

March 12, 1963

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3,080,988

GRAPPLE DEVICE FOR MATERIAL HANDLING APPARATUS

Filed May 9, 1960

2 Sheets-Sheet 1

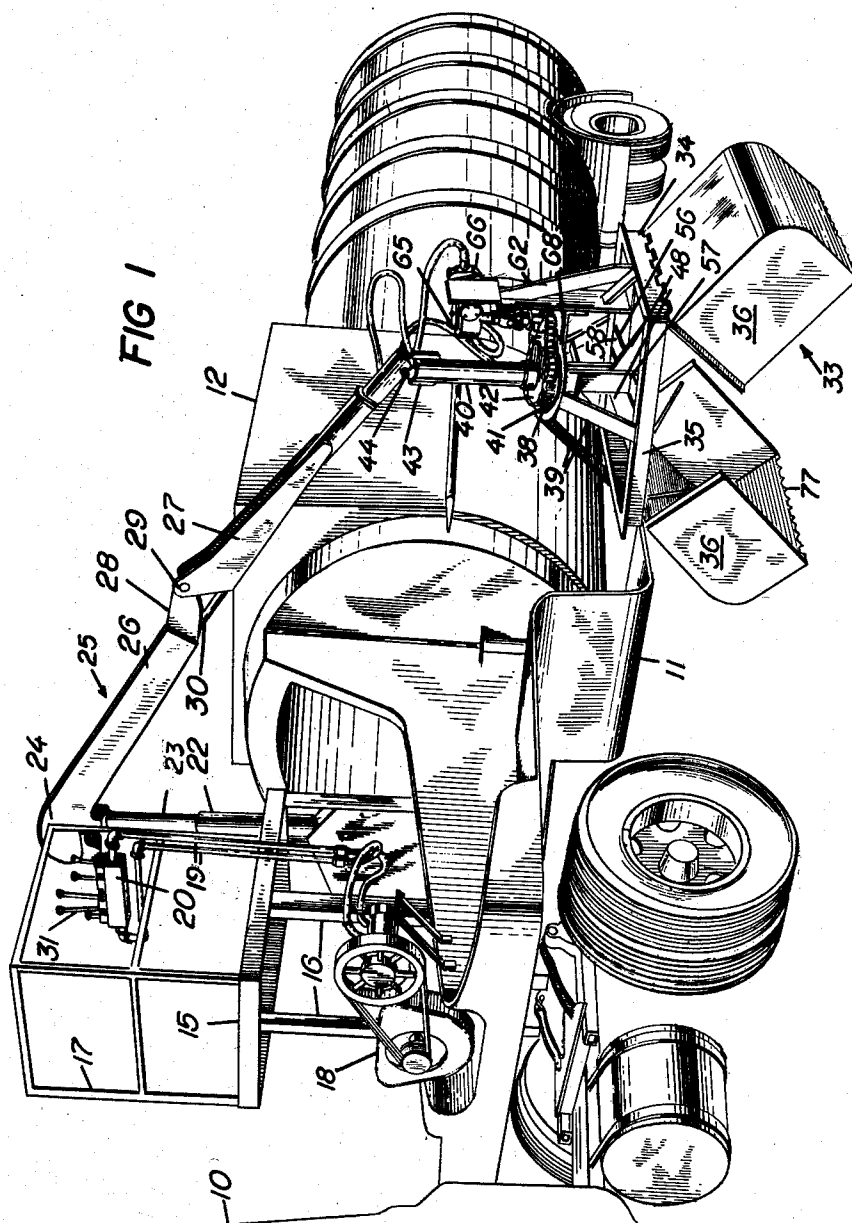


FIG 1

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2 Sheets-Sheet 2

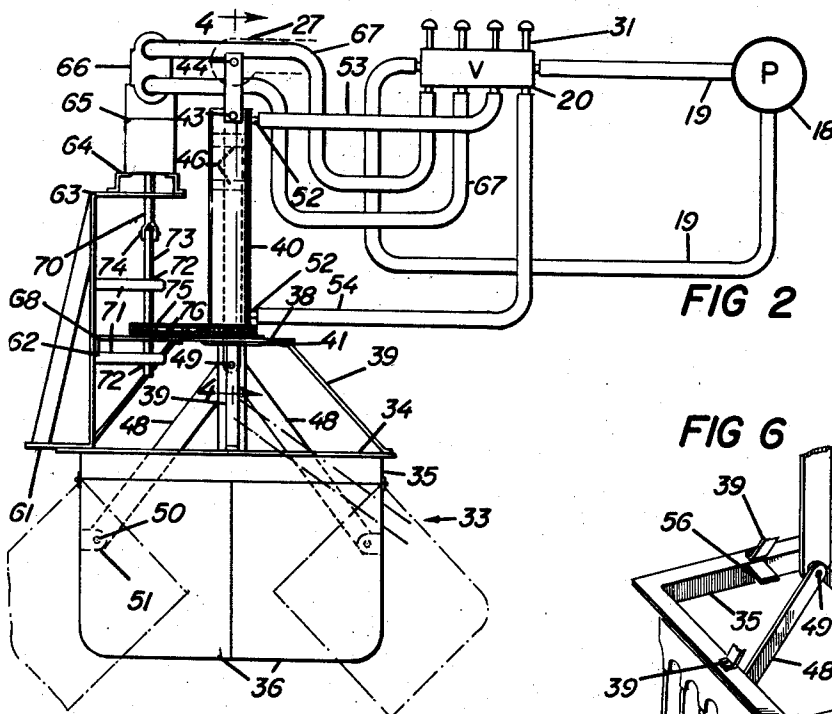


FIG 2

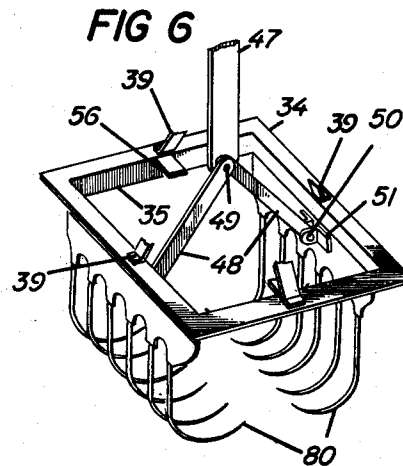


FIG 6

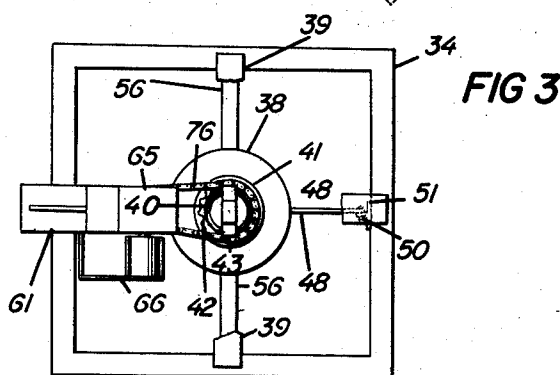


FIG 3

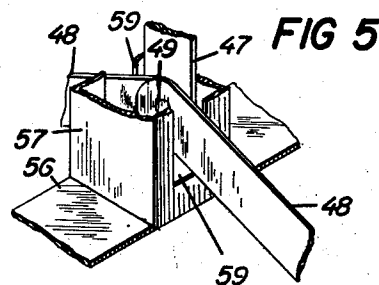


FIG 5

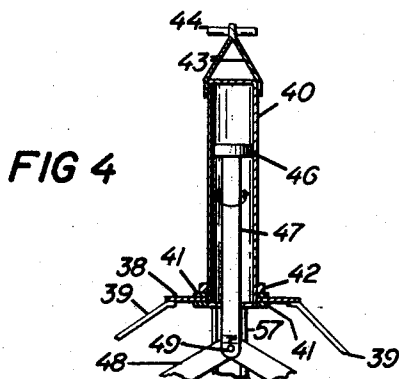


FIG 4

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## GRAPPLE DEVICE FOR MATERIAL HANDLING APPARATUS

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Filed May 9, 1960, Ser. No. 27,936

7 Claims. (Cl. 214-656)

The present invention relates broadly to a material handling apparatus and more specifically to a grapple or crane hook that is mounted on the end of a movable boom.

In prior devices the grapples have been connected to and supported from the free end of a movable boom by cables so that, the grapple is adapted to have a free swinging movement with respect to the boom. The grapple or crane hook of this type is extremely difficult to control and operate particularly as regards the positioning of the grapple in order to engage the material or article with the tongs or buckets of the grapple. Thus a grapple that is supported by a cable is not capable of operating in a manner that is as efficient and accurate as a grapple that is mounted upon and carried by the free end of the movable boom.

While attempts have been made to provide grapples of the aforementioned type with guide or check lines in an endeavor to more accurately position the tongs or buckets with respect to the materials or articles to be engaged, such efforts have not been overly successful. In some instances it has been found that the use of guide or check lines have restricted the maneuverability of the grapple, thereby rendering it ineffective for certain types of operations.

One of the objects of the present invention is to provide a grapple device that is connected to and carried by the free end of a movable boom, whereby an operator can accurately control the positioning of the grapple for picking up various materials or articles.

Another object is to provide a grapple device that is connected to a boom in such a manner as to be capable of rotative movement with respect thereto for more accurate positioning of the grapple with relation to the material or articles to be moved.

Another object is to provide a grapple device that is connected to and carried by the free end of a movable boom wherein the opening and closing of the grapple jaws or tongs is controlled by an operator at a remote station.

A further object is to provide a movable boom having a grapple device operatively connected to the free end thereof for rotative movement about a vertical axis under the control of an operator at a remote station.

A still further object is to provide a movable boom having a grapple device operatively connected to the free end thereof with the grapple jaws or tongs pivotally connected to a frame member that is maintained in a horizontal plane at all times for accurately positioning the grapple with respect to the material or article to be engaged by the jaws or tongs.

Still further objects are to provide a grapple device which is readily adaptable for mounting on a free end of a boom, which is economical of manufacture and is efficient in operation.

Other objects and advantages, more or less ancillary to the foregoing in the manner in which all of the various objects are realized will appear in the following description, which, when considered in connection with the accompanying drawings, sets forth the preferred embodiment of the invention.

Referring to the drawings, wherein the preferred embodiment of the invention is illustrated:

2

FIG. 1 is a perspective view of a material and article carrying vehicle employing a pivoted extensible boom with a grapple device of the present invention mounted on the free end thereof;

FIG. 2 is a side elevational view of the grapple device showing the grapple jaws in open and closed position and a fluid system for operating the grapple device;

FIG. 3 is a plan view of the grapple device shown in FIGURE 2 with the fluid system removed;

FIG. 4 is a vertical sectional view of the operating piston and cylinder with a portion of the piston rod guide member;

FIG. 5 is a detail view of guide member for the lower end of the piston rod and the link members or arms that are connected to the clam bucket;

FIG. 6 is a perspective view of a modified grapple device showing the use of tongs or fork members in lieu of the jaw or bucket members.

Referring to the drawings, there is shown in FIG. 1 a vehicle comprising a tractor 10 having a trailer 11 connected thereto by a conventional fifth wheel mounting. The type of trailer illustrated is primarily used for collecting trash or refuse which material can be deposited into the vehicle through a top opening or loading hopper 12. A suitable ram device, not shown, is customarily employed for compressing toward one end of the vehicle the refuse material as it is deposited therein. The vehicle or trailer 11 does not in and of itself constitute any part of the present invention but is simply illustrated to show a specific use to which the present device of the present invention is readily adaptable. The trailer 11 is provided at its forward end with an operator's platform 15 mounted on suitable supports 16 and provided with a guard rail 17. The front end portion of the trailer 11 beneath the operator's platform 15 has mounted thereon a suitable power source 18 such as an internal combustion engine and a compressor or pump for energizing pressure fluid circuits and power devices that operate a boom and a grapple device that is adapted to be mounted thereon. The power source 18 or pump unit is connected by conduits 19 to a hydraulic control unit 20 of any well known type, which is supported in any suitable manner with respect to the platform 15 for actuation by an operator positioned thereon.

The trailer 11 also has mounted on the forward end thereof, adjacent the platform 15, a vertically extending hydraulically actuated cylinder 22 and piston 23 of a conventional type. The free end of the piston 23 has pivotally mounted thereon the inner or lower end 24 of a boom 25 which is composed of an inner part 26 and an outer segment 27. The outermost end portion of the inner boom 26 terminates in an angularly disposed segment 28 which is pivotally connected to a complementary segment 29 formed on the inner or lowermost end portion of the outer boom segment 27. A suitable cylinder and piston 30 are connected to and carried by the inner and outer boom parts 26 and 27, respectively, so that the outer boom segment 27 may be moved about its pivotal connection and drawn toward the inner boom part 26, so as to reduce the overall length of the boom 25. The cylinder 22 and piston 23 are connected by suitable conduits to the hydraulic control unit 20 as are the cylinder and piston 30, so that upon the actuation of certain of the handles 31 of the control unit 20 the boom 25 may be elevated or lowered by means of the cylinder 22 and piston 23 or the boom may through the pivotal connection of the parts 26 and 27 be extended or retracted upon the actuation of the cylinder or piston 30. The description set forth thus far is known and per se forms no part of the present invention.

Referring to FIGS. 1 and 2, the outer or free end portion of the boom segment 27 has connected thereto and

depending therefrom a grapple device 33. The grapple device comprises a rectangularly shaped frame 34 having a depending flange portion 35 to which is pivotally connected on opposite sides thereof, a clam bucket consisting of two jaw members 36. The frame 34 has a plate member 38 supported thereabove in spaced parallel relation by means of a plurality of braces 39 which have one end secured to the frame 34 and the other end to the lower or bottom face of the plate member. The plate member 38, FIGURE 4, is formed with a central aperture through which extends, in a plane normal thereto, a cylinder 40. The cylinder 40 has secured to its outer surface a pair of annular disc members 41 that are positioned adjacent to the top and bottom surfaces of the plate member 38. The disc members 41 act as retainers and guide means for the plate member 38 which is not secured to the cylinder 40 and thus is capable of rotative movement between said disc members about the longitudinal axis of the cylinder 40. The cylinder 40 has secured thereto, in any suitable manner, a gear 42 which is positioned on the outer surface of the cylinder superjacent the topmost disc member 41. The upper end portion of the cylinder 40 has mounted thereon, an upwardly extending bracket member or housing 43 to which the free end of the segment 27 of the boom 25 is detachably connected by a pin or rod 44 that projects through suitable openings provided in the end of the boom and the bracket member. Thus the grapple device 33 is detachably connected to the outer end of the boom 25 and is capable of being raised or lowered through the boom action.

The cylinder 40 has slidably mounted therein a piston 46 which is also capable of rotative movement within the cylinder independently of the cylinder. The piston has secured thereto a depending rod or arm 47 that has secured to the lower end portion thereof, below the bottom of the cylinder 40, one end of a pair of links or arms 48. The links 48 are pivotally connected to the piston rod 47 by a pin 49 while the other end of the links are pivotally connected by a pin 50 to a boss or bracket 51 that is provided on the inner surface and adjacent the topmost portion of the jaw members 36, FIGS. 2 and 6. The upper and lower ends of the cylinder 40, FIGURE 2, are provided with suitable fittings 52 to which are connected conduits 53 and 54, respectively, which conduits are in turn connected to the control unit 20 for delivering fluid to opposite sides of the piston 46 within the cylinder 40.

The frame 34 has secured to opposite sides thereof a pair of inwardly extending brace members 56, FIGURE 3, which at their inner ends are connected to the bottom or base of a rectangularly shaped vertically extending guide member 57. The upper end of the guide member 57 terminates adjacent the bottom of the cylinder 40 and additional braces 58, FIGURE 1, are connected between the upper end of the guide member and the inner faces of the braces 39. The vertical or longitudinal axis of the guide member 57 coincides with the vertical or longitudinal axis of the cylinder 40 so that the piston rod 47 is adapted to be guided and braced during the reciprocatory movement of the piston 46 within the cylinder 40. The guide member 57 is provided on opposed sides thereof with longitudinal slots 59 through which extend the ends of the links 48 that are pivotally connected to the piston rod 47. Thus the guide member 57 not only guides the piston rod but also the links during the reciprocatory movement of the piston as the jaw members 36 of the bucket are being opened or closed so that if one jaw member should happen to open or close before the other jaw member the guide member 57 will prevent the piston rod and links from bending or twisting.

The frame 34 has secured to one side thereof a base portion 61 of a vertically extending bracket 62 which terminates in a supporting member 63 that extends inwardly towards the cylinder 40 in a plane normal to the

plane of the bracket 62, FIG. 2. The support member 63 has affixed thereto a plurality of braces 64 upon which is mounted a gear reduction unit 65 that in turn supports a hydraulic motor 66 which is in fluid communication with the control unit 20 by means of conduits 67. The bracket 62 has secured adjacent its side edges one end of a pair of tie rods 68 the other ends of which are secured to the peripheral edge of the plate member 38 for maintaining the bracket 62 in spaced relation to cylinder 40. The gear reduction unit 65 has a drive shaft 70 projecting downwardly therefrom in spaced parallel relation to the bracket 62. The bracket 62 has mounted thereon subjacent the support 63 and in spaced relation to one another, a pair of arms 71 which are provided with suitable bearing members 72 for rotatably supporting a drive shaft 73. The drive shaft 73 is operatively connected to the gear reduction unit drive shaft 70 by a universal connection 74.

The drive shaft 73 has secured thereto, intermediate the arms 71, a gear 75 that is engaged by a sprocket chain 76 which is entrained about the gear 42 that is secured to the cylinder 40. Thus upon operation of the hydraulic motor 66 by fluid flowing through the conduits 67 from the power source 18, the shaft 73 will be rotated by drive shaft 70 through the connection 74 and thus rotate gear 75 within the sprocket chain 76 so as to move or rotate bracket 62, plate 38, and frame 34 about the vertical axis of cylinder 40. In other words the cylinder 40 and gear 42 remain stationary while gear 75 by means of sprocket chain 76 walks or moves about the vertical axis of the cylinder 40 and thus carries the bracket 62 and all appurtenances, as well as frame 34 and clam bucket 33 about the vertical axis of said cylinder.

In the operation of the grapple device of the instant invention, the boom 25 can be elevated or lowered by means of the piston 23 reciprocating within the cylinder 22 upon the actuation of certain of the control handles 31 on the hydraulic control unit 20. The boom 25 may also be rotated about the vertical axis of the piston 23 and cylinder 22 through suitable hydraulic connections to the control unit 20, so that said boom can be controlled to project outwardly from either side of the trailer 11. The control unit 20 can cause the segment 27, of the boom 25, to be either extended or retracted about its pivotal connection 28—29, with respect to the boom part 26, so that the boom 25 is capable of being moved through a multiplicity of directions while either in an extended or retracted position. Assuming that a pile of trash or debris is to be picked up from the ground and deposited in the trailer 11 through the hopper or opening 12, the boom 25 is extended and lowered to the position shown in FIG. 1 by an operator actuating the various handles 31 on the control unit 20. As the boom 25 is being moved towards the debris on the ground the operator moves certain of the handles 31 on the control unit 20 to cause fluid to flow through conduit 53 to the top of cylinder 40 where it will engage piston 46 forcing same downwardly in the cylinder 40 which movement will cause any fluid in the cylinder beneath the piston 46 to flow through conduit 54, control unit 20 and finally to the source of supply. As the piston 46 is forced downwardly within the cylinder 40 the lower portion of the piston arm or rod 47 will move the upper ends of the links 48 downwardly by means of the pin 49, thus causing the jaw members 36 of the clam bucket to open by moving about their hinge connections with the flange 35 of the frame 34.

The operator after opening the jaws 36 of the bucket and while still lowering the boom 25 can rotate the frame 34 and bucket structure to properly position the jaw members 36 for engaging and collecting the pile of debris or trash. The frame 34 is readily rotated by the operator actuating various handles 31 on the control unit 20 to cause the hydraulic motor 66 to be rotated by hydraulic fluid being circulated thereto by conduits 67, so as to cause shafts 70 and 73 to be rotated by means of the gear re-

5

duction unit 65 and thus turn gear 75 which through the sprocket chain 76 causes the bracket 62, plate 38, and frame 34 to rotate about the vertical axis of cylinder 40. The frame 34 and associated parts can be rotated in either a clockwise or counterclockwise direction dependent upon the direction in which the hydraulic motor 66 is rotated by fluid delivered thereto by the conduits 67 from control unit 20.

When the jaw members 36 of the clam bucket have been properly positioned for engaging the trash or debris the operator can through the control unit 20 deliver fluid to the cylinder 40 through conduit 54 while at the same time opening conduit 53 to the source of fluid supply thereto causing the piston 46 and rod 47 to be raised or elevated within the cylinder, thus moving the jaw members 36 towards one another to a closed position. The lower contacting edges of the jaw members 36 are preferably serrated or formed with teeth 77 to facilitate the picking up of the trash or debris and collecting the same within the clam bucket. After the jaw members 36 have been closed, through the elevating of the piston 46 within the cylinder 40, the boom 25 is elevated and rotated so as to place the clam bucket over the opening 12 after which the piston 46 can be moved downwardly in the cylinder 40 to open the jaw members of the clam bucket.

In the rotation of the frame 34 by means of the hydraulic motor 66, the plate 38 is adapted to have a free rotative movement about the cylinder 40 between the disc members 41, thus, the gear 42, cylinder 40 and disc members 41 during the rotation of the frame 34, which movement is entirely independent of the movement required to open and close the jaw members 36 and also to raise and lower the clam bucket by means of the boom 25 remain in a stationary or non-rotative position. The rotative movement imparted to the frame 34 by means of the motor 66 insures the proper positioning of the clam bucket with respect to the material to be collected so that the clam bucket is capable of operating at any angle or position within its circle of rotation.

There is shown in FIG. 6 a modification of the clam bucket in that fork members 80 have been pivotally connected to flange 35 of the frame 34 instead of the jaw members 36. The fork members 80 are adapted to be used in lieu of the jaw members when large bulky items are to be collected and deposited in the trailer 11. The fork members 80 are operated in the same identical manner as the jaw members 36 and the frame and associated parts are the same as those to which the jaw members 36 are secured.

Although, the foregoing description is necessarily of a detailed character in order that the invention may be completely set forth, it is to be understood that the specific terminology is not intended to be restricted or confining and that various re-arrangements of parts and modifications of details may be resorted to without departing from the scope or spirit of the invention as herein claimed.

I claim:

1. A grapple device comprising a frame member having a plurality of depending jaw members pivotally connected thereto, a plate member secured to said frame member in spaced parallel relation therewith, said plate member having an opening therein, a cylinder extending through said opening, one end of said cylinder being connected to a carrying element, a piston slidably mounted in said cylinder, a rod connected to said piston and extending through one end of said cylinder, means connecting said rod to said jaw members, power means for actuating said piston and jaw members, a member secured to said cylinder adjacent said plate, a power device mounted on said frame and operatively connected to said member for rotating said frame and power device about the longitudinal axis of said cylinder.

2. A grapple device as defined in claim 1, wherein said power device comprises a pressure fluid motor having a

6

rotatable shaft connected thereto, and means connecting said shaft to said member.

3. A grapple device as defined in claim 1, wherein said power device includes a gear and a sprocket chain connected thereto with said sprocket chain engaging said member.

4. A grapple device as defined in claim 1, wherein said power device is mounted on a bracket that is secured to said frame member.

5. A grapple device comprising a horizontally extending frame member having a pair of depending jaw members pivotally connected thereto, a plate member secured to and carried by said frame member in spaced parallel relation therewith, said plate member having an opening therein, a cylinder extending through said opening, a pair of annular discs secured to said cylinder on opposite sides of said plate for positioning said cylinder in a plane normal to the plane of said plate, a bracket secured to the upper end of said cylinder, said bracket being connected to a carrying element, a reciprocating piston mounted in said cylinder, a rod connected to said piston and extending through the lower end of said cylinder, a pair of link members having an end pivotally connected to said rod, said links having the other end connected to said jaw members, power means for actuating said piston and link members to move said jaw members, a gear member secured to said cylinder adjacent one of said discs, a bracket secured to said frame member in spaced parallel relation to said cylinder, a pressure fluid motor mounted on said bracket, a drive shaft operatively connected to said motor, a plurality of spaced gearing supports mounted on said bracket and engageable with said shaft, a gear secured to said shaft intermediate said bearing supports, a sprocket chain entrained about said gear and gear member for rotatably moving said bracket, frame and plate member about the axis of said cylinder upon the actuation of said fluid motor.

6. A grapple device comprising a horizontally extending frame member having a pair of depending jaw members pivotally connected thereto, a plate member, a plurality of braces connected to said plate member and frame member for supporting said plate member in spaced parallel relation to said frame member, said plate member having an opening therein, a cylinder extending through said opening, a pair of annular discs secured to said cylinder on opposite sides of said plate for positioning said cylinder in a plane normal to the plane of said plate, a bracket secured to the upper end portion of said cylinder, said bracket being connected to a carrying element, a guide member secured to said frame member and said braces subjacent said plate member with the vertical axis of said guide member being concentric with the axis of said cylinder, said guide member having diametrically disposed slots therein, a reciprocating piston in said cylinder, a rod connected to said piston and projecting through the lower end of said cylinder into said guide member, a pair of link members having an end pivotally connected to said rod, said link members extending through the slots in said guide member with the other end of the link members being pivotally connected to said jaw members, and power means for actuating said piston and link members to open and close said jaw members.

7. A grapple device comprising a horizontally extending frame member having a pair of depending jaw members pivotally connected thereto, a plate member, a plurality of braces connected to said plate member and frame member for supporting said plate member in spaced parallel relation to said frame member, said plate member having an opening therein, a cylinder extending through said opening, a pair of annular discs secured to said cylinder on opposite sides of said plate for positioning said cylinder in a plane normal to the plane of said plate, a bracket secured to the upper end portion of said cylinder, said bracket being connected to a carrying element, a guide member secured to said frame member and said

7

braces subjacent said plate member with the vertical axis of said guide member being concentric with the axis of said cylinder, said guide member having diametrically disposed slots therein. a reciprocating piston in said cylinder, a rod connected to said piston and projecting through the lower end of said cylinder into said guide member, a pair of link members having an end pivotally connected to said rod, said link members extending through the slots in said guide member with the other end of the link members being pivotally connected to said jaw members, power means for actuating said piston and link members to move said jaw members, a gear member secured to said cylinder adjacent one of said discs, a bracket secured to said frame member in spaced parallel relation to said cylinder, a pressure fluid motor mounted on said bracket, a drive shaft operatively connected to said motor, a plurality of spaced bearing supports mounted on said bracket and en-

8

gageable with said shaft, a gear secured to said shaft intermediate said bearing supports, a sprocket chain entrained about said gear and gear member for rotatably moving said bracket, frame and plate member about the axis of said cylinder upon the actuation of said fluid motor.

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