Nov. 30, 1965 C. O. PEDERSEN ETAL 3,220,581

MATERIAL HANDLING EQUIPMENT

Filed Dec. 14, 1964 2 Sheets-Sheet 1

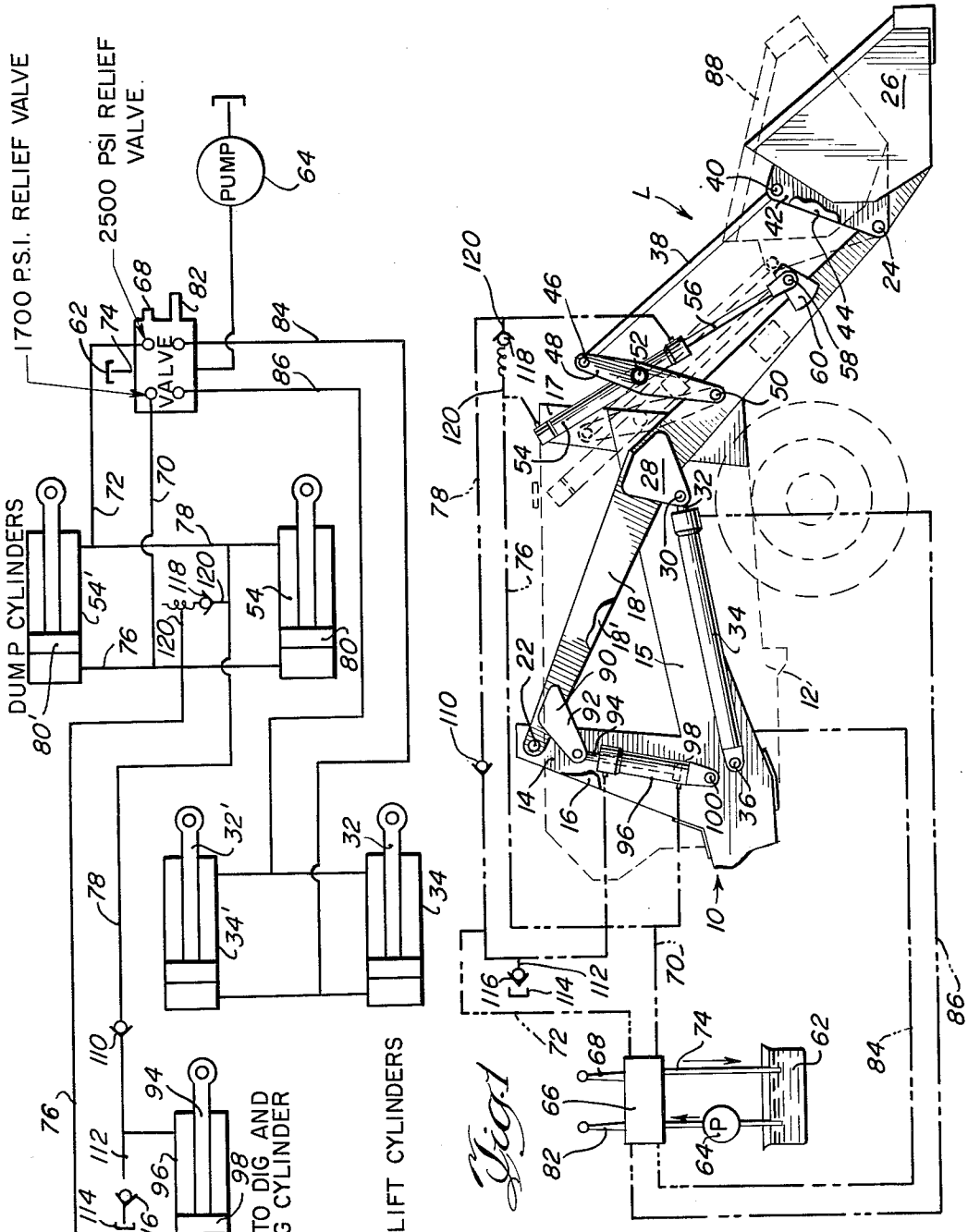


Fig. 1

Fig. 5

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Fig. 2

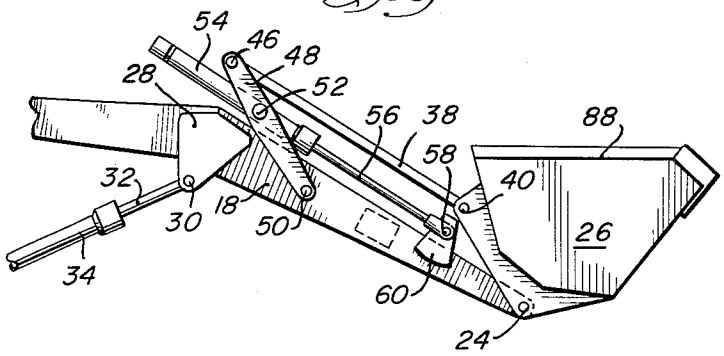


Fig. 3

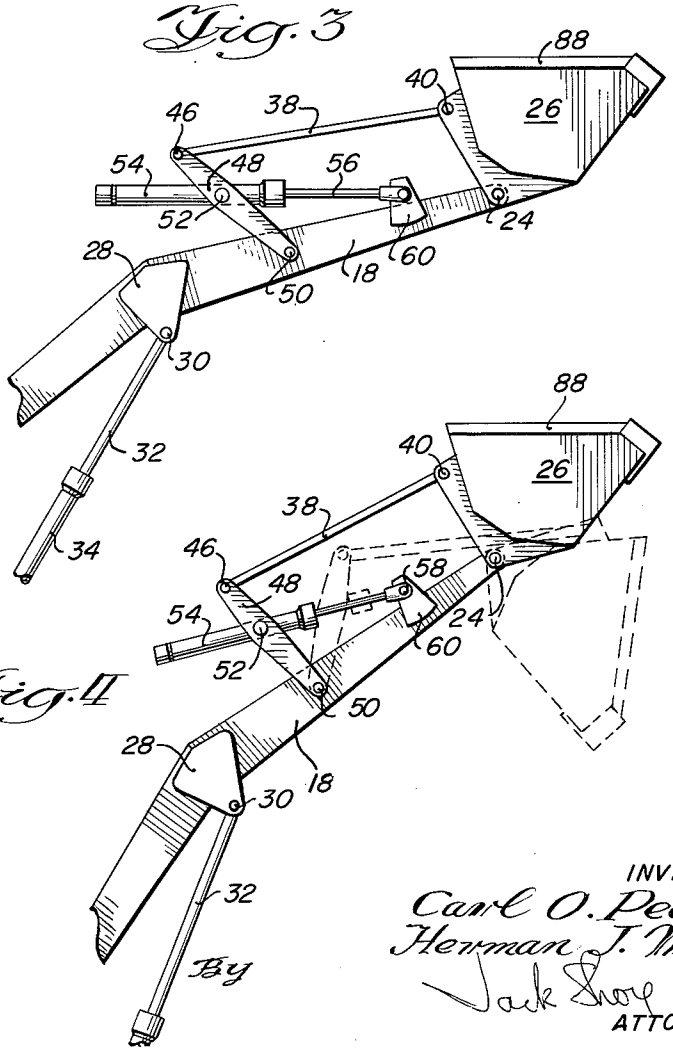


Fig. 4

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MATERIAL HANDLING EQUIPMENT

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5 Claims. (Cl. 214—140)

This invention relates to material handling equipment and, particularly, to a loader assembly secured to a prime mover, such as a tractor, which loader assembly includes a pivotally mounted bucket disposed across the front end of the tractor. Specifically, the invention is directed to a hydraulic control system wherein after the bucket is dumped it is automatically returned to the digging position during the downward movement of the loader lift arms.

Earth moving equipment, such as tractor mounted "front end loaders," to which the present invention is directed, have been on the market for some time. A typical loader assembly includes a pair of lift arms that are pivotally mounted on a main frame fixedly secured to the tractor. The inner ends of the lift arms are located adjacent the tractor operator and the outer ends of the lift arms, when in the lowered position, are disposed adjacent the ground between the tractor radiator and the front wheels. The bucket extends across the front of the tractor and is pivotally connected to the lower ends of the lift arms. The bucket is moved between the digging, lifting and loading positions by a hydraulically operated linkage mechanism that is controlled by the operator through a valve arrangement located adjacent the tractor seat.

When operating front end loaders of the type referred to above, it is the standard practice for the operator to manually control the bucket throughout its full range of movement. That is to say the operator must be continuously concerned with the bucket from the time it is moved to a digging position until it returns to take on another load. This requirement severely reduces the operating efficiency of both the operator and the equipment. Time and energy that could be spent moving the tractor to a new location must be used to watch the bucket and make sure that the bucket is level during the period that it is being lifted and the bucket is returned to the correct position for digging. It can be readily appreciated that a system which will automatically (1) maintain the bucket level while it is being raised and (2) return the bucket to the digging position when the bucket is lowered will leave the operator free to perform other functions. In this way better utilization can be made of the very expensive equipment and manpower involved.

Front end loaders currently on the market have for some time included some sort of bucket self-leveling mechanism. This has been done either hydraulically, or mechanically and has served to maintain the bucket level when the bucket is being raised to the dumping position. However, it is still essential that after the bucket is dumped the operator positively control the movement of the bucket so it will be in a digging position when the bucket has returned to ground evel. If this can be avoided by providing a system whereby the bucket will be automatically moved from the dumping to the digging position when the bucket is being lowered, it will be a substantial contribution both in reducing the demands on the operator and in accurately positioning the bucket. This frees the operator to move the tractor to a new location while this is taking place and eliminates the need for the operator to concern himself with seeing that the bucket is properly placed in the digging position.

In accordance with the present invention, there is provided a hydraulic control system wherein the bucket is automatically returned to the digging position after it has

been dumped by the operator. This is accomplished through a system including the utilization of a slave cylinder provided for effecting hydraulic self-leveling during the period that the bucket is lifted from the digging to the dumping positions. However, as will be pointed out hereinafter, the invention is not limited to a loader employing hydraulic self-leveling, but could be used with front end loaders that have mechanical self-leveling as is currently available on various models of such machinery.

The fluid for positioning the bucket linkage assembly to return the bucket to the digging position consists of that supplied from the slave cylinder plus fluid that is directed from the rod end of the bucket dumping cylinders back to the piston end thereof. The amount of fluid so provided is calculated to insure that the correct amount of movement of the bucket positioning linkage is attained to effect the desired bucket movement.

The advantages referred to above along with others will be apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a right side elevation of the loader mechanism with parts broken away and the bucket and associated control therefor illustrated in the digging and lifting positions, and the hydraulic system shown in diagrammatic form;

FIGURE 2 is a view showing the position taken by the bucket and bucket positioning mechanism when the arms have just been raised off the ground;

FIGURE 3 is a view similar to FIGURE 2 showing the lift arm, bucket and associated bucket linkage in the partially raised position;

FIGURE 4 is a view simiar to FIGURE 3 showing in solid lines the lift arms and bucket in the fully raised position and in dotted lines the positions of the various components after the bucket has been dumped; and

FIGURE 5 is a schematic diagram showing the hydraulic control system for the loader.

The same reference numbers have been given to the same or similar parts wherever they appear in the drawings and specification.

Referring first to FIGURE 1, there is shown a tractor **12** on which has been mounted at the front end thereof a loader mechanism indicated by the letter L. The loader mechanism includes a main frame structure **10** that is attached to the tractor **12** by suitable fastening means. The frame **10** serves as the main support member and is generally U-shaped in the plan view in that it extends parallel to the sides of the tractor forward of the operator and includes an inverted U-shaped section across the front thereof. The frame **10** includes uprights or stanchions **14, 16** spaced on opposite sides of the tractor **12**, which stanchions are connected to a transversely extending inverted U-shaped support **17** by forwardly extending braces **15**.

As shown, the loader structure consists of a pair of lift arms or booms **18, 18'** located on opposite sides of the tractor. The lift arms **18, 18'** are pivotally connected to stanchions **14, 16**, respectively, by pivot pins **22**. Connected to the lower ends of the lift arms **18, 18'** by means of pivot pins **24**, respectively, is the bucket **26**. The lower end of lift arm **18** is located between brackets **42, 44** secured to bucket **26** and the pin **24** extends therethrough. A similar arrangement (not shown) interconnects the lower end of lift arm **18'** with bucket **26** on the other side of the tractor.

The lift arms **18, 18'** are pivoted about pins **22**, by the operation of hydraulic cylinders **34, 34'** through the extension or retraction of piston rods **32, 32'** extending outwardly from cylinders **34, 34'**, respectively. The inner or lower ends of cylinders **34, 34'** are connected to stanchions **14, 16**, respectively, by pins **36**. The outer

ends of rods 32, 32' are disposed between and connected to pairs of downwardly extending re-enforcing plates 28 that are secured to an intermediate portion of the lift arms 18, 18', respectively. Thus, it can be seen that when fluid pressure is applied to the left-hand end of cylinders 34, 34' (FIGURE 1), the lift arms 18, 18' are moved in a counterclockwise direction about pivot pins 22 to raise the bucket 26. Conversely, when fluid is supplied to the opposite ends of cylinders 34, 34', the lift arms 18, 18' are moved in a clockwise direction to lower the bucket 26.

The positioning of the bucket relative to pivot pins 24 to move the bucket between the digging, loading, and unloading positions is accomplished by the hydraulically operated bucket positioning mechanism shown in various positions in FIGURES 1 through 4. The hydraulically operated bucket positioning mechanisms connected to each of the lift arms and at their opposite end to the bucket 26 are identical and thus only the one disposed between lift arm 18 and brackets 42, 44 will be described in detail.

The bucket positioning mechanism consists of a link 38 that is secured between the upper portion of the brackets 42, 44 by a pin 40. The opposite end of the link 38 is connected by pin 46 between a pair of levers 48. The levers 48 are in turn connected at their opposite ends to an intermediate portion of the lift arm 18 by pin 50. It can thus be seen that pivotal movement of the lever 48 about pin 50 will pivot bucket 26 in the same direction about the end of lift arm 18. To effectuate movement of the linkage mechanism and through it bucket 26, a fluid cylinder 54 is pinned to an intermediate portion of levers 48 by a pivotal connection 52 which comprises a trunnion type support for the cylinder 54. The cylinder 54 has a piston rod 56 that extends forwardly along lift arm 18 and is pivotally connected at its end thereof to a lug or stop 60 by means of pin 58. Thus, introduction of pressure fluid into one end of the cylinder 54 and corresponding withdrawal of fluid from the other end will result in axial movement of cylinder 54 which will cause pivotal movement of levers 48 and corresponding pivotal movement of bucket 26. It is, of course, understood that the two bucket positioning mechanisms operate simultaneously to bring about the desired result.

For effecting control of the lift cylinders 34, 34' and bucket cylinders 54, 54', a conventional or other suitable type of hydraulic system is employed, and is conventionally illustrated as follows. A reservoir 62 contains a supply of hydraulic fluid which is pressurized and transmitted by means of a pump 64 to a valve 66. A control lever 68 when actuated in one direction admits fluid to conduit 70 while allowing fluid in conduit 72 to return through an exhaust conduit 74 to reservoir 62. The conduit 70 leads to conduit 76, which in turn leads to the upper end of cylinders 54, 54'. The conduit 72 communicates with conduit 78, which communicates with the lower end of cylinders 54, 54'. The above described manipulation of control 68 will therefore cause upward movement of cylinders 54, 54' and tilting of bucket 26, for example, from the full line position of FIGURE 1 to the dotted or "rolled-back" position thereof. This, of course, is the "break-out" action of the device, and it will be noted that the larger capacity ends of the cylinders 54, 54'—those not encumbered by their corresponding piston rods—are used in the break-out operation. Since this operation is the one which requires the greatest development of force on the part of cylinders 54, 54', it is a decided advantage that the larger ends of these cylinders are utilized in this break-out operation.

The manipulation of handle 68 in the opposite direction directs pressure fluid through conduits 72 and 78 into the lower end of cylinders 54, 54', where it works on the limited area of pistons 80, 80' to cause downward movement of cylinders 54, 54'. The downward movement of cylinders 54, 54' causes tilting of levers 48 and bucket 26 in a clockwise direction and ultimately into the dotted position shown in FIGURE 4.

The valve 66 has another control lever 82 which when actuated in one direction will direct pressure fluid into conduit 84 which leads to the lower end of above-mentioned lift cylinders 34, 34'. Such action will also exhaust fluid from a conduit 86 which leads from the right end of cylinders 34, 34'. The pressure fluid will cause outward movement of piston rods 32, 32', and swinging of lift arms 18, 18' in a counterclockwise direction about pivotal connections 22 as hereinbefore suggested.

In the usual operation of a device of this kind, bucket 26 is placed approximately in the full line position indicated in FIGURE 1, and the tractor is maneuvered into a position to force the bucket into a pile of material to be handled. Next, lever 68 is actuated in the proper direction to cause bucket 26 to be tilted or "rolled back" to the dotted position in FIGURE 1. It will be noted that, in this position, which represents the extreme rearward position of the bucket, the upper rim 88 is tilted forwardly to some extent, which is undesirable since appreciable quantities of the load may spill if the tractor is driven any distance with the bucket in this position. Accordingly, control 82 is actuated to raise lift arms 18, 18' to some desired position for traveling to the point of discharge. Such a position is shown in FIGURE 2 in which the lift arms have been raised appreciably until rim 88 has become essentially level. It is to be noted that links 38 are still in close proximity to stops 60 if not actually in contact therewith. In other words, bucket 26 has changed its relation to lift arms 18, 18', if at all, only a very small amount in moving from the dotted position in FIGURE 1 to the full line position in FIGURE 2.

Turning now to FIGURE 3, it will be noted that the lift arms have been raised substantially from the FIGURE 2 position. Rim 88, however, is still level and this has been brought about by changing the relation between bucket 26 and lift arms 18, 18' substantially from that shown in FIGURES 1 and 2. This is brought about by the manipulation of cylinders 54, 54' to the right to swing lever 48 in a clockwise direction. It is to be noted that links 38 are now a substantial distance from stops 60.

In FIGURE 4, lift arms 18, 18' have been swung still further upwardly to approximately its maximum upward position. However, rim 88 is still level by virtue of further movement to the right of cylinders 54, 54', in the manner just described. FIGURE 4 also shows the dumping position of bucket 26, this being brought about by manipulation of control 68 and movement of cylinders 54, 54' to the right a maximum amount, as indicated in dotted lines in FIGURE 4.

As will be apparent, in order to maintain the described control of bucket 26, rather precise actuation of cylinders 54, 54' is required and, while this might be accomplished through control 68 by a highly skilled operator, in the present instance it is accomplished automatically without any attention on the part of the operator.

As discussed above, suitable provision must be made to change the position of the bucket relative to the lift arms, when the lift arms are being raised, to prevent the material contained in the bucket from spilling back over the operator. After the bucket has been loaded and moved to an upright position by the operator, the normal tendency is for the bucket to dip toward the operator during the upward movement of the lift arms. This is due to the fact that the lift arms and the bucket move in an arcuate path due to their pivotal movement about pivot pins 22.

In order to prevent the bucket from tipping out of the level position, provision must be made to move the bucket forward about pivot pins 24 an amount necessary to compensate for the backward tilting movement of the bucket during raising of the lift arms. To this end, the tilting and attendant spilling is prevented by providing a hydraulic self-leveling mechanism which directs fluid under pressure to the hydraulic bucket positioning cylinders to

move the bucket forward a predetermined incremental amount, relative to the end of the lift arms, to compensate for the rearward bucket movement brought about by the arcuate travel of the lift arms.

The system in question includes a hydraulic slave cylinder **96** that has one end thereof connected to the lower portion of stanchion **14** by a pin **100**. Extending outwardly of the cylinder **96** is a piston rod **94** and atttached piston **98** that is connected between a pair of rearwardly extending brackets **90** secured to the lift arm **18** by a pin **92**. The opposite ends of the cylinder **96** are connected through suitable hydraulic lines **76, 78** to opposite ends of the cylinders **54, 54'**. In particular, the head end of the cylinder **96** communicates with the head end of the cylinders **54, 54'** through conduit **76** and the rod ends of the cylinders **54, 54'** are interconnected through conduit **78**.

Briefly, it will be seen that when the lift arm **18** is raised, it carries with it the rod **94**, which displaces fluid from the rod end of the cylinder **96** through conduit **78** to the rod end of cylinders **54, 54'** to effectuate downward movement of the cylinders **54, 54'** and clockwise movement of levers **48** (FIGURE 1). This clockwise movement of levers **48** will tend to tilt the bucket forwardly an amount calculated to compensate for the tendency of the arcuate action of the lift arms to move the bucket rearwardly and thus retain the bucket in the horizontal position.

Specifically, swinging motion of lift arms **18, 18'** will eventually cause movement of piston **98** and a pumping action in cylinder **96**. However, in the position of the parts shown in FIGURE 1, such motion will be insignificant or very slight, whereas as the lift arms swing upwardly and piston rod **94** becomes more nearly tangent to the arc described by the lever arm represented by the distance between pivotal connections **22** and **92**, the motion will become greater until in the position of the lift arm shown in FIGURE 3 it is quite substantial. Since all of the several cylinders and conduits are normally entirely full of fluid, the motions of piston **98** will be reflected in similar motions of cylinders **54, 54'** and, therefore, without any manipulation of control **68**, the upward swinging of lift arm **18**, through cylinder **96** will cause movement of cylinders **54, 54'** and shifting of the relation of bucket **26** to the lift arms. As will be apparent, upward swinging of lift arm **18** will cause development of pressure in the upper end of cylinder **96** which will be transmitted through conduit **78** to the lower end of cylinders **54, 54'**. This will cause a certain amount of downward movement of cylinders **54, 54'**, and relative tilting of bucket **26** in a clockwise direction. However, owing to the fact that lift arm **18** under these conditions is swinging in a counterclockwise direction, the result will generally be to maintain bucket **26** in a level position, and the dimensions of cylinder **96** and cylinders **54, 54'** are readily chosen so that these relations will be obtained. The dimensions of cylinder **96** are chosen to supply sufficient fluid to actuate both cylinders **54, 54'** the necessary amount to maintain the bucket in the required position. However, it is undesirable to maintain bucket **26** in the dotted position of FIGURE 1, relative to the lift arms throughout the lifting movement, and it is for this reason that cylinder **96** is so placed as to be in a substantially "dead center" relation to pivot **22** when lift arm **18** is lowered. The initial movement of lift arm **18** from the FIGURE 1 to the FIGURE 2 position, causes little, if any, pumping action in cylinder **96**. Therefore, bucket **26** is not shifted in relation to lift arm **18, 18'** to any appreciable extent, at least, in its movement from the FIGURE 1 to the FIGURE 2 position. However, after leaving the FIGURE 2 position, the pumping action of cylinder **96** will have increased to such an extent as to supply sufficient fluid to cylinders **54, 54'** to maintain bucket **26** substantially in a level position throughout the rest of the upward movement, even to the extreme position shown in FIGURE 4.

From this latter position, the bucket may be readily dumped by a simple manipulation of control **68**, which will feed the necessary fluid into conduit **78** to cause movement of cylinders **54, 54'** into the dotted position of FIGURE 4, which will cause dumping of the bucket.

It can be appreciated that since this hydraulically operated self-leveling system operates independently of the operator, he is left free to perform his other duties, such as moving the tractor to and from the pile being moved, and to perform any other functions that may be required during the lifting action of the bucket.

After the bucket has been raised to its uppermost position and dumped (FIGURE 4), it must be subsequently moved to the position shown in FIGURE 1 to handle the next load. Heretofore, it has been the operator's job to take the time and effort to reposition the bucket, and event then it was necessary to provide him with some sort of indicating means due to the lack of clear visibility.

In accordance with the instant invention, there is provided a hydraulic system that functions to automatically return the bucket to the digging position from the dumped position as the lift arms are being lowered. The details of this arrangement can best be seen by referring to FIGURES 1 and 5 which show the apparatus and hydraulic circuitry provided for accomplishing this function.

Referring first to FIGURE 5, it is seen that conduit **78** leading between the rod end of the dump cylinders **54, 54'** and the rod end of the slave cylinder **96** contains a check valve **110** which prevents the flow of fluid back into the rod end of cylinder **96**. Leading into the rod end of cylinder **96** is conduit **112** which interconnects reservoir **114** with cylinder **96**. A check valve **116** permits flow between reservoir **114** and cylinder **96**, but prevents flow between cylinder **96** and reservoir **114** when piston rod **94** is raised. Thus, during the raising movement of lift arms **18** and rod **94** fluid is free to flow from cylinder **96** to the rod ends of cylinder **54, 54'** but during the lowering movement of the lift arms **18** fluid is prevented from returning to cylinder **96**. This is remedied by supplying fluid to the rod end of cylinder **96** from reservoir **114**, past check valve **116** and into conduit **112**. This latter arrangement is necessary to effect the hydraulic self-leveling action referred to hereinbefore.

In order to automatically return the bucket to the digging position after it has been dumped, a predetermined volume of fluid must be directed to the piston end of cylinder **54, 54'**. This fluid comes from the slave cylinder and the rod end of the cylinder **54, 54'** as described hereinafter.

During the downward movement of the lift arms, the fluid contained in the piston end of cylinder **96** will be forced by piston **98** into conduits **76** to the piston end of dump cylinders **54, 54'**. This action will act to move the dump cylinders to the left, thus tending to return the bucket from the dumping to the digging position. When the cylinders **54, 54'** are moved to the left, the fluid forced out of the rod end of dump cylinders **54, 54'** is not free to return to the rod end of cylinder **96** due to the location of back check valve **110**. The continued movement of the dump cylinders **54, 54'** will build up the pressure in conduit **78** to the point that it will open the inline relief valve **118** located in conduit **120**, which interconnects conduit **78** and conduit **76**. The by-passed fluid then flows into conduit **76** leading to the piston end dump cylinders **54, 54'**. The total volume of fluid received from the head end of cylinder **96** through conduit **70** combined with that by-passed between conduits **78** and **76** is calculated to be the amount required to move the dump cylinders **54, 54'** sufficiently far to the left to move the buckets from the dumping to the digging position as the bucket is being returned to ground level during the lowering of the lift arms. It is to be noted that while an inline relief valve is shown, this can be replaced with a shuttle or pilot operated relief valve, it such is desired. Other relief valves are also provided wherever necessary

to relieve an undesirable build-up of pressure occurring during the operation of the loader.

The method of operation of the entire system illustrated in the drawings can best be seen in FIGURE 5, and is summarized as follows:

The operating sequence will be set forth with the bucket in the digging position and will be carried through the loading, lifting, self-leveling, dumping, and return-to-dig stages.

After the bucket is loaded, the control valve **66** is operated to move the bucket positioning cylinders **54, 54'** and bucket **26** to the position shown in dotted lines in FIGURE 1. Fluid is then directed through conduit **84** to the piston ends of lift cylinders **34, 34'** to raise the lift arms **18, 18'** to move the bucket to the dumping position. During this upward movement of the lift arms, the piston rod **94** of cylinder **96** is moved outwardly to pump fluid through check valve **110**, and conduit **78** to the rod end of cylinders **54, 54'** to move the bucket clockwise (FIGURE 1) to compensate for the arcuate movement of the lift arms and thus maintain the bucket level and prevent spilling during the raising of the lift arms. The fluid forced out of the piston ends of the cylinders **54, 54'** is simultaneously returned to the piston end of self-leveling cylinder **96** through conduits **76**.

When the lift arms have reached their maximum raised position and the tractor is properly positioned, the bucket is dumped by introducing fluid to the rod end of cylinders **54, 54'**. When the dumping has been completed, the lift arms are again lowered by suitable operation of lift cylinders **34, 34'**. When this occurs, the piston rod **94** of self-leveling cylinder **96** is moved to the left (FIGURE 5) or down (FIGURE 1) to force liquid out of the piston end of cylinder **96** and into conduits **76**. The fluid in conduit **76** is introduced into the piston ends of dump cylinders **54, 54'** to move the cylinders to the left, which is forcing fluid out of the rod ends into conduit **78**. The fluid under pressure in conduit **78** is blocked from returning to the rod end of cylinder **96** by check valve **110**. When the pressure in conduit **78** exceeds the setting of check valve **118**, for example 1100 p.s.i., the fluid forced out of cylinders **54, 54'** is by-passed from conduit **78** into conduit **76** through conduit **120**. The amount of fluid added to conduit **78** combined with that received from the piston end of cylinder **96** is calculated to be sufficient to move the dump cylinders **54, 54'** to the left to move the bucket from the dumping to the digging position. The void in the rod end of cylinder **96** is filled by fluid supplied from reservoir **114** past check valve **116** into conduit **112**.

While a particular embodiment has been disclosed, many changes and substitutions of equivalence can be made without departing from the scope of the invention. For example, the return-to-dig system can be used with front end loaders that have mechanical self leveling by eliminating the connection between the rod end of the slave cylinder and dump cylinder but retaining the 1100 p.s.i. relief valve.

It is, of course, intended to cover by the appended claims all such modifications that fall within the true spirit and scope of the invention.

We claim:

1. A front end loader for a tractor including a frame adapted to be secured to said tractor, a pair of transversely spaced lift arms pivotally mounted on one end thereof to said frame, a bucket pivotally connected to the opposite ends of said lift arms, hydraulic means disposed between the frame and one of said lift arms for raising and lowering said lift arms, a bucket positioning means disposed between at least one of said lift arms and bucket and including a hydraulic cylinder for moving the bucket between the digging and dumping positions, a slave cylinder assembly interconnected between said frame and one of said lift arms, means for supplying fluid from one side of said slave cylinder to one side of said bucket positioning cylinder when the lift arms are lowered, conduit means for bypassing fluid from the other side of said bucket positioning cylinder to said one side thereof when fluid is supplied to said one side of the bucket positioning cylinder, valve means for controlling the flow through said last-mentioned conduit means, said slave cylinder and bucket positioning cylinder being designed to direct a predetermined amount of fluid to said one side of said bucket positioning cylinder to move the bucket from the dumping to the digging positions when the lift arms have been returned to ground level.

2. A front end loader for a tractor including a frame adapted to be secured to said tractor, a pair of transversely spaced lift arms pivotally mounted on one end thereof to said frame, a bucket pivotally connected to the opposite ends of said lift arms, means disposed between the frame and one of said lift arms for raising and lowering said lift arms, a bucket positioning means disposed between at least one of said lift arms and bucket and including a hydraulic cylinder for moving the bucket between the digging and dumping positions, a slave cylinder assembly interconnected between said frame and one of said lift arms whereby the slave cylinder is operated by the movement of said lift arm, means for supplying hydraulic fluid from one side of said slave cylinder to the side of the bucket positioning cylinder tending to move the bucket into the digging position when the lift arms are lowered, conduit means for bypassing fluid from the other side of said bucket positioning cylinder to said one side thereof when fluid is supplied to said one side of the bucket positioning cylinder, inline relief valve means located in said last-mentioned conduit for controlling the flow of fluid between the other side of said bucket positioning cylinder and said first side thereof, the slave cylinder and bucket positioning cylinder being designed so that the total volume of fluid directed to said one side of said bucket positioning cylinder regulates the movement thereof to move the bucket from the dumping to the digging position when the lift arms have been returned to ground level.

3. A front end loader for a tractor including a frame adapted to be secured to said tractor, a pair of transversely spaced lift arms pivotally connected at one end thereof to said frame, a bucket pivotally connected to the opposite ends of said lift arms, hydraulic means disposed between said frame and one of said lift arms for raising and lowering said lift arms, a bucket positioning means disposed between at least one of said lift arms and said bucket and including a double acting cylinder for moving said bucket between the digging and dumping positions, means for leveling said bucket during the raising of said bucket by said lift arms, a slave cylinder assembly interconnected between said frame and one of said lift arms, means for supplying fluid to one side of said first slave cylinder from one side of said double acting cylinder during the raising of said lift arms and for supplying fluid from said slave cylinder to said one side of said slave cylinder during the lowering movement of said lift arms, conduit means interconnecting the other side of said bucket positioning cylinder with said one side thereof, relief valve means controlling the flow of fluid through said last-mentioned conduit means, the total volume of fluid directed to said one side of said bucket positioning cylinder from one side of said slave cylinder combined with that received from the other side of said bucket positioning cylinder being sufficient to move the bucket from the dumping to the digging position when the lift arms reach ground level.

4. A front end loader for a tractor including a frame adapted to be secured to said tractor, a pair of transversely spaced lift arms pivotally connected at one end thereof to said frame, a bucket pivotally connected to the opposite ends of said lift arms, hydraulic means disposed between said frame and one of said lift arms for raising and lowering said lift arms, a bucket positioning

means disposed between at least one of said lift arms and said bucket and including a double acting cylinder for moving said bucket between the digging and dumping positions, a slave cylinder assembly interconnected between said frame and one of said lift arms, means for directing fluid between one side of said double acting cylinder and one side of said slave cylinder during the raising of said lift arms, means for directing fluid from the other side of said slave cylinder to the other side of said bucket cylinder during the raising of said lift arms to effect leveling of the bucket, conduit means for bypassing fluid from the other side of said bucket positioning cylinder to the one side thereof to aid in returning the bucket to the digging position after the bucket has been dumped, valve means controlling the flow of fluid through said last-mentioned conduit means, check valve means preventing the flow of fluid between the other side of said bucket positioning cylinder and the other side of said slave cylinder during the lowering of said lift arms, and means for supplying fluid to ther other side of said slave cylinder when the lift arms are being lowered, the total volume of fluid being directed to said one side of said bucket positioning cylinder from one side of said slave cylinder combined with that received from the other side of said bucket positioning cylinder being sufficient to move the bucket from the dumping to the digging position when the lift arms reach ground level.

5. A front end loader for a tractor including a frame adapted to be secured to said tractor, a pair of transversely spaced lift arms pivotally mounted at one end thereof to said frame, a bucket pivotally connected to the opposite ends of said lift arms, hydraulic means disposed between said frame and one of said lift arms for raising and lowering said lift arms, bucket positioning means disposed between each of said lift arms and said bucket and including a double acting cylinder for moving said bucket between the digging and dumping positions, a slave cylinder assembly interconnected between said frame and one of said lift arms, means for directing fluid between one side of said double acting cylinders and one side of said slave cylinder during the raising of said lift arms, means for directing fluid from the other side of said slave cylinder to the other side of said bucket cylinders during the raising of said lift arms to effect leveling of the bucket, conduit means for by-passing fluid from the other side of said bucket positioning cylinders to said one side of said bucket positioning cylinders to bias the bucket toward the digging position after the bucket has been dumped, inline relief valve means controlling the flow of fluid through said last-mentioned conduit means, check valve means preventing the flow of fluid between the other side of said bucket positioning cylinders and the other side of said slave cylinder during the lowering movement of the lift arms, and means for supplying fluid to said other side of said slave cylinder when the lift arms are being lowered, said last mentioned means comprising a conduit interconnecting a reservoir and the other side of said slave cylinder and a check valve in said conduit for preventing the flow of fluid into said reservoir during the lifting action of said lift arms, the total volume of fluid being directed to said one side of said bucket positioning cylinders from one side of said slave cylinder combined with that received from the other side of said bucket positioning cylinders being sufficient to move the bucket from the dumping to the digging position when the lift arms reach ground level.

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