

Sept. 24, 1957

J. S. PILCH
MATERIAL HANDLING DEVICE

2,807,379

Filed Feb. 6, 1952

5 Sheets-Sheet 1

Fig. 1.

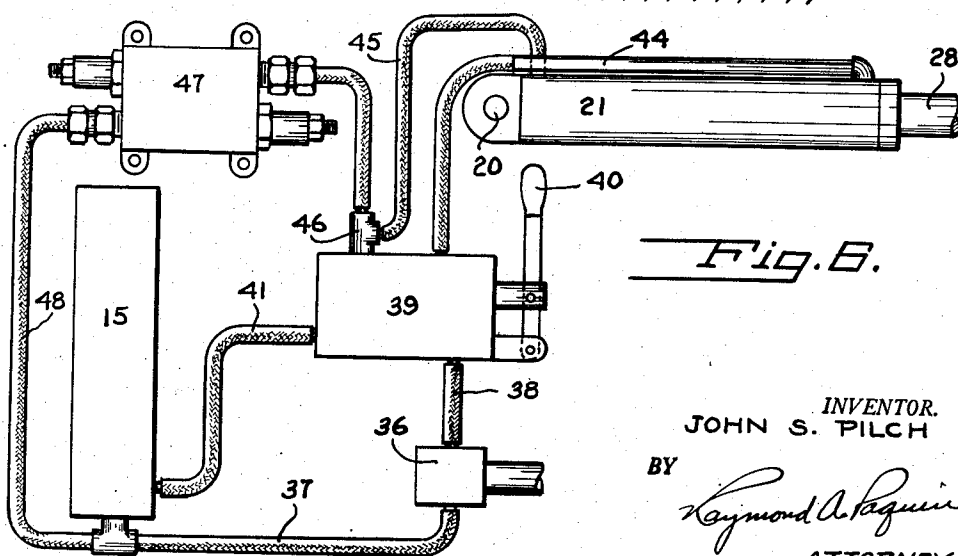
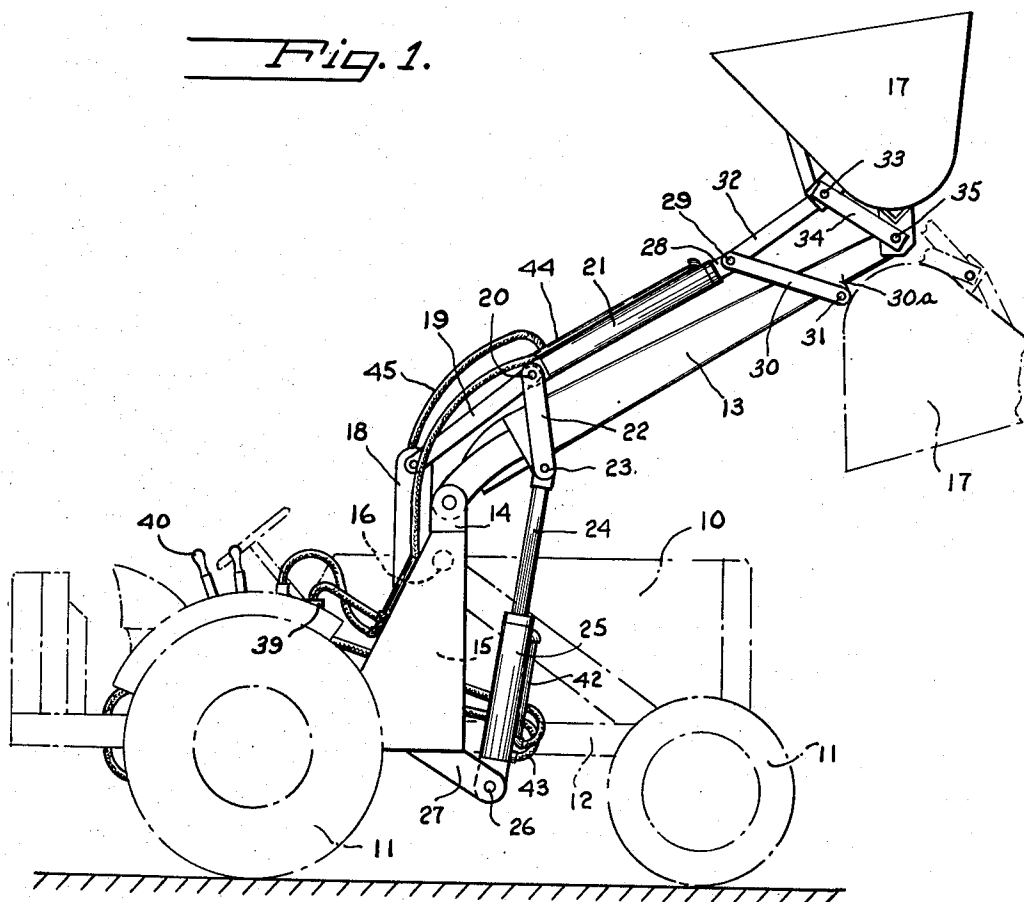


Fig. 6.

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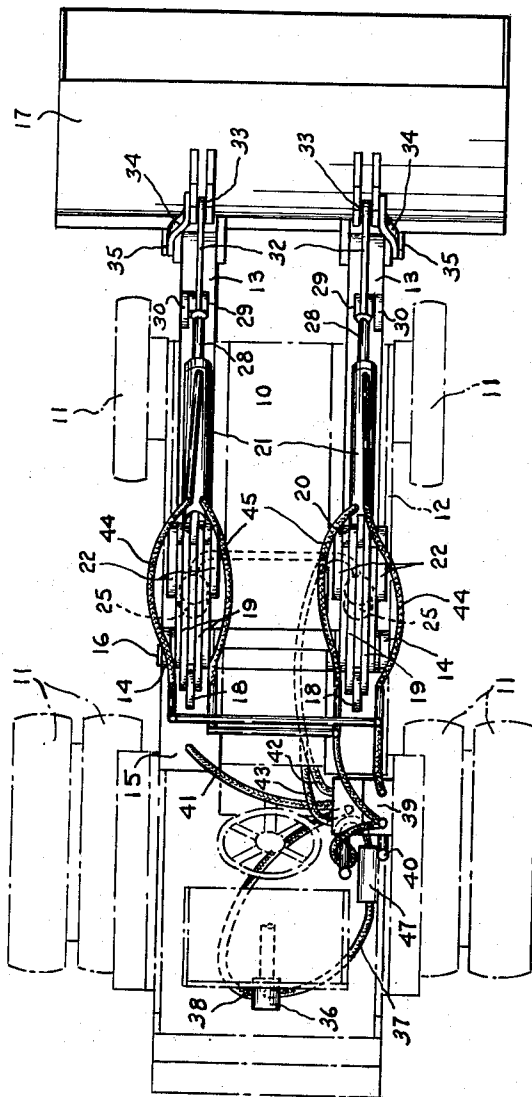
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Fig. 2.



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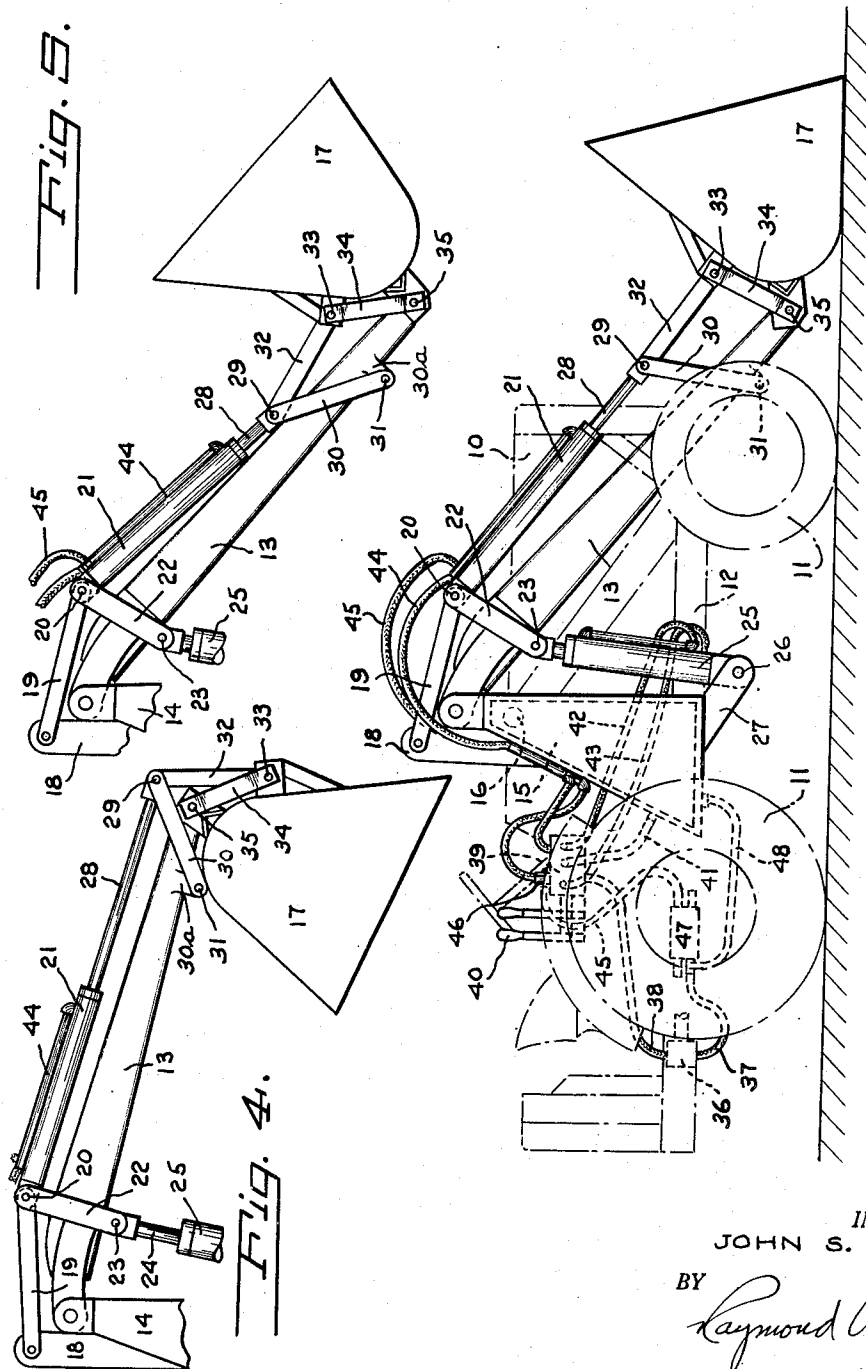
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5 Sheets-Sheet 3



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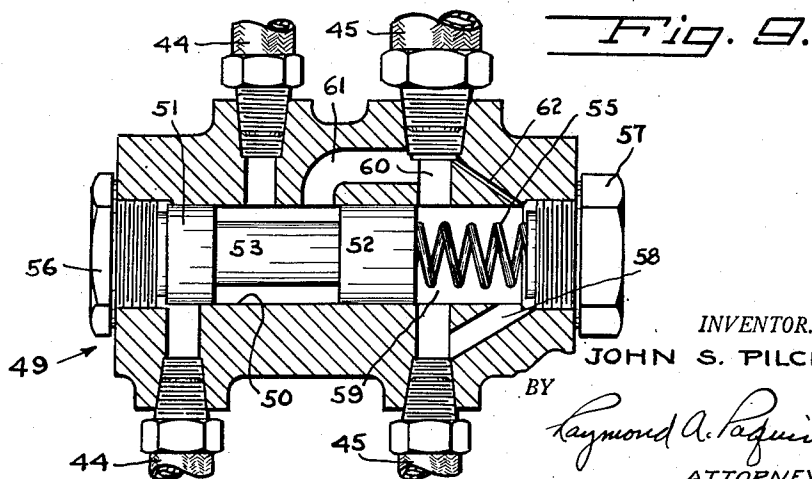
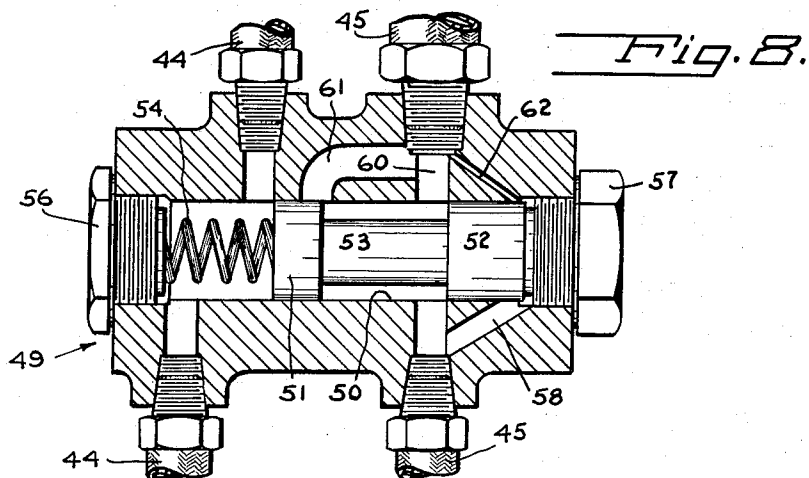
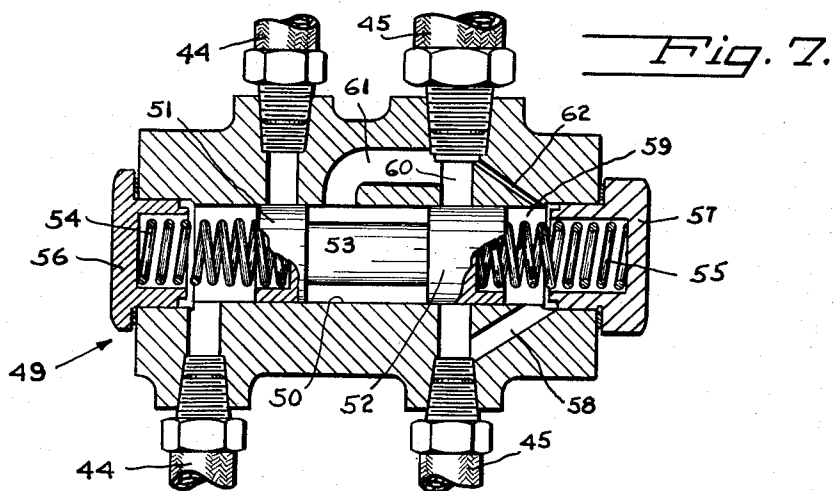
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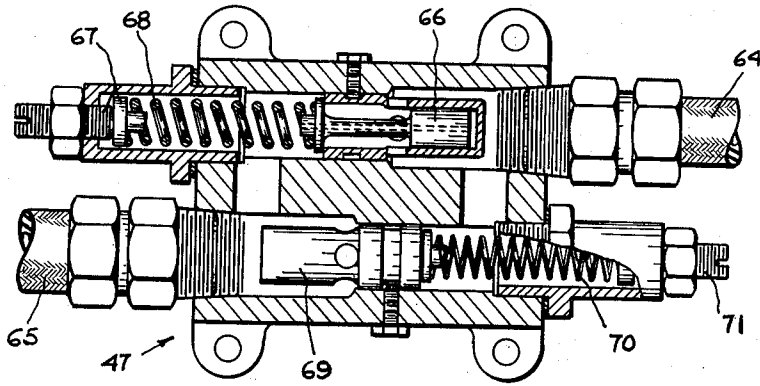


Fig. 10.

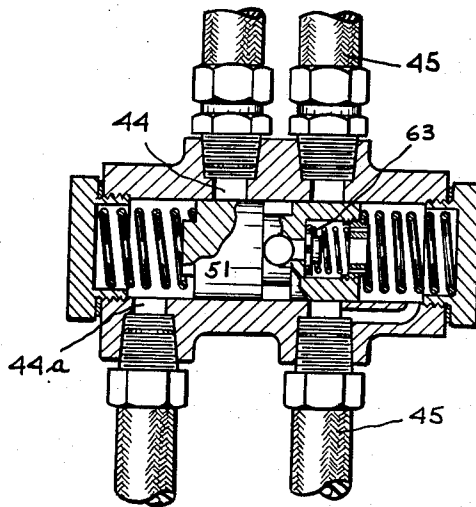


Fig. 11.

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2,807,379

MATERIAL HANDLING DEVICE

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Application February 6, 1952, Serial No. 270,118

13 Claims. (Cl. 214-140)

This invention relates to material handling devices such as loaders or the like and has specific reference to such devices which are hydraulically operated and to a new and improved hydraulic system therefor.

An object of the invention is to provide a material handling device of the type set forth wherein the speed of operation of the device is considerably increased while maintaining control of the device.

Another object of the invention is to provide a new and improved loader which is hydraulically operated and in which the speed of dumping of the loader bucket has been considerably increased while maintaining control over the movement of the bucket.

Another object of the invention is to provide a new and improved hydraulically operated apparatus in which the operation of the device is considerably speeded up while allowing the operator to maintain full control of such operation.

Another object of the invention is to set forth a new and improved hydraulic system for use in apparatus of the type set forth.

Another object is to provide a new and improved material handling apparatus such as a loader wherein ample bucket rotation may be obtained and wherein such bucket may be hit against the lift arms of the device to knock material out of the bucket and without danger of damage to the bucket or mechanism regardless of the height of the lift arms.

Another object is to provide a new and improved bucket loading arrangement for material handling apparatus which gives ample bucket rotation in both directions.

Another object is to provide a new and improved equalizing or leveling arrangement for material handling apparatus such as a loader.

Another object is to provide a new and improved fluid reservoir arrangement for material handling apparatus.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings and it will be understood that changes may be made in the details of construction and arrangement of parts without departing from the scope of the invention, as set forth in the accompanying claims, as the preferred form of the invention has been given by way of illustration only.

At least some of the features of the present invention are shown in my application Serial No. 307,311, filed August 30, 1952, now abandoned, and which was a division of my application Serial No. 150,230, filed March 17, 1950, also now abandoned.

While, for the purpose of illustration the present invention has been shown and described as applied to a loader, it will be understood that the features thereof are also capable of application and utilization in other forms of material handling apparatus.

Referring to the drawings:

Fig. 1 is a side view of a tractor mounted loader embodying the invention;

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Fig. 2 is a top or plan view thereof;

Fig. 3 is a view generally similar to Fig. 1, but showing the loader bucket in lowered position;

Figs. 4 and 5 are fragmentary views generally similar to Figs. 1 and 3, but showing the loader bucket in other positions;

Fig. 6 is a schematic view of a portion of the loader hydraulic system;

Figs. 7, 8 and 9 are sectional views of the flow control or bypass valve in its various positions;

Fig. 10 is a sectional view of one form of combined relief and vacuum relief valves; and

Fig. 11 is a sectional view of a modified form of the flow control or bypass valve.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, the loader apparatus shown embodying the invention is mounted on a tractor having the engine 10, wheels 11 and frame 12.

The apparatus is entirely hydraulically operated with the hydraulic system actuated by a hydraulic pump driven by the tractor engine.

The loader arrangement comprises a pair of loader push arms 13 which are pivotally mounted at one end to the upper end of upright support 14 which is secured to the tractor frame 12 and one of the uprights or supports 14 has the fluid reservoir 15 of the hydraulic system combined therewith or supported thereby and adapted to contain the supply of fluid for the hydraulic system which fluid reservoir can be open or covered by the cap 16.

On the forward or free ends of the push arms 13 is pivotally mounted the bucket 17.

Adjacent the uprights or supports 14 is positioned a second pair of uprights or supports 18, one on either side of the engine 10 and which supports 18 are connected to said tractor frame 12 and adjacent the upper ends of said supports 18 are pivotally connected the links 19 of the equalizing system which links are pivoted in their forward ends 20 to the adjacent ends of the bucket operating cylinders 21 and also at the same point to link 22, which is pivotally connected at 23 to ram 24 which is also pivotally connected at the same point 23 to push arms 13. Ram 24 extends into cylinder 25 which is pivotally connected at 26 to the support 27 which is secured to the tractor frame 12 adjacent one end and extends downwardly therefrom for connection to cylinder 25 as set forth above.

Ram 28 extends into cylinder 21 and is pivotally connected at 29 to a bucket actuating linkage system comprising link 30, which is pivotally connected at its opposite end to push arms 13 or an off-set portion 30a from said push arm which extends beneath said push arm and to which said link 30 is pivotally connected at 31.

Link 32 is pivotally connected at one end at 29 to ram 28 and is pivotally connected at its forward end at 33 to bucket 17. Link 34 is also pivotally connected to said link 32 and bucket 17 at pivot 33 and its opposite end is pivotally connected to push arm 13 at 35 adjacent the forward end of said push arm.

While only one push arm 13 and bucket support and equalizing or leveling system has been described, it will be understood that as shown a complete similar system may be provided for each push arm.

The hydraulic system comprises the tank 15 and pump 36 connected thereto by low pressure line 37 and the pump is connected by line 38 to control valve 39 adapted to be controlled by the operator through lever 40 and valve 39 is connected to tank 15 by a return line 41.

Cylinders 25 are connected to control valve 39 by means of hydraulic lines 42 and 43 and cylinder 21 is connected to said control valve 39 by means of hydraulic lines 44 and 45 with line 45 connected through the T

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connection 46 to valve 39 and valve 47, which in turn is connected to tank 15 by line 48.

Cylinders 25 and rams 24 operate to raise and lower push arms 13 and bucket 17 and cylinders 21 operate to pivot bucket 17 for loading and dumping as hereinafter described.

It is pointed out that the linkage arrangement for rotating the bucket 17, as shown in Figs. 1, 3, 4 and 5 allows a much greater degree of bucket rotation while the operator maintains positive control of the bucket at all times and that with the link 30 pivotally connected to arm 13 or to the offset 30a under arm 13 that this arrangement allows much greater bucket rotation in both directions. As seen in the drawings, the link 30 is so designed as to allow pivoting of the bucket from loading position as shown in full lines in Fig. 1 around the end of the push arms 13 to full dump position as shown in broken lines in Fig. 1 without going over the center position and thereby allowing ample bucket rotation which is essential for dumping and if desired, allows the hitting of the bucket against the lower side of the lift arms to knock material out of the bucket without the necessity of the arms reaching full height. Also extension link 32, pivot link 30 and piston 28 are connected together by a single pin connection.

The links (pivot and extension) are so designed as to allow the force of the piston to follow substantially the arc of travel of the bucket in nearly a direct plane, thus providing a maximum degree of rotation of the bucket with a minimum amount of piston travel.

Due to the arrangement of this linkage maximum power is obtained with the bucket in digging position and the speed of rotation of the bucket is continuously increased as the bucket is rotated to dumping speed.

The equalizing or leveling links 19 provide a simpler and better means of equalization of the bucket and allow the getting around of the offset in arms 18 and by providing links 19 it is possible to connect directly to the cylinder 21 as link 19 allows the equalization connection to be at any desired point as it allows the adjustment of the equalizing means as shown in Figs. 3, 4 and 5.

The equalizing or leveling links are so designed as to allow bucket equalization at all positions, without restricting the degree of bucket rotation.

The flow control or bypass valve arrangement shown in Figs. 7 through 9 is provided for the purpose of increasing the speed of tripping or dumping of the bucket and, therefore, considerably increasing the speed of loading with the device.

The object of this valve is to allow the diverting of the hydraulic fluid directly from the return line 44 to the pressure line 45 when the bucket 17 is being rotated to dumping position without the necessity of such fluid passing through control valve 39 to reach such pressure lines and thereby considerably speeding up the dumping of the bucket during dumping.

The valve 49 as shown in Figs. 7, 8 and 9 contains the bore 50 to which the lines 44 and 45 or 42 and 43 connect as the case may be, as a separate valve is provided for each set of the cylinders where the cylinders are operated in unison and interposed in the hydraulic lines thereof and in bore 50 is mounted the sliding valve comprising the land portions 51 and 52 connected by the reduced portion 53.

The normal position of said movable valve member is controlled by means of coil springs 54 and 55 bearing against the opposite ends of said sliding member and which valve may be positioned through the ends of said bore 50 which are closed by the caps 56 and 57.

The valve 49 is provided with port 58 bypassing land 52 whereby when fluid under pressure reaches said valve through line 45 from the control valve said pressure will enter the space 59 beyond the end of land 52 and move said land to the position shown in Fig. 9 at which time fluid will pass through passage 60 to line 45 from control

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valve 39 and returning fluid from the cylinder will pass from the bore 50 through passage 61 directly back into line 45 without passing through valve 39 and it will be seen that because of the off timing of the lands 51 and 52 that the land 51 will close off the return line to the tank from the valve so that all of said fluid returning through line 44 will pass directly into line 45 through bore 61 and as the volume of the pump depends on the speed of the motor, that with the present construction it is possible to dump at high speed regardless of the speed of the motor.

It will be seen that by the closing off of the return line the bypassing of fuel from the return to the pressure line begins and is effected from the beginning of the tipping of the bucket and is instantaneous from the beginning of the cycle without delay and, therefore, considerably speeds up the operation of dumping of the bucket.

The small bypass or bleed line 62 connecting line 45 with chamber 59 is provided to bleed off chamber 59 to allow the spool or valve to reach shut-off position as shown in Fig. 7.

From the foregoing it will be seen that with the present construction that pressure line 45 is partially open, all of the fluid being returned through line 44 is bypassed thus assuring an open port with the slightest movement of the valve to connect said line 45 with the control valve, that is, fluid in the pressure line 45 effects immediate opening of the valve and effects immediate closing off of port 44, thus diverting all of the oil flow from line 44 directly to line 45.

Because of displacement differential in the cylinder the fluid necessarily will go from line 44 to line 45 and the action cannot be reversed.

In Fig. 11 is shown a valve arrangement generally similar except that port 44a is offset from port 44 whereby said port 44a will be closed off by land 51 upon movement of the valve member to position whereby fluid may pass from the pump to line 45 and because said port 44a is shut off, all fluid returned from the cylinder through line 44 and port 44 is bypassed directly to line 45 through check valve 63 thereby increasing the efficiency of the bypass system.

In Fig. 10 is shown a relief valve combined with a vacuum relief valve. It will be understood that either of these valves are capable of employment separately or jointly as shown.

The relief valve comprises a valve member interposed between the high pressure line 64 and the low pressure return line 65 and includes a check valve member 66 adapted to be set to desired pressure by means of said screw 67 which adjusts the pressure on spring 68 which normally retains the valve member in closed position.

However, should bucket 17 hit an obstacle which might otherwise break the bucket or cause strain or stress on the apparatus, when the pressure in the high pressure line is greater than the force retaining check valve 66 in closed position such pressure forces said valve to open and allows the pressure to escape through the low pressure line until the bucket comes down to a mechanical stop at a predetermined position on the arms and thereby eliminates damage to the bucket or apparatus.

Also when the arms are lifted from an intermediate position with the bucket rolled back to the position shown in broken lines in Fig. 1 there would be a mechanical breakage unless release means were provided to allow cylinder retraction without bucket movement.

This relief valve as previously described allows the escape of such high pressure fluid by the inward movement of the ram controlling the bucket movement. This could also occur when the bucket were driven into a bank and struck the bank or other obstacle in which case the rams would be forced into the cylinders with the same valve action and prevent breakage of parts.

It will be seen that this valve is only connected to the

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back side of the cylinder and has no effect on the power pickup.

The vacuum relief arrangement is interposed between the high pressure line and the low pressure line and comprises a check valve 69 similar to check valve 66 and which is set through spring 70 and adjusting screw 71 to desired pressures.

Whereas valve 66 is set for high pressures, it will be seen that valve 69 is set for relatively low pressure.

When the bucket 17 is in loading position as shown in Fig. 5 the weight of the material in the bucket creates a heaving drag on the ram 28 and there is a tendency to have a vacuum form behind the ram in cylinder 21 only when the operating valve is actuated to dump. This is caused by fluid being forced out of the front of the cylinder faster than the hydraulic pump can replace it at the rear or pressure side of the cylinder, thus creating a vacuum. In such cases oil is drawn through the vacuum relief valve 69 for supplementing oil from the operating valve 39 to overcome this vacuum and also speeds up bucket rotation through the supplementing of the fluid in the pressure line by fluid directly from the return line. Also when the bucket is lowering through its own weight or momentum it may create a vacuum in the line behind the cylinder which allows oil to be drawn into this line directly from the reservoir to eliminate the possibility of vacuum.

From the foregoing, it will be seen that I have provided efficient and economical means for obtaining all of the objects and advantages of the invention.

I claim:

1. In a device of the character described, a pair of push arms, a bucket pivotally connected to said push arms adjacent the free end thereof, means for rotating said bucket relative to said push arms, said means including hydraulic means for effecting said bucket rotation and a linkage arrangement interposed between said hydraulic means and said bucket, said linkage arrangement comprising a first link pivotally connected adjacent its opposite ends to said hydraulic means and bucket, a second link pivotally connected to said first link and to said push arm and a third link pivotally connected adjacent one end to said push arm adjacent the free end of said push arm and adjacent its opposite end to said pivotal connection of said first link to said bucket.
2. In a device of the character described, a pair of push arms, a bucket pivotally connected to said push arms adjacent the free end thereof, means for rotating said bucket relative to said push arms, said means including hydraulic means for effecting said bucket rotation and a linkage arrangement interposed between said hydraulic means and said bucket, said linkage arrangement comprising a first link pivotally connected adjacent its opposite ends to said hydraulic means and bucket, said second link being pivotally connected to an offset portion on said push arm and to said first link and a third link pivotally connected adjacent one end to said push arm adjacent the free end of said push arm and adjacent its opposite end to said pivotal connection of said first link to said bucket.
3. In a device of the character described, a pair of push arms, a bucket pivotally mounted relative to said push arms, means for pivoting said bucket, said means comprising a pair of hydraulic means and a first pair of links, said links each being pivotally connected adjacent their opposite ends to one of said hydraulic means and to said bucket, and a second pair of links each pivotally connected adjacent its opposite ends to one of said push arms and to said first links, such links being of such length as to allow said bucket to be pivoted around the end of said push arms and to hit the underside of said push arms at all dumping heights of said arms.
4. In a device of the character described, a pair of push arms, a bucket pivotally mounted relative to said push arms, means for pivoting said bucket, said means comprising a pair of hydraulic means and a first pair of links,

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said links each being pivotally connected adjacent its opposite ends to one of said hydraulic means and to said bucket and a second pair of links each being pivotally connected adjacent its opposite ends to one of said push arms at a point beneath said push arm and to said first links, such links being of such length as to allow said bucket to be pivoted around the end of said push arms and to hit the underside of said push arms at all dumping heights of said arms.

5. In a device of the character described, a pair of push arms, a bucket pivotally mounted relative to said push arms, means for pivoting said bucket, said means comprising a pair of hydraulic means and a first pair of links, said links each being pivotally connected adjacent their opposite ends to one of said hydraulic means and to said bucket, and a second pair of links each pivotally connected adjacent its opposite ends to one of said push arms and to said first links, such links being of such lengths as to allow said bucket to be pivoted around the end of said push arms and to hit the underside of said push arms at all dumping lengths of said arms, hydraulic lines connected to said hydraulic means for pivoting said bucket and a relief valve interposed in said hydraulic lines whereby when said bucket is pivoted to position to substantially hit the underside of said push arms, any further movement of said bucket by an obstruction will allow cylinder retraction.

6. In a device of the character described, a pair of push arms, a bucket pivotally mounted relative to said push arms, means for pivoting said bucket, said means comprising a pair of hydraulic means and a first pair of links, said links each being pivotally connected adjacent its opposite ends to one of said hydraulic means and to said bucket and a second pair of links each being pivotally connected adjacent its opposite ends to one of said push arms at a point beneath said push arms and to said first links, such links being of such lengths as to allow said bucket to be pivoted around the end of said push arms and to hit the underside of said push arms at all dumping lengths of said arms, hydraulic lines connected to said hydraulic means for pivoting said bucket and a relief valve interposed in said hydraulic lines whereby when said bucket is pivoted to position to substantially hit the underside of said push arms, any further movement of said bucket by an obstruction will allow cylinder retraction.

7. In a device of the character described, a support, a bucket rotatably mounted relative to said support, a hydraulic system including a pair of hydraulic lines for effecting rotation of said bucket and a by-pass type relief valve interposed in the hydraulic lines of said hydraulic system, said relief valve providing means allowing the escape of high pressure fluid from one hydraulic line to the other hydraulic line and thereby allowing cylinder retraction in said hydraulic system without bucket movement relative to said support.

8. In a device of the character described, a support, a bucket mounted for rotation relative to said support, hydraulic means for effecting rotation of said bucket, a hydraulic system including a pair of hydraulic lines for said hydraulic means and a by-pass type relief valve connected to both lines of said hydraulic system, said relief valve providing means allowing the escape of pressure from one hydraulic line to the other hydraulic line to by-pass hydraulic fluid when the piston of said hydraulic system is forced into the cylinder thereof upon striking of an object by said bucket and while the operating valve of said system is closed.

9. In a device of the character described, a support, a bucket mounted for pivotal movement relative to said support, hydraulic means for effecting pivotal movement of said bucket, a hydraulic system including a pair of hydraulic lines for actuating said hydraulic means and a by-pass type vacuum relief valve connected to both lines of said hydraulic system, said relief valve providing means to eliminate any vacuum in the cylinder of the hydraulic

system during the actuating of the hydraulic means for dumping the bucket.

10. In a device of the character described, a support, a bucket mounted for rotation relative to said support, hydraulic means for effecting rotation of said bucket, a hydraulic system including a pair of hydraulic lines for said hydraulic means and a by-pass type relief valve connected to both lines of said hydraulic system for allowing the escape of pressure therefrom to allow the by-pass of fluid when the piston of said hydraulic system is forced into the cylinder thereof upon the striking of an object by said bucket and while the operating valve of said system is closed and a vacuum relief valve in said hydraulic system, said relief valve having means to eliminate any vacuum in the cylinders of the hydraulic system during the actuating of the hydraulic means for dumping of the bucket.

11. In a device of the character described, a tractor, a pair of supports mounted on said tractor at each side thereof, a pair of push arms pivotally mounted near the top of said supports and extending generally forwardly of said tractor, a bucket pivotally connected to said push arms at their forward ends for rotation about a horizontal axis normal to the length of said push arms, a lug at the side of said bucket normally above each said push arm, the location of said lugs being such that upon forward swinging of said bucket the lugs will move downwardly to a position below the plane of said push arms, a pair of hydraulic ram means mounted one on each said support adjacent the pivotal mounting of said push arms, a pair of first links connecting said hydraulic ram means to the corresponding lug on the bucket to exert a force on said bucket to rotate it on its pivot, and a pair of second links one of which is pivoted to each of said push arms and to said first links, said links being of a length to deflect the line of the force exerted by said ram means on the pivotal connection of said lugs and said first link means away from parallelism with said push arms to extend at a substantial angle to the line of said push arms and to prevent dead centering of said last mentioned pivotal connection with respect to said links.

12. In a device of the character described, a support, a loader bucket, a pair of arms pivotally connected to said bucket and pivotally mounted on said support for pivotally supporting said bucket, lugs on said bucket spaced radially from and normally above said pivotal connection between said bucket and said arms, hydraulic means on said support and connected to said arms for effecting pivotal movement of said arms on said support, second hydraulic means on said support for pivoting said bucket, said second hydraulic means extending generally longitudinally of said arms, link means directly pivotally connected to said second hydraulic means and to said lugs on said

bucket to transmit the force from said second hydraulic means to said bucket to control the rotation of said bucket on said arms, and second link means pivotally connected at their one ends to said first link means and at their opposite ends to said arms to deflect the line of force of said second hydraulic means transmitted through said first link means out of alignment with said arms, whereby said bucket may rotate to a position in which said lugs are below said arms under the control of said hydraulic ram means.

13. In a device of the character described, a support, a loader bucket, a pair of arms pivotally connected to said bucket and pivotally mounted on said support, hydraulic means on said support and connected to said arms for effecting pivotal movement of said arms on said support for raising and lowering said bucket, second hydraulic means on said support for pivoting said bucket on said arms, link means connected to said second hydraulic means and to said bucket to transmit the force from said second hydraulic means to said bucket for rotation of the same with respect to said arms, and second link means pivotally connected at one end to each of said arms and at the other end to said first link means to so space the connection between said second hydraulic means and said first link means from said arm that for all conditions of operation the direction of the force applied by said second hydraulic means to said bucket through said first link means is spaced substantially from the pivotal connection between said arms and said bucket, the length of said first and said second link means being such as to permit rotation of said bucket to a position in which said lugs are below the plane of said arms.

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