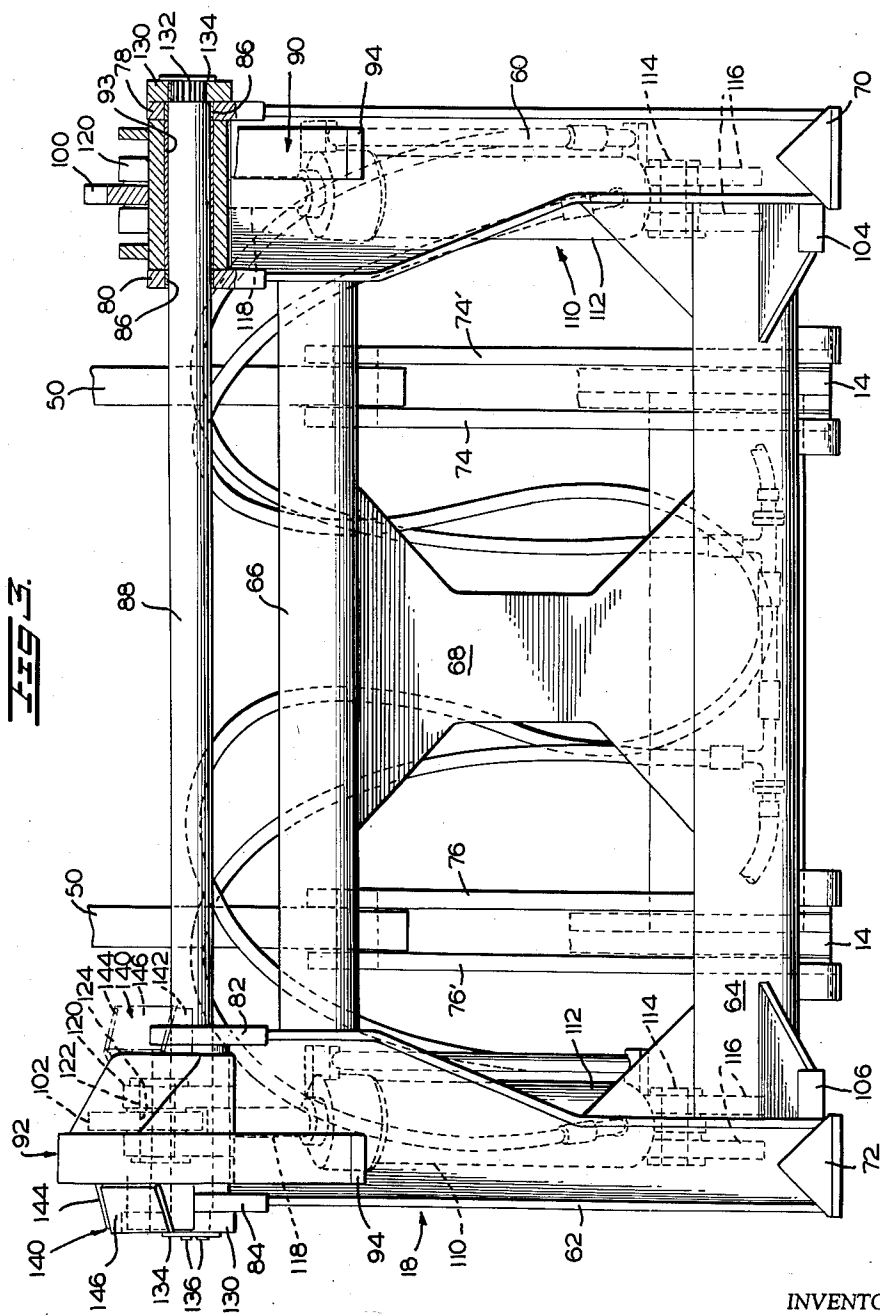
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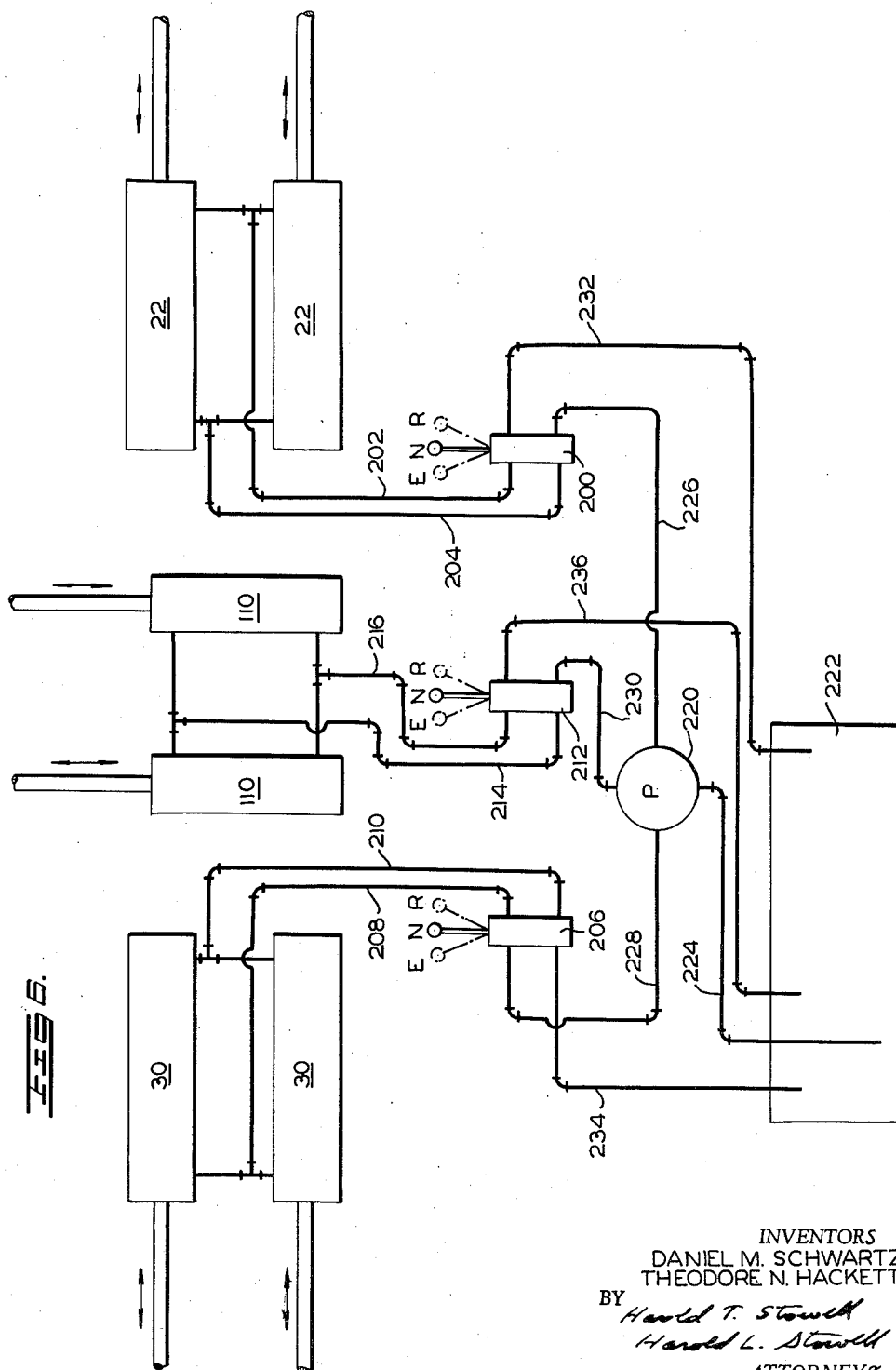
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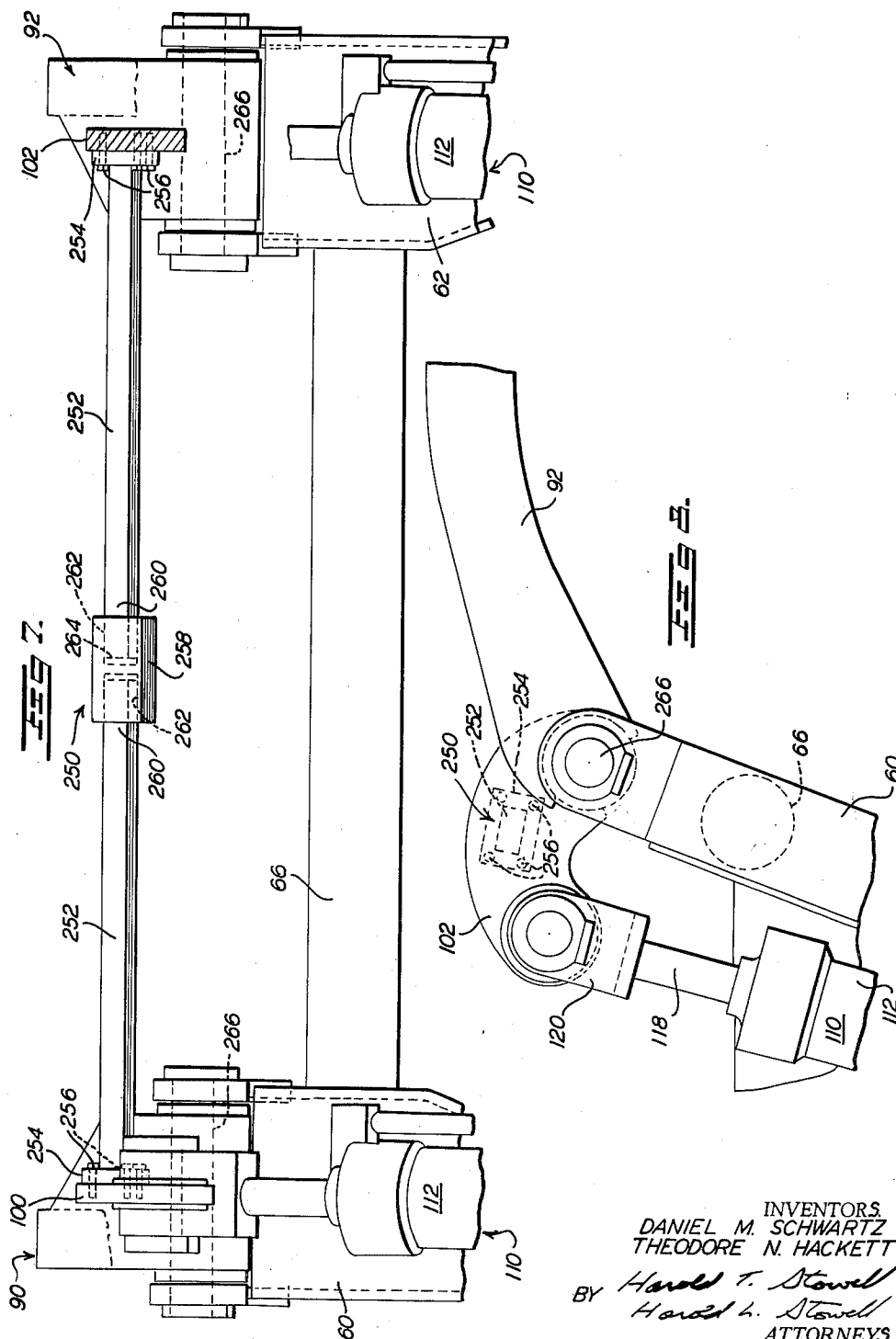
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6 Sheets-Sheet 6



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MATERIAL HANDLING DEVICE

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Filed Oct. 14, 1958, Ser. No. 767,111
11 Claims. (Cl. 294—88)

This invention relates to a material handling device and, more particularly, to an improved clamping fork attachment for a mobile material handling machine which has many uses such as excavating and clearing land and in the carrying and handling of bulky objects and materials such as logs, large stones and bales.

Many of the clamping fork attachments that have been developed have used expensive and complicated structures in an attempt to provide for balanced controlled opening of multiple articulated fork arms and in attempting to provide means giving a reasonable balance and/or transfer of forces applied to fork arms. Some of these structures of the art have been successful in some measure but, it does not appear that any provide a satisfactory answer to all the problems. Some fork attachments have been provided with an expensive hydraulic system wherein each cylinder is separately controlled via an expensive multipurpose valve or a duplicate valve and separate hydraulic circuits. Even forgetting the expense and maintenance problems with such a system, it still did not provide an easy automatic control action such as provided with our improved material handling fork attachment.

It is, therefore, a major object of the present invention to provide a material handling device including resilient means constructed to interconnect a pair of clamping fork members.

Another object is to provide for balanced operation of a two movable arm clamping fork unit with actuating means for each movable arm.

A further object is to provide an improved system for distribution of the load and loading of a pair of articulate material handling arms.

Another object is to provide an improved material handling assembly including fixed arms and movable arms wherein the movable arms may be selectively positioned either in or out of vertical alignment with the fixed arms.

A further object is to provide an improved material handling fork attachment with dual articulated clamping fork arms each with a separate hydraulic power cylinder with the hydraulic power cylinders interconnected by a common hydraulic system controlled by a single simple valve and with balanced opening of the dual articulated clamping fork arms assured by resilient means interconnecting the dual arms.

Further objects and advantages will appear from the following description and appended claims when read in conjunction with the attached drawings, wherein:

FIG. 1 is a side elevation view of a crawler mounted tractor equipped with the improved material handling fork means;

FIG. 2 is an enlarged partial side elevation view of the improved material handling fork means;

FIG. 3 is a front elevation view of the material handling fork means of FIG. 2;

FIG. 4 is a front elevation cut-away view showing detail of another torsion means embodiment and of one of the movable fork arms in phantom in an offset position;

FIG. 5 is a section view on line 5—5 of FIG. 4, illustrating further detail of the torsion means embodiment of FIG. 4;

FIG. 6 is a schematic view of a hydraulic system for

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operating the improved material handling fork means of the invention;

FIG. 7 is a partial rear elevation view showing detail of a resilient means embodiment; and

FIG. 8 is a partial side elevation view of the embodiment of FIG. 7.

Referring to FIG. 1 of the drawings, 10 generally designates a mobile material handling machine mounted on conventional crawler treads 12. The material handling machine includes a front end material handling structure having a boom 14 which is pivotally mounted at 16 to the superstructure of the vehicle. At the extended end of the boom 14 is a log or other bulk material handling device generally designated 15. The frame 18 of the logging attachment 15 is pivotally mounted to the boom by pivot pin 20. The boom is pivoted from its low forward position shown in solid lines to an upwardly extending position, shown in broken lines, by a hydraulic ram 22.

The hydraulic ram 22 is pivotally mounted to the main frame of the vehicle as at 24 while the extended end of the piston rod 26 of the ram is pivotally connected as at 28 to the boom 14 below the boom's pivotal connection to the frame of the vehicle.

The front end material handling structure also includes means for pivoting the frame 18 relative to the boom 14. The means for pivoting the frame 18 includes a hydraulic ram 30 which is pivotally connected to the frame of the vehicle as at 32 and to a bell crank 34 by pivot pin 36. The bell crank 34 is also pivoted as at 38 to the superstructure of the vehicle, and to an arm 40 as at 42.

The other end of arm 40 is pivotally center connected as at 44 to a cross-arm 45. One end of the cross-arm is pivoted as at 48 to the boom 14 while the other end is pivotally mounted 49 to a link or rod 50, the lower end of which is connected by pivot pin 52 to the upper portion of the frame 18 at a point spaced from the pivotal connection between the frame 18 and the boom 14.

An identical system of boom, lever arms, bell crank, links and hydraulic rams is provided for the other side of the material handling machine whereby upon directing pressure fluid into the hydraulic rams 22 the booms 14 are pivoted about the axis of the pivot shaft 16 and raised to the extended position as shown in broken lines in FIG. 1 of the drawings. By directing pressure fluid to the hydraulic rams 30, the frame 18 of the material handling device is pivoted about the axis of pivot shafts 20 for dumping, positioning or picking up structures maintained between the forks or arms thereof as shown in phantom lines when the boom is, for example, in the raised position.

Referring also to FIGS. 2 and 3 the preferred embodiment of the improved clamping fork attachment is shown to have a frame 18. Frame 18 has a pair of spaced parallel structural members 60 and 62 interconnected adjacent their lower ends by a tubular member 64 and adjacent their upper ends by a tubular member 66 which tubular members are, in turn, interconnected by plate 68. Rigidly secured to the lower ends of each of the side members 60 and 62 of the frame 18 are respectively forwardly extending fork arms 70 and 72. Arms 70 and 72 which are rigid with members 60 and 62 and frame 18 are pivoted with frame 18 relative to the booms 14 by actuation of rods 50 through bell cranks 34 and hydraulic rams 30 as hereinbefore described.

Clamping fork attachment frame 18 is also provided with spaced frame plates 74, 74' and 76 and 76' which extend between and are fixed to the upper and lower tubular members 64 and 66. The upper and lower ends of the spaced frame plates 74, 74' and 76, 76' are bored for and receive pivot pins 20 and 52 for the pivotal connections between frame 18 and the booms 14 and the tilting rods 50.

Spaced parallel projections 78, 80 and 82, 84 at the upper ends of respective frame side members 60 and 62 are bored to receive and bushed 86 for relative rotation of torsion bar 88. Torsion bar 88 also functions as a pivot pin mounting for an articulated fork arm 90 mounted between projections 78 and 80 and as a pivot pin mounting for an articulated fork arm 92 mounted between projections 82 and 84. Although fork arms 90 and 92 generally rotate with torsion bar 88 they are bushed 93 to provide for relative rotative movement of the bar 88 when torsional stress is being imposed or being removed from torsion bar 88. Fork arms 90 and 92 are generally urged to and maintained in parallel relation by torsion bar 88 which encounters torsional stressing and displacement generally only when the fork arms 90 and 92 clamp a load of varying thickness to fixed fork arms 70 and 72. Tubular pivot pins (not shown) could be used, if desired, instead of torsion bar 88 for pivot pin mounting of fork arms 90 and 92. Torsion bar 88 would extend through the tubular pivot pins and be connected to fork arms 90 and 92 in the manner hereinafter described for the preferred embodiment.

Each fork arm 90 and 92 may be provided with a depending tooth member 94 or the like at its forwardmost end to aid in gripping logs, bales or other objects to be grasped between the fixed and movable fork jaws 70 and 90, 72 and 92. As shown in FIG. 3, the forwardly extending portions of each of the movable fork arms 90 and 92 are laterally offset from the medial plane of the respective sleeve bushings 93.

Rearwardly extended portions 100 and 102 of respective fork arms 90 and 92 are located on the medial plane of the respective sleeve bushings 93. With this construction movable fork arms 90 and 92 may be positioned on frame 18 in vertical alignment with the respective complementary fixed arms 70 and 72 as shown in FIG. 3 or the arms 90 and 92 may be interchanged, as indicated in phantom in FIG. 4, so that arm 90 cooperates with fixed arm 72 and movable arm 92 cooperates with fixed arm 70. With arms 90 and 92 interchanged they are inset with respect to the fixed arms 70 and 72 whereby the arms 90 and 92 may close into abutting relationship with stop members 104 and 106 provided at the inner sides of respective fixed arms 70 and 72. Since the rearwardly extended portions 100 and 102 of fork arms 90 and 92 respectively are on the medial plane of the respective sleeve bushings 93, interchanging the position of the two arms 90 and 92 does not affect the lateral spacing between the portions 100 and 102.

Movable fork arms 90 and 92 are caused to pivot about the center line of their mountings (torsion bar 88) by traction devices such as the double acting hydraulic rams 110 one for each arm 90 and 92. The lower end of each cylinder 112 of hydraulic rams 110 is mounted by a pivot pin 114 on the respective projections 116 which are so positioned that the piston output rod 118 of each cylinder 112 is in operative alignment with the respective rearwardly extended portion 100 and 102 of arms 90 and 92. Each piston output rod 118 is provided with a forked member 120 which mounts a pivot pin 122 which is pivotally received in opening 124 of the respective portion 100 and 102 for the operative pivotal connections of a conventional nature between hydraulic rams 110 and the respective arms 90 and 92. Reciprocation of piston rods 118 raises and lowers rearwardly extended portions 100 and 102 of movable arms 90 and 92 causing the forward ends of the arms 90 and 92 to move toward and away from the fixed arms 70 and 72.

A torsion arm 130 is nonrotatably mounted as by splines 132 on each end of torsion rod 88 and each arm 130 is held thereon by an end plate 134 which is secured in place as by screws 136. The projection 138 of each torsion arm 130 extends into a torsion member 140 mounted on the outer side of the respective arm 90 or 92 where it is received between walls 142 and 144. Tor-

sion members 140, which are mounted on each side of arms 90 and 92 in order that the arms may be interchanged as hereinbefore described, are each provided with a sloped deflecting wall 146 at the forward facing end so that branches of logs and the like will be deflected out of the way. Mounting of torsion arms 130 to the outside from frame 18 and from the movable arms 90 and 92 insures a maximum of available effective length for torsional deflection of torsion bar 88.

The interconnection of the two arms 90 and 92 through torsion arms 130 and torsion rod 88 is effective to normally maintain movable arms 90 and 92 at a balanced degree of opening and at the same time permits these arms to adjust within limits determined by the elasticity or resilience of torsion members to reasonable degrees of unequal spacing normally required of the pair of arms when handling loads having variable diameters. Rocking of movable arms 90 and 92 by simultaneous operation of hydraulic rams 110 causes the torsion bar 88 to rotate or twist after one of the movable arms 90 and 92 has clamped a load and rocking of the other arm 90 or 92 is continued. This means that the arm 90 or 92 in grasping the larger diameter portion of an uneven sized load will be applying the greater grasping force generally to the heaviest portion thereof. It is preferred that the stiffness (or elasticity) of the torsion bar assembly be such as to receive a full torsional load so that the force of both hydraulic rams 110 will be applied to the arm 90 or 92 grasping a load when only one of the pair of arms 90 and 92 is engaged with the load. To accomplish this the torsion bar assembly must absorb the full actuating force of a hydraulic ram 110 rocking the arm 90 or 92 not engaging the load before that arm 90 or 92 bottoms on the respective lower fixed arm 70 or 72 or stop members 104 or 106 as the case may be. Of course bottoming of the loose arm 90 or 92 may occur if the load grasped by the other arm 90 or 92 is of relatively small diameter.

Referring now to FIGS. 4 and 5 for another torsion means embodiment, a torsion bar structure 160 is shown which may be used in place of torsion bar 88. Torsion bar structure 160 has a center substantially rigid bar 162 which projects into and engages at 164 two resilient material bushing like members 166. Each bushing like member 166 is contained within and engaged by a tubular container 170. The resilient bushing like members 166 may comprise natural or synthetic rubbers, or plastic materials having high shear strength and a suitable modulus of elasticity. To prevent free movement between the surfaces of the resilient bushing like members 166 and their mating surfaces of bar 162 and tubular containers 170, the bushing like members are vulcanized or bonded thereto or secured thereto by adhesives or in the case of castable plastic materials, the plastic resilient composition may be molded or cast in the assembled relationship.

Each tubular container 170 is provided with a bolt flange 172 at the outer end in order that it may be fastened as by bolts 174 to the flange 176 of the respective torsion bar structure 160 end mounting rod 178. End mounting rods 178 are mounted in frame 18 and connected to the movable arms 90 and 92 in the same manner as for torsion bar 88. While torsion bar 88 is assembled in the structure by insertion from one end torsion bar structure 160 must be assembled in the structure by first inserting end mounting rods 178 in place where they act as pivot pins for the movable arms 90 and 92 then lifting the subassembly 180 including bar 162 bushing like members 166 and tubular containers 170 into position for bolting to the end mounting rods 178. It is intended that substantially all the torsional displacement and resilient forces be taken up in and stored by the resilient bushing like members 166. Operation of a logging attachment 15 equipped with a torsion bar structure 160 will be substantially the same and give the

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same results as described hereinbefore for an attachment 15 equipped with torsion bar 88.

FIG. 6 illustrates a hydraulic circuit for actuation of a material handling machine equipped with a logging attachment 15 using either of the torsion means embodiment hereinbefore described. A three-position valve 200 is connected by conduits 202 and 204 to hydraulic rams 22 for raising booms 14. Three position valve 206 is connected by conduits 208 and 210 to hydraulic rams 30 for tilting the frame 18 and thereby attachment 15 and any load carried thereby. Three position valve 212, which is connected by conduits 214 and 216 to hydraulic rams 110, is provided for controlled actuation of the hydraulic rams 110 for opening, closing and holding of movable fork arms 90 and 92. Conduit 214 provides free fluid communication between hydraulic rams 110 above the pistons in cylinders 112 and conduit 216 provides free fluid communication between hydraulic rams 110 below the pistons in cylinders 112. This permits the hydraulic fluid in the cylinder chambers of hydraulic rams 110 to shift from cylinder to cylinder upper chamber to upper chamber and lower chamber to lower chamber as imposed by difference in load diameters at the movable arms 90 and 92 and by the torsion means when an uneven diameter load is released and the arms are returned to a balanced degree of opening by the torsion means.

The control handles of the respective valves 200, 206 and 212 when placed in the "N" or neutral position block the flow of fluid through the respective valves to or from conduits, 202, 204, 208, 210, 214 and 216. When control handles of the valves are placed in the "E" or extend the respective cylinders urge the piston rods outward. When control handles of the valves are placed in "R" or retract the respective cylinders urge the piston rods inwardly. These different valve control settings bring about the desired movement of the booms, tilt rods and the movable fork arms 90 and 92. Other elements of a hydraulic circuit as illustrated in FIG. 6 for a material handling machine, which are of a conventional nature, are: a pump 220 which draws from a fluid reservoir 222 through line 224, fluid pressure lines 226, 228 and 230 from pump 220 to valves 200, 206 and 212 respectively and fluid exhaust lines 232, 234 and 236 from the respective valves to fluid reservoir 222.

Although material handling fork attachment 15 has been described with paired fixed arms 70 and 72 substantially all the advantages attributed thereto would also apply to a fork attachment having only one fixed arm below a pair of movable arms. It will be apparent to those skilled in the art that other torsion means embodiments may be used in place of the several embodiments shown and described. It should also be apparent to those skilled in the art that other traction means than the hydraulic rams 110 could be used for a fork attachment.

Referring now to FIGURES 7 and 8 for another resilient means embodiment, a spring bar structure 250 is shown which may be used instead of torsion bar 88 or torsion means structure 160. Spring bar structure 250 has two bar members 252 equipped with flanged ends 254 for mounting as by bolts 256 to the inner side of the respective rearwardly extended portion 100 or 102 of fork arms 90 and 92. An aligning cap member 258 receives the inner ends 260 of the bar members 252 for relative longitudinal movement in openings 262 to maintain alignment of the ends 260 and transmit resilient force of one bar member 252 to the other whenever one fork arm 90 or 92 is pivoted out of alignment with the other. Aligning cap member 258 has inner wall 264 which maintains its position with respect to bar ends 260. Openings 262 could be one opening and a pin through cap member 258 would replace wall 264. Pivot pins 266 are provided in place of torque rod 88 or end mounting rods 178 for pivot mounting of fork arms 90 and 92 in a conventional manner on frame 18.

Other components in the spring bar structure 250 em-

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bodiment other than those directly a part of a torsion means structure are the same and function the same as the corresponding parts hereinbefore described with respect to the other embodiments. With spring bar members 252 mounted to the rear of the pivotal axis of fork arms 90 or 92 as shown in FIGURE 8 and one arm 90 or 92 pivoted out of alignment with the other spring bar members 252 are resiliently bent and resiliently urge fork arms 90 and 92 to return to a balanced degree of aligned opening.

We have herein provided an improved material handling machine fork attachment. It is an attachment which if positioned with fixed arms 70 and 72 close to and parallel with the ground, forward vehicle 10 movement, provided movable arms 90 and 92 are up out of the way, will force arms 70 and 72 under a log as illustrated A in FIG. 1. The operator by actuation of valve 222 clamps movable arms 90 and 92 down on the log A and to fixed arms 70 and 72. The log A may be raised by boom 14 and rams 22 by suitable control of valve 200. The vehicle may then transport the log A to another location where the log A may be dropped by pivoting frame 18 and thereby attachment 15 by suitable actuation of rams 30 by valve 206 to the tilt position desired and then releasing movable arms 90 and 92 with suitable control of hydraulic rams 110 by valve 212.

We have provided resilient means interconnecting a pair of clamping fork members for balanced operation of the two movable arms in a clamping fork unit with actuating means for each movable arm.

While we have shown and described several embodiments of our invention, various changes and modifications may be effected without departing from the spirit and scope of the invention as defined in the appended claims.

Related subject matter is disclosed and claimed in application entitled "Material Handling Machine," Case I, T. N. Hackett et al. Serial Number 767,165, filed Oct. 14, 1958.

What we claim and desire to secure by Letters Patent is:

1. An attachment for a material handling device comprising a frame, fixed arm means extending from one end of said frame, a pair of movable arms, means pivotally mounting said pair of movable arms adjacent the other end of said frame for movement of the extended ends thereof toward and away from said fixed arm means to engage an object therebetween, symmetrically positioned traction means to move said movable arms about their pivotal connections to said frame, and means permitting movement toward said fixed arm means of either of said movable arms relative to the other of said movable arms, said means comprising resilient means positioned remote from the extended ends of the pair of movable arms and interconnecting said movable arms and normally urging said movable arms into parallel relationship.

2. An attachment for a material handling device comprising a frame, fixed arm means extending from one end of said frame, a pair of movable arms, means pivotally mounting said pair of movable arms adjacent the other end of said frame for movement of the extended ends thereof toward and away from said fixed arm means to engage an object therebetween, symmetrically positioned traction means to move said movable arms about their pivotal connections to said frame, and means permitting movement toward said fixed arm means of either of said movable arms relative to the other of said movable arms, said means comprising resilient means interconnecting said movable arms and normally urging said movable arms into parallel relationship, said resilient means comprising a torsion bar.

3. An attachment for a material handling device comprising a frame, fixed arm means extending from one end of said frame, a pair of movable arms, means pivotally mounting said pair of movable arms adjacent the other end of said frame for movement of the extended

ends thereof toward and away from said fixed arms to engage an object therebetween, symmetrically positioned traction means to move said movable arms about their pivotal connections to said frame, and means permitting movement toward said fixed arm means of either of said movable arms relative to the other of said movable arms, said means comprising resilient means interconnecting said movable arms and normally urging said movable arms into parallel relationship, said resilient means comprising a torsion bar, and said torsion bar comprises the pivotal connection between said movable arms and the frame.

4. The invention defined in claim 1 wherein said resilient means includes a bushing of resilient material.

5. The invention defined in claim 4 wherein said resilient means includes a tubular member containing said bushing and bonded to said bushing and a rod inserted into said bushing and bonded to said bushing.

6. The invention defined in claim 5 wherein a resilient means end rod member is fastened to said tubular member and is constructed to provide said pivotal connection between the respective said movable arm and the frame and means nonrotatably connecting said resilient means end rod member to the respective said movable arm.

7. The invention defined in claim 1 wherein said resilient means is a spring bar structure.

8. The invention defined in claim 7 wherein said spring bar structure is mounted on said movable arms and interconnects said movable arms off center with respect to pivotal connections of said movable arms to said frame.

9. An attachment for a material handling device comprising a frame, fixed arm means extending from one end of said frame, a pair of movable arms, means pivotally mounting said pair of movable arms adjacent the other end of said frame for movement of the extended ends thereof toward and away from said fixed arm means to engage an object therebetween, two hydraulic cylinder traction means one operatively connected to each of said

pair of movable arms constructed to move said movable arms about their pivotal connections to said frame, and resilient means positioned remote from the extended ends of the pair of movable arms and interconnecting said movable arms for torque transmitting communication therebetween and to permit relative differential movement of said movable arms.

10. The invention defined in claim 9 wherein said hydraulic cylinders are double acting cylinders with upper cylinder chambers and lower cylinder chambers and a hydraulic system with conduit means constructed to provide free fluid communication between one upper cylinder chamber and the other upper cylinder chamber and conduit means constructed to provide free fluid communication between one lower cylinder chamber and the other lower cylinder chamber.

11. An attachment for a material handling device comprising a frame, fixed arm means extending from one end of said frame, multiple movable arms, means pivotally mounting said movable arms adjacent the other end of said frame for movement of the extended ends thereof toward and away from said fixed arm means to engage an object therebetween separate traction means for each of said movable arms to move respective movable arms about their pivotal connections to said frame, and resilient means positioned remote from the extended ends of the pair of movable arms and interconnecting said movable arms for torque transmitting communication therebetween and to permit relative differential movement of said movable arms.

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